BME Design-Fall 2025 - ISABEL PLOESSL Complete Notebook

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Table of Contents

Project Information	
Team contact Information	2
Project description	3
Team activities	4
Client Meetings	4
09/08/25 Preliminary Client Meeting	4
09/15/25 PDS Client Meeting	6
09/22/25 Design Matrix Client Meeting	
10/20/25 Design Update Client Meeting	9
11/03/25 Client Update Meeting	10
Advisor Meetings	11
2025/09/12 Advisor Meeting 1	
2025/09/19 Advisor Meeting 2	
2025/09/26 - Advisor Meeting 3	
2025/10/10 Advisor Meeting 4	
2025/10/17 - Advisor Meeting Prototyping Updates	
2025/10/24 - Advisor Meeting Prototype Update	
2025/11/14 - Advisor Meeting Fabrication Updates	
2025/11/21 Advisor Meeting	
Design Process	
10/15/25 - Initial Circuit Prototyping	
Materials and Expenses	
10/14 Amazon Band Invoice	
10/27 Microcontroller Invoice	
10/30 Digikey Products	
11/20 Amazon microcontroller	
11/21/25 Seeed Studio microcontroller	
12/07/25 BGAP Expense Spreadsheet	
Testing and Results	
Protocols	31
2025/12/10 Physical design of the box (3D printed) Protocols	
2025/12/10 Brightness Testing Protocol	
2025/12/06 Connectivity Testing Protocol	
Experimentation	
2025/12/05 - Physical design of the Box (3D printed) Experimentation results	
2025/12/06 - Brightness Testing Results	
2025/12/06 - Connectivity Testing Results	
Project Files	
09/18/25 - Product Design Specifications (PDS) Version 1	
09/26/25 - Design Matrices	
12/10/2025 - Preliminary Presentation	
12/10/2025 - Preliminary Report	41
12/10/25 - Final Poster	42
Team Meetings	
11/24/2025 Team Meeting	43
Isabel Ploessl	44

Research Notes	
Biology and Physiology	
09/10/2025 - Family Interaction in Pediatric Diabetes	
09/18/2025 - Play Space sizing	
Competing Designs	
09/10/2025 - Evolution of Devices in Diabetes Management	
09/10/2025 - Health Technologies for Monitoring and Managing Diabetes	
09/18/2025 - Most accurate CGM Yet	
Transmission	
09/22/2025 - Dexcom direct to apple watch	
09/22/2025 - BLE connections	
09/22/2025 - BLE security	
Hardware	
12/06/2025 - Solders and Soldering 12/06/2025 - Exploring Solder Bumps	
12/06/2025 - Exploring Solder Bumps 12/06/2025 - PCB Design	
12/06/2025 - PGB Design 12/06/2025 - Getting Started with XIAO	
12/06/2025 - Soldered Electronics Datasheet	
Fabrication	
2025/10/20 - PLA from the makerspace	•
2025/10/20 - Selected Watch Band	
2025/10/20 - Emerging Uses for PLA in the Medical Field	
2025/10/20 - Possible Microcontrolers: Seeed	
Testing Research	
2025/12/10 - Testing with Chilren	
2025/12/10 - Care for Diabetes in School	
2025/12/10 - Diabetes Mangaement in Daycare	
Design Ideas	
09/25/2025: Connection Design Drawings	
09/25/2025: Battery Design Drawings	
09/26/2025: More Battery Design Drawings	
09/30/2025: Final Design Sketch	
09/30/2025: Final Design SolidWorks SS	
12/06/2025 - PCB Designs, Not final	
12/06/2025 - PCB Design for Presentation	
12/06/2025 - Final Circuit Images	
12/06/2025 - Images for Testing on Poster	-
Training Documentation	
CITI training	
Lecture Notes	
09/10/25: Lecture 1. BME Career Prep	98
09/17/2025: Lecture 2. Leadership Roles	
09/24/2025: Lecture 3:Near peer	
10/01/2025: Lecture 4, Sustainability in BME	104
10/08/2025: WARF	
10/15/2025: Valuation of intellectual property	108
10/22/2025 - Learning about post grad options	
10/29/2025: Lecture 8	
11/05/2025: Lecture 9	
11/06/2025: Tong Lecture	115
11/12/2025: Lecture 10	
11/19/2025: Lecture 11	119
Claudia Beckwith	
Research Notes	121
Biology and Physiology	
2025/09/11 Type 1 Diabetes in Children	
2025/09/12 Caring for a Child with T1D at School	
2025/09/18 Average Wrist Sizes of Children	
Competing Designs	
2025/09/18 Glowcose Background	
Existing Methods	129

2025/09/11 CGM Use with Children	130
2025/09/19 CGM Sharing Setting	132
2025/12/10 Using Apple Watch for blood glucose monitoring	134
Transmission	
2025/09/21 Nightscout Introduction	
2025/09/21 Dexcom Developer Program	138
2025/09/22 Real-Time Data Access in Diabetes Management	
2025/10/10 Domain Setup	
2025/10/16 Google Cloud Setup	144
2025/10/16 Virtual Machine Setup	
2025/10/23 Pydex Initial Research	146
2025/10/23 Glance Initial Research	
2025/11/28 Flutter Introduction	
2025/11/28 Dexcom Share Services	152
2025/12/10 PyDexcom - developing and compatibility	154
Hardware	
2025/12/10 Seeed Studio XIAO nRF52840 (XIAO BLE)	156
2025/12/10 Soldered Smart LED WS2812B Ring7	
Design Ideas	
2025/09/25 Dexcom Developer Program	
2025/09/25 Dexcom Share Program	
2025/09/25 Nightscout API	
Development	
2025/11/12 Dexcom API Development stage 1	167
2025/11/12 Dexcom API Development Stage 2	
2025/11/20 Dexcom Front End API Code - glucose_reading.dart	
2025/11/20 Dexcom Front End API Code - api_service.dart	
2025/11/20 Dexcom Front End API Code - main.dart	
2025/12/06 Final main.dart Code Upload	195
2025/12/06 Final api_service.dart upload	211
2025/12/06 Final ble_glucose_sender.dart code	215
2025/12/01 Arduino Code for on-board LED (testing) - arduino_glucose_send_version1.ino	221
2020/12/01 Arduno Code for on board LED (testing) arduno_glacose_seria_version1.ino	
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino	
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino	
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino	226 229 233
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code	226 229 233 237
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation	226 229 233 237
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training	226 229 233 237 237
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes	226 229 233 237 237 239
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1	226 229 233 237 237 239 239
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2	226 229 233 237 237 239 239 241
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/24 Lecture 3	226 229 233 237 237 239 239 241 243
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/24 Lecture 3 2025/10/01 Lecture 4	226 229 233 237 237 239 239 241 243 245
2025/12/04 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/24 Lecture 3 2025/10/01 Lecture 4 2025/10/08 Lecture 5	229 233 237 237 239 239 241 243 245 247
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/24 Lecture 3 2025/10/01 Lecture 4 2025/10/08 Lecture 5 2025/10/15 Lecture 6	229 233 237 237 239 239 241 243 245 245 250
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/24 Lecture 3 2025/10/01 Lecture 4 2025/10/08 Lecture 5 2025/10/15 Lecture 6 2025/10/22 Lecture 7	229 233 237 237 239 239 241 243 245 250 252
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/24 Lecture 3 2025/10/01 Lecture 4 2025/10/08 Lecture 5 2025/10/15 Lecture 6 2025/10/22 Lecture 7 2025/10/29 Lecture 8	229 233 237 237 239 239 241 243 245 250 252
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/24 Lecture 3 2025/10/01 Lecture 4 2025/10/08 Lecture 5 2025/10/15 Lecture 6 2025/10/22 Lecture 7 2025/10/29 Lecture 8 2025/11/05 Lecture 9	226 229 233 237 237 239 239 241 243 245 250 252 254 256
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/17 Lecture 3 2025/09/24 Lecture 3 2025/10/01 Lecture 4 2025/10/08 Lecture 5 2025/10/08 Lecture 6 2025/10/22 Lecture 7 2025/10/29 Lecture 8 2025/11/05 Lecture 9 2025/11/07 Tong Speaker	226 229 233 237 237 239 239 241 243 245 245 250 252 254 256 258 261
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/17 Lecture 3 2025/10/11 Lecture 4 2025/10/10 Lecture 5 2025/10/15 Lecture 6 2025/10/22 Lecture 7 2025/10/29 Lecture 8 2025/11/05 Lecture 9 2025/11/07 Tong Speaker 2025/11/12 Lecture 10	226 229 233 237 237 239 239 241 243 245 245 250 252 254 256 258 261 263
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/12 Lecture 3 2025/10/01 Lecture 4 2025/10/08 Lecture 5 2025/10/15 Lecture 6 2025/10/22 Lecture 7 2025/10/29 Lecture 8 2025/11/05 Lecture 8 2025/11/05 Lecture 9 2025/11/10 Lecture 10 2025/11/19 Lecture 11 Lauren Klein Research Notes	229 233 237 237 239 239 241 243 245 245 250 252 254 256 263
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/17 Lecture 3 2025/10/01 Lecture 4 2025/10/01 Lecture 4 2025/10/08 Lecture 5 2025/10/08 Lecture 6 2025/10/02 Lecture 7 2025/10/29 Lecture 8 2025/10/29 Lecture 8 2025/11/05 Lecture 9 2025/11/10 Lecture 9 2025/11/10 Lecture 10 2025/11/11 Lecture 11 Lauren Klein Research Notes Biology and Physiology	226 229 233 237 237 239 239 241 243 245 250 252 254 256 265
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/17 Lecture 3 2025/09/24 Lecture 3 2025/10/01 Lecture 4 2025/10/08 Lecture 5 2025/10/15 Lecture 6 2025/10/15 Lecture 7 2025/10/29 Lecture 8 2025/11/02 Lecture 8 2025/11/07 Tong Speaker 2025/11/10 Lecture 10 2025/11/11 Lecture 11 Lauren Klein Research Notes Biology and Physiology 09/08/25 - Type 1 Diabetes Overview	226 229 233 237 237 239 239 241 243 245 250 252 254 266 265
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/17 Lecture 2 2025/09/24 Lecture 3 2025/10/01 Lecture 4 2025/10/08 Lecture 5 2025/10/15 Lecture 6 2025/10/22 Lecture 7 2025/10/29 Lecture 8 2025/11/05 Lecture 9 2025/11/07 Tong Speaker 2025/11/19 Lecture 10 2025/11/19 Lecture 11 Lauren Klein Research Notes Biology and Physiology 09/08/25 - Type 1 Diabetes Overview 09/22/25 - Lithium Ion Batteries in Microelectronics	226 229 233 237 237 239 239 241 243 245 245 250 252 254 266 268 265 265 265 267
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/24 Lecture 3 2025/10/01 Lecture 4 2025/10/08 Lecture 5 2025/10/01 Lecture 6 2025/10/02 Lecture 7 2025/10/29 Lecture 8 2025/11/07 Tong Speaker 2025/11/07 Tong Speaker 2025/11/19 Lecture 11 Lauren Klein Research Notes Biology and Physiology 09/08/25 - Type 1 Diabetes Overview 09/22/25 - Lithium Ion Batteries in Microelectronics 09/22/25 - Wearable Devices and Lithium Ion Batteries	226 229 233 237 237 239 239 241 243 245 245 250 252 254 266 265 265 265 265 267 272
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/17 Lecture 3 2025/10/01 Lecture 4 2025/10/01 Lecture 5 2025/10/01 Lecture 6 2025/10/02 Lecture 7 2025/10/08 Lecture 9 2025/11/05 Lecture 9 2025/11/07 Tong Speaker 2025/11/12 Lecture 10 2025/11/19 Lecture 11 Lauren Klein Research Notes Biology and Physiology 09/08/25 - Type 1 Diabetes Overview 09/22/25 - Lithium Ion Batteries in Microelectronics 09/29/25 - Sources of Error for Prelim Report	226 229 233 237 237 239 239 241 243 245 245 250 252 254 266 268 267 267 275
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/24 Lecture 3 2025/10/01 Lecture 4 2025/10/01 Lecture 5 2025/10/01 Lecture 6 2025/10/15 Lecture 7 2025/10/22 Lecture 7 2025/10/29 Lecture 8 2025/11/05 Lecture 9 2025/11/07 Tong Speaker 2025/11/10 Lecture 10 2025/11/19 Lecture 11 Lauren Klein Research Notes Biology and Physiology 09/08/25 - Type 1 Diabetes Overview 09/22/25 - Lithium Ion Batteries in Microelectronics 09/22/25 - Sources of Error for Prelim Report 10/01/25 - G7 Information	229 233 237 237 239 239 241 243 245 245 250 252 254 256 258 261 265 265 265 265 267 272
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/04 Arduino Code to test external LED - arduino_glucose_send_version3.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/17 Lecture 3 2025/09/24 Lecture 3 2025/10/01 Lecture 4 2025/10/08 Lecture 5 2025/10/15 Lecture 6 2025/10/22 Lecture 7 2025/10/29 Lecture 8 2025/11/10 Tong Speaker 2025/11/10 Tong Speaker 2025/11/10 Lecture 10 2025/11/11 Lecture 11 Lauren Klein Research Notes Biology and Physiology 09/08/25 - Type 1 Diabetes Overview 09/22/25 - Wearable Devices and Lithium Ion Batteries 09/29/25 - Sources of Error for Prelim Report 10/01/25 - G7 Information 10/10/25 - PCBS in Medical Devices	226 229 233 237 237 239 239 241 243 245 245 250 252 254 266 265 265 265 265 267 272 275
2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino 2025/12/06 Final Arduino Microcontroller Code Training Documentation 2025/10/31 CITI training Lecture Notes 2025/09/10 Lecture 1 2025/09/17 Lecture 2 2025/09/24 Lecture 3 2025/10/01 Lecture 4 2025/10/01 Lecture 5 2025/10/01 Lecture 6 2025/10/15 Lecture 7 2025/10/22 Lecture 7 2025/10/29 Lecture 8 2025/11/05 Lecture 9 2025/11/07 Tong Speaker 2025/11/10 Lecture 10 2025/11/19 Lecture 11 Lauren Klein Research Notes Biology and Physiology 09/08/25 - Type 1 Diabetes Overview 09/22/25 - Lithium Ion Batteries in Microelectronics 09/22/25 - Sources of Error for Prelim Report 10/01/25 - G7 Information	226 229 233 237 237 239 239 241 243 245 245 250 252 254 266 268 265 265 265 267 272 278 281

09/10/25 - Current Glucose Alerting Systems	
09/15/25 - Standards for PDS	290
09/15/25 - Continuous Standards for PDS	
09/15/25 - Specifications (ISO) for PDS	295
Circuits & Related Info	
10/17/25 - PLA & Properties in Medicine	
10/17/25 - Dexcom Cloud Access	301
10/18/25 Useful LEDs & other Components	304
10/21/25 - BLE Connections in Circuits	
10/28/25 - Resin & 3D Printing	
10/30/25 - Flutter & Dart	
11/07/25 - Microcontrollers in Medicine	315
11/07/25 - XIAO nRF52840 Series	
11/18/25 - Soldering and Desoldering	
11/20/25 - Perf Boards	
11/23/25 - Common Circuit Error Sources	
Design Ideas	
09/25/25 Design Idea #1 - Lithium Ion with USB insert	328
09/25/25 - Design Idea #2 - Lithium Ion with Wireless Charging	
11/19/25 - Circuit Soldering	
11/21/25 - 2nd Circuit Soldering Session	
Training Documentation	
09/12/25 - BSAC General Meeting	
09/19/25 - BSAC Executive Meeting	
09/26/25 - BSAC General w/ Faculty	
09/29/25 - Mentee Initial Meetings	
10/03/25 - BSAC Executive Meeting	
10/10/25 - BSAC General Meeting	
10/24/25 - BSAC General Meeting w Faculty	
10/24/25 - CITI "Training throughout the Curriculum"	
11/07/25 - BSAC General Meeting	
11/21/25 - BSAC General w Faculty	
Lecture Notes	
09/10/25 - Lec #1 - BME Career Prep	
09/17/25 - Lec #2 - Leadership	
09/24/25 - Lec #3 "Near peer mentoring"	
10/01/25 - Lec #4 "Sustainability in design"	
10/08/25 - Lec #5 "Patents & licensing with WARF"	352
10/15/25 - Lec #6 "Valuation of Intellectual Property"	
10/22/25 - Lec #7 "Advising Day Pt 2, Post-Grad Plans"	
10/29/25 - Lec #8 "Regulatory pathways" 11/05/25 - Lec #9 "Bringing biologics to market"	
11/07/25 - Tong Lecture 11/12/25 - Lec #10 "Do I need an Institutional Review Board (IRB)?"	
11/19/25 - Lec #10 Do meed an institutional neview board (Inb): 11/19/25 - Lec #11 "How medical product R&D works in industry"	
Ella Prose	
Research Notes	
Biology and Physiology	
09/11/25 - Pancreas of Type 1 Diabetics	
10/08/25 - Stress for Caregivers	
10/08/25 - Type 1 Diabetes	
12/10/2025 - Blood Glucose ranges	
Competing Designs	
09/12/25 - Dexcom GCM Background	
09/18/25 - Glowcose	
09/18/25 - Apple Watch aid in T1D	
10/01/25 - Sugar Pixel	
10/23/25 - Apple Watch Patent 1	
10/23/25 - Apple Watch Patent 2	
Design/Material Research	
09/21/25 - Design One (material)	388

00/04/05 Design Three (light)	392
09/21/25 - Design Three (light)	395
11/19/25 - Box Material Research	399
11/19/25 - Box Material Research 2	402
11/21/25 - Microcontrollers	405
11/21/25 - Dexcom Developer	408
12/10/2025 - Circuit Schematics	
12/10/2025 - PCB	412
12/10/2025 - Nightscout	414
Design Ideas	416
10/19/25 - 3D Box sketch	416
10/31/25 - Pictures and Designs	419
Training Documentation	421
09/26/25 - BPAG Meeting	421
10/30/25 UW Safety Training	423
10/30/2025 Machining Training	
11/07/25 - Tong Lecture	
11/18/25 - Testing	427
Audrey Zeller	
Research Notes	430
Biology and Physiology	
9/12/2025- Insulin Practices	
11/12/25 Type One Diabetes Research	432
11/19/25 Type One Diabetes Research	434
11/26/25 Type One Diabetes Research	436
Competing Designs	
9/12/2025 Omnipod	
9/12/25 Glowcose	
9/17/25 Sugarpixel	441
9/25/25 Diabetic Alert Dogs	
Research for PDS	
9/15/2025- Weather Data	444
9/15/2025 -Battery/watches	447
Box research/material research	
9/20/25 More background information	448
9/24/25 PLA research	
9/24/25 PLA	451
10/1/25 PETG	452
10/1/25 Resin Research	454
10/17/25 Box one design	456
10/20/25 Printed PETG	458
10/20/25 Printed PETG 10/25/25 Resin	
	459
10/25/25 Resin	459 460
10/25/25 Resin Other Research	459 460 460
10/25/25 Resin Other Research Nightscout	459 460 460 460
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API	459 460 460 460 462
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info	459 460 460 460 462 462
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info Design Ideas	459 460 460 460 462 464 464
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info Design Ideas 9/20/25Design One	459 460 460 460 462 464 464 464
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info Design Ideas 9/20/25Design One 9/2025 Design Two	459 460 460 460 462 464 464 467 469
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info Design Ideas 9/20/25Design One 9/2025 Design Two 9/20/25 Design 3	459 460 460 460 462 464 464 467 469 471
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info Design Ideas 9/20/25Design One 9/2025 Design Two 9/20/25 Design 3 9/24/25 Pictures/Designs	459 460 460 460 462 464 464 467 469 471
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info Design Ideas 9/20/25Design One 9/2025 Design Two 9/20/25 Design 3 9/24/25 Pictures/Designs OnShape/Box Designs/3D printing	459 460 460 460 462 464 464 467 469 471 473 473
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info Design Ideas 9/20/25Design One 9/2025 Design Two 9/2025 Design 3 9/24/25 Pictures/Designs OnShape/Box Designs/3D printing 10/17/2025 Box	459 460 460 460 462 464 464 467 469 471 473 473
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info Design Ideas 9/20/25Design One 9/2025 Design Two 9/20/25 Design 3 9/24/25 Pictures/Designs OnShape/Box Designs/3D printing 10/17/2025 Box 10/24/2025 Box Design 2	459 460 460 460 462 464 464 467 469 471 473 473 475
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info Design Ideas 9/20/25Design One 9/2025 Design Two 9/20/25 Design 3 9/24/25 Pictures/Designs OnShape/Box Designs/3D printing 10/17/2025 Box 10/24/2025 Box Design 2 10/31/2025 Box Design 3	459 460 460 460 462 464 464 467 469 471 473 475 477
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info Design Ideas 9/20/25Design One 9/2025 Design Two 9/20/25 Design 3 9/24/25 Pictures/Designs OnShape/Box Designs/3D printing 10/17/2025 Box 10/24/2025 Box Design 2 10/31/2025 Box Design 3 11/16/2025 Resin designs	459 460 460 460 462 464 464 467 469 471 473 475 477 479 481
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info Design Ideas 9/20/25Design One 9/2025 Design Two 9/20/25 Design 3 9/24/25 Pictures/Designs OnShape/Box Designs/3D printing 10/17/2025 Box 10/24/2025 Box Design 2 10/31/2025 Box Design 3 11/16/2025 Resin designs 11/18/2025 Testing of materials for box	459 460 460 460 460 464 464 464 467 469 471 473 475 477 479 481
10/25/25 Resin Other Research Nightscout 10/5/2025 NightScout API 10/9/2025 Nightscout info Design Ideas 9/20/25Design One 9/2025 Design Two 9/2025 Design 3 9/24/25 Pictures/Designs OnShape/Box Designs/3D printing 10/17/2025 Box 10/24/2025 Box Design 2 10/31/2025 Box Design 3 11/16/2025 Resin designs 11/18/2025 Testing of materials for box 12/5/25 Final design	459 460 460 460 460 464 464 464 467 469 471 473 473 475 477 479 481 482

Biosafety and OSHA training documents 10/24/2025	489
11/7/2025 Tong lecture	
Kiera Klemm	491
Research Notes	491
Biology and Physiology	491
9/11/25 - Type 1 Diabetes in Children	491
9/13/2025 - Sizing/Wrist Circumference	493
9/18/25 - Comfort of smart watches	495
9/18/25 - Managing T1D at School - Parent Perspectives	496
Competing Designs	498
9/11/25 - Sugar Mate App	498
9/15/25 - Dexcom Alarms and Alerts	499
10/2/25 - Dexcom for Apple Watch	500
10/6/25 - Glowcose	
Material and Design Research	503
9/25/25 - Battery options research	
9/25/25 - Dangers of Button Battery Consumption	
10/2/25 - Customizable Wearable Device batteries	
10/6/25 - Nightscout research	
10/9/25 - Micro controller basics	
10/9/25 - Battery Security Laws	508
10/15/25 - Optimizing 3D sketches for 3D printing	510
10/22/25 - Apple watch band design guidelines	
11/6/2025 - 3D Printing Material Options	512
11/18/2025 - On Shape Simulation Software	
11/14/2025 - Tong Lecture Video Notes	514
Design Ideas	515
9/23/25 - Battery Designs	515
10/17/25 - Device box 3D sketch	
10/31/25 Show and Tell Box Design Improvement Notes	
10/22/25 - 3D sketch of Box with apple watch band attachment	519
10/29/25 - Improved 3D Sketch of box	
11/9/25 - Larger Box Cad Model	
11/18/25 - Final Poster Format	
12/3/25 - Final Box Design	
Training Documentation	
9/26/24 Interegr 170 training	
10/29/25 - UW Safety trainings	
10/29/25 - Machining Training	
2014/11/03-Entry guidelines	
2014/11/03-Template	

Audrey Zeller - Sep 10, 2025, 1:36 PM CDT

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Klein	Lauren	BSAC	lgklein2@wisc.edu	651-955-8275	
Zeller	Audrey	BWIG	aazeller@wisc.edu	262-331-3845	
Prose	Ella	BPAG	eprose2@wisc.edu	651-425-9266	



Lauren Klein - Sep 09, 2025, 12:39 PM CDT

Course Number: BME 200/300

Project Name: Glucose alerting system and improved durability for Continuous Glucose Monitor (CGM) for kids

Short Name: Glucose Alerting System

Project description/problem statement:

About the client:

Claudia Beckwith - Sep 12, 2025, 1:06 PM CDT

Title: Preliminary Client Meeting

Date: 09/08/2025
Content by: Team

Present: Team

Goals: We want to introduce ourselves to the clients and ask our preliminary questions regarding the project. There are a few different avenues to this project and we want to align on which route we will take. Also, we had questions about the purpose and initial timeline for this project.

Content:

Questions for Client Meeting 9/8/2025

 Going forward, how would you like communication to proceed? (Email weekly progress reports, schedule more zoom calls on a weekly, biweekly basis, etc?)

Group chat, scheuled time to meet, likely over teams

Olive - 860 280 1931

Callie - 920 716 1584 cberg23@wisc.edu

- Why is this important to her? How did she start working on these types of devices?
- · What have prior students done with this and what more would you like to see?
- Cost considerations/budget (mentioned flexible, ballpark estimate? Opportunity to increase if needed?)

\$400 over the course of the year? Donation from pharmacist, CGM not included in budget

Leaning more resources into adapting CGM for children or the bracelet/app system?

Leaning more into the bracelet idea, grey area when it comes to extent of modifications for accessibility because are limited in access/authority. Bracelet in combination with an app? More research to be done on degree of integration.

Display dosing suggestions based on height/weight/age/etc, potential feature to the wristband/monitor/app

Im thinking about bracelets from concerts, and maybe a watch battery

• Should the app/bracelet system be compatible with multiple types of CGM or focus on one? Mentioned a Dexcom G7 or a Freestyle Libre.. Preference on either of these models?

Likely picking on CGM and working off of that

- What primary difficulties are most prevalent to you in the design of CGM for children? (Size, impeding movements, durability, etc)
- What are some "Must Haves" in the design and functionality of the app/bracelet system?
- How customizable would CGM modifications need to be (specific type of activity or general improvements targeted to an active child)
- How important is device size/visibility (do families prefer it is more obvious)?
- For the bracelet route, does it need to be waterproof and have a long battery life? Rechargeable at night?

Waterproof nice but not necessary, not distracting bright but noticeable. Options for customization (charms, accessories)

•

- · Will this need to meet FDA/medical device standards? And if we should focus on them?
- · Are there any safety concerns that you would have with this device and that we should consider?
- · What is her background & motivation for the project?
- How soon can she get us a Dexcom or similar CGM device to start prototyping with?
- What is her priority in terms of focus; see project description
- With time we will figure out what we need to prioritize and look into the market
- Future patenting and SHARx logistics?
- a. Entrepreneurship club
- b. Board of school of pharmacy has a yearly meeting with alumni and such
- c. Presenting against other pharmacy student teams
- d. 3 min pitch

Meeting Notes:

- -Both are undergrad alumni
- -Olive + Callie Berg
- -Group chat with the two of them for communications
- -Olive: 860-280-1931 -Callie: 920-716-1584
- -Callie email: cberg23@wisc.edu

Conclusions/action items:

After our initial meeting, we have a good idea of what research we need to do next. Before our advisor meeting on Friday, we plan to have researched current CGMs on the market and how a diabetes diagnosis affects children/their caregivers. We also will send our clients questions regarding specifics to assist us in drafting the PDS.

Lauren Klein - Sep 22, 2025, 8:30 PM CDT

Title: PDS Client Meeting

Date: 09/15/25

Content by: Claudia

Present: Whole Group

Goals: To get the client's insight on our PDS so we can make sure we follow their criteria.

Content:

PDS:

Performance: rechargeable our decision

Maybe no light when in range

Red high

Rainbow colors

Safety: If malfunctioning turn off immediate (kill switch)

Accuracy: if not accurate turn off or flash just obvious signal

Life in service: at least one year but as long as possible

Shelf life: should always work, battery corrosion basically equal to battery life

Operating environment: water resistance, durable, easy on and off, visible light 100ft

Kid proof like a medicine bottle, look at baby proofing, wont fall off

Ergonomics: cannot cause physical harm

Size: 5-7 in, hopefully adjustable

Weight: maybe similar to apple watch 58g, or a watch

Materials: Rubber, silicon, no latex

Reach out to stadium to get concert bracelets

Aesthetics: no sharp, comfortable, no fracturing, custom maybe

Croc jibets

Probably not this semester, more on their side

Quantity: only one per kid

Cost: \$500 going upwards based on sponsorships and such

Conclusions/action items: We need to update the PDS and continue to update/revise it until Thursday evening. We will update Dr. P on Friday and get his insight on their thoughts as well.

Lauren Klein - Sep 22, 2025, 8:22 PM CDT

Title: Design Criteria/Matrix Client Meeting

Date: 09/22/25

Content by: Lauren

Present: Whole Group

Goals: To update Callie and Olive on our Design Matrix stuff and get updates from them.

Content:

Battery Design Matrix Criteria:

Focus on Installation/Security, Length of Life (total battery life, shouldn't take more than 6hrs or less to fully charge, charge should last like 18hrs, not a super high demand on the battery),

Installation & Security, Safety, Duration/Length, Compatibility, Cost, Size & Weight

Connectivity Design Matrix Criteria:

Focus on Replicability, Delay, and Reliability

Materials/Lights Design Matrix Criteria:

Focus on Sensitivity, Cost, Distractibility

Updated Olive and Callie on the following:

- -Battery and charging options
- -Leaning towards Lithium-Ion but not sure how costly
- -Swappable options would need to be screwed in or something like that to avoid kids eating the batteries
- -Compatibility looking at NightScout or API
- -Olive and Callie also have a CS contact who works at Mortgridge and will talk to their advisor at their meeting tomorrow at 12pm and will make contact by the end of the week
- -Isabel looked into the bluetooth low energy signal aspects on how the data is transmitted to a CGM
- -We could "weak-hack" it by buying a hacking device to hack into the Bluetooth signal, it's 300\$ and they think its not ethical
- -Dr. P would likely not advise it as well
- -Lots of the standstill devices use wifi to transmit data
- -Connect the bracelet to your phone? (Dexcom Share API) but has a delay
- -Open APS could be an option as well
- -We kind of are between either taking on a delay or dealing with safety encryption
- -Could maybe vamp up encryption with API
- -Most diabetic kids have phones but we want to ideally work away from the phone by maybe using just the braclet as a cellular device?
- -All diabetics either have an Apple Watch, Phone, or Glucose Monitor
- -Lots of options for lights, there's silicon, vinyl, etc
- -Looking at pros and cons leaning towards Silicon
- -Usually water resistant and sweat resistant, cheap, common in Apple Watch bands too

- -LEDS are the straightforward choice, cheap, easy to program and use, very efficient, not as breakable
- -Crocs material springs back because it's made for a shoe and isn't recommended for anything besides feet
- -Regular LEDS should do the job for the bracelet
- -They care a lot about delay time
- -NightScout has a delay of up to 5 mins but has a contingency about privacy
- -Focus on keeping the latency delay down
- -HIPPA Rules and what DexCom follows too
- -GluRoo LOOK INTO INSTEAD OF NIGHTSCOUT
- -LibreLinkUP
- -Specific way we need to request funds
- -Need to connect with faculty member on how we need to get the money to order stuff
- -Sending email tomorrow about CGMS, Funds, and CS Person
- -Olive and Callie are working on the pitch and talking to parents (for marketing data)
- -Marketing survey to be sent out in the next couple of months

Conclusions/action items: They are going to keep us in the loop with contact coming tomorrow. They will update us on: CS correspondence, CGM options, and funds! We discussed the Design Matrix stuff and need to write the criteria.

Lauren Klein - Oct 20, 2025, 7:28 PM CDT

Title: Design Update Client Meeting

Date: 10/20/25

Content by: Lauren

Present: Ella, Lauren, Isabel, & Clients

Goals: To update our clients on what we've been up to since Preliminary Presentations

Content:

- -Olive wasn't present due to travels (on a plane)
- -Updated her on initial prototyping
- -Showed her the initial circuit (large scale) showing the different color with the led through the box
- -Audrey is making more boxes cause we need more space
- -Show & Tell is next Friday!
- -Explained what S&T is
- -Claudia working on connection from CGM to Bracelet
- -Can get Claudia in contact with the BME who got them to work with the phone
- -Explained Claudia's computer was out of commission due to water damage but will be posting the server/website soon
- -Can't get access to G6's but have definitely more than enough G7's

Conclusions/action items: Are very on board with what's going on currently being done! We still need to make progress before Show & Tell. We will convene again with Olive and Callie next week to show our updated prototype.

Claudia Beckwith - Nov 03, 2025, 7:40 PM CST

Title: Client Update Meeting

Date: 11/3/2025

Content by: Claudia Beckwith

Present: Team and clients

Goals: We want to update our clients on the progress we've made over the last few weeks. We've transitioned to a new API and have some changes to the watch box. We also want to connect on getting the parts that were delivered into our hands.

Content:

Updated clients on show and tell

Switching to pydexcom as a new backend API

Asking for the CS connection

issues with battery life for this semester. Looking like max of 4 hours of battery life.

- · commercially available batteries aren't suited for the load of our electrical components
- · limiting factor of the batteries is the market availability
 - o custom battery or really expensive batteries
 - · custom PCB and selected LED also hindering the batteries we can be considering at all right

Updated the clients on the progress on the app creation and the limitations with the translations between languages and using VS Code for the first time

Conclusions/action items:

By Friday, we are looking to have a new box printed that fits the size of our new battery, working on the PCB, and spending more time with the app connection.

Lauren Klein - Sep 12, 2025, 5:30 PM CDT

Title: Initial Advisor Meeting

Date: 09/12/2025

Content by: Lauren

Present: Whole Team

Goals: To meet with Dr. P and update him on our current status while also getting advice.

Content:

- -Went through intros & motivation
- -Izzy is Dr. P's TA/assistant for this semester
- -Make sure to have PDF in the research
- -Wealth of info: social media groups of kids who use DexComs/current CGMs
- -Research entries are more about getting enough info to move onto the next step than hitting a "golden number"
- -PDS due next week!
- -Idea is not to pitch the solution but say what the device needs to do at the bare minimum and maximum
- -Need to do research to identify some of those points
- -More of an amount of work that goes into things
- -We're not waiting = engineer group with T1D who try to hack G sensors

Conclusions/action items: We need to split up the PDS sections and complete them individually. It is due next Thursday evening. We also need to get our Progress Report done and meet with the clients on Monday.

Claudia Beckwith - Sep 19, 2025, 12:54 PM CDT

Title: Advisor Meeting 2

Date: 9/19/2025

Content by: Claudia Beckwith

Present: Whole team, Dr. P

Goals: We want to connect with Dr. P about our progress for the week, our research, and our PDS. We had some questions regarding a few sections of the PDS that we wanted to clarify before our final draft.

Content:

We updated Dr. P with our PDS updates (updated, sent, submitted)

We walked down the notebook 1 by 1 to talk about the new research we collected in writing the PDS. Each of these entries are in our notebook under research, dated from 9/13 to 9/19.

We looked into the Glowcose and talked into similarities, differences, and changes when compared to our device

with FDA guidance, if it is similar enough to existing products, the process for getting approval is much more streamlined. if not and we need FDA approval, the process becomes much more complex. Link to FDA site: https://www.ecfr.gov/current/title-21

We looked at how cgms transmit with apple watches and if they require intervention from a cellular device in between

We discussed some of the insulin injection practices have changed over the years, it seems that increased knowledge directly corresponds with quality of life in management of T1D.

Looked into statistics with weather, safety requirements, size, weight, and materials

Conclusions/action items:

We need to discuss with the client how close the child is to a device will cell service. Do we need to link the bracelet directly to the CGM or through the cloud?

Explore the range of bluetooth signal, is that a limitation we should be considering.

look into 21CFR11 (code of federal regulations, FDA is chapter 21) for specifics on the electronic specs (every device has its own number with specs). Also looking into protecting the medical data, what standards are they regarding that? There are other regulatory bodies that control the signals we receive throughout the day (not FDA controlled)

Explore IP ratings of waterproofness. Particle resistance, water resistance, water proof. Find which rating we are going for and update in the PDS

Implement a system that could differentiate that range is good vs dead battery. Blinking light? Soft light that continuously runs?

Define and rank our most important criteria (visibility, comfort, cost, feasability)

- explore different design matrices for different aspects (connection, energy cost)
- look into how competing designs actually work

Planned Matrices:

battery & charging - Lauren and Kiera

lights & materials - Ella and Audrey

connectivity (bluetooth vs wifi vs cloud) - how do the long range bands work at concerts - Claudia and Isabel

- cost
- feasibility

plan is to each have 3 independent designs, then discuss with the partner, decide on 3 designs to go into the matrix

timeline:

Monday: have 3 designs narrowed down between the pairs and the categories determined. we will walk through each design as a team and rank with help from the clients

Wednesday/Thursday: write our paragraphs

ISABEL PLOESSL - Sep 26, 2025, 3:35 PM CDT

Title: Advisor Meeting 3 - Design Matrix

Date: 09/26/25

Content by: Isabel Ploessl

Present: Individual

Goals: To discuss upcoming goals with Dr. P and our design matrix

Content:

- · Connectivity Matrix
 - Nightscout
 - free data base tools
 - main one is MongoDV, you can use google cloud
 - expand for multiple users
 - pay for services
 - classes through google cloud
 - PDS
 - do these individulas have a phone near them
 - bluetooth range of devices
 - perhaps in SIM card
 - future work
 - Dexcom Follow
 - hard to get into third party source
 - Sugar Mate
 - third party compnay
 - web program
 - seperate login to dexcom
 - apple app only or web browser
 - Dexchrome
 - extension log in
 - icon of numbers
 - Ryan Mason Jar
 - creater of app
 - code on Get Hub
 - Glance watch face
 - · Night scout for you
 - charges \$4/5 a month
 - Alum, VP Accusations at Omnipod
 - could reach out to her
 - o Dexcom, original technology was patented here
- Battery Matrix
 - Less graphics
 - isabel can re draw to get them in the same form
 - Change degredation to life span
- Band/LED Matrix
 - o get rid of the OLED and change to just an LED
 - accuracy- less important
 - more with the LED
 - o possible include ergonomics
 - · change radiance to adjustability

חח

• look over annotations

list exact materials to order
play around with low fidelity
arduino nano
make it work on our bench

Conclusions/action items: Use Dr.P's insight to edit PDS, and design Matricies, look into a few changes in designs of batteries and fix before the preliminary presentations next week,

Claudia Beckwith - Oct 10, 2025, 12:23 PM CDT

Title: Advisor Meeting 4

Date: 10/10/2025

Content by: Claudia Beckwith

Present: Whole team

Goals: We want to update Dr. Puccinelli on our progress from the past week. We worked on our report this past week, which took away form some of our physical progress. We want to start working on the physical proof of principle for next week.

Content:

We updated Dr Puccinelli on the setup of our domain and I spoke about the process of connection with Google Cloud and mentioned I am looking into using my credits from my CS320 class toward this VM, but we might need to look into getting more support and credits.

In terms of materials, we showed Dr P our proposed microcontroller and he said it seems pretty reasonable for our purposes. We also talked about the band we are looking to order that fits our size requirements and the security constraints.

Our next steps are looking at setting up a simple circuit to show proof of concept. We will likely have to split up into different teams (Nightscout, circuit team, materials, etc). We should try to make a circuit that flips to different colors based on input parameters.

He brought up having a lower running light for steady state. Even though it consumes more power, it might be really helpful for caregivers to have the option to have an "always on" setting for peace of mind.

Might be worth having others on the team dig into Sugarmate or other apps that pull directly from Dexcom for simplicity purposes.

BMEDESIGN is the account in the makerspace

Conclusions/action items:

- Goal for next week to have something that pulls Dexcom data into an Arduino and have some sort of output related to ranges
- Focus on large scale application of the circuitry, show proof of principle first $% \left(1\right) =\left(1\right) \left(1\right$

2025/10/17 - Advisor Meeting Prototyping Updates

Lauren Klein - Oct 17, 2025, 12:21 PM CDT

Title: Advisor Meeting Prototyping Updates

Date: 10/17/25

Content by: Lauren

Present: Whole Team

Goals: To show Dr. P our prototyping pieces and our current struggles

Content:

- -Displayed our progress!
- -Solidworks box made by the 200s
- -Circuit and Arduino by 300s
- -Also got our band in and it is definitely very secure
- -Fits on our Apple Watches
- -Dexcom developer won't work long term
- -Started working on the API with google cloud set up and initialized a machine we can run the project off of
- -All free as of right now but might need to pay if it gets booted up
- -Accepts http and https requests right now
- -Need to download Linex
- -Claudia computer out of commission so on hold for now
- -We messed around with Dexcom developer but was difficult and not needed long term so would've been a waste of time
- -Don't need to store longitudinal data only need like an hour at a time
- -NightScout settings are very very minimal
- -Normal small and micro processing levels, everything's on micro
- -Got our code to open the Dexcom sign in for data but logging in the sandbox came up with fire walls
- -Other competing devices use production Dexcom developer which pulls data faster(less delay)
- -Need to figure out attaching band to box
- -Will be making box bigger
- -Great progress!
- -Look into locking closure patent for Apple
- -Firewall settings allow HTTP and HTTPS currently but we might need a converter
- -Dexcom issue was Python only does HTTP so it would need another middle man to function (app to dexcom to python)
- -Need to figure out the best way to get help out of Show & Tell
- -Always issues with the connection piece

Conclusions/action items: We need to research band patents on the latching mechanism. We also need to connect the band to the box. The box will need to be updated as well to be a little bit longer and allow for more space for our components.

2025/10/24 - Advisor Meeting Prototype Update

Lauren Klein - Oct 24, 2025, 12:27 PM CDT

Title: Advisor Meeting Prototyping Update

Date: 10/24/25

Content by: Lauren

Present: Whole Team

Goals: To update Dr. P and Izzy on what we've been up to

Content:

- -New boxes are printed with the slits on the side for the band
- -Kiera did a great job and even found the blueprint for the Apple Watch insert
- -No patent issues with that type of clasping situation
- -Showed Dr. P our new flow chart according to the pydexcom from Github
- -Talked about future work
- -Dr. P agrees were on a good track and the next biggest challenge will probs be the communicating between different languages
- -Need to make an app and the code
- -Need to update band again to fix the insertions
- -Think of questions for S&T

Conclusions/action items: We overall have made solid progress and are in good shape for S&T. We need to order the necessary materials today or next week. We also need to write the code and start making the PCB diagram.

2025/11/14 - Advisor Meeting Fabrication Updates

Claudia Beckwith - Nov 14, 2025, 12:40 PM CST

Title: Advisor Meeting - Fabrication Updates

Date: 11/14/25

Content by: Lauren

Present: Team

Goals: To update Dr. P and Izzy on our fabrication process and any issues

Content:

- -Got our Battery, LED, and Microcontroller
- -Talked to Dr. N about the PCB and he basically told us to just directly use the microcontroller instead
- -Relayed this info to Dr. P and saw an example of what ours might look like
- -Claudia displayed the makeshift app we have going right now and discussed what issues we're having with it
- -Flutter is the middle pan between Python and Arduino
- -Need to connect Flutter to a phone
- -Battery too long for box
- -They will review poster if sent by 12pm on Wednesday 12/3
- -More pics, less words, better but while showing overall flow for poster
- -Wants clear pic of color ranges on poster

Conclusions/action items: We need to check out the Makerspace to see if they have the circuit components we need. The box doesn't fit the battery so we will need to make it a little bit bigger.

By next week

- · Ella ordering parts
- · 200s formatting the report and poster (not filling out yet)
- · Claudia working on code
- Kiera and Audrey making new boxes, writing and testing protocol

Claudia Beckwith - Nov 21, 2025, 12:58 PM CST

Title: Advisor Meeting

Date: 11/21/2025

Content by: Claudia

Present: whole team

Goals: Update Dr. P on this week's progress. We have updates to software, hardware, and the box fabrication.

Content:

software updates:

- · App built
- · Need to work on BLE connection with Arduino
- · Issue is with the connection between Flutter and Arduino

Hardware updates:

- · Fried microcontroller, just received new one
- · needed to solder the components
- · thinking of ordering PCB in the future

Box fabrication:

- · printed in resin
- · one side fitting with the watch band better that the other
- going to test printing on on its side without supports next in hopes the lid fits better

Conclusions/action items:

Continue working on the poster, looking for a rough draft by Dec 2nd.

Print box again, need it to be a little taller, fix dimensions of watch band interface

10/15/25 - Initial Circuit Prototyping

Lauren Klein - Oct 17, 2025, 12:30 PM CDT

Title: Initial Circuit Prototyping

Date: 10/15/25

Content by: Lauren

Present: 300s

Goals: We need to come up with a circuit and Arduino code to simulate what we want our device to do

Content:

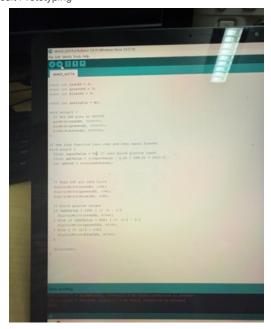
- -See below pictures for physical initial prototype
- -Claudia will be connecting what we did to the API
- -Dexcom Developer and Python are no longer compatible due to not allowing HTTPS requests
- -We did get to sandbox and the Dexcom login page where one would input there data but since we don't have an actual app it theoretically wouldn't work right now
- -Used similar to a blink test done in 201 for Arduino code

Conclusions/action items: We successfully created a circuit and wrote Arduino code that simulates what we want. We looked into Dexcom Developer but hit a few firewalls and errors with the HTTPS and HTTP traffic. We need to get the code into an API like Nightscout to continue.

Lauren Klein - Oct 17, 2025, 12:25 PM CDT

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Download

IMG_8487.jpg (706 kB)

Ella Prose - Oct 14, 2025, 10:41 AM CDT



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Amazon_Watch_Band.pdf (30 kB)

Ella Prose - Oct 27, 2025, 5:46 PM CDT



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BME_Student_Project_Order_2.pdf (216 kB)

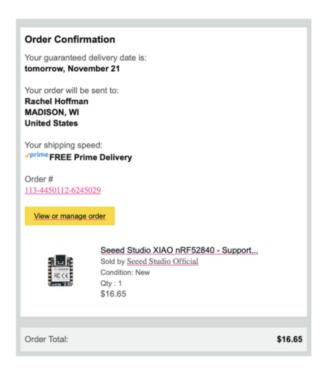
Ella Prose - Oct 30, 2025, 1:58 PM CDT

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DigiKey_-_Print.pdf (144 kB)

Ella Prose - Nov 20, 2025, 1:14 PM CST



Download

Screenshot_2025-11-20_at_1.13.09_PM.png (130 kB)



11/21/25 Seeed Studio microcontroller

Ella Prose - Nov 21, 2025, 12:54 PM CST



Download

BME_Student_Project_Order_3.pdf (219 kB)

Ella Prose - Dec 07, 2025, 1:47 PM CST

Title: BGAG Expense Spreadsheet

Date: 12/07/25

Content by: Ella Prose

Present: N/A

Goals: I want to stay updated with materials and cost. I want an organized way to see all of the ordered materials and keep track of our spending.

Content:

							QT			
Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#		Υ	Cost Each	Total	Link
Category 1 - App	pearance	•	•					•	•	•
	Silicone band for kids - 38/42		113-723256							Silicone
Silicone Band	mm	Amazon	8-5800209	DQ-Tech	N/A	10/13/2025	2	\$5.00	\$9.99	<u>Band</u>
	Preliminary box - 30x30x15									
Black PLA Box	mm	Wendt DI Lab	N/A	N/A	N/A	10/24/2025	6	\$0.25	\$1.50	N/A
Clear Resin Lid	Box clear Lid	Wendt DI Lab	N/A	N/A	N/A	10/24/2025	2	\$2.34	\$4.68	N/A
Clear Resin Lid	Final Clear Lid	Wendt DI Lab	N/A	N/A	N/A	11/18/2025	2	\$1.00	\$2.00	N/A
Black Resin Box	Final Resin Box	Wendt DI Lab	N/A	N/A	N/A	11/18/2025	1	\$2.77	\$2.77	N/A
Black Resin Box	Final Resin Box	Wendt DI Lab	N/A	N/A	N/A	11/20/2025	1	\$3.32	\$3.32	N/A
Resin Box	Final Box	Wendt DI Lab	N/A	N/A	N/A	12/2/2025	1	\$2.34	\$2.34	N/A
Resin Lid	Final Lid	Wendt DI Lab	N/A	N/A	N/A	12/2/2025	1	\$1.05	\$1.05	N/A
Category 2 - Inte	ernal/Electronic Components		,							
Seeed Studio										
XIAO nRF52840	Microcontroller used for led		ORDER#	Seeed						Microcontr
(XIAO BLE)	light control	Seeed Studio	4000434924	Studio	N/A	10/25/2025	1	\$17.59	\$17.59	<u>oller</u>
	LED Opto/Lighting Evaluation				5032-33305					
LED Board	Board	Soldered Electronic	333055	DigiKey	5-ND	10/30/2025	1	\$8.40	\$8.40	LED
	3.7 V Lithium Polymer Battery									
	Rechargeable (Secondary)				1832-1051-					
Battery	500mAh	TinyCircuits	ASR00035	DigiKey	ND	10/30/2025	1	\$11.31	\$11.31	<u>Battery</u>
Perfboard	Printed circuit board	MakerSpace	N/A	N/A	N/A	11/14/2025	1	\$1.00	\$1.00	N/A
Header	Electrical connector	MakerSpace	N/A	N/A	N/A	11/14/2025	1	\$0.02	\$0.02	N/A
Seeed Studio			113-44501							
XIAO nRF52840	Mcrocontroller used for led		12-624502	Seeed						Microcontr
(XIAO BLE)	light control	Amazon	9	Studio	N/A	11/14/2025	1	\$16.65	\$16.65	oller
Seeed Studio										
XIAO nRF52840	Mcrocontroller used for led			Seeed						Microcontr
(Pre-Soldered)	light control	Seeed Studio	102010631	Studio	N/A	11/20/2025	1	\$17.49	\$17.49	<u>oller</u>
								TOTAL:	\$100.11	

Conclusions/action items: This is the final expense spreadsheet. In total, we spent \$100.11. This spreadsheet will continue to be used in the next semester as this project gets finalized.

Ella Prose - Nov 20, 2025, 1:15 PM CST



Battery	3.7 V Lithium Polymer Battery R	TinyCircuits	ASR00035	DigiKey 8	32-1051-ND	10/30/2025	1	\$6.95	\$6.95	https://www
Perfboard	Printed circuit board	MakerSpace				11/14/2025	1	\$1.00	\$1.00	
Header	Electrical connector	MakerSpace				11/14/2025	1	\$0.02	\$0.02	
Seeed Studio XIAO nRF52840 (XIAO BLE)	Mcrocontroller used for led light	Amazon		Seeed Studio		11/14/2021	1	\$16.65 TOTAL:	\$16.65 \$66.19	https://www

Download

Screenshot_2025-11-20_at_1.15.17_PM.png (271 kB)



2025/12/10 Physical design of the box (3D printed) Protocols

Audrey Zeller - Nov 21, 2025, 2:44 PM CST

Protocols

1. Impact Tests (Drop + Point Impact)

Purpose: Evaluate due bility of troccs when dopped during everyday use. Corners and watche bit regions are the highest-risk failure areas.

- Dispeach box onto a hand surface (concrete, ble, or hardwood) from the following heights:
 - □ 2 ft (0.609 m)

 - □ 8.2 ft (2.5 m average playground-equipment height)
- Perform three drops per height, rotating the box so it is not on a different face each
- . Record: Cracia, seam spills, corner demage, lid failure.

2. Compression Test (Crush Resistance)

Purpose: Messure how much foce the addressis can withstend before deforming.

- Use a clamp and slowly tighten.
- . Count the number of turns of the handle until deformation is observed.
- Record: Number of turns, weak point location, and basek description.

Download

Protocal_Box.pdf (59.8 kB)

2025/12/10 Brightness Testing Protocol

ISABEL PLOESSL - Dec 06, 2025, 11:37 AM CST

Testing Protocol: LED Color-Change Visibility Test (=46 m Distance)

Objective

To verify that the wearable device's LED correctly changes colors based on programmed conditions and that each color is visible to an observer positioned 46 meters away (converted from 150 ft).

Emineent and Materials

- Prototype wearable device with controllable LED
- Fully charged battery
- Measuring tape or pre-measured markers (≥ 50 m)
- Data sheet/checklist for recording results:
- At least one observer positioned at the 46 m line
- Controlled testing environment (preferably dusk, nighttime, or consistent indoor lighting)

Test Conditions

Perform the test under the following lighting scenarios:

- Full daylight
- Shade/overcast
- Indoor ambient lighting
- Evening/drad
- Nighttime

Download

Visibility_Testing.pdf (92.4 kB)

2025/12/06 Connectivity Testing Protocol

Claudia Beckwith - Dec 07, 2025, 10:37 AM CST

Title: Connectivity Testing Protocol

Date: 12/6/2025

Content by: claudia

Present: claudia

Goals: In order to test the effectiveness of the software flow, we want to perform a test over the course of a few hours to observe the LED color and transmitted microcontroller blood glucose values. We want to ensure that the led can update on its own and consistently. We are using Isabel's blood glucose values for the purposes of these tests.

Content:

Objective:

To verify that the wearable device's LED correctly changes colors based on programmed conditions and the microcontoller is getting the correct updated values.

Equipment and Materials:

- · Prototype wearable device with controllable LED
- Computer running Flutter app, logged into Isabel's Dexcom
- · usb-c serial connection cord
- · Isabel's phone with dexcom app

Setup:

- 1. log into Isabel's Dexcom account on Flutter app
- 2. program microcontroller with latest Arduino code (glucose arduino send version4.ino)
- 3. push data to microcontroller and confirm initial color matches expected

Procedure:

- 1. Repeat the following steps at ~5 minute intervals
 - 1. Record timestamp
 - 2. Record latest dexcom blood glucose level as displayed by the Dexcom app
 - 3. Record predicted color based on dexcom level
 - 4. Record latest transmitted glucose level as displayed in the serial monitor of the microcontoller
 - 5. Record observed LED color

Success Standard:

Goal is to maintain the MARD of <8.5% that Dexcom aims to maintain with their CGM. This means that microcontroller/software flow doesn't reduce the accuracy of the CGM. Also, per client requests, we cannot observe a time delay of greater than 5 minutes. Blood glucose levels can change rapidly, and it's important our device is successful at getting the most up to date readings.

Notes:

Testing may be done non-consecutively to gather a larger range of colors (ex. if isabel is only displaying values in a certain range for a period of time, test later when values are in a different range)

Conclusions/action items:

We will perform testing based on the listed procedure. Goal is to get 2-3 hours of testing data to understand how the code is updating. Successful testing will maintain the specified MARD of 8.5% from the glucose data.



Audrey Zeller - Nov 21, 2025, 2:46 PM CST

Ext			

PLA	PLA	PETG	PETG
Carpet -	Wood -	Carpet-	Wood-
2 ft - minimal demage nearwatch sixt	2 ft - some damage to the corners	2 ft - little to no da mage	2 ft - minimal damage on the comers
3 ft - minimal demage neerwatch sibt	3 ff - some damage to the corners	3 ft - little to no da mage neer wetch sibt	3 ft - minimal damage on the corners
9 ft - minimal damage rearcomes	9 ft - some damage rear corners	9 ft - minimal damage near corners	9 ft - minimal damage man watch alot

2. Compression Test

	PLA	PETG
Number of turns	54 turn	% turn
Weak point, description (see photos)	Entire tottom falling off, clean beak of bottom, more damage	Part of bottom falling off, crack down side of bottom

Absocion Tax

	PLA	PETG
Starting Length	32.04mm	32.02mm
Ending Length	31.87mm	31.97mm
Difference	0.17mm	0.0 Smm
Number of Files	20	20
Visible wearkle rage (see photos)	More scuffed on the edges, discobred, rough texture	Edges were rougher, better resistance to file

Oversit PETG had a better maistance to the Six.

Download

Experimental_Resuts_for_Box.pdf (62.4 kB)

2025/12/06 - Brightness Testing Results

ISABEL PLOESSL - Dec 08, 2025, 9:41 AM CST



<u>Download</u>
Visibilty_Testing_Results.pdf (3.93 MB)

2025/12/06 - Connectivity Testing Results

Claudia Beckwith - Dec 07, 2025, 11:46 AM CST

Title: Connectivity Testing Results

Date: 12/06/2025

Content by: Claudia

Present: Claudia

Goals: I want to follow the procedure to perform 2-3 hours of connectivity testing to see how the device performs. The goal is to have the LED updating to the correct color within 5 minutes of an observed change. The led should be able to update without any prompting.

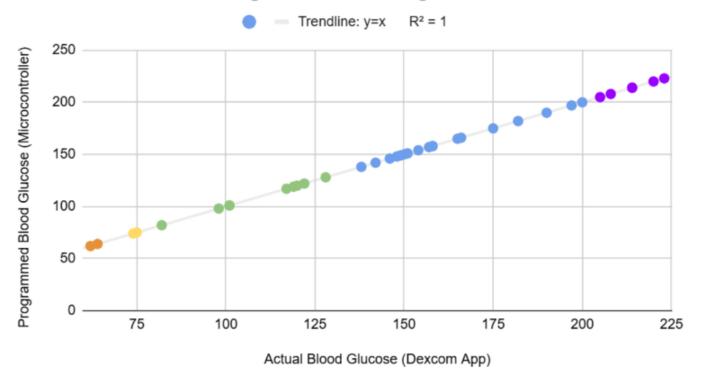
Content:

Attached is the raw data of the testing. Note that testing was conducted over 4 different time blocks to get a representative range of values (multiple colors)

Time	PyDexcom Reading	Microcontroller reading	Expected color	Actual color
9:20	160	160	Blue	Blue
9:25	158	158	Blue	Blue
9:30	154	154	Blue	Blue
9:36	148	146	Blue	Blue
9:41	149	149	Blue	Blue
9:45	157	157	Blue	Blue
9:50	165	165	Blue	Blue
9:55	175	175	Blue	Blue
10:01	182	182	Blue	Blue
10:08	190	190	Blue	Blue
10:09	200	200	Purple	Purple
10:16	208	208	Purple	Purple
10:19	214	214	Purple	Purple
10:26	220	220	Purple	Purple
4:19	74	74	Yellow	Yellow
4:27	62	62	Orange	Orange
4:32	62	62	Orange	Orange
4:39	84		Green	Green
4:44	98		Green	Green
4:50	108	148	Green	Green
4:58	122	122	Green	Green
5:03	117	117	Green	Green
5:08	119	119	Green	Green
5:16	148	101	Blue	Blue
5:22	166	166	Blue	Blue
8:42	223	223	Purple	Purple
8:48	214	214	Purple	Purple
8:54	205	205	Purple	Purple
9:02	197	197	Blue	Blue
1:32	150	150	Blue	Blue
1:33	151	151	Blue	Blue
1:38	158	158	Blue	Blue
1:45	142	142	Blue	Blue
1:50	138	138	Green	Green

The graphical representation of this data with line of best fit and r^2 is displayed below

Blood Glucose Readings Actual vs Programmed



results show a 100% correlation between expected values and the values received and programmed microcontroller values. On that note, the displayed LED colors. I observed the color updating on its own without having to send it to the microcontroller after the initial push. With this data, I am confident moving forward with this software flow as it meets our PDS and customer requirements.

Conclusions/action items:

Next steps are to update the poster and report with this data. In the future, we will work to update the microcontroller to be fully Bluetooth and not reliant on the physical connection. Once we find these updates, we will repeat the testing to make sure the LED is still updating on its own and successfully.



09/18/25 - Product Design Specifications (PDS) Version 1

Lauren Klein - Sep 18, 2025, 9:55 PM CDT

Title: PDS Version 1

Date: 09/18/25

Content by: Lauren

Present: Whole Team

Goals: To attach the team's initial version of the PDS

Content:

See pdf attached below

Conclusions/action items: The PDS has been attached. We will continue to update it as it is a living document. We will utilize it when testing our prototypes and final design.

Lauren Klein - Sep 18, 2025, 9:53 PM CDT



Product Design Specifications

Wearable Glucose Alerting System

Team Members: Isabel Placed Clindia Beckwith Lauren Klein Ella Prose Andrey Zeller Kiera Klerun

Clients: Olive Cerniglia and Callie Berg Advisor: Dr. John Puccinelli

> September 18, 2025 BME 200/300

function:

Download

CGM_Bracelet_PDS.pdf (311 kB)

Lauren Klein - Sep 26, 2025, 11:04 AM CDT

Title: Design Matrices #1, #2, and #3

Date: 09/26/25

Content by: Lauren

Present: Whole Team

Goals: To attach our Design Matrices pdf

Content:

See attached file

Conclusions/action items: Attached the file. We submitted it a little late last night and wrote very descriptive paragraphs.

Lauren Klein - Sep 26, 2025, 11:05 AM CDT

Danigra	Design 1: Descore Deve	11"	Danign 2: Nightscout AP	-	Design 3: BLE Connection	
Criteria Passibility (20)	3/5	12	4/5	16	2/5	a
Privacy [15] Delay Time (25)	1/5	12 6	3/5 4/5	20	4/5	12 20
Relinbility (20)	5/5	20	3/5	12	2/5	a
Cost (10)	5/5	10	5/5	10	1/5	2
Reptication (10)	2/6	4	4/5	8	1/5	2
Total (100)		3			- 5	2

Delay Time: As the device continuously notifies caregivers of current CGM readings of the child, it is important that the bracelet receives read-time data with the minimum delay time. Por this reason, datay time was smalled as the highest weighted cottages of 25. The Applications of Pillolovestor outsinitiation interval and telestratemistism with most splannth intering in real-delay of 3 minutes. Because of this feature, delay time received a 4/5 because while it is the best option. It is not perfectly continuous. The Decomp Developer Programs immortal estignished for relocation analysis of a retirical leading to the total care and the analysis of a retirical leading to the total care and the analysis of the total care and the continuous of the second property of the sec

Feesbillity: Another important criterion in the team is a billy to cepture COH data and successfully transmit it to the broadet, which is wright in a mixed at 30 on the matrix. The Decom Develope of Pregram contains a straight have do conscious for the user for soon and our the requires a highly thread or authoritication to access the Decom API and become an authorised Digital Health Partner. Because of authoritication to access the Decom API and become an authorised Digital Health Partner. Because of external containing the design resolved a 3% in freesbillity. The Night soon. API indeed API and containation and containation largest to initially develope, but this open-neuron project, certainman abundance of recourses and the highest level of outdomisation, certain it a reniring of 45°. The BLE connection requires a substantial number of additional resources and innoveledge to hadd into the transmitter. The additional benier lead ato a feesbility score of 25°s.

Download

DesignMatrix.pdf (216 kB)

ISABEL PLOESSL - Dec 10, 2025, 11:14 AM CST

Title: Preliminary Presentation

Date: 12/10

Content by: Isabel Pleossl

Present: N/A

Goals: Complete Preliminary Presentation

Content: attached in pdf below

Conclusions/action items: Continue editing information to use in final report.

ISABEL PLOESSL - Dec 10, 2025, 11:15 AM CST



Download

CGM_Group_Preliminary_Presentation.pptx (1.98 MB)

ISABEL PLOESSL - Dec 10, 2025, 11:16 AM CST

Title: Preliminary Report

Date: 12/10

Content by: Isabel Ploessl

Present: N/A

Goals: To put into words what we said in our preliminary report

Content: attached in pdf below

Conclusions/action items: Use this information in our final report

ISABEL PLOESSL - Dec 10, 2025, 11:16 AM CST



Download

CGMPreliminaryReport.docx (1.27 MB)

Lauren Klein - Dec 10, 2025, 11:16 AM CST

Title: Final Poster Presentation

Date: 12/10/25

Content by: Lauren

Present: Whole Team

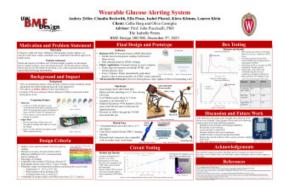
Goals: To attach our Final Poster

Content:

See attached PDF

Conclusions/action items: The Final Poster Presentation went amazing! We're really excited to further expand the project. We still need to turn in the Final Report.

Lauren Klein - Dec 10, 2025, 11:15 AM CST



Download

Glucose_Alerting_-_Final_Poster_-_Copy.pdf (1.76 MB)

Claudia Beckwith - Nov 24, 2025, 7:52 PM CST

Title: Pre-Thanksgiving Break Planning

Date: 11/24/2025

Content by: Claudia

Present: whole team

Goals: Update the team on the recent limitations with the software and hardware and plan what our next moves are.

Content:

Worst case scenario is a large scale circuit

- microcontroller doesn't have the ability to charge the battery
- current led is fried, connection was initially powering but we lost that today and have to order a new led
- doesn't seem like we can get the circuit into the box this semester
- goal for box is to make it look as neat as possible for show and tell
- working to get the poster done by tuesday, may need to leave some blank parts in testing
- dividing up poster
 - · claudia to work on block diagram with communication, backend API
 - · lauren to work on discussion and future work
 - · split final design into software (claudia), hardware (isabel), and physical (kiera)
 - · ella finished background
 - · audrey worked on abstract
 - · kiera working on pds
 - · 200s working on design criteria

- testing

- · test updating numbers with colors
- · test with visibility of the led
- testing resin box with MTS machine on (monday)

Conclusions/action items:

we want to get most of the poster done over thanksgiving break

claudia will try to work on the code and get that functional over break

testing of the led and connectivity will be done early next week (monday/tuesday)



09/10/2025 - Family Interaction in Pediatric Diabetes

ISABEL PLOESSL - Sep 10, 2025, 6:34 PM CDT

Title: Family Interaction in Pediatric Diabetes

Date: 09/10/2025

Content by: Isabel

Present: N/A

Goals: To learn more about how children's families should/are interacting with each other and with their diabetic children, this will help us better understand the needs of the families we hope to cater our device to.

Content:

- · Children and their families are the often primarily responsible for their complex diabetic treatment regimen
 - · this can lead to added family stress and complications
 - · level of parental involvement should change with children's age and management stage
 - "several studies have found that when parents give up responsibility for treatment management too early, adolescents have poorer adherence and deteriorating glycemic control "
 - "In fact, a recent multinational study found that adolescent perceptions of parents as overly involved in diabetes care were a stronger predictor of poor glycemic control than age, gender, or insulin treatment regimen"
 - · While most research has focused on mothers, recent studies acknowledge the importance of fathers' involvement.
 - Parents also need to have support and emotional support when dealing with a child with diabetes
 - "Continued parental involvement—particularly monitoring—in the management of diabetes care is important as children transition into adolescence, and the best outcomes are evident when this involvement occurs in a warm, collaborative manner."

Citation: [1] S. S. Jaser, "Family Interaction in Pediatric Diabetes," *Curr. Diab. Rep.*, vol. 11, no. 6, pp. 480–485, Dec. 2011, doi: 10.1007/s11892-011-0222-y.

Conclusions/action items: Parents are just as stressed as their children when it comes to diabetic management, our device can help provide piece of mind for parents when they can simply look over and see if their child is in a good range or not based on their bracelet, additionally, we may want to consider more of what a mother would look for than a father, as research shows they are often more involved in treatment.

ISABEL PLOESSL - Sep 12, 2025, 12:23 PM CDT

Cor fine Any CRISO 11-884-89
DOI 10.0000-0000-01-1-885-99
PSYCHOSOCIAE. ASPECTS (BORET HOOR, SECTION EDITOR)

Family Interaction in Pediatric Diabetes

Awah 5. Jane

Published indisc. 20 Augus 2-80
C Spring folions-Houses whole. ILC 2011

Abstract Adjustions to type 1 diabetes is optimized in the processor of engaging family support and supervision. Wherefore, it is particularly important to indicate all bow processor of engaging family support and supervision. Wherefore, it is particularly important to indicate all bow many purpose of this is fine and include face are presented by the part to a mixed in course Excessive in a submonitorial in the fine and include generate specified by company of proposition of the course for the fine and include generate specified by the contract of the fine and include generate specified by the contract of the fine and include generate specified by the contract of the fine and include generate specified by the contract of the fine and include generate specified by the contract of the fine and include generate specified by the contract of the fine and include generate specified by the fine and general specified by the general general for fine and general general

Introduction

The treatment regimes for type I diabetes is complex and demanding, requiring frequent blood glucose checks, careful receivering of diet and execute patterns, and manufactly delay administrations of insulis, as well as manufact, episodos of hype- or hyperphysemia [1]. As

S. S. Amer 1010 Yule School of Staning. 100 Cheath Steam Snath, PO Blas WIRO, New Haves, CT 0641 USA and the commencement of the street or transfer contraction (and begin to some recent table, such as graph in 1 years) and the street contraction in tradit in ignorable below and blood planor entodram, the they contrine to not alignificant ministers and supervises when realing ranagement destrons. Adoltors on the street of the street of the street of fasheon management on their own, but they demand to the street of the street of the street of fasheon management on their own, but they alignorable in 1). As children reach advisorers, the alignorable in 1). As children reach advisorers, the street alignorable in 1) and the street of the street of the street of the developmental late of in reacting administry, first void sudden have found that when present piev open possible, the transfer of transfer of the street of the street of the street of the transfer of transfer of the street of the street of the street of the transfer of transfer of the street of the street of the street of the transfer of transfer of the street of

6) Serious

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ISABEL PLOESSL - Sep 18, 2025, 4:14 PM CDT

Title: Average sizes of Play Spaces

Date: 09/18/2025

Content by: Isabel Ploessl

Present: n/a

Goals: To understand how far our device's light needs to be seen from, for this we are looking at the average sizes of playgrounds and parks to determine length of visibility.

Content:

Playground Type	Typical Area	Key Features / Use-cases
Small	~ 550 to 1,600 sq ft	Ideal for compact spaces (urban, rooftops, daycares). Limited variety in equipment. Serves up to \sim 20 children
Medium	~ 1,600 to 3,200 sq	More equipment, more diversity of play. Suitable for schoolyards, suburban community parks. Serves \sim 20-50
Mediaiii	ft	children
Largo	~ 3,200 to 9,700+ so	Allows multiple zones, large structures, adult + older child use, possibly sport or fitness components. Serves
Large	ft	50+ children/adults

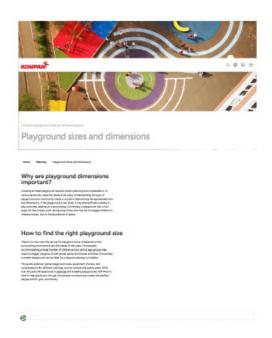
Shows how busy playground ususally are and how big, visibility will change with more kids/mkore equipment

Visibility of Children is typically cosidered when designing play spaces, so this would help us with the parents/caretakers being able to see the child with they are playing

Citation: KOMPAN, "Playground Sizes and Dimensions," KOMPAN, 2025. [Online]. Available: https://www.kompan.com/en/us/planning/playground-sizes-and-dimensions. [Accessed: Sep. 17, 2025].

Conclusions/action items: We are going to go with an average playground size, on the large side of the medium playground for our wanted visibility of light range. About 150 ft on a clear day (aka on a medium playground) the light should be easily visible, this information will be used in the PDS.

ISABEL PLOESSL - Sep 18, 2025, 4:15 PM CDT



Download

Playground_Sizes_and_Dimensions___KOMPAN.pdf (3.76 MB)



09/10/2025 - Evolution of Devices in Diabetes Management

ISABEL PLOESSL - Sep 10, 2025, 5:58 PM CDT

Title: Evolution of Devices in Diabetes Management

Date: 9/10/2025

Content by: Isabel

Present: N/A

Goals: To learn more about how far diabetic alerting devices have come over the past decade in order to have a better understanding of what our teams device needs to have/accomplish.

Content:

- Insulin pens have largely replaced vial-and-syringe methods, offering greater dosing accuracy, ease of use, and convenience, which contribute to better adherence and reduce hypo-/hyperglycemia risk
- · Continuous Subcutaneous (Right below the skin barrier) Insulin Infusion (CSII) pumps simulate physiological insulin release (Omnipod)
 - studies show that CSII has the greatest decrease in HA1C (.4-.5%)
- Finger-pricking to check BGL is largely decreasing due to inconvenience, pain, and long-term sensory issues in fingers, which is already
 an issue for diabetics
- CGM's
 - o Medtronic's is bad with a 28% failure rate
 - · Dexcom and freestyle update in real time and are often much more accurate and reliable
- Bionic pancreas has been in the works since the 70's with little trials and approvals
- A key long-term goal in diabetes management is... to develop an automated and accurate closed-loop system for blood glucose
 monitoring and insulin delivery ... this 'artificial pancreas' would offer the most innovative intervention for diabetes management and has
 the potential to considerably reduce the patient's burden of self-care."
- the path to bettering the disease has been centuries in the making and sensors still have a great amount of inaccuracies and issues adhering and updating BGL's in real time

Citation: [1] A. Penfornis, E. Personeni, and S. Borot, "Evolution of Devices in Diabetes Management," *Diabetes Technology & Therapeutics*, vol. 13, no. S1, 2011. DOI: 10.1089/dia.2011.0058.

Conclusions/action items: Diabetes is an ongoing medical challenge and any advancement in the field is truly groundbreaking. Sensors are already 10-20% inaccurate so understanding what a blood sugar means for a child is much more important, especially when they are too young to understand their own bodies yet.

ISABEL PLOESSL - Sep 12, 2025, 12:25 PM CDT





Download

Evolution_of_Devices_in_Diabetes_Management___Diabetes_Technology_Therapeutics.pdf (2.62 MB)

ISABEL PLOESSL - Sep 10, 2025, 6:22 PM CDT

Title: Health Technologies for Monitoring and Managing Diabetes

Date: 09/10/2025

Content by: Isabel Ploessl

Present: N/A

Goals:

Content:

- roughly 8% of the American population has diabetes (type 1 and 2)
- Eighteen trials were selected and grouped according to the following major device categories: (1) SMBG, (2) pedometers, and (3) cell phone/wireless devices.
- Based on the results of the studies discussed in this review, there is moderately strong evidence that SMBG is an effective way to improve glycemic control inpatients with noninsulin-treated T2DM
- "Self-monitoring of blood glucose continues to be an effective tool for the management of diabetes. Wireless technologies can improve diabetes self-care, and pedometers are effective lifestyle modification tools."
- · A table below summarizes the tables shown in the paper

Category	Evidence Strength & Findings
SMBG (Self-Monitoring Glucose)	Strong to moderate evidence for improving A1C; behavior change is essential alongside usage
Pedometers	Limited to weak evidence; may motivate activity but limited metabolic impact
Wireless/Cell Phone Tools	Moderate to limited evidence; systems like Well Doc show promising glycemic improvements and satisfaction
Feasibility & Usability	Often measured simplistically; patients generally satisfied, but more rigorous evaluation needed
Research Gaps	Integration with BP/HR devices lacking; need for trials on usability, costs, and new tech

Citation: [1] E. Russell-Minda, J. Jutai, M. Speechley, K. Bradley, A. Chudyk, and R. Petrella, "Health Technologies for Monitoring and Managing Diabetes: A Systematic Review," *J. Diabetes Sci. Technol.*, vol. 3, no. 6, pp. 1460–1471, Nov. 2009, doi: 10.1177/193229680900300628.

Conclusions/action items: Most diabetics are using SMBG's which do in fact have the best evidence for A1C decrease, this means that if our device caters to the SMBG community it should have the highest level of outreach in the diabetic community.

ISABEL PLOESSL - Sep 12, 2025, 12:26 PM CDT





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Health_Technologies_for_Monitoring_and_Managing_Diabetes__A_Systematic_Review_-_Elizabeth_Russell-Minda_Jeffrey_Jutai_Mark_Speechley_Kaitlin_Bradley_Anna_Chudyk_Robert_Petrella_2009.pdf (1.17 MB)



09/18/2025 - Most accurate CGM Yet

ISABEL PLOESSL - Sep 18, 2025, 4:02 PM CDT

Title: Dexcom G7 accuracy

Date: 9/18/2025

Content by: Isabel Ploessl

Present: n/a

Goals: To understand how accurate the Dexcom G7 is claiming to be in order to gain an accurate number to use in the PDS, and to compare it's new features to what I know about other marketed CGM's

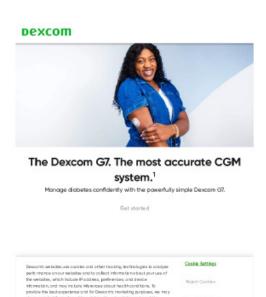
Content:

- 30 miniute warm up period, "twice as fast as other CGM's"
 - · G6 has a two hour warm up
 - o ensures more accuracy becaues its less time where blood glucose levels are unknown
- can alert fasting of an "urgent low soon"
 - o about 20 minutes before
- 60% smaller than the previous generation
 - · less error in placement and less obstructive
- sends glucose readings every 5 minutes
 - o same as the previous system
- · claims to help people have more time in range with lowers A1C
- still recommending back of arm wearing for 7 and up
- upper buttocks wearing for 2-6
- CGM use is not recommended for kids < 2 years old
- typically show a mean absolute relative difference (MARD) of approximately 8.5% between blood glucose readings and CGM measurements

Citation: "Most accurate glucose monitor for diabetes," Dexcom, https://www.dexcom.com/accuracy (accessed Sep. 14, 2025).

Conclusions/action items: With this being the most accurate in many ways according to the dexcom site, I think we should attempt to match the accuracy and load CGM data from the G7 if possible.

ISABEL PLOESSL - Sep 18, 2025, 4:03 PM CDT



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Dexcom_G7_CGM_-_Powerfully_simple_diabetes_management___Dexcom.pdf (17 MB)



09/22/2025 - Dexcom direct to apple watch

ISABEL PLOESSL - Sep 22, 2025, 10:20 AM CDT

Title: Dexcom Direct to apple watch

Date: 09/22/2025

Content by: Isabel Ploessl

Present: n/a

Goals: To learn how the Dexcom 7 can directly input data onto an apple watch, rather than go from phone to apple watch. Possibly use this was of transmission in our design matrix and in our fabrication process.

Content:

- The feature allows the Dexcom G7 sensor to connect directly (via Bluetooth) to a compatible Apple Watch, without needing the iPhone to
 be within Bluetooth range. This means glucose readings, alerts, and trends can be viewed on the watch even if the user leaves their
 phone behind
 - exactly what we want to do but without the signal, this way a child could be far from their devices and still have a signal being produced, rather than having to stay within connectivity ranges
- Connectivity occurs directly from transmitter to watch via a bluetooth signal and an app
- With the Direct to Apple Watch feature, the watch itself becomes a primary Bluetooth receiver, so it connects *directly* to the G7 without always needing the iPhone in range
- This means your Apple Watch, iPhone, and optionally an insulin pump or receiver can all receive the glucose data from the same sensor in parallel.
- · only one smartwatch can be connected at a time
- · Uses a BLE connection, Bluetooth low energy
 - · doesn't drain the transmitters energy
- · first of its kind to connect directly through this technology

Citation: [1] Dexcom, Dexcom G7 Direct to Apple Watch: Manage Diabetes Hands-Free. Jun. 25, 2025. [Online]. Available: https://www.dexcom.com/all-access/dexcom-cgm-explained/direct-to-apple-watch

Conclusions/action items: to find out more how to create/hack this BLE connection and research more about what a BLE connection, this type of connection could decrease the market for our device, but the newest devices are needed from both iPhone and apple Watch, which could increase the price point significantly, and for children parents would have to worry about kids breaking/damaging an apple watch rather than our watch.

ISABEL PLOESSL - Sep 22, 2025, 10:25 AM CDT



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Dexcom_G7_Direct_to_Apple_Watch__Easy_Glucose_Monitoring___Dexcom.pdf (12.7 MB)

ISABEL PLOESSL - Sep 22, 2025, 10:41 AM CDT

Title: BLE connections

Date: 09/22/2025

Content by: Isabel Ploessl

Present: n/a

Goals: To learn about BLE (Bluetooth low energy) connections that are used in medical devices, and how to create/piggyback onto one in order to transmit the connection to another device.

Content:

- BLE standard includes mechanisms like various pairing schemes (Just-Works, Passkey, Numeric Comparison), encryption, authentication, etc. These are intended to defend against threats like eavesdropping, spoofing, MITM (man-in-the-middle).
- It enabled a multitude of new <u>product categories</u> like smart watches or connected health care devices that would not be feasible without such a technology.
- · attack vectors including but not limited to:
- · Weak or mis-configured pairing allowing for MITM or downgrade attacks
- · Eavesdropping when encryption is not used or when broadcasting happens in the clear
- · Privacy issues from tracking: even when devices use random addresses it may still be possible to track them via metadata
- Because of limited power, processing, complexity, many devices compromise: simpler security is easier/cheaper, but less secure.
 Usability is also a factor (stronger pairing/authentication methods are more cumbersome)
- As its name suggests, BLE is intended for low power devices, or to put in another way, devices with limited power supply
 (e.g. <u>battery</u> powered) as well as limited computational and memory capabilities. Since these devices should last as long as
 possible without replacing the battery, special communication protocols, like BLE are necessary.
- BLE allows connection oriented and connection-less communication

Layer	Main Functions	Key Details
2.1 Physical Layer (PHY)	Defines radio capabilities and frequencies.	Operates in 2.402–2.480 GHz ISM band; 40 channels (2 MHz spacing); 3 advertising channels $+$ 37 data channels; frequency hopping to reduce interference.
2.2 Link Layer (LL)	Handles time-critical tasks, packet processing, and device addressing.	Tasks: CRC checks, encryption/decryption, MIC calculation, BD_ADDR assignment. States (v5.2): standby, advertising, scanning, initiating, connection, synchronization, isochronous broadcasting. Supports connection-oriented (central ↔ peripheral) and connection-less (broadcaster ↔ observers) modes.
2.3 Host Controller Interface (HCI)	Defines communication between host and controller.	HCI commands & events exchanged via SPI, UART, USB. On PCs/phones: separate IC/module for controller. On small devices: often integrated as a SoC (system-on-chip).
2.4 Logical Link Control & Adaptation Protocol (L2CAP)	Multiplexes multiple upper- layer protocols.	Tags packets with Channel Identifiers (CIDs) to route them correctly.
2.5 Security Manager (SM)	Provides cryptographic toolbox, pairing, and key exchange.	Cryptographic functions: hashing, key generation. Pairing methods updated in BLE 4.2 (see LE Secure Connections).
2.6 Attribute Protocol (ATT)	Client–server protocol for exposing attributes.	Attributes = (UUID type, handle, permissions + value). Clients can discover/read/write attributes; servers notify/indicate attributes. GATT (Generic

Layer	Main Functions	Key Details
		Attribute Profile) builds on ATT to define characteristics, services, and profiles.
2.7 Generic Access Profile (GAP)	Defines discoverability, connections, and device roles.	Roles: broadcaster, observer, peripheral, central. GAP sets mandatory/optional functions from lower layers to ensure interoperability.

• includes many diagrams and codes on how to code for a BLE which could be extremely useful if we want to go that route

Citation: [1] M. Cäsar, P. D. Le, and M. Hollick, "A survey on Bluetooth Low Energy security and privacy," *Computer Networks*, vol. 192, p. 108712, Jul. 2021, doi: 10.1016/j.comnet.2021.108712

Conclusions/action items: Dexcom uses a BLE connection, so if we take this information and are able to somehow access the service it is on, which the article states is far easier than it should be, we will be able to directly access and hopefully redirect this data into our device.

ISABEL PLOESSL - Sep 22, 2025, 10:42 AM CDT



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A_survey_on_Bluetooth_Low_Energy_security_and_privacy_-_ScienceDirect.pdf (5.55 MB)

ISABEL PLOESSL - Sep 22, 2025, 12:35 PM CDT

Title: BLE cybersecurity

Date: 09/22/2025

Content by: Isabel Ploessl

Attack Vactor

Present: N/a

Goals: To learn about the ability of the team to set up our own BLE connection and/or tap into the Dexcom's BLE connection

Content:

- Many current diabetes devices use wireless or radio-frequency (RF) communication (pump > remote controller > glucose monitor > transmitters)
- These communications often lack strong authentication and/or encryption, making them vulnerable to unauthorized access or manipulation
- Exploits have been demonstrated (or are plausible) showing that someone with proximity (within RF range) could send malicious commands to deliver too much or too little insulin, possibly causing hypoglycemia or diabetic ketoacidosis.
- As diabetes management increasingly relies on closed-loop or automated / connected systems, cybersecurity becomes a patient safety issue, not just data/privacy

Possible Consequences

Attack Vectors on Connected Diabetes Devices

How It Works

•	Attack vector	How It Works	Possible Consequences
	Wireless Communication Exploits	Intercept unencrypted RF/Bluetooth signals, replay or inject malicious commands.	Unauthorized insulin delivery, stolen glucose data.
	Weak/No Authentication	Exploit fixed or weak keys, or lack of device authentication.	Impersonate controller, send commands directly to pump.
	Denial-of-Service (DoS)	Jam radio frequencies or flood device with fake packets.	Blocks user/device communication, prevents stopping insulin delivery during emergencies.
	Firmware Exploits	Push malicious firmware if updates lack cryptographic verification.	Permanent device compromise, uncontrolled insulin dosing.
	Physical Access Attacks	Use USB/debug ports to extract keys, firmware, or load malware.	Long-term backdoor access, theft of sensitive data.
	Relay (Man-in-the-Middle)	Intercept & alter communications between pump, CGM, and controller.	Fake glucose readings, altered insulin commands without user awareness.
	Third-Party App/Cloud Exploits	Exploit insecure smartphone apps, APIs, or cloud dashboards.	Remote access to device data, possible indirect control of insulin delivery.

Citation: R. Andre, M. Neuman, and F. R. Krichevsky, "Cybersecurity for Connected Diabetes Devices," *J. Diabetes Sci. Technol.*, vol. 10, no. 6, pp. 1413–1423, 2016.

Conclusions/action items: We could potentially use low-level hacking that you can buy "off the self" to get into the BLE, This may raise ethical concerns but I could be a potential solution until something more secure is come up with.

ISABEL PLOESSL - Sep 22, 2025, 12:35 PM CDT

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Cybersecurity_for_Connected_Diabetes_Devices_-_PMC.pdf (359 kB)

ISABEL PLOESSL - Dec 06, 2025, 9:31 AM CST

Title: Solders and Soldering: Materials, Design, Production, and Analysis for Reliable Bonding

Date: 12/06/2025

Content by: Isabel Ploessl

Present: N/A

Goals: Begin learning about soldering and what it does to metals and alloys.

Content:

- Defines soldering as a metallurgical bonding process, not a mechanical attachment: "Soldering depends upon wetting and interaction between molten solder and base metal surfaces... not upon mechanical interlocking"
- Discusses eutectic Sn-37Pb solder, noting that its "single sharp melting point at 183 °C eliminates a plastic range, reducing disturbance during cooling" one reason it dominated electronics for decades
- Explains the role of intermetallic compound (IMC) growth (e.g., Cu₆Sn₅) and warns "excessive IMC formation embrittles the joint, increasing susceptibility to failure under thermal cycling or vibration"
- Describes how flux chemistry removes oxides and promotes wetting but must be controlled: "Improper flux selection or residues may result in corrosion, dendritic growth, or latent failures"
- Identifies solderability factors such as surface finish, contamination, and plating: "Solder cannot wet a contaminated surface regardless
 of the strength of the flux"
- Compares heating methods (wave, torch, induction, reflow) and notes: "Method selection must consider thermal gradients to avoid lifted pads or damage to polymeric substrates"
- Provides reliability case studies showing that joints stressed near yield under cycling loads exhibit creep deformation, with Sn-rich alloys "creeping at room temperature under sustained load"
- Explains whisker formation in tin finishes "Tin whiskers can grow millimeters in length, causing shorts between conductors in highdensity assemblies" — driving modern mitigation standards

Citation: H. H. Manko, Solders and Soldering: Materials, Design, Production, and Analysis for Reliable Bonding, 4th ed., McGraw-Hill Professional, Mar. 2001.

Conclusions/action items: Continue building my knowledge of soldering, as it is something I will have to do for this project, but I have never done it before.

ISABEL PLOESSL - Dec 06, 2025, 9:35 AM CST

Here is an embedded link to the book, not allowing me to

download: https://archive.org/details/solderssoldering0000mank

12/06/2025 - Exploring Solder Bumps

ISABEL PLOESSL - Dec 06, 2025, 9:51 AM CST

Title: An Overview of Solder Bump Shape

Date: 12/06/2025

Content by: Isabel Ploessl

Present: N/A

Goals: To learn what a correct solder bump looks like and what I should try to accomplish for the project

Content:

- States that solder joint reliability is "highly dependent on solder joint geometry characterized by standoff height, contact angles, pad diameter, and pad shape"

 motivating accurate bump prediction methods
- Identifies three primary prediction methods used in industry:
 - (1) Truncated-sphere geometry model,
 - (2) Force-balanced analytical solution using Laplace surface tension physics, and
 - (3) Energy-based algorithms considering gravitational and external forces
- Notes that truncated-sphere theory assumes molten solder forms a truncated sphere constrained by the solder pad, and provides closed-form relationships for diameter, bump height, and volume
- Derives the force-balanced model using pressure equilibrium and surface tension contributions; applies a Laplace equation to
 calculate solder bump contour, requiring iterative solution until unbalanced force converges to zero
- Introduces the energy-based method, minimizing total solder free energy (surface tension + gravity + external energy) through variational calculus; employs Surface Evolver for 3-D refinement
- Provides experimental standoff and width data confirming that energy-based and truncated-sphere methods perform nearly identically
 for small solder joints, but force-balanced models degrade when package weight increases (e.g., TBGA)
- Demonstrates this weight sensitivity using two package types:
 - o Flip-Chip, 800 I/Os (lightweight) → all methods accurate
 - TBGA, 256 I/Os → gravitational effects reduce force-method accuracy
- Shows fully validated SEM images overlayed with simulation predictions for Flip-Chip bumps, confirming geometrical model accuracy (Fig. 6)

•	Method	Measured Height	Predicted Height Accuracy
	Truncated-Sphere	e Under-estimates width; over-estimates heigh	t Medium
	Energy-Based	Closest match	Best
	Force-Balanced	Deviates significantly	Poor

Citation: K.-N. Chiang and C.-A. Yuan, "An Overview of Solder Bump Shape Prediction Algorithms with Validations," *IEEE Transactions on Advanced Packaging*, vol. 24, no. 2, pp. 158-162, May 2001.

Conclusions/action items: When soldering for this project it is best to do a truncated sphere shape, or stiff peaks as Lizzie Maly says.

ISABEL PLOESSL - Dec 06, 2025, 10:11 AM CST

An Overview of Solder Bump Shape Prediction Algorithms with Validations
Kee-Neg Ching and Chang An Yuan

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An_overview_of_solder_bump_shape_prediction_algorithms_with_validations.pdf (145 kB)

ISABEL PLOESSL - Dec 06, 2025, 10:19 AM CST

Title: PCB Design Tutorial

Date: 12/06/2025

Content by: Isabel Ploessl

Present: N/A

Goals: Considering making a PCB for our project, hoping to learn the basic of what a PCB is.

Content:

- Stresses that PCB layout influences electrical performance:
 "The PCB layout may make or break the operation and electrical performance of the design. PCB traces have resistance, inductance, and capacitance, just like your circuit does."
- Defines track width selection and introduces copper weight dependency, noting that thicker copper supports higher current loads (p. 7):
 "The thickness of the copper on your PCB is nominally specified in ounces per square foot, with 1oz copper being the most common."
- Provides a track width reference table for selecting trace size based on current and temperature rise (10°C), showing real values
 designers rely on (p. 7):

Current (A)	1 oz Width (thou)) 2 oz Width (thou) mΩ / Inch
1	10	5	52
3	50	25	10.3
5	110	55	4.7
10	300	150	1.7
	1 3 5	1 10 3 50 5 110	3 50 25 5 110 55

- Specifies pad-to-hole ratio design rule critical for solder joints and drill alignment (p. 7): "As a simple rule of thumb, the pad should be at least 1.8 times the diameter of the hole, or at least 0.5 mm larger."
- Warns against overusing vias and explains via stitching terminology (p. 8):
 "Using a via to connect two layers is commonly called 'stitching'... throw the term stitching a few times into a conversation and you'll really sound like a PCB professional!"
- Lists trace routing rules, arguing against 90° corners for both aesthetic and manufacturing reasons (p. 11):
 "Tracks should only have angles of 45 degrees... sharp right-angle corners don't produce measurable EMI... but look ugly and may have implications."
- Provides ground and power guidance, validating modern PCB practice (p. 19):
 "Use copper, and lots of it. The more copper you have in your ground path, the lower the impedance."
- Offers bypass capacitor rule that directly applies to microcontroller boards (p. 19):
 "Have one decoupling capacitor per power pin... track the IC power pin to the bypass capacitor first, and then to the power plane."
- Describes controlled impedance requirements in high-frequency boards such as BLE modules (p. 19–20):

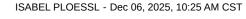
 "A signal will travel roughly 6 inches every nanosecond... a track becomes a transmission line when its length approaches this."
- Defines microstrip and stripline geometries used in RF/BLE boards (p. 19–20):
 Microstrip = top trace over a plane
 Stripline = trace between two planes- essential for our Dexcom BLE reverse-engineer path.

Citation: D. L. Jones, PCB Design Tutorial, Rev. A, Alternate Zone, Sydney, Australia, Jun. 29, 2004

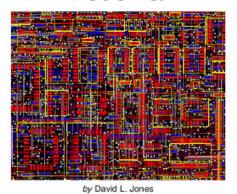
Conclusions/action items: I am looking into creating a PCB for this project so knowing these key components is vital to digital creation

DCR Docion





Tutorial



Email: david AT alternative one DOT com

Revision A - June 29th 2004

The latest version of this storial can be tound through www.alternatiozog

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ourdev_422724.pdf (394 kB)

12/06/2025 - Getting Started with XIAO

ISABEL PLOESSL - Dec 06, 2025, 10:42 AM CST

Title: Getting Started with Seeed Studio XIAO nRF52840 Series

Date: 12/06/2025

Content by: Isabel Ploessl

Present: N/A

Goals: To learn more about hardware and coding for our microcontroller

Content:

- The XIAO nRF52840 board uses a Nordic nRF52840 MCU an ARM® Cortex-M4 32-bit processor with FPU, running at 64 MHz
- It includes Bluetooth 5.0 / BLE 5.0 with an onboard antenna for wireless communicationIn "Sense" variants, the board integrates an
 onboard 2 MB flash storage, plus optional built-in sensors: a PDM microphone and a 6-axis IMU (LSM6DS3TR-C) useful for audio or
 motion-based sensing tasks
- The form-factor is very compact ≈ 21 × 17.8 mm making it ideal for wearable, battery-powered, or size-constrained devices
- Interfaces supported: 1× UART, 1× I2C, 1× SPI, 1× NFC, 1× SWD, up to 11 GPIO pins with PWM, and 6 analog inputs (ADC) on the standard version; "Plus" versions expand UART/SPI/I2S and increase GPIO count
- Power design: supports battery charging/discharging via built-in battery-management circuitry useful for portable or wearable applications needing recharging
- Programming options: compatible with Arduino, MicroPython, CircuitPython providing flexibility for rapid prototyping or embedded firmware development
- For Bluetooth and low-energy projects, the board is supported by libraries such as "Seeed nRF52 Boards" (for BLE) or "Seeed nRF52 mbed-enabled Boards" (for sensor / TinyML / IMU / microphone tasks) depending on application emphasis.
- · We cannot connect directly to the RX or TX pins as they do not allow serial monitor debugging
- The 5 V pin is listed as 5vusb and is the top right(we will use this)
- Pins are hardcoded as D(#) in Arduino code
- · Arduino code can be not exactly aligned with the XIAO
- · WIKI provides link for the direct library to import into Arduino (must update cause it s on the new version)

Citation: Seeed Studio, "Getting Started with Seeed Studio XIAO nRF52840 Series," Seeed Wiki, Nov. 28, 2024.

Conclusions/action items: We learned that this particular XIAO cannot charge our battery, rendering it to be not the best choice for this project. I also must update my Arduino.

ISABEL PLOESSL - Dec 06, 2025, 10:31 AM CST





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Getting_Started_with_Seeed_Studio_XIAO_nRF52840_Series___Seeed_Studio_Wiki.pdf (3.91 MB)



12/06/2025 - Soldered Electronics Datasheet

ISABEL PLOESSL - Dec 06, 2025, 10:48 AM CST

Title: Isabel Ploessl

Date: 12/06/25

Content by: Isabel Ploessl

Present: N/A

Goals: To learn more about our chosen Led and its pin configuration and any Arduino considerations

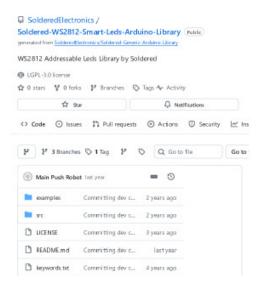
Content:

- The library supports LEDs of type WS2812 (or WS2812B) individual LEDs each contain a small integrated controller IC, allowing single-wire control of many LEDs.
- Operating characteristics (from README): Voltage: 5 V; maximum per-pixel current: ~60 mA/pixel (though many boards draw ~18 mA per LED under typical use).
- The repo contains a /src directory with .cpp and .h library files and an /examples directory enabling easy testing and demonstration sketches for Arduino IDE. Library metadata via library.properties ensures it can be installed via the Arduino Library Manager simplifying integration into new projects.
- The README describes various hardware form factors that use these LEDs: e.g. pixel boards, circular rings, "stick" LED strips —
 indicating flexibility for different board shapes and enclosures.
- The project is LGPL-3.0 licensed meaning you can reuse and modify the code commercially or personally, provided you comply with the license terms.
- In its "About" section, the authors note this library is derived from the widely used library Adafruit NeoPixel so it remains compatible
 with many existing WS2812-based projects and follows a known, established interface.
- The library documentation includes a tutorial and installation instructions for Arduino (on GitHub Pages), facilitating introductory use even for beginners.

Citation: SolderedElectronics, Soldered-WS2812-Smart-Leds Arduino Library, GitHub repository, Apr. 19, 2023. Accessed: Dec. 6, 2025. [Online]. Available: https://github.com/SolderedElectronics/Soldered-WS2812-Smart-Leds-Arduino-Library

Conclusions/action items: We should look into the library for easy driving and coding of LED

ISABEL PLOESSL - Dec 06, 2025, 10:49 AM CST





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GitHub_-_SolderedElectronics_Soldered-WS2812-Smart-Leds-Arduino-Library__WS2812_Addressable_Leds_Library_by_Soldered.pdf (1.99 MB)

2025/10/20 - PLA from the makerspace

ISABEL PLOESSL - Oct 20, 2025, 4:13 PM CDT

Title: 3D Printing Date: 10/20/2025

Content by: Isabel Ploessl

Present: n/a

Goals: To learn which makers we would make our box out of, get a cost estimate and figure out what there is available to 3D print in the makerspace.

Content:

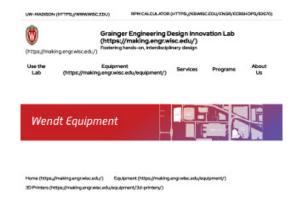
- The lab has 19 "prosumer" 3D printers, composed of models from the Ultimaker line (including S3 and S5)
- · Having "prosumer" rather than purely industrial machines keeps costs lower while still delivering usable quality.
- For better results: design with appropriate supports, tolerances, and finish methods (e.g., sanding or painting) since PLA has typical thermoplastic limitations.
- If you're doing class or group work, the capacity suggests you can run several jobs in parallel just plan your jobs and ensure you prepare files ahead of time.
- They provide a **Cost Estimator Tool** that lets you compute the cost of a print based on the amount of material (e.g., grams of filament, mL of resin, cubic cm for certain machines).
- The cost calculator page lists example costs for certain materials: for example:
 - Nylon 12 (fused) material: \$100.00/kg
 - o Onyx filament (for composite prints): \$0.28/gram
 - · Glass-fiber (cc) support material: \$1.96/cc
 - · QSR support filament (cubic inches): \$4.01/in
- They note that filament or resins must be purchased in-house (i.e., you cannot bring your own material) for the printers
- . The pricing isn't just a flat fee; it is material-based, so a larger, more complex print or one using premium material will cost more
- · There is a myriad of colors and weights available for printing, but PLA is by far the most available and common

Citation: "3D printers," Design Innovation Lab, https://making.engr.wisc.edu/equipment/3d-printers/ (accessed Oct. 9, 2024)

Conclusions/action items:

The team will move forward with printing the box out of PLA, the top of the box will use a clipping mechanism and will be printed with clear PLA, which is significantly more expensive, and the base will be black PLA which is extremely cost effective and will ensure we can create multiple prototypes before choosing our final one.

ISABEL PLOESSL - Oct 20, 2025, 4:05 PM CDT



3D Printers

Get Started:



Download

3D_Printers_Grainger_Engineering_Design_Innovation_Lab_UW_Madison.pdf (819 kB)

ISABEL PLOESSL - Oct 20, 2025, 4:10 PM CDT

Title: Selected Watch Band

Date: 10/20/2025

Content by: Isabel Ploessl

Present: n/a

Goals: To select a watch band to purchase and have secured to our prototype by show and tell in two weeks.

Content:

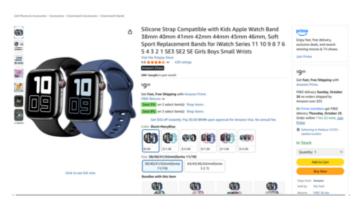
- Compatibility: Designed for various Apple Watch sizes 38 mm/40 mm/41 mm/42 mm/44 mm/45 mm/46 mm for models Series 1/2/3/4/5/6/7/8/9/10, SE/SE2/SE3.
- Adjustable Size: Fits small-wrist users for example the smaller size variant is adjustable between approximately 5.1" to 7.1" wrist
 circumference, this is extremely close to our client requirements
- Material: Made of premium skin-friendly silicone, described as soft, lightweight, washable, breathable, and suitable for sports or daily wear
- Closure: Features an integrated buckle + silicone loop and peg (strap-and-loop style) for secure fit (important for active wear, swimming, etc.)
- Purpose: Marketed especially for children or users with smaller wrists ("Small Wrists" / "kids" variants) though fits many standard watch sizes
- · Customer Service: The listing mentions 24 h support for dissatisfaction or issues

Citation: "Polyjoy Silicone Replacement Watch Band," Amazon, accessed Oct. 8, 2025. [Online]. Available: https://www.amazon.com/Polyjoy-Silicone-Replacement-Compatible-Suitable/dp/B0B28PBHY9

Conclusions/action items:

This bracelet will be ordered and going forward we will have to look into apple watch securing patents to figure out if we can use this exact closure on our device.

ISABEL PLOESSL - Oct 20, 2025, 4:13 PM CDT



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Screenshot_2025-10-20_161241.png (846 kB)



2025/10/20 - Emerging Uses for PLA in the Medical Field

ISABEL PLOESSL - Oct 20, 2025, 4:22 PM CDT

Title: Emerging Uses for PLA in the Medical Field

Date: 10/20/2025

Content by: Isabel Ploessl

Present: n/a

Goals: To be sure that PLA is safe for our project in terms of use on skin and irritational properties.

Content:

- Poly(lactic acid) (PLA) A biodegradable, biocompatible polymer made from renewable resources such as corn starch, commonly used
 in biomedical 3D printing.
- 3D Printing Benefits Enables precise, customizable, and cost-effective production of patient-specific medical devices.
- Tissue Engineering 3D-printed PLA scaffolds support bone, cartilage, and soft-tissue regeneration through adjustable porosity and structure.
- Drug Delivery PLA constructs can be loaded with therapeutic agents for controlled and localized drug release.
- · Medical Devices and Implants Used for prosthetics, orthotic supports, and surgical tools tailored to individual anatomy.
- Educational Models Provides realistic anatomical and surgical models for training and medical education.
- · PLA Composites Combining PLA with ceramics or bioactive fillers improves mechanical strength and cell compatibility.
- · Challenges Includes low mechanical strength, slow degradation, and acidic by-products that limit implant longevity.
- Future Directions Development of functionalized PLA, nanocomposites, and hybrid printing methods to expand applications.
- Clinical Potential Strong promise for personalized medicine and protheses, pending further work on regulatory approval and long-term biocompatibility.

Citation: P. Tan, A. Mohamed, L. M. H. Yusof, and M. N. Ahmad, "Emerging Biomedical and Clinical Applications of 3D-Printed Poly(lactic acid) (PLA)," Frontiers in Bioengineering and Biotechnology, vol. 11, p. 1133551, 2023. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11273440

Conclusions/action items:

Based on its current and emerging applications, PLA has been deemed safe to use in the project. It is used in clinical setting on the skin and doesn't cause any irritation or discomfort.

ISABEL PLOESSL - Oct 20, 2025, 4:22 PM CDT



Represente: 30 pri ni nj med kine, sanjenji, tisa	g. drug delivery: medical device; polylectic acid; radiotherapy; regene ue engineering.	
Fall Medical Processing		
Figures		

Download

Emerging_Biomedical_and_Clinical_Applications_of_3D-Printed_Poly_Lactic_Acid_-Based_Devices_and_Delivery_Systems_-_PubMed.pdf (212 kB)



2025/10/20 - Possible Microcontrolers: Seeed

ISABEL PLOESSL - Oct 20, 2025, 4:29 PM CDT

Title: Seeed Microcontroller

Date: 10/20/2025

Content by: Isabel Ploessl

Present: n/a

Goals: To start focusing on the final circuit design, and pick the correct microcontroller as that will be the brains of our device and it is very important to select the correct one for your project.

Content:

- Ideal for wearable devices, wireless sensor nodes, Bluetooth/IoT applications, and TinyML projects due to its small size, wireless
 connectivity and low power.
- Because of the XIAO form-factor, it fits into constrained spaces (e.g., embedded into product prototypes, small PCBs, wearable form factors) more easily than full-sized development boards
- With Bluetooth 5.0 + NFC + rich I/O + compact size, it's well-suited for projects where you want wireless control or sensing plus compact
 packaging.
- Because it's so small, available I/O pins are somewhat limited compared to larger boards
- Memory: On-chip 1 MB Flash + 256 kB RAM; additionally, 2 MB QSPI (on-board) flash in the XIAO variant
- Wireless: Bluetooth 5.0, BLE support; NFC (tag/wake) also supported
- Size & Form: Extremely small footprint, about 21 × 17.5 mm in typical XIAO form-factor
- Power & Battery: Ultra-low power consumption (≤ ~5 µA in deep-sleep mode) when used appropriately. USB Type-C interface, supports
 battery charging management (on Sense variant especially)
- I/O & Interfaces: Multiple GPIOs (in one version ~11 digital + 6 analog), supports UART, I2C, SPI, NFC, SWD
- · Need to make extra sure of the I/O interfaces to be sure that this is correct for this project, everything else seems to be on point.

Citation:

"Seeed XIAO BLE nRF52840," Seeed Studio. [Online]. Available: https://www.seeedstudio.com/Seeed-XIAO-BLE-nRF52840-p-5201.html. [Accessed: Oct. 8, 2025].

Conclusions/action items: I think that this would be a great fit for our project based on the size and abilities and common use for things like this, the only drawback is it will be a lot of learning and new information, but we are definitely capable, next steps would be to order this and start making a schematic of what we want the final circuit to look like so we can move into a PCB file.

ISABEL PLOESSL - Oct 20, 2025, 4:29 PM CDT



As the first virioless product in the Seeed Studio XIAO family, Seeed Studio XIAO nRF52840 is equipped with a powerful Nordic nRF52840 MCU which integrates Bitestooth 5.0 connectivity. Meanwhile it has a small and exquisite form-factor which can be used for verable devices and let ment of Thing projects. The single-laided surface-mountable design and the orboard Bivetooth antenna can greatly facilit are the rapid deployment of loft projects.

In addition, there is an advanced version of this board, Seeed Studio XBAD nRF52840 Servas. It is integrated with two data orboardsers are. One of them is a Pulsa Density Mediulation (PDM) Digital Microphone. It can records earlied oftain resident mental above it both used for audio recognition. The other one is a 6-axis intential Minesurement Unit (BMD), this INU can be very useful in TripML projects like gratter recognition. These onboard censors provide a great convenience for users while the board is ultra-version.

The newly upgraded XIAO nRF52840 Plus and XIAO nRF52840 Sense Plus provide considerable increases in functionality and usability. The number of multifunctional pins has been increased to 20.

Download

Getting_Started_with_Seeed_Studio_XIAO_nRF52840_Series___Seeed_Studio_Wiki.pdf (4.65 MB)

2025/12/10 - Testing with Chilren

ISABEL PLOESSL - Dec 10, 2025, 12:15 PM CST

Title: Guidelines for testing with Children

Date: 12/10/2025

Content by: Isabel Ploessl

Present: N/A

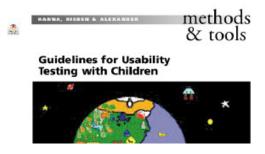
Goals: To gain knowledge in order to write our final report, ethics and testing sections.

Content:

- The authors note that user-centered design in children's products is a recent focus, explaining that "not until recently have publications begun to appear addressing the need to include the user in the design process of children's computer products."
- Children must be treated differently than adults in usability scenarios, as traditional methods must be "tailor[ed]... to allow children to participate."
- The article divides testing groups into three developmental cohorts—preschool (2–5), elementary (6–10), and middle-school (11–14)—because behaviors and capabilities differ substantially across ages.
- Preschool children often struggle to articulate preferences verbally, so designers must observe non-verbal cues such as "sighing, smiling, or sliding under the table."
- Elementary-aged children are comfortable following directions and answering questions, often showing readiness to "try new things with ease" when using computer-based interfaces.
- Middle-school children exhibit adult-like behavior in testing, though some may have such advanced experience that they risk skewing
 usability results if their skill level exceeds the intended user group.
- Testing environments should remain simple and minimally distracting; overly playful labs can derail sessions—for example, one test failed after children started a pillow fight instead of interacting with the software.
- The authors advise that younger children need encouragement but not instructions, warning testers not to ask, "'Do you want to play?'... that gives them the option to say no." Instead, phrases like "Now I need you to..." should be used.
- Behavioral evidence outweighs verbal statements when assessing enjoyment—"These behavioral signs are much more reliable than children's responses...particularly for younger children," who may answer to please adults.
- The article stresses that late-stage playtesting is insufficient, stating that child usability testing must occur iteratively because "no amount
 of adult evaluation will find all the issues that children will stumble into as a matter of course."

Citation:[23] L. Hanna, K. Risden, and K. J. Alexander, "Guidelines for usability testing with children," interactions, vol. 4, no. 5, pp. 9–14, Sept.—Oct. 1997.

Conclusions/action items: Children require developmentally tailored usability testing methods because their behaviors, communication styles, and interaction patterns differ significantly from adults, and only direct child involvement can reveal design issues unique to young users.





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2025/12/10 - Care for Diabetes in School

ISABEL PLOESSL - Dec 10, 2025, 12:21 PM CST

Title: Diabetes Care in School and Daycare

Date: 12/10/2025

Content by: Isabel Ploessl

Present: N/A

Goals: To learn about the typically regimen for kids in school that have diabetes.

Content:

- Diabetes is highlighted as "one of the most common chronic diseases of childhood" with more than 186,000 U.S. youth affected, underscoring the widespread need for informed school support.
- Federal protections—including Section 504, IDEA, and the ADA—require that schools "reasonably accommodate the special needs of children with diabetes."
- Despite these laws, the article notes persistent discrimination, such as schools refusing admission or failing to assist with glucose
 monitoring, prompting ADA advocacy.
- Appropriate school-based diabetes care is essential for "immediate safety, long-term well being, and optimal academic performance."
- The Diabetes Medical Management Plan (DMMP) must provide specific, individualized instructions for monitoring, insulin dosing, food
 intake, hypoglycemia, hyperglycemia, ketone checks, and emergencies.
- Schools are responsible for ensuring tiered diabetes training for staff—from basic awareness for all personnel to advanced training for those administering insulin or glucagon.
- The article stresses that schools must provide "immediate accessibility to the treatment of hypoglycemia", ensuring a trained adult is always present.
- Students who are capable should be permitted to carry their own supplies, perform self-management tasks, and have cell phone access to reach caregivers or clinicians.
- The article emphasizes that students with diabetes must be allowed to monitor glucose "in the classroom or anywhere", to avoid dangerous delays and unnecessary loss of instructional time.
- With proper planning, training, and collaboration, "children and youth with diabetes can fully participate in the school experience," ensuring both safety and equity.

Citation: American Diabetes Association, "Diabetes Care in the School and Day Care Setting," *Diabetes Care*, vol. 33, suppl. 1, pp. S70–S74, Jan. 2010, doi: 10.2337/dc10-S070.

Conclusions/action items: Schools must implement individualized plans, trained personnel, and legally required accommodations to ensure that children with diabetes can manage their condition safely and participate fully in all school activities

ISABEL PLOESSL - Dec 10, 2025, 12:33 PM CST

Diabetes Care in the School and Day Care Setting

Aurentus Divarres Association

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GENERAL GUIDELINES FOR THE CARE OF THE CHILD IN THE SCHOOL AND DAY CARE

1. Dialetes Medical Managemen

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2025/12/10 - Diabetes Mangaement in Daycare

ISABEL PLOESSL - Dec 10, 2025, 12:37 PM CST

Title: Municipal Support of Diabetes Management in Daycare, Kindergarten and School

Date: 12/10/2025

Content by: Isabel Ploessl

Present: N/A

Goals: To learn about what kind of role teachers can play in education and maintenance of diabetes

Content:

- The study identifies four major national themes in Denmark's institutional diabetes care: "(1) Institutional staff initially feel insecure... (2) There is a high degree of parental involvement... (3) The role of health employees varies, and (4) Fluctuating allocation of special needs assistants (SNAs)."
- Institutional staff frequently feel unprepared for diabetes care, with one employee stating, "We felt incapable and alone... is this really a school responsibility?", reflecting widespread fear of handling emergencies.
- Many teachers refuse tasks like insulin dosing or glucose checks because these feel "too far from their professional expertise," leading to
 inconsistent care.
- Parents play an outsized role in day-to-day diabetes management; municipal employees described parents as "at the centre of all of this", often expected to remain available for calls at any time.
- Parental burden is intensified by staff inconsistency, with some parents even told to stay home temporarily because "we don't have the staff to do these tasks."
- Training for institutional staff varies dramatically, and in many cases, parents themselves are expected to provide diabetes education, despite gaps in staff confidence and readiness.
- The role of municipal and regional health employees—particularly school nurses—is unclear and inconsistent, with some nurses
 reporting they "aren't the primary informants" due to the specialized nature of diabetes management.
- Adolescents are especially vulnerable, as they may skip glucose checks or insulin to "fit in," and staff often feel uncertain about their responsibility to intervene.
- The allocation of Special Needs Assistants (SNAs) is inconsistent, depending partly on whether a municipality interprets diabetes as "a handicap" or "a chronic illness," leading to inequitable support across regions.
- Institutional staff report frustration because criteria for SNA approval are vague: for example, one case noted a child was "too old" to qualify, despite high need, illustrating systemic gaps.

Conclusions/action items: Despite legal guarantees, institutional diabetes support remains inconsistent and heavily dependent on parental involvement across many grade years

Citation: L. B. Johansen *et al.*, "Municipal Support of Diabetes Management in Daycare, Kindergarten and School: A Qualitative Study of Differences, Challenges and Potentials," *Healthcare*, vol. 10, no. 8, p. 1557, Aug. 2022, doi: 10.3390/healthcare10081557.

ISABEL PLOESSL - Dec 10, 2025, 12:38 PM CST





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09/25/2025: Connection Design Drawings

ISABEL PLOESSL - Sep 25, 2025, 9:49 PM CDT

Title: Connection Drawings

Date: 09/25/2025

Content by: Isabel Ploessl

Present: N/A

Goals: Create design diagrams from my research to be used in the connectivity design matrix, be able to explain and write critera based on these

drawings

Content: Attached in PNG format below, includes 3 drawings.

Conclusions/action items: Use these designs in our design matrices and in our reports

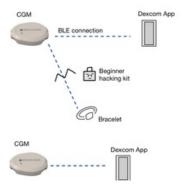
ISABEL PLOESSL - Sep 25, 2025, 9:49 PM CDT



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BLE-2.jpg (115 kB)

ISABEL PLOESSL - Sep 25, 2025, 9:49 PM CDT





Download

BLE-1.jpg (164 kB)

ISABEL PLOESSL - Sep 25, 2025, 9:50 PM CDT

Title: Connection Drawings

Date: 09/25/2025

Content by: Isabel Ploessl

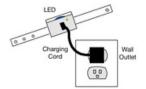
Present: N/A

Goals: Create design diagrams from my research to be used in the battery design matrix, be able to explain and write critera based on these drawings

Content: Attached in PNG format below.

Conclusions/action items: Use these designs in our design matrices and in our reports

ISABEL PLOESSL - Sep 25, 2025, 9:50 PM CDT



Download

Untitled_Draft_-1.jpg (98.2 kB)

09/26/2025: More Battery Design Drawings

ISABEL PLOESSL - Sep 26, 2025, 3:37 PM CDT

Title: Updated Battery Design Drawings

Date: 09/26/2025

Content by: Isabel Ploessl

Present: N/A

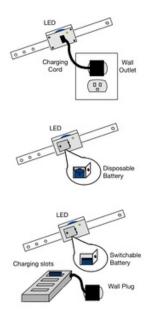
Goals: Create more clean and streamlined design diagrams from my research to be used in the battery design matrix, be able to explain and write

critera based on these drawings

Content: 3 designs attached in PNG format below.

Conclusions/action items: Use these designs in our design matrices and in our reports

ISABEL PLOESSL - Sep 26, 2025, 3:37 PM CDT



Download

LED-1.jpg (202 kB)

ISABEL PLOESSL - Sep 30, 2025, 9:37 PM CDT

Title: Final Sketch

Date: 09/30/2025

Content by: Isabel Ploessl

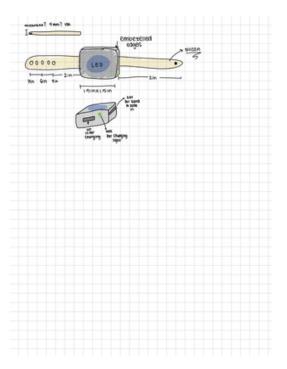
Present: N/A

Goals: Create a reference sketch for me to use when creating a final design in solid works

Content: attached in below

Conclusions/action items: Use this design, put it into mm and create it in solid works for presentations

ISABEL PLOESSL - Sep 30, 2025, 9:38 PM CDT



Download

Final-1.jpg (343 kB)

09/30/2025: Final Design SolidWorks SS

ISABEL PLOESSL - Sep 30, 2025, 9:41 PM CDT

Title: Final Sketch

Date: 09/30/2025

Content by: Isabel Ploessl

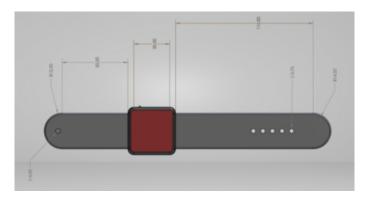
Present: N/A

Goals: Create a solid works of the final looking design for the bracelet

Content: attached in below

Conclusions/action items: Will come in handy for prototyping when it comes to appearance and dimensions, will also be used in reports and presentations moving forward

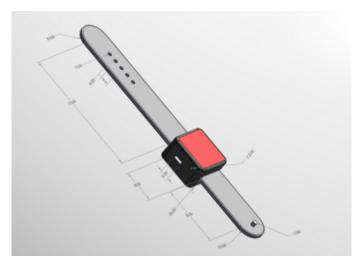
ISABEL PLOESSL - Sep 30, 2025, 9:39 PM CDT



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Screenshot_2025-09-30_184958_1_.png (190 kB)

ISABEL PLOESSL - Sep 30, 2025, 9:39 PM CDT



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Screenshot_2025-09-30_184846.png (303 kB)

ISABEL PLOESSL - Dec 06, 2025, 10:57 AM CST

Title: Beginning PCB Designs

Date: 12/06/2025

Content by: Isabel Ploessl

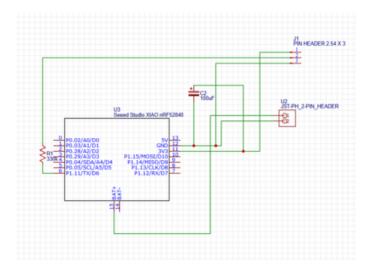
Present: N/A

Goals: Initial PCB work

Content: attached below

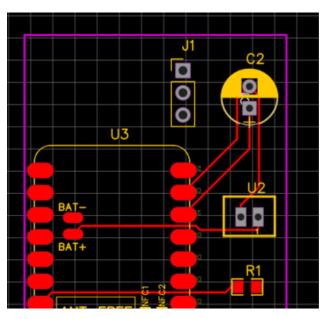
Conclusions/action items: Continue thinking about circuit and need for a PCB

ISABEL PLOESSL - Dec 06, 2025, 11:01 AM CST



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Screenshot_2025-11-05_212303.png (45.2 kB)

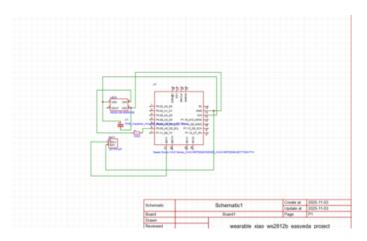




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Screenshot_2025-11-05_213647.png (34.8 kB)

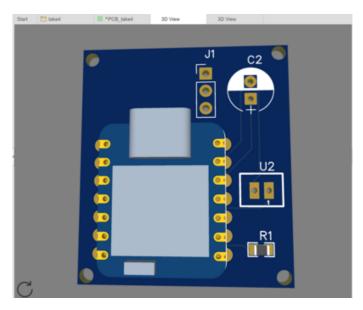
ISABEL PLOESSL - Dec 06, 2025, 11:01 AM CST



Download

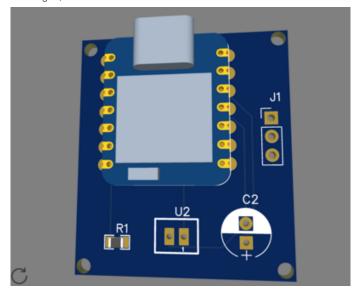
Screenshot_2025-11-05_220220.png (84.8 kB)

ISABEL PLOESSL - Dec 06, 2025, 11:01 AM CST



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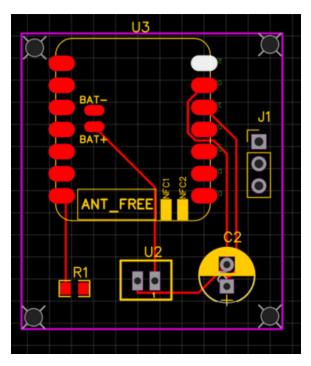
Screenshot_2025-11-05_222941.png (128 kB)



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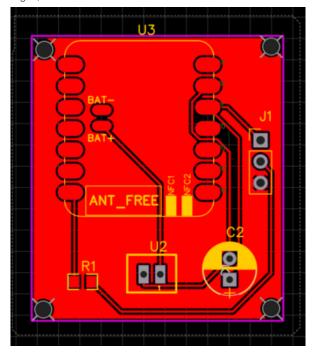
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ISABEL PLOESSL - Dec 06, 2025, 11:01 AM CST



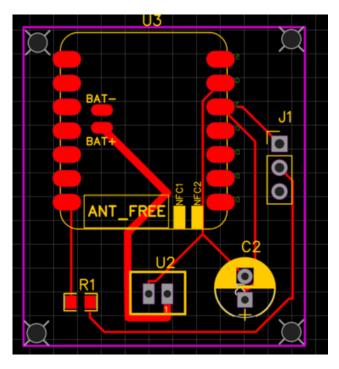
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Screenshot_2025-11-05_223813.png (79.7 kB)



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Screenshot_2025-11-05_224733.png (103 kB)



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Screenshot_2025-11-06_153957.png (89.2 kB)

12/06/2025 - PCB Design for Presentation

ISABEL PLOESSL - Dec 06, 2025, 11:02 AM CST

Title: PCB for Poster

Date: 12/06/2025

Content by: Isabel Ploessl

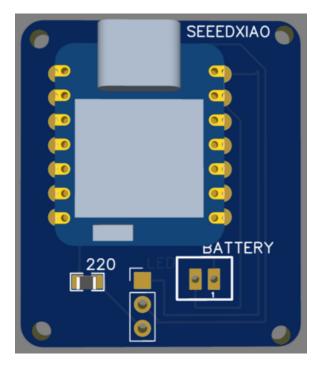
Present: N/A

Goals: To make a Potential PCB design for future semester use

Content: attached below

Conclusions/action items: For use on poster in the future work section as an example.

ISABEL PLOESSL - Dec 06, 2025, 11:03 AM CST



Download

Screenshot_2025-12-01_185539.png (85.8 kB)

ISABEL PLOESSL - Dec 06, 2025, 11:05 AM CST

Title: Final circuit images for poster use

Date: 12/06/2025

Content by: Isabel Ploessl

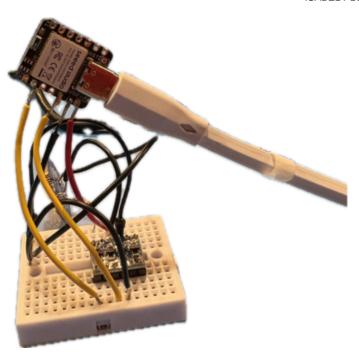
Present: N/A

Goals: Gather images of the circuit that are clear and can be used on our poster and in the final report

Content: attached below

Conclusions/action items: for use in final prototype section of poster and final report

ISABEL PLOESSL - Dec 06, 2025, 11:06 AM CST



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12/06/2025 - Images for Testing on Poster

ISABEL PLOESSL - Dec 06, 2025, 11:08 AM CST

Title: Dexcom images and App images

Date: 12/06/25

Content by: Isabel Ploessl

Present: N/A

Goals: Gather screen shots and images to be used for testing on poster

Content: attached below

Conclusions/action items: Images show that the app is functioning correctly with both Dexcom and the LED output

ISABEL PLOESSL - Dec 06, 2025, 11:08 AM CST



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ISABEL PLOESSL - Dec 06, 2025, 10:52 AM CST

Title: CITI Training

Date: 10/31/25

Content by: Isabel Ploessl

Present: N/A

Goals: Complete citi training

Content: PDF below

Conclusions/action items: Use this training as a consideration going forward with design projects.

ISABEL PLOESSL - Dec 06, 2025, 10:52 AM CST



Download

citiCompletionCertificate_15013966_73156309.pdf (77.4 kB)

ISABEL PLOESSL - Sep 10, 2025, 2:02 PM CDT

Title: BME Career Prep

Date: 9/10/2025

Content by: Isabel Pleossl

Present: BME 300's

Goals: To prepare for the upcoming Career fair, and job searching!

Content:

Stephanie Kann, Engineering Career Services

- · Job Search Tips
 - · Keep track of what you do
 - · Connect BEFORE you are a candidate
 - Applying is step 1- follow up is required (2-3 weeks)
 - Connect with someone at the job! alum
 - Start early and don't hit panic
- · Resume Tips
 - · Tailor your resume to the position quick changes
 - Show a picture of your experience
 - · Read description and add skills/projects
 - always under construction
- · Cover Letter Tips
 - · Always based on the job posting
 - · CUSTOM to each job
 - · Ampliflying your greatest selling points
 - · Clear and concise support
 - o Demonstrate employer knowledge
 - · Address to perosn
 - Recommended vs required
 - Outline BASICS
 - Intro: who you are, applying for, where you found it, and "thesis" statement
 - ex. Based on my experience in A and B, I believe I would be able to make a difference in the X role at Y company.
 - Paragraph all about A
 - Paragraph all about B
 - Why this employer/role + closing/next steps
- Career Fair Advice for BME
 - o Identify your purpose- more than just an internship
 - · Looking beyond the obvious overlap with other disciplines
 - · Research the employer feedback from our partners
 - Develop your "valued added" statement why you?
 - look at where BME overlaps with the other engineering majors
 - for instrumentation, look at electrical engineering

Conclusions/action items: Use this information to take into account during the upcoming career fair, make sure to go out and talk to other companies that don't list BME! Research companies and specific job roles, in order to be the most prepared veriosn of myself I can present

Questions:

Objective: "Summer internship with design skills in the midwest" only for career fair

Start by looking at expiration dates, wait untill after the career fair to apply specifically

Skills should be real and tacticle, as long as real and relevant, posting with many buzz words, matlab, exel, etc.

Ai parsing: dont select out, time constraints

09/17/2025: Lecture 2. Leadership Roles

ISABEL PLOESSL - Sep 17, 2025, 2:02 PM CDT

Title: Exploring your leadership style

Date: 09/17/2025

Content by: Isabel Ploessl

Present: 300's

Goals: To learn about my leadership style and how to be a better leader for the 200's and in other areas of my life.

Content:

· What is leadership

- assertive
- listener
- confidence
- communication
- self-awareness
- vision
- transparent
- decision-making
- empathy
- · Levels of leadership
 - personal
 - inter-personal
 - team
 - organization

· Leadership styles

- power model
 - leadership=power
- servant
 - leadership=mutual service
- authentic
 - leadership=authentic self
- · identify one from each
 - power Current president
 - authentic Swe leadership past and present
 - servant most leaders try to embody this study
- people oriented (glue)
- process oriented (sets the pace)
- thought oriented (big picture)
- · impact oriented (sets bar)

Connect

- **s**elf assess
 - what motivates your
- observe and reflect
 - what give you a sense of accomplishment

· Goal Setting

- what leadership skill would you like to develop this semester? how will you practice that skill? what would success look like?
 - I would like to work on my self awareness, sometimes I think that my actions and words can be construed in the wrong way. I will work on practicing that skill me thinking more often about what others might think of my leadership and try and tweak my actions based off of that. I would measure success in doing this by

asking my friends on my team if they ever think I am coming off in a way that is portraying any sort of bad leadership.

Conclusions/action items: I think going forward it is important to me to work on my goal and continue trying to improve as a leader. As coleader of this specific team it is really important for me to be able to collaborate as well as lead and be a person that the 200's feel okay coming to for questions as well. To do this I must continue to be a well rounded leader that embodies many of the listed traits that a good leader should have.

ISABEL PLOESSL - Sep 24, 2025, 1:48 PM CDT

Title: Near Peer Mentoring

Date: 09/25/2025

Content by: Isabel Ploessl

Present: 300's

Goals: To learn about how to be a really good mentor for the 200's in our group and to learn how to better answer their questions.

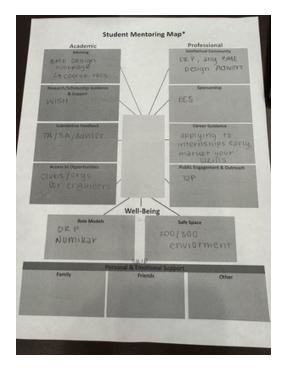
Content:

- purpose of mentoring 200 students
 - be there for them to ask questions about BME that they might not have anyone else to ask
 - have them be able to observe the process more before getting into leading their own project
 - · you can relate based on our own previous questions
 - we are alot more approachable than asking professors
 - · helps increase belonging in BME
- · Transferable skills
 - leadership
 - communication
 - active listening
 - o study practices
 - self awareness
 - o interpersonal skills
- · general benefits of mentoring
 - o incresed self-esteem
 - increased patience
 - bulid positive habitsfoster personal growth
 - o ioster personal growth
 - gaps in own knowledge
- sense of accomplishmentwhat does it mean to be a good mentor
 - patience
 - fostering open communication
 - o building trust
 - share w/o fear
 - reliability
 - support/enthusiasm
 - being avalible
 - transparency
 - · be the coach
- · listening effectively
 - get rid of distractions
 - stop talking
 - o act like you're interested
 - look at them
 - o get the main idea
 - · ask questions
 - check for understanding
 - react to ideas not to the person
 - avoid hasty judgement
- what do you wish you knew in BME 200
 - make a list of tanina management advisa

- BME Design Resources
- 4-year plan feature on DARS
- · Lots of advice on Lab Archives
- o course recommendations
 - fall/spring spreadsheet

Conclusions/action items: Use the attached mentor plan as an action plan for mentoring the 200's

ISABEL PLOESSL - Sep 24, 2025, 1:53 PM CDT



Download

MentorMap300.jpg (2.47 MB)

10/01/2025: Lecture 4, Sustainability in BME

ISABEL PLOESSL - Oct 01, 2025, 1:49 PM CDT

Title: Sustainability in BME

Date: 10/01/2025

Content by: Isabel Ploessl

Present: 300's

Goals: To learn how to integrates sustainability in our classes and in our future careers.

Content:

Andrea Hicks

- · What is sustainability
- · Circular economy
 - · how to keep resources in the economy
 - lots of energy to get rid of waste
 - · when is it worth it and when is it not
- · lifecycle assessment
 - · carbon footprint
 - · water footprint
 - quantitative
- · Keurig vs coffee pot
 - · actually about the same
 - · maker energy cancels out plastic
- · White paper in doctors office
 - · white paper was lots of waste
 - o don't need it
 - save money
 - o everyone wins
- · speculums
 - metal vs plastic
 - o plastic single use
 - · metal wash and autoclave
 - · think about electricity, labor, water, for things that are reusable
 - consider possibilities of shortages
- NO2 has 300 times the CO2 emissions
- · Important to reuse medical devices
- How do we use these tools to engineer a more sustainable world?
 - when is it important to consider this?

Conclusions/action items: I realized there is a lot more things to consider and think about with sustainability rather than just things that are on the surface. Often times there are two options that end up breaking even in the long run but it is still important to consider when designing and engineering. For us I think reusability is very important to consider moving forward.

ISABEL PLOESSL - Oct 08, 2025, 2:01 PM CDT

Title: Warf

Date: 10/08/2025

Content by: Isabel Ploessl

Present: 300's

Goals: To learn about patenting and such regarding current project from Jeanine Burmania via WARF

Content:

- · WARF works with technology transfer
- · IP overview
 - patents
 - · keeping something secret
 - a patent is a property right, granted by a governmental agency
 - us patent and trademark office
 - patent holder has right to exclude others from asking, using, selling, or importing the claimed invention
 - there are three different types of us patents
 - design (15 year)
 - plant (20 year)
 - utility
 - provisional (1 year placeholder)
 - non provisional (20 year)
 - o copyrights
 - protection for creative works that are expressed in a tangible medium
 - music movies, software
 - trademarks
 - protection for names, marks, logos, dress
 - protects consumer rather than producer
 - trade secrets
 - used to protect anything of value
 - the least compatible
 - recipe (Coca-Cola)
 - biomaterials
 - · technique and know how
 - data
 - data sets and problem sets
- Patents
 - utility nonprovisional patents
 - · issued for the invention of a new and useful process machine manufacture or composition of matter
 - o a quid pro quo with the USPTO and the public
 - applicant gets a time limited monopoly on your invention
 - o often takes 2-5 years to issue after filing
 - o costs on average 30k for attorney fees
 - o 90% of patents issued by USPTO are non-provisional utility patents
- · requirements
 - $\circ\hspace{0.4cm}$ 101- eligible; cannot be a product of nature, an abstract idea, or natural phenomenon
 - 102- novel; new
 - 103- non-obvious; it cannot be simple modifications or combination of existing concepts
 - · 112- enabled and described; must provide enough detail to teach others how to make or use the invention

- patent examiners are scientists hired and trained by the USPTO to review patent applications for these requirements
- · disclosing an innovation to WARF
 - WARF gets about 400 new innovation disclosures each year
 - disclosing (on website)
 - describe the innovation
 - identify the advantages and potential applications
 - name contributors
 - provide funding and public disclosure details
 - meeting
 - discuss the innovation in more detail
 - ask questions about WARF and patenting processes
 - discuss next steps
- · assessing univeristy inventions
 - IP consideraitons
 - type of ip protection
 - potential breadth and strenth of ip protection
 - public disclosure
 - stage of development
 - licensing considerations
 - applications
 - likelihood of identifying a commercial partner
 - likely return from licensing
- · Marketing and licensing
 - · Licensing the IP is the next step in transferring the technology
 - market analysis
 - market status established, emerging, new
 - size and type large and growing, medium and contracting
 - potential licensees companies in the market
 - · license negotiation
 - types and terms
 - considerations
 - ongoing
 - technology development, enforcement, amendment, termination
- · value of licensing
 - benefits to the company
 - reduced r and d costs
 - improved time to market
 - opportunity to enter new markets
 - o determining the value
 - technology application
 - key selling points/features/benefits
 - technology trends
- Al and IP
 - o can Al invent?
 - no
 - o can AI assist in inventing?
 - evolving but likely yes under pannu factors
 - copyright
 - original works of human authorship
 - Al must be incidental to conception and creation
 - original conception by human master mind

Conclusions/action items:

If we hope to patent our device, WARF is a very good resource for us! It is important to keep all these details in mind as we continue along the design process and definitely something to consider as we finish up this semester.



10/15/2025: Valuation of intellectual property

ISABEL PLOESSL - Oct 15, 2025, 2:10 PM CDT

Title: Valuation of intellectual property

Date: 10/15/2025

Content by: Isabel Ploessl

Present: 300's

Goals: Learn about legalities of engineering

Content:

- · intellectual property attorney
- · importance of intellectural property
 - biomedical engineering create life changing solutions
 - IP protection allows research to safety transfer into products, processes, and or systems
 - IP enables investment, partnerships and ethical competition
 - · legal career paths for engineers in IP
 - technical advisor no degree required
 - patent agent technical advisor with patent bar, can sign and have interviews, mini lawyer
 - patent examiner stem degree (patent bar eventually) us gov job
 - patent attorney law degree + patent bar
 - patent litigator law degree (stem degree + patent bar optional)
 - IP license attorney law degree (stem degree + patent bar optional)
 - tech transfer manager stem degree preferred (law degree optional)
 - engineer stem degree (work with IP lawyers to protect your inventions)
 - o skills from engineering help her in the attorney field
 - · she started a patent in school that didn't go all the way
- ownership
 - · university: disclose before publishing; university usually owns IP; possible license opportunities
 - · company: employer typically owns inventions, trademarks, copyrights and other IP; review employee agreements
 - o startup: you own IP; file early, use NDA's, document development
 - know what you're signing
 - need much more legal documents
 - typically, an informal patent
- · timing and publication
 - disclose internally first
 - publishing before filing and offers for sale = lost patent rights abroad and possible loss of rights in the US
 - o posters or abstracts can count as public disclosures
 - · first to file system (not first to invent)
- · legal and ethical duties
 - · respect others IP
 - · keep invention notebooks
 - · understand inventorship vs authorship
 - maintain confidentiality agreements
- · lab archives is important
- · biomedical startup
 - · invent something new, novel, non-obvious
 - · conduct patentability search
 - file patents early
 - use NDA's
 - file trademarks
 - o form business entity

- obtain business insurance
- o funding, licensing and franchising
- don't have to have a prototype to file for patent application
- understanding part
 - o front page
 - drawnings
 - specifications
 - o claims (builds the fence)
 - abstract
- you can get a patent and still be infringing on someone else patent
- trademark
 - o smells, sounds, colors, building
- you have trade secrets until you don't
- · huge counterfeit market in the medical and pharmacy space

Conclusions/action items: Once the team has a general prototype, we should file for a patent so then we can continue to work on it while the patent application is pending. Law is always an interesting path you can take after completing my BME degree.



10/22/2025 - Learning about post grad options

ISABEL PLOESSL - Oct 22, 2025, 1:59 PM CDT

Title: Options Post Grad

Date: 10/22/2025

Content by: Isabel Ploessl

Present: 300's

Goals: To learn about my options after we get our degree!

Content:

- · use your undergraduate experience to "build a story"
- do your homework what does your ideal career look like
 - · what programs have opportunities you are looking for
 - thin about letter writers or references early 3 strong ones
- · look of typical and wrong personal statement or cover letters
- · writing your story better
 - start with what you want to do
 - your narrow expirences
 - specific to each position
 - personal statement
- · graduate school options
 - MS
 - stepping stone/change directions/gain depth/expand credentials
 - industry focused
 - generally ONE YEAR
 - rewrite your story
 - MS will make you more desirable
 - fill gaps in your resume
 - really powerful if you add in industry experience
 - higher starting salary
- • PHD
 - o desire to be an independent researcher
 - write research grants
 - · work in academia
 - lead projects in industry, startups, and consulting
- · Three MS options within BME 24 credits
 - o research (1.5-2 years)
 - for those continuing on for a PhD
 - can be funded
 - thesis required
 - accelerated program (1 year)
 - funding (TA only) stipend only (no tuition remission \$1200/credit)
 - no co-op allowed
 - accelerated
 - coursework only
 - independent study
 - biomedical innovation, design, entrepreneurship (BIDE)
 - project based project required
 - partnership with business school
- · Applying for BME programs
 - · apply online, pay fee and submit, fall and spring start

- statement of purpose
- o special for UW BME students
 - no letters of recommendation
 - easy to meet deadline of 12/15, spring entry allowed
 - your application is reviewed separately, and we give special consideration to BME undergraduate students, need at least a 3.0 overall
 - essentially already in, even if less than 3.0
- · Masters elsewhere
 - MEng
 - o MS in global health
 - MS in other engineering dept
 - MBA comes later, usually paid for via employer
- research shows you can apply what you learn in the classroom

Conclusions/action items: There is a myriad of options to lean on post grad, especially if a job option isn't there. I feel like I would be open to doing a project based accelerated MS degree, if a job offer isn't there right away.

ISABEL PLOESSL - Oct 29, 2025, 2:06 PM CDT

Title: To Regulate or Not To

Date: 10/29/2025

Content by: Isabel Ploessl

Present: 300s

Goals: I want to learn about different regulatory processes and policies and the FDA

Content:

- · Dr Kip Ludwig
- · CDRA center for devices and radiological health
- FDA doesn't determine if a device is safe, it determines if the benefits outweigh the risks
- FDA doesn't approve materials
- Class 1, low risk
 - o tongue depressor
- · Class 2, moderate/controlled risk
 - 510k pathway
- · Class 3, high risk
 - PMA approval
 - HDE pathway
- FDA started monitoring medical devices until 1976
- First pacemaker implantation in 1958, lasted about 6 weeks
- · Animal and biological testing is becoming less representative, which leads to many surgeons not wanting the FDA presence
- · Pre and Post 1997
 - Dalkon Shield
 - implantable contraceptive
 - o 2.2 million devices implanted
 - · it didn't stop pregnancy
 - o caused a myriad of other issues
 - septic pregnancy and maternal death
- · Device information pathways isn't quick (failures can be idle for years)
- · Recalls barely affect firms at all
- No market consequence because they don't come to people's feeds
- CEO and founder charged with implanting millions of dummy devices that did absolutely nothing for treating back spasms at all
 - o fired, in jail, company bankrupt
 - employees knew???
- Took growth hormones from a cadaver with Altheimer's, given it to the kids that received the proteins, unrecognizable until 15-20 years after

Conclusions/action items: The FDA isn't perfect; there are lots of things that are overregulated and others that are extremely underregulated. Over the years the regulation has changed a lot. It is an ever-changing system of strictness and is different between biologics and even within the same devices. There are bigger media issues at hand with device recalls, things that kill many people are simply passed onto the next.

ISABEL PLOESSL - Nov 05, 2025, 2:10 PM CST

Title: Regulatory Strategy

Date: 11/5/2025

Content by: Isabel Ploessl

Present: 300s

Goals: To learn the framework guiding advanced therapeutic product development, understand the overall structure of the FDA

Content:

- Understand the regulatory system in order to get into higher paying jobs
- FDA Structure
 - Device (CDRH)
 - PMA, 510k, IDE
 - Drug (CDER)
 - NDA, IND
 - · Biologic (CBER)
 - BLA, IND
- US Laws
 - FD&C
 - PHS
 - CURES of 2016
 - CARES of 2016
 - Regulations
 - FDA Guidance (what we would typically care the most about)
 - Not a step by step guide
- 351 vs 361
 - 351
 - regulated as drugs and or biologics (homologous use)
 - o 361
 - largely unregulated
 - can be done immediately
 - every time we get a no, there is a risk or safety concern
- · Product Development Life Cycle
 - "each stage of the product development cycle faces its own risks and challenges and proper management of these risks is vital for successful commercialization"
 - · run lots of safety test
- Target Product Profile
 - Like our PDS
 - · when to use it
 - why to use it
 - how to use it
 - will patients and prescribers want it : validate TPP with key opinion leaders
 - will regulators accept it: discuss plans with regulatory agencies
 - will payers reimburse for it: understand the evidence payers require
 - why should I fund development: show people will buy it is the cost reasonable what are the risks
- · Considerations when developing
 - non clinical studies
 - quality
 - clinical
 - regulatory

- If you really understand quality management, you can separate yourself from the bunch
- Quality Management system
 - · a system that documents policies, processes, internal rules, procedures, and other records to ensure consistent quality.
 - any place that can cause unexpected outcomes, emerging differences, pre, in and post run need to be thoroughly documented
- · Career Options
 - characterization and analytics
 - o process development
 - · manufacturing development
 - o gene delivery

Conclusions/action items: There is a lot of available jobs opportunities and money available in the FDA regulation jobs and it might be something to look into post grad.

ISABEL PLOESSL - Nov 07, 2025, 12:44 PM CST

Title: Tong Lecture Fall 2025

Date: 11/07/2025

Content by: Isabel Ploessl

Present: BME's

Goals: To learn from the guest speaker on her life story

Content:

Kristen Myers BME Class of 2002

- MBA from Harvard in 2007
 - Medtronic
 - CVS health
 - Startup
 - o Chief operating officer at Blue Cross Blue Shield
 - o 30 students when she graduated UW
 - People didn't know what BME was
- "Run towards the hard problems, they are the ones that change the world"
- · The Foundation
 - Solve tangible problems, work hard, add value
 - UW Madison
 - had odd jobs
 - finance internship
 - Abiomed full function heart
 - Guidant
 - Medtronic
 - 5 years
 - Harvard MBA
 - Venture Capital
 - investor in healthcare startup
 - · Arboretum Ventures
 - investor in healthcare startup technology
- The Growth
 - · Climb the growth curve
 - o combine EQ with IQ to multiply impact and reach
 - Aetna
 - chief of staff to CEO president, student health president, great lakes region commercial and medicare
 - turned into CVS
 - Unified Women's Healthcare
 - president and chief operating officer
 - OBGYN
 - worked during covid
- Build and Transform
 - drive system-level impact through innovation and scale
 - Hopscotch Health
 - Founder and CEO
 - Advanced Primary Care of Rural Communities
 - Blue Cross Blue Shield Association
 - Chief Operating Officer

- Enable Access, Affordability, Outcomes and Experiences for 1 in 3 Americans
- "You don't need to know your final destination just follow hard problems and build skills that allow you to make an impact"
- Quadruple Aim
 - Improved Provider Experience
 - · Improved Patient Outcomes
 - · Lower Cost of Care
 - · Improved Patient Experience
- How much do we spend on healthcare in the US? (\$\$ and % of GDP)
 - \$5.3 T and 18% GDP
 - 2X per person on healthcare
 - · US ranked last on equity, access and outcomes
- 1
- · Work Hard and Build Range
 - Take on the hardest projects, classes and experiences you can find. Effort and range are your foundation
- 2
- Seek Diverse Exposure
 - Explore different sectors, teams and geographies. Gain perspective and learn how systems connect, not just how parts work
- 3
- · Choose Your People Wisely
 - Surround yourself with curious, driven, high-integrity people. They will shape who you become
- 4
- Know Your Values and Protect Them
 - Define what matters most family/friends, health, career/impact, values and make decisions that align
- 5
- Embrace Challenge and Keep Growing
 - Run towards hard problems. Growth lives on the edge of discomfort where big impact starts

Conclusions/action items: You don't have to know what you want to do in life, just know yourself and your values and you can work to meet those as you go, and still achieve a very successful and rewarding career. She took so many paths and did so many different things but she ended up being very successful and happy with where she is at. I am extremely lucky with the people I pick in my life right now are shaping me to become more driven and successful. You can't go wrong at this point!

ISABEL PLOESSL - Nov 12, 2025, 1:59 PM CST

Title: IRB Review

Date: 11/12/2025

Content by: Isabel Ploessl

Present: 300's

Goals: To learn about IRB and when its needed

Content:

- · Stephanie Matzger PHD
- Historical problematic research
 - US Public Health Service untreated syphilis study
 - · WWII Nazi prisoners experiments
 - us public health service Guatemala syphilis
 - willow brook state school hepatitis experiments
 - studies weren't aware
 - scientific rigor wasn't strong
- Ethical Research Frameworks
 - Nuremberg Code
 - voluntary consent
 - · Declaration of Helsinki
 - medical research
 - National Research Act
 - US response to us public health service untreated syphilis study
 - publication of Belmont report and creation of IRBs
- Belmont Report
 - · respect for persons/autonomy
 - respect for those with diminish autonomy and those will full autonomy
 - beneficence
 - maximize possible benefits and minimize possible harms
 - justice
 - who will receive benefits and we will bear burdens
- · Applying Belmont Priniciple
 - 1991 Department of Health and Human Serives
 - Common rule
 - Criteria for approving research
 - protections for vulnerable groups
 - requirements for IRB operations
 - Revised common rule
 - modifications to reduce administrative burden
- IRB Composition
 - · Diversity of membership required
 - race, gender, cultural backgrounds
 - scientific expertise
 - non-scientists
- IRB Purpose
 - Protect rights and welfare of people enrolled in research
 - IRB review human research according to:
 - Ethical principles
 - federal regulations

- state laws
- institutional policy
- · IRB Review Requirements
 - · UW Madison requires IRB review of all research involving human subjects, including exempt human subjects research
 - research CANNOT begin until the IRB approves
- Criteria
 - Risks
 - Benefits
 - Risk/Benefit Ratio
 - Equitable selection of subjects
 - Informed consent
 - · Privacy and confidentiality
- · De-identifying Data
 - o Directly Identifiable
 - Coded/Indirectly Identifiable
 - · Anonymized/Deidentified
- · What Happens After Approval
 - Begin your study
 - · Changes of protocol
 - · Reportable events
 - Continuing reviews

Conclusions/action items: IRB coincides with our CITI training. When doing research, it is incredibly important to make sure you are following gall the correct steps in place for your research in order to maintain ethical and scientific credibility.

ISABEL PLOESSL - Nov 19, 2025, 1:58 PM CST

Title: How medical product R&D works in industry

Date: 11/19/2025

Content by: Isabel Ploessl

Present: 300s

Goals: To be able to explain how new product development works at most medical device companies

Content:

NPD: New Product Development

- · NPD in the medical device industry is:
 - · highly regulated
 - expensive
 - resource intensive
 - competitive
- · Selecting and Prioritizing Projects
 - Corporate Business Strategy
 - o Product Portfolio Review
 - Project Review
 - · Budgeting and Resource Allocation
 - all an annual review
- · Types of NPD Projects
 - Line extensions: additional sizes and configurations
 - o Product improvements: existing product change
 - New-to-company
 - New-to-world: new market
- · Managing NPD: Stage gate process
 - o Stage 0
 - Ideation (Cloud)
 - Stage 1
 - Exploration
 - o Stage 2
 - Concept Development
 - Funnel
 - o Go/no-go
 - Stage 3
 - Design Development
 - o Stage 4
 - Design Confirmation
 - (Often longest stage)
 - Design Freeze
 - Stage 5
 - Design Transfer and Commercialization
 - Tunnel
 - Launch
 - o Stage 6
 - Post-market Surveillance
- · Case Study: Fluid Management
 - o Cardinal Health Vs Stryker
 - Have to beat the Neptune System

- Cleaner and more efficient
- Stage 0: Automating Fluid Collection
- Stage 1: Came up with 8 designs
- · Stage 2: Finalize one concept
- Stage 3: Move to functional Prototype
- Stage 4: Accelerate manufacturing process
- Stage 5: Complete and finalize design, begin looking at sales
- Post Market Surveillance
 - On a 4-6-month cadence
 - View complaints
 - Sale metrics
- Stryker launched a new system to improve design
- · Summary:
 - Medical device development is expensive complex and highly collaborative
 - Having limited resources, most businesses have instituted processes lake Stage-Gate to reduce risk and increase probability of success
 - · Good product design and development tis necessary for commercial success but not sufficient

Conclusions/action items: The market for new medical devices is very complex and often hard to get a jump in, lots of big companies fail often at it as well. NPD seems very similar to BME design in terms of the stages and idea work.



2025/09/11 Type 1 Diabetes in Children

Claudia Beckwith - Sep 11, 2025, 9:35 PM CDT

Title: Type 1 Diabetes in Children

Date: 9/11/2025

Content by: Claudia Beckwith

Present: Claudia Beckwith

Goals: I want to get a baseline understanding of type 1 diabetes and how it affects children. As our project focuses on T1D in children, I am also looking for differences in adult vs children type 1 diabetics. I also am interested to learn about the symptoms to see how parents/caregivers initially observe and diagnose T1D.

Cite:

[1] "Type 1 diabetes in children - Symptoms and causes," *Mayo Clinic*. https://www.mayoclinic.org/diseases-conditions/type-1-diabetes-in-children/symptoms-causes/syc-20355306

Content:

T1D: condition in which the body doesn't produce the sufficient amount of insulin (a hormone) to survive. To treat T1D, patients recieve insulin shots or use an insulin pump to get the correct amount.

T1D in children is known as juvenile diabetes or insulin-dependent diabetes

there is no cure for T1D, but it can be managed.

Symptoms:

- · increased thirst
- · frequent urination
- · extreme hunger
- · unintentional weight loss
- fatigue
- · behavior changes
- · fruity smelling breath

Causes:

the exact cause is unknown, in most people, the immune system mistakenly destroys insulin-producing cells in the pancreas

genetics and environmental factors play a role

once insulin-producing cells (islet cells) are destroyed, the body produces little to no insulin

insulin moves sugar from the bloodstream to the body to be used as energy

without insulin, sugar builds up in the bloodstream and can cause life threatening complications

Risk Factors:

- family history
- genitics
- race (more common among white children of non-hispanic descent)
- certain virus exposure can trigger autoimmune destruction

Complications:

- heart and blood vessel disease, increased risk for stroke
- nerve damage (excess sugar can damage neuron cell walls)

- kidney damage
- eye damage
- osteoporosis

Conclusions/action items:

After this, I feel like I have a better understanding of T1D in children along with how the disease works. I believe understanding how the physiology works better will help me, so I plan to dive deeper into this next. I also was interested in the other complications of T1D, such as heart issues, eye damage, and osteoperosis.

Claudia Beckwith - Sep 11, 2025, 9:36 PM CDT



Download

Type_1_diabetes_in_children_-_Symptoms_and_causes_-_Mayo_Clinic.pdf (662 kB)



2025/09/12 Caring for a Child with T1D at School

Claudia Beckwith - Sep 12, 2025, 12:00 PM CDT

Title: Managing Diabetes at School

Date: 9/12/2025

Content by: Claudia Beckwith

Present: Claudia Beckwith

Goals: I want to get an understanding of the considerations and action plans that parents undergo as they send their child with t1d to school. For children that are not old enough to monitor their own glucose/insulin, it can be scary to be away from your kid and leave them in the care of people that don't understand their symptoms. These considerations will help me start thinking about what we need to include in our device.

Cite:

[1] "Managing diabetes at school," Diabetes, May 15, 2024. https://www.cdc.gov/diabetes/caring/managing-diabetes-at-school.html

Content:

This page highlights differences between children in school who are old enough/self sufficent when it comes to tracking their glucose levels, injecting insulin, and adjusting their insulin pump with those who are not. Children who are younger obviously need assistance from teachers/school nurses to stay healthy

Recommendation 1: creating a diabetes management plan

- each kid with T1D handles it differently
 - · unique target blood sugar range
 - · level of assistance in checking blood sugar
 - specific hypoglycemia symptoms
 - · treating low blood sugar
 - · insulin or other medicines used
 - · meal/snack plans (including special events)
- schools offer the option to set up a 504 plan
 - outlines legally the specific accommodations and services a student needs to safely and effectively manage their t1d at school, ensuring
 equal access to education and activities
 - often incorporates a DMMP (diabetes medical management plan)
 - · specifies the responsibilies of school staff and ensures they are properly trained to support the student
 - individualized plan

teaming up with school staff (nurse and teachers) helps kids adjust at school

- typically nurse is primary staff member in charge of monitoring the child
- often parents opt to visit the teacher in person and visit the classroom to discuss specific policies and action plans, gives peace of mind to the parents and teacher alike
 - o go over what the child can do specifically (leave class without asking, etc)
 - · teacher can note the obvious signs and help the child
 - o promote equal opportunities for the child

cafeteria - get menus and nutrition services to help child plan insulin usage (or pack home lunch)

familiarize with after school staff

option to monitor with smartphone app and alert caregivers when blood glucose is dropping

diabetes checklist:

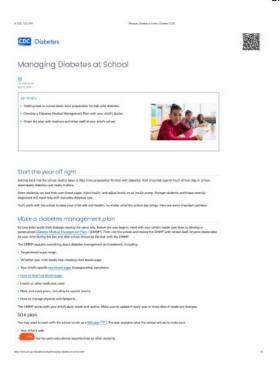
- · blood sugar meter, extra bateries, testing strips, lancets
- water

- · glucose tablets or juice boxes
- · antiseptic wipes
- · insulin and syringes/pens

Conclusions/action items:

I have a better understanding of what parents can do to best support their child as they go to school. There are a lot of factors that I haven't ever considered, and I can see how sending a child to school can be really nerve wracking when they aren't self sufficent enough to monitor their glucose on their own. I now have a better idea of factors that a caretaker might benefit from knowing when caring for a child with t1d.

Claudia Beckwith - Sep 12, 2025, 12:02 PM CDT



Download

Managing_Diabetes_at_School___Diabetes___CDC.pdf (266 kB)



2025/09/18 Average Wrist Sizes of Children

Claudia Beckwith - Sep 18, 2025, 9:56 PM CDT

Title: Wrist size chart for children

Date: 09/18/2025
Content by: Claudia

Present: Claudia

Goals: Considering our bracelet will be going onto a child, I wanted to find some research about the average wrist sizes of children. One of our requirements is to have a bracelet that is adjustable for different children, which will also allow for flexibility as the child grows. This requirement will be outlined in our PDS.

Cite:

[1]

The Jewelry Vine, "Child bracelet size Chart by Age & length| Bangle Size Chart," The Jewelry Vine, Oct. 27, 2024. https://www.thejewelryvine.com/bracelet-size-chart/

Search:

Average child wrist sizes

Google

Content:

Size Chart For Bangles

(a general size guide for a children's bangle bracelet)

Age	Size	Bangle Size
Baby	XS	4 ½" circumference
2 – 6 years	S	5 1/4" circumference
6 – 8 years	М	5 3/4" circumference
8+ years	L	6 1/4" circumference

Size Chart for Bracelets ~ Link or Chain Bracelets (a general size guide for a children's chain bracelet)

Age	Bracelet Size
Newborn – 6 months	4" – 4 ½"
6 -12 months	4 1/2" – 5"
1 – 4 years	5" – 5 ½"
4 – 7 years	5 1/2" - 6"
7 – 10 years	6" - 6 1/4"
Teen	6 ½" – 7"+

Conclusions/action items:

From this, I can conclude that the average wrist sizes for the target audience is from 5.5in to 7.5 in. This translates to 13.5-17.5cm. If our bracelet can adjust to these sizes, we will have accommodated to the average child wrist size and met the client requirement.

Claudia Beckwith - Sep 18, 2025, 9:57 PM CDT





<u>Download</u>

Child_Bracelet_Size_Chart_by_Age_Length__Bangle_Size_Chart.pdf (396 kB)

Claudia Beckwith - Sep 19, 2025, 10:29 AM CDT

Title: Introduction to Glowcose Monitor

Date: 09/18/2025

Content by: Claudia

Present: Claudia

Goals: One of our teammates, Ella, found this device that has a similar concept to our device with a different application. The glowcose is an orb light that connects to the users CGM and displays a range of colors corresponding to blood glucose levels, making it easy for others to get updates about someones blood glucose levels. I want to look more into this device and see how it works and connects.

Cite:

"Glowcose is Lighting up the Diabetes World." https://www.type1strong.org/blog-post/glowcose-is-lighting-up-the-diabetes-world

Search:

Glowcose light

Google

Content:

The glowcose is a light that reads info from a CGM and displays a cooresponding color

red = hypoglycemic

green = levels are good

purple = hyperglycemic

compatable with dexcom g6, g7, freestyle libre 3

founder developed a rudimentary device for his wife, turned it into a product

goal is to reach t1d/their caregivers

connects directly to cgm

addresses mental toll of constantly having to check blood sugar levels

light updates every 5 minutes

helps t1d patients feel like checking levels is on the "backburner" so it doesn't consume as much space mentally

especially beneficial for newer diabetics and those caring for someone with t1d

looking into the setup, I see glowcose has its own "wifi network" that connects to the users phone. I am not sure if this concept is something we will be able to replicate or not as again, we have very limited space.

the glowcose also has the user log into their dexcom account right at the signup page. I think this would be the easiest way to connect to the CGM but I'm not sure if we have the rights to access that kind of information. I wonder if we can latch onto the concept of "sharing data with friends/family" to transmit data.

glowcose offers an urgent low flash setting

Conclusions/action items:

After understanding the background of the glowcose, I think I have a better idea of what our device can do. The biggest hurdle will be getting this technology onto a small scale and switching over to a portable power supply that is housed inside a small enough encasement to be worn around a child's wrist. I want to know more about the compatibility aspect with connecting a cgm to a 3rd party device.

Gitrwoore is Lighting up the Displace World

TID Dure

Glowcose is Lighting up the Diabetes World

Discover how a personal challenge developed into innovation with Glowcose, a color-changing lamp that displays blood sugar levels for individuals with type 1 diabetes. Glowcose works to blend modern TIO technology with everyday life to ease the toil of blood sugar management. It also helps loved ones see when your levels are dipping.



Seven years ago, Kevin Terry, an embedded systems engineer from Charlotte, North Carolina, realized a need in his life wasn't being met. After twenty years of living with type 1 diabetes (T1D), Terry's wife was pregnant

His females in the authorized by the second

Download

Glowcose_is_Lighting_up_the_Diabetes_World.pdf (8.8 MB)

2025/09/11 CGM Use with Children

Claudia Beckwith - Sep 11, 2025, 9:20 PM CDT

Title: Continuous Glucose Monitors for Children: All You Need to Know

Date: 9/11/2025

Content by: Claudia Beckwith

Present: Claudia Beckwith

Goals: I aim to get a baseline understanding of the use of CGMs on children. I understand T1D can be more difficult when parents are trying to understand their child's condition and best care for them, so I want to learn more about the factors that go into deciding whether to use a CGM and if so, which one. This will be a good baseline for me to understand our project.

Cite:

[1] W. Payne, "Continuous glucose monitors for children: All you need to know," *Gluroo*, May 14, 2024. https://gluroo.com/blog/diabetes-101/all-about-continuous-glucose-monitors/

Content:

What is a CGM: tracks blood glucose at regular intervals (like every 5 minutes)

- children CGMs can be smaller, more discreet, easy to use
- customizable alarms to alert if child's glucose level is too high or low
- helpful with young kids when recognizing their signs can be harder
- helps in long term decisions about treatment

How do CGMs work:

- sensor: inserted just under the skin, measures glucose in interstitial fluid
- transmitter: sends glucose readings to monitor/display device
- display device: shows reading and trends, some alert user at limits
- active 24/7
- CGM readings often "lag" current measures by 15 minutes
- finger prick is more accurate and used to calibrate CGM

notes for CGM use with children:

- approved for as young as 2 years old
- most popular for children use are Dexcom G6/G7, Medtronic Guardian Connect, Freestyle Libre 2/3, Senseonics Eversense

Dexcom G6/G7:

- one of the smallest on the market

Libre 2 uses NFC scan from a reader or smartphone

Libre 3 connects via bluetooth, no NFC scanning, more affordable than other options

- advantages include
 - · improved glucose control
 - · increased awareness, helping children understand their levels
 - decreased risk of hypoglycemia
 - · increased confidence
- disadvantages of CGMS for children

- cost
- maintenance/replacement
- accuracy (occasionally inaccurate)
- · adhesion issues

Conclusions/action items:

I have a good baseline understanding of what a CGM does and how it works in kids. I'm interested to see how tracking works from a parents' perspective. I also want to understand how this shifts when a child is in the care of another adult.

Claudia Beckwith - Sep 11, 2025, 9:21 PM CDT

Gluroo

Continuous Glucose Monitors For Children: All You Need to Know
February 21, 2023 by Walker Payne

F you or your child have daiberes, you may have heard about a continuous glucose monitoring system or CGM.

CGMs are a good way to losep tabs on your child's blood glucose levels every clay. They use a small sensor to measure glucose levels in the fluid between the cells every few min.e.ss. This data is transmitted wirelessely to a receiver, phone, or smartwatch, so you can see your child's blood glucose levels in managing their child's diabetes. Instead of relying on fingerstick blood glucose testing, which only provides a snapshot of your child's

Download

Learn_All_About_Using_a_CGM_For_Your_Child_With_T1D.pdf (1.86 MB)

Claudia Beckwith - Sep 19, 2025, 10:45 AM CDT

Title: Continuous glucose monitoring with data sharing in older adults: A qualitative study

Date: 09/19/2025

Content by: Claudia Beckwith

Present: Claudia Beckwith

Goals: I want to read about the sharing settings/process with a CGM to see how sharing vitals affects the user in various ways. One idea I had for how to connect the Dexcom to the device was by making the device a "friend or family member" that the user chooses to share data with. This might be easier than having the user sign in with their account right away as we might experience some roadblocks in data sharing to a 3rd party device.

Cite:

N. A. Allen, E. G. Grigorian, K. Mansfield, C. A. Berg, and M. L. Litchman, "Continuous glucose monitoring with data sharing in older adults: A qualitative study," *Journal of Clinical Nursing*, vol. 32, no. 19–20, pp. 7483–7494, Jun. 2023, doi: 10.1111/jocn.16808.

Search:

Dexcom Share Settings

Google Scholar

Content:

This study follows older adults with diabetes and the sharing of vitals to caregivers through a specific platform

the platform included a training session where caregivers learned about T1D treatment to better prepare themselves

collaboration helped partners understand symptoms and behaivors and knowing when to interviene

in a few cases, conflicts on how to care for the patient arose

live in care partners felt peace of mind

care partners living away had increased worry and concern

highlights the importance of communication strategies for partners

older adulthood makes it more difficult for an individual to manage t1d (as it does in childhood)

intervention components for what this platform offered

Communication strategies

- Encouraging patient willingness to discuss glucose levels (hypo and hyperglycemia)
 with care partner
- Effective communication strategies to promote support and collaboration and avoid controlling/critical communications
- Identify desirable/undesirable feedback from care partner

Problem-solving strategies

- Discuss the expectations and length of waiting time before the care partner should contact the PWD for a concerning glucose level and problem solve an agreeable strategy
- The preferred mode the care partner will contact the PWD (phone, text, etc.)

Action plan

- Communication plan in writing—how to give feedback, length of waiting time, communication mode and actions to take in case of an emergency including emergency services.
- Set alarms with PWD and care partner
- · Written responsibility and frequency of monitoring glucose levels for the dyad
- Written diabetes management targets after an in-depth analysis of RT-CGM data with the dyads

Overall results:

- peace of mind for spouses, felt "mentally safer about diabetes"
- increased worry for partners living away from PWD, found alerts to be stressful
- feeling powered to intervene when necessary

Conclusions/action items:

I was interested to learn that the proximity to the patient determined how they reacted to knowing levels. To compare to our project, the parents would be more worried while the direct caregivers (teacher, daycare, etc) would feel much more peace of mind. This helps back up the market need for a device like our monitoring bracelet.

Claudia Beckwith - Sep 19, 2025, 10:45 AM CDT



Download

Journal_of_Clinical_Nursing_-_2023_-_Allen_-_Continuous_glucose_monitoring_with_data_sharing_in_older_adults_A_qualitative.pdf (1.2 MB)



2025/12/10 Using Apple Watch for blood glucose monitoring

Claudia Beckwith - Dec 10, 2025, 2:07 PM CST

Title: Your Apple Watch can track blood sugar levels — here's how with Dexcom G7

Date: 12/10/2025

Content by: claudia

Present: claudia

Goals: I want to understand how T1Ds are currently using their apple watches to monitor blood glucose levels with their CGM. This will give me some insight into thing we can incorportate into our device to best meet the user's needs. I will also learn about pros and cons with this method vs our proposed design.

Search: apple watch with CGM levels for type 1 diabetics on google

Cite: [1]

K. Hill, "Your Apple Watch can track blood sugar levels — here's how with Dexcom G7," *Tom's Guide*, Oct. 03, 2024. https://www.tomsguide.com/how-to-sync-dexcoms-blood-sugar-monitor-to-your-apple-watch

Content:

Dexcom → Apple Watch integration

- · uses Dexcom G7 CGM sensor
- requires Apple Watch Series 6 or newer, running watchOS 10+; iPhone with iOS 17+ for setup

setup steps

- update Dexcom iPhone app (this updates watch app too)
- open Dexcom app on Apple Watch → choose "Pair Watch with Sensor"
- select your sensor name when it appears \rightarrow tap "Pair" to connect sensor to watch

Direct-to-Watch mode (no phone needed continuously)

- · Dexcom G7 sensor can connect directly to Apple Watch via Bluetooth, no iPhone needed nearby to stream glucose data
 - this is huge!! could be an avenue to explore with our device, especially because kids might not have a phone
- · When direct-watch mode is active, watch shows live glucose readings & trends, alerts appear on Apple Watch

when direct-watch isn't active / fallback

- If the watch shows an orange phone icon next to reading → watch is getting data via phone, not directly from sensor
- In that case, you need iPhone nearby for data flow to watch
 - we can implement something similar but for connectivity updates

considerations / compatibility

- Direct-to-watch currently supported for G7 only (per Dexcom)
- Only one smartwatch can be directly paired per sensor at a time

benefits

- glanceable glucose data on wrist, no need to pull out phone all the time
- · better freedom, phone can stay behind, charge, or be out of range, but watch still works
 - o ideally our project would do this too

Conclusions/action items:

I have a good understanding of dexcom users set up their apple watch to read CGM values. I am super interested in the option to connect the G7 directly to the apple watch because that takes out a huge barrier for kids (having to carry a phone at all times). I think it's worth looking into to see if we can replicate.

Claudia Beckwith - Dec 10, 2025, 2:07 PM CST



Download

How_to_use_Apple_Watch_with_Dexcom_G7_to_monitor_blood_glucose_levels___Tom_s_Guide.pdf (16 MB)

Claudia Beckwith - Sep 21, 2025, 8:18 PM CDT

Title: Welcome to Nightscout

Date: 09/21/2025

Content by: Claudia

Present: Claudia

Cite:

[1] "Welcome to Nightscout — Nightscout Documentation documentation." https://nightscout.github.io/

Search: open source solution nightscout dexcom g7 (google)

Goals: I just learned about Nightscout, an open source project that enables real time sharing of CGM data to a personal website or app. It gives a t1d the capacity to customize reminders, limits, info, data, etc into a method of their choosing. The data within Nightscout is advised to be used at the users risk, so there is gray space in this technology.

Content:

Nightscout aka CGM in the Cloud: open-source cloud application used by people with diabetes and parents of kids with diabetes to visualize, store and share the data from their Continuous Glucose Monitoring sensors in real-time

acts as central repo of blood glucose and insulin treatment/dosing for a single person

components:

- online storage, processessing, and visualization (like a nightscout site)
- something to upload CGM data to the nightscout (an uploader)
- devices to access the data (a follower)

site:

Nightscout cloud application can be installed by an individual using hosting services

- option to pay to use fully managed hosting service, takes out the work

uploader:

sends CGM data to an uploader device such as phone app like xDrip+, Spike, xDrip4iOS, Medtronic Uploader

- data can be pulled directly from dexcom acct

followers:

apps for devices and other cloud based services that allow other ways to view and interact with nightscout info

cost to set up personalized nightscout ranges. depends on the platform.

users in the past have used Digital Ocean, Microsoft Azure, and Salesforce Heroku to host sites. most other sites charge other serves are offered and set it up for you. this includes T1Pal, NS10BE, Nightscout Pro, etc

Data delay is typically 2-3 minutes and can be even faster with proper setup

Conclusions/action items:

Now that I have a basic understanding of what Nightscout is, I can start to apply it to my project's design matrix. As Cloud storage was one of the methods to transmit data, I have some information I can use to weigh this against other options. I am intreigued that we have the option to set this up ourselves for free but that there are also services if we can't.

Claudia Beckwith - Sep 21, 2025, 7:41 PM CDT



Download

Welcome_to_Nightscout_Documentation_documentation.pdf (449 kB)

2025/09/21 Dexcom Developer Program

Claudia Beckwith - Sep 21, 2025, 8:17 PM CDT

Title: Dexcom Developer Program

Date: 09/21/2025

Content by: Claudia

Present: Claudia

Cite: [1] "Dexcom API | Overview," Dexcom Developer. https://developer.dexcom.com/docs/

Source: Dexcom Offical API

Goals: In exploring different methods to transmit CGM data onto new platforms, I learned about the dexcom developer program. In essence, this program offeres developers the opportunity to apply for access to the dexcom API (application programming interface) and become an authorized digital health partner. This opens doors for transmitting data onto new platforms.

Content:

API: allows authorized third-party developers to connect to and retrieve a user's continuous glucose monitoring (CGM) data from their Dexcom continuous glucose monitoring (CGM) system

- enables the integration of Dexcom's real-time and historical glucose data into other digital health apps, diabetes management systems, and devices, providing users with more comprehensive tools for managing their diabetes

3 components:

- authorization
- data retrival
- application

offers benefits with personalized management and ecosystems of solutions

lots of user control

RESTful - Dexcom's API, uses OAuth 2.0 standard for authentication

following privacy rules and regulations, decxom users can add permissions to 3rd party applications

ofted used across care teams

to get authorized:

- register as a dexcom developer and create 1st app

(app gives access to creds necessary to make API requests)

- need app description (inspo available at dexcom partnerships gallery)
- explore available data in endpoint overview
- make the request, the best way to learn is by trial and error (example starter code provided)
- test app with sandbox data
- apply for limited access (allows up to 5 authenitcated users)
- apply for full access (complete developer testing)

it appears API's can be used with Python, which is interesting to me because I have a decent amount of experience using Python already. I understand online tutorials could aid me in this and I could get more support from online forums and such.

implementing OAuth 2.0 Authentication:

need this to access production data. involves directing users to dexcom login page, getting an authorization code, exchanging it for an access token and refresh token

this system is already designed to comply with privacy regulations, ensureing user data is handled securely and responsibly

rate limiting at 60k requests per app per hour. shouldn't be an issue but is a consideration

may have up to one hour data delay from dexcom g6 and g7 in the US. this could be a huge barrier

Conclusions/action items:

If we decide to move forward with Dexcom, I think this could be a potential option for us and should be considered in the design matrix. I think I need to look more into RESTful API's and gain more familiarity on that front before making a decision on what is best. I am worried that this would limit us on number of users (making the project highly personal and less replicatable)

Claudia Beckwith - Sep 21, 2025, 8:14 PM CDT



Download

Dexcom_API___Overview.pdf (148 kB)



2025/09/22 Real-Time Data Access in Diabetes Management

Claudia Beckwith - Sep 22, 2025, 10:43 AM CDT

Title: Unlocking Real-Time Data Access in Diabetes Management: Toward an Interoperability Model

Date: 09/22/2025

Content by: claudia

Present: claudia

Cite: [1]

P. Randine, M. K. Wolff, M. Pocs, I. R. O. Connell, J. A. Cafazzo, and E. Årsand, "Unlocking Real-Time Data Access in Diabetes Management: Toward an interoperability model," *Journal of Diabetes Science and Technology*, Mar. 2025, doi: 10.1177/19322968251327602.

Search: dexcom share API (google scholar)

Goals: I am exploring different ways to transmit data to a personalized API in real time and want to get an understanding of existing methods that have been used to accomplish this task. One of the largest barriers so far in going through the Dexcom developer program is the delay, but the problem with the DIY solutions is concerns with confidentiality. I would love to find a solution that is real time while still protecting data.

Content:

"Comparisons between vendor-specific and open-source software expose interoperability and accessibility challenges. While Do-It-Yourself (DIY) solutions foster innovation, they face technical and legal barriers."

diy solutions often face issues when it comes to legal barriers. I will have to connect with the client to understand if we are more looking for replication potential and accessability or a secure, easy startup where anyone can join and have their data protected

side note: the EU and EEA are collectively shifting towards a movement of transparency and data sharing, aimed to empower individuals and orgs through accessible and reusable health data

user friendly APIs are playing a big role in this

"Strengthening interoperability between systems like electronic health record (EHR) and enabling secure, real-time data exchange among all stakeholders—including patients, caregivers, health care professionals, researchers, and developers—is essential."

important to focus on real time data for a seamless and accurate experience

DIY AND OFF LABEL SOLUTIONS:

movement known as #WeAreNotWaiting

involves open-source hybrid closed-loop systems and improved access to CGM data

these solutions are particularly helpful for parents managing their children's diabetes

using reverse-engineering original software or modify vendor applications to gain more control over their medical devices

highlights in the field include OpenAPS (open artifical pancreas system) Loop, and Nightscout (CGM in the Cloud)

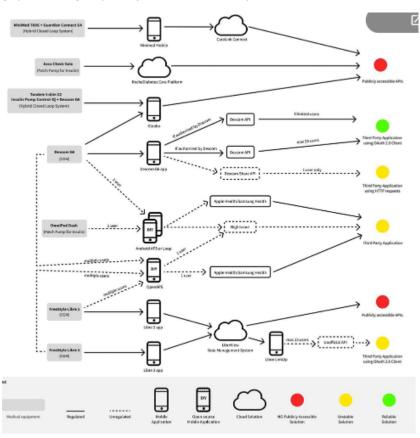
cybersecurity is a crucial aspect, FDA issuing med device security recommendations

table showing med devices available in Norway and Associated Regulated Software Able to Provide Real-Time Diabetes Data.

Medical equipment (<i>n</i> = 7)	Туре	Regulated software that processes data (n = 9)	Publicly accessible APIs.
MiniMed 780G + Guardian Connect Insulin pump and CGM—		CareLink Connect, MiniMed Mobile	No
G4	hybrid closed-loop system	Carcellik Connect, Williamica Mobile	140
Tandem t: slim X2™ Insulin pump	Insulin pump and CGM—	Glooko	No
Control-IQ + DXCM1 G6	hybrid closed-loop system	GIOUKO	
Omnipod DASH	Insulin patch pump	Not Available in Norway	No
Accu Check Solo	Insulin patch pump	RocheDiabetes Care Platform	No <u>38</u>

Medical equipment (n = 7)	Type		Regulated software that processes data (n = 9)	Publicly
Medical equipment (II = 1)	Туре	accessible APIs.		
Freestyle Libre 2	CGM		LibreView Data Management System, LibreLink Up,	No
Freestyle Libre 3		CGM	FreeStyle Apps for Libre 2 and Libre 3	NO
Dexcom G6	CGM		Dexcom G6 mmol/L DXCM1, Glooko	Yes <u>39</u>

graphic showing the pathways for each of these explored methods



Lable showing software solutions that enable access to real time data along with their limitations

Solution identified (software category)	Limitation for a third-party application	Devices
OpenAPS (DIY software)	Additional software involved (Nightscout, Samsung Health, etc) Taking control over the insulin delivery in the pump	Dexcom G6, Freestyle Libre 2 and Libre 3
Android APS (DIY software)	1-1 user cardinality Additional software involved (Nightscout, Samsung	Omnipod DASH, Dexcom G6, Freestyle Libre 2 and Libre 3
Loop (DIY software)	Health, etc) Taking control over the insulin delivery in the pump	
Dexcom Official (manufacturers' device software)		
Dexcom Authorized (manufacturers' device software)	20 users with 30-minute delay (not real-time)	Dexcom G6
Dexcom DIY solution (DIY software)	1-1 user cardinality requiring plain username and password credentials for access	
Libre (DIY software)	Limit to 15 users with one LibreLink Up account Non-functional if 2FA (two-factor authentication) is enabled	Libre 2 and Libre 3

Conclusions/action items:

from this table, nightscout is jumping out to me because of its compatibility with the dexcom g6

loop involves taking control of the insulin pump which is not the target of this project

deccom offical software and authorized both work with g6 but deccom authorized has a risk of a 30 minute delay

dexcom diy software is 1-1, uses username and pw credientials for access

dexcom legal restrictions: : "Reverse engineer or derive the source code for any DexCom Product, DexCom Service, or Software App not provided to you in source code form, except to the extent such restriction is expressly prohibited by applicable law."

diy solutions are generally regarded as impractical for large-scale use, even without technical limitations

legal contraints often limit these solutions for a max of 15 users or overall limited security meausres

hybrid closed-loop systems are unable to provide real-time data

2 factor authentication is recognized as one of the most effective security measures

Conclusions/Action Items:

This article gave a really in depth analysis of different solutions on/off market for controlling CGM data output. I realize this may have been generated more in the context of data sharing regulations in the EU, but they raised several arguments on pros/cons/limitations on different models. I found it really helpful to visualize which models have been used in the past before and I think we will have a strong foundation off of which to research future methods before deciding on a final one.

Claudia Beckwith - Sep 22, 2025, 10:43 AM CDT



Download

randine-et-al-2025-unlocking-real-time-data-access-in-diabetes-management-toward-an-interoperability-model.pdf (762 kB)

Claudia Beckwith - Oct 16, 2025, 3:52 PM CDT

Title: Domain Setup (Nightscout Step 1)

Date: 10/10/2025

Content by: Claudia Beckwith

Present: Claudia Beckwith

Goals: The first step in setting up the Nightscout API involves building a DNS from which the program runs off of. There are free DNS resources available online that I want to start working through. The step by step instructions for setting up a FreeDNS are linked in the process to setting up Nightscout using Google Cloud.

Cite:

[1] "Google Cloud Nightscout FreeDNS Setup Guide," xDrip, 2025.

https://navid200.github.io/xDrip/docs/Nightscout/FreeDNS.html (accessed Oct. 16, 2025).

Content:

1. going to https://freedns.afraid.org/

Signing up with a free account using my @wisc.edu email.

team name is WGAS (stands for wearable glucose alerting system, name subject to change)

username: wgasteam

password: Puccinelli2025

- 2. Activated account
- 3. choosing a subdomain.

again, choosing WGAS.

4. linking it to a domain

the domain is the public part of the server that essentially houses the website.

there were some funky names linked to the domains, but deciding to move forward with "mooo" as our hostname

moving forward, we will be accessing the Nightscout website using the link:

wgasteam.mooo.com

corresponding IP:

A 50.93.221.169

Conclusions/action items:

Although basic, the domain setup is the first step in getting our Nightscout server up and running. We can work off of this site without having to worry about paying for the domain now or in the future so long we stay on this host domain. Next, I'l work on connecting this domain to my google cloud account.

Claudia Beckwith - Oct 16, 2025, 4:09 PM CDT

Title: Google Cloud Setup (Step 2 in Nightscount launch)

Date: 10/16/2025

Content by: Claudia Beckwith

Present: Claudia Beckwith

Goals: Now that the DNS has been established, I am looking to build a new project within google cloud. I have leftover credits from a past course that we can use to kick off our project before we have to dig into funding, which is why we are deciding at this point to move forward with this platform.

Cite:

[1] "Create a Google Cloud Project for Nightscout," xDrip, 2025.

https://navid200.github.io/xDrip/docs/Nightscout/NS_GCProject.html (accessed Oct. 16, 2025).

Content:

- 1. logging into https://console.cloud.google.com with my wisc account
- 2. initalizing a new project for the WGAS project

project ID: wgas-fall2025

- 3. setting up new API
 - · compute engine
 - · enabling new compute engine API

linking billing details, I think I am charging to my education credits but I am not 100% sure. Will follow up with old CS professor to ensure this is allowed and established.

Conclusions/action items:

The next step with the Nightscout setup is to initialize the VM instance. The VM (virtual machine) is where the data exists and is the part that actually will charge the account. I might end up holding off on this until I can confirm the billing is established correctly. The good news is that I already am familiar with working in a VM.

Claudia Beckwith - Oct 16, 2025, 4:29 PM CDT

Title: Virtual Machine (VM) Setup (step 3 in Nightscount setup)

Date: 10/16/2025

Content by: Claudia Beckwith

Present: Claudia Beckwith

Goals: Now that the Google Cloud instance has been set up, the next step is to create the virtual machine (VM) from which the program will run. If I choose the correct parameters, this should be a free service, which gives me confidence to move forward with this before confirming on the credits. Also, until we actually start running data through here, it will sit idle.

Cite:

[1] "Google Cloud Virtual Machine for Nightscout," xDrip, 2025.

https://navid200.github.io/xDrip/docs/Nightscout/VirtualMachine.html (accessed Oct. 16, 2025).

Content:

VM: a software-based emulation of a physical computer. It operates like a physical computer with its own CPU, memory, storage, and network interface, but it exists only as code within a physical host computer. Virtual machines are created through a process called **virtualization**, which involves creating a virtual version of a computer system with dedicated resources borrowed from a physical host.

creating the new VM instance

- under the project created in step 2

speficic configurations with the VM:

Parameters	Requirements	Why
Machine Region	Oregon, Iowa or South Carolina	Free Tier
Machine Type	e2-micro	Free Tier
Disk type	persistent disk	Free Tier
Disk size	Less than or equal to 30GB	Free Tier
Operating system	Ubuntu	Compatibility
Version	24.04 LTS Minimal x86 /64, amd64 noble .	Nightscout compatibility
Data protection	No backups	Free
Firewall	Allow HTTP traffic	Nightscout access
Firewall	Allow HTTPS traffic	Nightscout access
Network Service TierStandard		Free

following these parameters should yield a free version of the VM. I can confirm in the future that the estimated cost is still 0 and link to my education credits as a backup just in case.

Conclusions/action items:

Now that the VM is established (and ideally on a free server) I can link the Nightscout and Linux installation. This begins to be new territory for programming experience for me, so I think I'll reach out to my old professor for assistance on the installation here. The framework has been built, now we just need to add the content.

Claudia Beckwith - Oct 23, 2025, 11:17 PM CDT

Title: Pydex Initial Research

Date: 10/23/2025

Content by: Claudia Beckwith

Present: Claudia

Goals: Due to various complications with Nightscout, we are looking into alternative transmission options before fully committing to building the framework for Nightscout. Pydex was one of the options that Dr. Puccinelli suggested for our group, and my goal is to learn as much as I can about it. Also, since I already started a Google Cloud VM, I am looking to see if any other options are compatible with that base.

Cite:

"pydexcom API documentation." https://gagebenne.github.io/pydexcom/pydexcom.html

Content:

Pydexcom: simple Python API to interact with dexcom share serves

get real time data (meets our customer requirements)

requires setup of at least one follower

- still needs your credentials (as opposed to a follower)

instructions to install on python detailed below. seems very intuitive and all code I have done before

```
>>> from pydexcom import Dexcom
>>> dexcom = Dexcom(username="username", password="password") # `region="ous" if outside of US, `region="jp" `
if Japan
>>> dexcom = Dexcom(username="+11234567890", password="password") # phone number
>>> dexcom = Dexcom(username="user@email.com", password="password") # email address
>>> dexcom = Dexcom(account_id="12345678-90ab-cdef-1234-567890abcdef", password="password") # account ID
(advanced)
>>> glucose_reading = dexcom.get_current_glucose_reading()
>>> print(glucose_reading)
85
>>> glucose_reading.value
85
>>> glucose_reading.mmol_l
4.7
>>> glucose_reading.trend
>>> glucose_reading.trend_direction
'Flat'
>>> glucose_reading.trend_description
'steady'
>>> glucose_reading.trend_arrow
^{1}\rightarrow
```

```
>>> print(bg.datetime)
2023-08-07 20:40:58

>>> glucose_reading.json
{'WT': 'Date(1691455258000)', 'ST': 'Date(1691455258000)', 'DT': 'Date(1691455258000-0400)', 'Value': 85,
'Trend': 'Flat'}
```

as opposed to the offical Dexcom Devloper API, this is better for real time data. the dexcom API is more for retroactive analysis and stats, not real time info

Conclusions/action items:

I am interested in setting this program up with Ella or Isabel's Dexcom accounts. It seems really promising and I would like to start testing out numbers to see what we can pull from. My biggest unknown at the time is how to program the API and link it to the microcontroller continuously, so it would be good to establish an initial connection to work off of.

Claudia Beckwith - Oct 23, 2025, 11:17 PM CDT



<u>Download</u>

pydexcom_API_documentation.pdf (382 kB)

Claudia Beckwith - Oct 23, 2025, 11:33 PM CDT

Title: Glance Initial Research

Date: 10/23/2025

Content by: Claudia Beckwith

Present: Claudia

Goals: Due to various complications with Nightscout, we are looking into alternative transmission options before fully committing to building the framework for Nightscout. Glance was one of the options that Dr. Puccinelli suggested for our group, and my goal is to learn as much as I can about it. I understand it is created with FitBit compatibility in mind, so I wonder if we can mimic the connection for our bracelet.

Cite:

Rytiggy, "GitHub - Rytiggy/Glance: Mg/dL and mmol/L Fitbit watchface for CGM in the Cloud Group," GitHub. https://github.com/Rytiggy/Glance/

Content:

Glance used on fitbit faces to see blood glucose levels and other health stats at a glance

current features include

- Current BG
- · Insulin on Board (IOB)
- · Carbs on Board (COB)
- · Trend direction
- Delta
- · Time since last pull
- · Graph of BG's over time
- · Error reporting
- Temperature
- Step count
- Heart rate
- Time
- Date
- · Battery levels
- Vibration Alerts
- · Changing background color

Although many of these are irrelevant, I think the current BG, trend direction, and even the changing background color are all components we can use to our advantage for the bracelet.

The github code for this process is slightly less strightforward. It seems the best way to get access it to follow the downloads of a zip file and import it that way. Because of this, I think it might be a little more difficult to modify this code for our needs. In terms of the connection to the fitbit,

Starts with initial download

option to pull the source from Dexcom, Nightscout, Spike, xDrip, Tomato, or other custom source. I like the compatibility with Nightscout off the bat because it shows that there is potential to integrate with diy systems.

this pairing requires proximity to a phone at all times

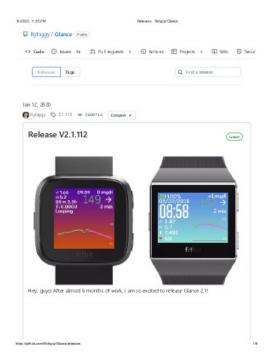
Like the pydexcom, you need at least one follower for this process to work.

Uses app downloaded onto fitbit to show data. I wonder if that since the bluetooth connection is run thrrough the phone to fitbit path vs phone to app, would this be a potential limitiation?

Conclusions/action items:

I am interested in starting the process of setting up Glance and seeing if I can reverse engineer the code to get it to connect to a 3rd party platform or API. I think it's important to start testing these options with some sort of rudimentary verson of an API, but I think depending on the route we take this could end up looking very different. My biggest unknown at the time is how to program the API and link it to the microcontroller continuously, so it would be good to establish an initial connection to work off of, whether that is Glance, Pydexcom, or another option.

Claudia Beckwith - Oct 23, 2025, 11:36 PM CDT



Download

Releases_Rytiggy_Glance.pdf (616 kB)



Claudia Beckwith - Dec 10, 2025, 1:1

Title: Flutter Initial Research

Date: 11/28/2025

Content by: Claudia Beckwith

Present: Claudia

Goals: I want to familiarize myself with flutter considering it is the primary base of our app. I am programming an app to pull data form our backend API and push to the microcontribation of the primary base of our app. I am programming an app to pull data form our backend API and push to the microcontribation of the primary base of our app. I am programming an app to pull data form our backend API and push to the microcontribation of the primary base of our app. I am programming an app to pull data form our backend API and push to the microcontribation of the primary base of our app. I am programming an app to pull data form our backend API and push to the microcontribation of the primary base of our app. I am programming an app to pull data form our backend API and push to the microcontribation of the primary base of our app. I am programming an app to pull data form our backend API and push to the microcontribation of the primary base of our app. I am programming an app to pull data form our backend API and push to the microcontribation of the primary base of our app. I am programming an app to pull data form our backend API and push to the microcontribation of the primary base of our app. I am programming an app to pull data form our backend API and push to the microcontribation of the pull data form our backend API and push to the microcontribation of the pull data form our backend API and push to the pull data form our backend API and push to the pull data form our backend API and push to the pull data form our backend API and push to the pull data form our backend API and push to the pull data form our backend API and push to the pull data form our backend API and push to the pull data form our backend API and push to the pull data form our backend API and push to the pull data form our backend API and push to the pull data form our backend API and push to the pull data form our backend API and push to the pull data form our backend API and push to the pull data form our backend API and push to the pull

Search: How does Flutter work (in google)

Cite: [1]

"Flutter - Build apps for any screen." https://flutter.dev/?

utm_source=google&utm_medium=cpc&utm_campaign=pmax_cta_test_gads_brand&utm_content=na_us&gclsrc=aw.ds&gad_source=1&gad_campaignid=19926980346&gbraid=INI8iSyMTtYy4i2icmk6zhxUF1&gclid=CjwKCAiA0eTJBhBaEiwA-Pa-hfcroGxuPrxyq_yr8oqgazQgB2wlW0cqam9wc88Q7hX2B08LzwOOYhoC7PYQAvD_BwE

Content:

What is Flutter

- · Flutter is an open-source UI software development kit (SDK) created by Google
 - meant to let developers build apps for mobile, web, desktop, embedded devices from a single codebase.
- · The idea: write UI code once, and send out across Android, iOS, Windows, macOS, Linux, web browsers (and others)
 - saves time, reduce duplication, and unify user experience across platforms
- "beautiful, natively compiled, multi-platform applications" from the same codebase

how Flutter works

- · Flutter uses a layered, extensible architecture
 - built as a collection of independent libraries layered over one another.
 - No layer has privileged access to lower layers; components are modular and replaceable
- core is the Flutter engine (written in C++)
 - provides low-level rendering support and runs the runtime
- Because Flutter controls its own rendering pipeline (rather than delegating to native widgets), it can guarantee consistent look-and-feel across platforms

Programming language

- · Flutter apps written using Dart.. a language created by Google
- Dart
 - class-based
 - object-oriented
 - strongly typed language
 - · C-style syntax
 - It can compile to native machine code or JavaScript (or other JS-compatible formats) to run in browsers.
- During development, Dart (via Flutter) supports hot reload so developers can make code changes and see UI updates almost instantly without full recompilation or restarting app

UI model: Widgets, reactive UI, and state

- In Flutter, everything is a widget
 - basic building blocks of the UI
 - o define UI elements, layout, styling, interactions
- 2 kinds
 - stateless immutable; their appearance does not change over time (unless their inputs change)

- stateful can hold internal state and respond to changes (user input, asynchronous data, etc.). When state changes, Flutter triggers a rebuild of the widget subtree to reflect updates.
- The UI is reactive: when state or data changes, the UI updates accordingly through widget rebuilds
- reactive model helps in building dynamic, interactive user interfaces
- Because the rendering is handled by Flutter directly (via its engine), UI behaves consistently across platforms no platform-specific UI behavior unless explicitly coded.

advantages of Flutter

- · Cross-platform efficiency: good for projects that need broad reach with minimal duplication
- · Native-like performance: Because Flutter compiles to native machine code apps tend to perform well
- · High customizability & consistent UI
- · Developer productivity: hot reload
- great widget & tooling ecosystem:
- · Flexibility for many app types

disadvantages

- you won't automatically get every native UI nuance
- · bad on older or lower-powered devices

Conclusions/action items:

I have a general understanding of how flutter operates and what the structure is. coding with flutter has been pretty intuitive because it auto prompts a lot. It seems like a great fit for our project.

Flutter transforms the development process. Build, test.
and deploy beautiful mobile, web, desistop, and
embedded experiences from a single codebase.

<u>Download</u>
Flutter_-_Build_apps_for_any_screen.pdf (2.25 MB)

Claudia Beckwith - Dec 10, 2025, 1:39 PM CST

Title: Dexcom Share services for developers

Date: 11/28/2025

Content by: claudia beckwith

Present: claudia

Goals: I want to understand how the dexcom share services works. If we are using this as our backend API, I want to know how to integrate it with my

developing app.

Search: dexcom share services for programmers on google

Cite:

[1] #016: The dexcom share API. hello everyone and happy 2025. I know... | by Christopher Coco | Medium, https://cjcocokrisp.medium.com/016-the-dexcom-share-api-ba6410954d5d (accessed Dec. 10, 2025).

Content:

What the Dexcom Share API is

- unofficial, reverse-engineered API, not publicly documented by the manufacturer, discovered by analyzing how one of the official mobile apps communicates
- logging in with a Dexcom account (username/password) to fetch recent glucose readings, allowing access to near real-time CGM data, rather than delayed data

How it works (authentication & retrieval flow)

- First, you authenticate: send a request containing the username, password, and an "applicationId" to get an account ID
- using the account ID + password + applicationId, you request a session ID
- With the session ID, you can call endpoint to retrieve the latest glucose values

Why people use it / What problem it solves

- . The official Dexcom API (the public API) only provides retrospective / historical CGM data, delayed several hours
- The Share API bypasses those limitations and gives more immediate access, useful for applications needing "real-time" glucose data
- great for developers, especially to those building custom setups (for example, using a Raspberry Pi to display CGM readings at home)

Caveats, limitations, and unofficial status

- . Because it's not official, there is no guarantee of long-term support: backend changes by the manufacturer could break compatibility
- Some community reports suggest the legacy Share API may be getting deprecated or less reliable
- The method requires providing actual Dexcom account credentials (username/password), which may have security/privacy implications (especially if used in shared or less-secure code)

Conclusions/action items:

I have a basic understanding of how dexcom share services work and are integrated with my app. I think it's interesting how much has become available due to curious programmers and it's extremely helpful in our project. I also am happy we can meet the pds time delay requirement.



Download

dexcom_share_for_programmers.pdf (6.1 MB)



2025/12/10 PyDexcom - developing and compatibility

Claudia Beckwith - Dec 10, 2025, 1:31 PM CST

Title: PyDexcom development and compatibility

Date: 12/10/2025

Content by: claudia beckwith

Present: claudia

Goals: I want to understand how pydexcom works. If we are using this as our backend API, I want to know how to integrate it with my developing app. It is currently running on a bme sharedlab page but I want to know how to scrape from it.

Search: pydexcom for programmers on google

Cite: [1]

"pydexcom," PyPI, Dec. 01, 2021. https://pypi.org/project/pydexcom/0.2.1/

Content:

What is pydexcom

- simple Python API/library to interact with Dexcom "Share" service
- It is used to get real-time CGM sensor data from Dexcom devices (e.g. G7, G6, G5, G4) rather than retrospective/day-level
 data
- · licensed under the MIT license

How to use pydexcom (Quick-start)

When calling get_current_glucose_reading() (or similar), you get a "glucose_reading" object with properties including:

- · value: glucose level
- mmol_l: level in mmol/L units
- · trend: shows trend rate of change
- trend_direction, trend_description, trend_arrow (ex flat, steady) to show direction/stability
- · timestamp (datetime): recording time
- · json represnetion of raw data
- pydexcom uses the Dexcom "Share" service, which requires that the Dexcom account has at least one "follower" set up
- You must supply the correct credentials, mistakes lead to invalid-password errors
- It is unofficial / community-maintained: the "Share" service is not always officially documented by Dexcom, and may break if Dexcom changes their backend APIs
- · Not all Dexcom devices or services work, but G7 does

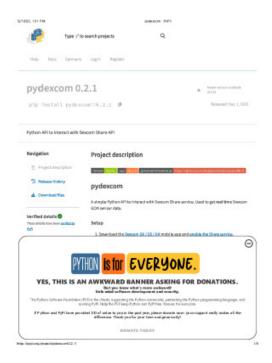
Use-Cases & Who uses pydexcom

- · pydexcom is used by community / open-source projects integrating real-time CGM data
- It has been used in DIY or custom setups: ex a small display (Raspberry Pi + e-ink display) that shows glucose levels in real time
- pydexcom is sometimes preferred over the "official" Dexcom API because official API tends to be retrospective / delayed and more suited to trend/day-level data rather than immediate CGM stream

Conclusions/action items:

I have a much better understanding of whay pydexcom is and how to use it. Although I didn't create the platform it runs on (Dr. P did) I think it's helpful to understand the variables that exist and how to use them.

Claudia Beckwith - Dec 10, 2025, 1:32 PM CST



Download

pydexcom_PyPI.pdf (870 kB)



2025/12/10 Seeed Studio XIAO nRF52840 (XIAO BLE)

Claudia Beckwith - Dec 10, 2025, 1:47 PM CST

Title: seeed studio xiao nRF52840 research

Date: 12/10/2025

Content by: claudia

Present: claudia

Goals: This is the exact microcontroller we are using for our project at the moment. I am trying to program this microcontroller with my app and with the LED, so I need to have a solid understanding of how it works and how to program it.

Search: seeed studion xiao nrf52840 microcontroller on google

Cite:

"Seeed Studio XIAO NRF52840 (XIAO BLE)." https://www.seeedstudio.com/Seeed-XIAO-BLE-nRF52840-p-5201.html? srsltid=AfmBOorUokY71O9A8E-9rTEmQ2U3y soQ91wX94vUHV7nqVIIFvHuW7p

Content:

what it is

- · tiny IoT development board
- · based on Nordic nRF52840 MCU
- · supports BLE 5.0 and Bluetooth Mesh
- · ultra-low-power, wearable-friendly form factor

core hardware

- ARM Cortex-M4F @ 64 MHz
- 512 KB Flash, 256 KB RAM
- · onboard 6-axis IMU (motion sensing)
- · USB-C interface
- · supports battery via pads
- 21 × 17.8 mm footprint
- · castellated pads for easy soldering

wireless features

- BLE 5.0 long-range
- · Bluetooth Mesh capability
- · supports peripheral/central modes
- · optimized for low-energy communication

power + efficiency

- · ultra-low standby current
- suited for long-term wearables

• built-in PMIC for stable power regulation

I/O + expandability

- 11 digital pins, some multifunction
- PWM, ADC, I2C, SPI, UART
- supports Grove ecosystem via expansion
- programmable via Arduino / CircuitPython

programming environment

- · official Arduino core supported
- · also works with Nordic SDK / Zephyr
- · bootloader supports USB UF2 flashing
- CircuitPython compatible (depending on firmware)

best-fit applications

- · wearables
- · BLE beacons
- · lightweight sensor nodes
- · handheld controllers
- · motion-tracking devices

limitations / considerations

- · few GPIO pins compared to larger boards
- no built-in Wi-Fi
- · small size limits connector options
- · careful power wiring needed for battery modes

why useful for your Dexcom-related projects

- BLE communication for app → device data flow
- extremely small → can embed in custom sensor housings
- Python-adjacent workflow (CircuitPython option)
- low power → continuous background data display possible

pin outputs (general)

- 11 digital I/O pins
- · configurable as input, output, PWM, or interrupt
- · support 3.3V logic only
- some pins multiplexed with I2C / SPI / UART functions

- · multiple pins support hardware PWM
- · useful for LEDs, motors, buzzers
- frequency + duty cycle adjustable in Arduino IDE

analog output (DAC)

- no true DAC
- · analog-like output achieved via PWM smoothing

analog input

- · several pins support ADC (12-bit)
- read sensors, voltages (0-3.3V range)

communication pins

- I2C: SDA/SCL on assigned pins
- SPI: MISO/MOSI/SCK available
- · UART: TX/RX pins for serial communication

power pins

- 3.3V output (regulated)
- GND
- battery pads for LiPo input (with charging support)

special notes

- pins are tiny → breadboard use requires header soldering
- many pins shared internally → check pin mapping when combining features
- · safe to drive LEDs directly with resistor; high-current loads need transistor/driver

Conclusions/action items:

This is a pretty good intro to the microcontroller and its features. I looked into the pin inputs too because we had some issues where the original pin blocked the serial monitor in arduino, making troubleshooting a nightmare. Also, all pins must be called with D#. Ex. D8.

Claudia Beckwith - Dec 10, 2025, 1:48 PM CST



Download

XIAO_nRF52840_-_Tiny_Arduino_Board_Supports_Bluetooth_5.0.pdf (3.59 MB)



2025/12/10 Soldered Smart LED WS2812B Ring7

Claudia Beckwith - Dec 10, 2025, 1:56 PM CST

Title: Smart LED WS2812B Ring7 research

Date: 12/10/2025

Content by: claudia beckwith

Present: claudia beckwith

Goals: This is the led we are using for our project. It is super bright and has the option to display millions of colors. I want to learn how to program this using the microcontroller updates.

Search: Smart LED WS2812B Ring7 on google

Cite:

Soldered Electronics, "7 RGBLED addressable ring for arduino and microcontrollers," *Soldered Electronics*, Dec. 10, 2025. https://soldered.com/product/smart-led-ws2812b-ring7/

Content:

WS2812B Ring7: 7-pixel addressable RGB LED ring

- 7 WS2812B LEDs in circular layout
- · individually addressable RGB pixels
- · single-wire data control

power + electrical

- 5V supply
 - o my computer powers 5.5, level shift needed
- · 3.3V data usually OK, level shift recommended
- ~18 mA per LED (full white)
- ~126 mA max ring draw

pins

- VCC (5V)
- GND
- DIN (data in)
- DOUT (data out for chaining)

data behavior

- chainable: DOUT \rightarrow next module DIN
- 24-bit color (R/G/B 8-bit each)
- internal PWM + timing handled by WS2812B
- MCU sends only serial color frames

required Arduino packages / libraries

• Adafruit NeoPixel (core library to control WS2812/WS2812B)

- · Adafruit BusIO (dependency for NeoPixel)
- Seeed nRF52 Boards package (board support for Seeed XIAO BLE nRF52840)
- optional: FastLED (alternative control library, not required if using NeoPixel)

usage

- · ideal for indicators, small lighting effects, wearables
- works with Arduino, CircuitPython, MicroPython
- · one GPIO pin controls entire ring

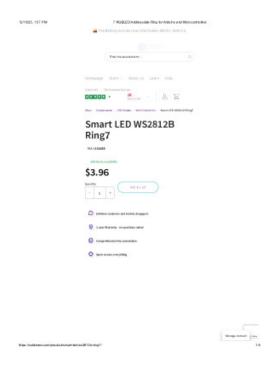
considerations

- · don't power full brightness from MCU 5V pin
- add 330Ω resistor on data line
- add 1000 μF capacitor across +5V/GND for stability

Conclusions/action items:

I have a basic understanding of this led and how it functions. I am interested in learning more about its compatibility with the microcontroller we are using and how I can code it. We must test colors and led brightness next. I also know all the packages to download to code with it.

Claudia Beckwith - Dec 10, 2025, 1:58 PM CST



Download

7_RGBLED_Addressable_Ring_for_Arduino_and_Microcontrollers.pdf (884 kB)

Claudia Beckwith - Sep 26, 2025, 10:46 AM CDT

Title: Dexcom Developer Program

Date: 09/25/2025

Content by: Claudia Beckwith

Present: Claudia Beckwith

Goals: I want to come up with 3 different potential designs to use for the connection system between the CGM and the bracelet. I am interest in utilizing the existing resources of Dexcom itself as G7 users will already be transmitting to the app. I am interested in seeing what methods can be used to transmit data externally.

Cite:

"Dexcom API | Scopes & Access," Dexcom Developer. https://developer.dexcom.com/docs/dexcom/scopes-access/

Content:

Process flow:

The Dexcom G7 transmits to the Dexcom App (the existing model already used by the patient)

We get authorization from Dexcom to be part of the Dexcom Developer Program where we can develop a 3rd party device the Dexcom authorizes to be compatible with its system. The initial model allows for up to 5 users to use the app/3rd party service and requires extensive authorization and validation to get full access (ex. omnipod)

Once authorization is granted, we can use the Dexcom API (application programming interface). This allows for communication between software via a series of requests and responses. We can use our 3rd party device and the Dexcom API to communicate data.

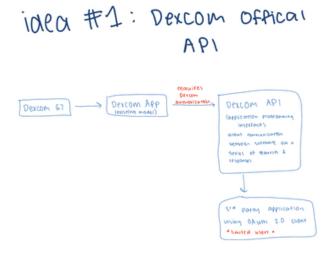
Our 3rd party device and the Dexcom API communicate. Dexcom data is shared to our API using the OAuth 2.0 client authorization. One limitation here is the amount of users is limited based on tier of authorization.

Our third party application would then send data to the bracelet corresponding with different colors.

Conclusions/action items:

This is a promising start with the Dexcom interface and is mostly a streamlined process. Dexcom even offers "sandbox data" to test out the application before you use real patient data, which is very developer friendly. However, limitations with time delay may rule out this option.

Claudia Beckwith - Sep 26, 2025, 11:05 AM CDT



IMG_0504.jpeg (281 kB)

Claudia Beckwith - Sep 26, 2025, 10:54 AM CDT

Title: Dexcom Share API

Date: 09/25/2025

Content by: Claudia Beckwith

Present: Claudia Beckwith

Goals: I want to come up with 3 different potential designs to use for the connection system between the CGM and the bracelet. I am interested in tapping into the existing connection between the transmitter of the CGM and the app, using the share features of the app to connect to a 3rd party platform. This would streamline connection and provide enhanced privacy, not unalike how Dexcom users can share their data with friends and family.

Content:

Process flow:

The Dexcom G7 directly connects to the Dexcom app using the current methods.

The Dexcom app transmites to the Dexcom Share API, which doesn't require Dexcom authorization. It the same kind of process that Dexcom users do to share their data with friends and family.

The Dexcom Share API connects to our 3rd party application using a series of HTTP requests. This process is much slower than alternitaves due to the very "back and forth nature" of the request system. That being said, it is the only system in which I have familiarity and experience. However, each server is only allowed 1 user max, creating issues with replication.

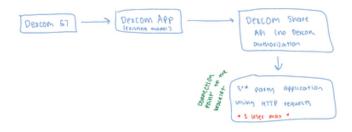
Our customized API (via HTTP requests) will connect to our bracelet and transmit signals for bracelet colors.

Conclusions/action items:

While this idea shows promise in simplicity and my own familiarity with the process, I don't think it will be the most feasable for our project. It is a pretty rudimentary system with a lot of back and forth communication, and the HTTP server generates a risk for security breaches. Also, the limited user issue would not work in the long term.

Claudia Beckwith - Sep 26, 2025, 11:05 AM CDT

idea #2: Dexcom Share API



Download

IMG_0505.jpeg (256 kB)

Claudia Beckwith - Sep 26, 2025, 11:02 AM CDT

Title: Nightscout API

Date: 09/25/2025

Content by: Claudia Beckwith

Present: Claudia Beckwith

Goals: I want to come up with 3 different potential designs to use for the connection system between the CGM and the bracelet. Nightscout is an open source project that follows a series of DIY's to build a totally customizable database for CGM users. I am very interested in the level of customization and supportive community surrounding this route.

Content:

Process flow:

The Dexcom G7 transmits data to a mobile app. Options here for both existing and DIY options, such as OpenAPS (artifical pancreas system). This is another side open source DIY project that related CGM levels to insulin doses. We could bypass this system or integrate some of the knowledge with the pharm team as I believe that was one of their future goals. It should be noted that this initial connection allows multiple users to access.

Once through the first app, data is transmitted to the Nightscout API. This is an unregulated API and would be created, designed, and maintained by the team.

From this Nightscout API, we would connect the data to the bracelet. The system should give us enough flexibility to customize different color levels, transmission times, etc to make the product best fit our needs.

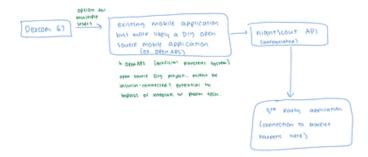
- This requires a cloud source, some options are free of charge (ex. Google Cloud) but this would likely only be suitable for individual users. We might have to look into paying for a cloud service in order to make this project available across multiple users.
- Some services exist to help you get started on the initial development of Nightscout API's. One example I looked into was Nightscout4U, which costs between \$4-5 a month.

Conclusions/action items:

So far, this design seems to be the most promising. It uses an extensive amount of programming knowledge and data science, but it seems doable. There are also paid services to help you get started along with an entire community of people willing to help out.

Claudia Beckwith - Sep 26, 2025, 11:04 AM CDT

idea #3: nightscout



Download

IMG_0506.jpeg (330 kB)

2025/11/12 Dexcom API Development stage 1

Claudia Beckwith - Nov 12, 2025, 7:16 PM CST

Title: Dexcom API Development stage 1

Date: 11/12/2025

Content by: Claudia

Present: Claudia

Goals: Start building the connection between a python server producing fake data and a flutter app to display the data

Content:

Building project backend

FIRST: SET UP DIR IN POWERSHELL

• cd ~

mkdir dexcom_project

cd dexcom_project

python -m venv venv (note: have to override computer settings with Set-ExecutionPolicy -Scope Process -ExecutionPolicy Bypass)

.\venv\Scripts\activate

pip install flask flask-cors (flask is python web framework, helps create APIs, returns jsons to the app can read it, serves data to the

frontend aka Flutter)

mkdir mock_api

cd mock_api

- · together this code establishes the project as a file. also installing flask for the connection later on
- the venv is a virtual environment. self contained mini python environment that keeps everything isolated
 - otherwise everything would go into the global python installation, leading to potential conflicts or dependecny errors down the road

NEXT: WORKING IN VS CODE

- · code mock api.py
 - makes python file in VS code

```
from flask import Flask, jsonify
from flask cors import CORS
import random, datetime
app = Flask(__name__)
CORS(app) # allow requests from Flutter
@app.route('/data')
def get data():
  data = []
  now = datetime.datetime.now()
  for i in range(10):
    entry = {
       'timestamp': (now - datetime.timedelta(minutes=5 * i)).strftime("%Y-%m-%d %H:%M:%S"),
       'glucose level': random.randint(80, 160)
    data.append(entry)
  return jsonify(data)
if name == ' main ':
  app.run(host='0.0.0.0', port=5000)
```

the above code randomly generates values that will serve as my tester before i pull real data

in powershell again, "python mock_api.py" to start running the flask server

```
NEW POWERSHELL TAB
cd C:\Users\cjbec\dexcom_project
flutter create flutter app
cd flutter app
code . (opens the project in VS code)
IN VS CODE
going to the file "pubspec.yaml"
update the dependencies to include http: ^1.2.0
IN POWERSHELL:
run flutter pub get to install HTTP package that lets flutter make web requests
IN VSCODE:
making new file called api service.dart - its a new dart file were I will build the API code
code:
import 'dart:convert';
import 'package:http/http.dart' as http;
class ApiService {
 final String baseUrl = 'http://127.0.0.1:5000'; // or your computer's IP
 Future<List<dynamic>> getGlucoseData() async {
  final response = await http.get(Uri.parse('$baseUrl/data'));
  if (response.statusCode == 200) {
   return json.decode(response.body);
  } else {
   throw Exception('Failed to load glucose data');
  }
}
this code will be imported by the main.dart file and then calls from the flask server
changing main.dart code to the following:
import 'package:flutter/material.dart';
import 'api_service.dart';
void main() {
 runApp(const MyApp());
class MyApp extends StatelessWidget {
 const MyApp({super.key});
 @override
 Widget build(BuildContext context) {
  return MaterialApp(
   title: 'Dexcom Mock App',
   home: GlucoseScreen(),
  );
 }
```

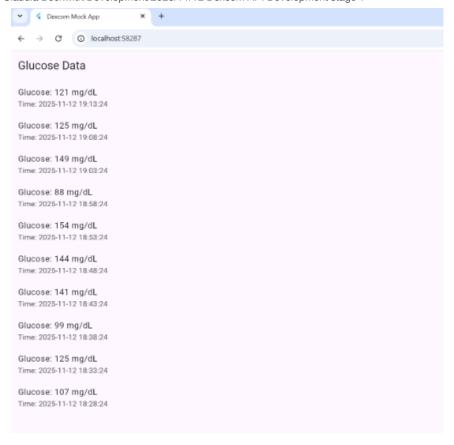
```
class GlucoseScreen extends StatefulWidget {
 @override
 _GlucoseScreenState createState() => _GlucoseScreenState();
class _GlucoseScreenState extends State<GlucoseScreen> {
 final ApiService apiService = ApiService();
 List<dynamic> glucoseData = ∏;
 @override
 void initState() {
  super.initState();
  fetchData();
 }
 void fetchData() async {
  final data = await apiService.getGlucoseData();
  setState(() {
   glucoseData = data;
  });
 }
 @override
 Widget build(BuildContext context) {
  return Scaffold(
   appBar: AppBar(title: const Text('Glucose Data')),
   body: glucoseData.isEmpty
      ? const Center(child: CircularProgressIndicator())
      : ListView.builder(
        itemCount: glucoseData.length,
         itemBuilder: (context, index) {
          final entry = glucoseData[index];
          return ListTile(
           title: Text('Glucose: ${entry['glucose_level']} mg/dL'),
           subtitle: Text('Time: ${entry['timestamp']}'),
         );
        },
       ),
  );
}
}
```

IN POWERSHELL:

to test the code and everything, running flutter

- flutter run
- opening in chrome
- note that the mock_api.py is still running in PowerShell

this results in the mock glucose data being displayed on the web browser, screenshot below is the webpage of the flutter app!



Conclusions/action items:

This was the first step in building the backend API. I have fake data being sent to a flutter application. Now that the connection has been established, my next step will be to make the data refresh and eventually start pulling from pydexcom.

2025/11/12 Dexcom API Development Stage 2

Claudia Beckwith - Nov 12, 2025, 7:57 PM CST

Title: Dexcom API Development Stage 2

Date: 11/12/2025

Content by: Claudia

Present: Claudia

Goals: Now that my connection has been established between my fake data and the flutter app, I need to make upgrades so that I can eventually pull real data. Step 1 is to get auto refreshing data. Then I can hopefully connect with Pydexcom (code provided by Dr. P)

Content:

current system refreshes data once (upon opening)

updating the _GlucoseScreenState class to auto update every 5 seconds (eventually will be ~5 minutes but for now I want more feedback

```
Timer.periodic(Duration(seconds: 5), (timer) {
  fetchData();
});
```

also added import 'dart:async' at the top with the other import statements

added a setting to have colors displayed corresponding to the values in our PDS

final code in the main.dart file:

```
import 'package:flutter/material.dart';
import 'api_service.dart';
import 'dart:async';
void main() {
 runApp(const MyApp());
class MyApp extends StatelessWidget {
 const MyApp({super.key});
 @override
 Widget build(BuildContext context) {
  return MaterialApp(
   title: 'Dexcom Mock App',
   home: GlucoseScreen(),
  );
 }
class GlucoseScreen extends StatefulWidget {
 _GlucoseScreenState createState() => _GlucoseScreenState();
class GlucoseScreenState extends State<GlucoseScreen> {
 final ApiService apiService = ApiService();
 List<dynamic> glucoseData = [];
```

```
@override
void initState() {
 super.initState();
 fetchData();
 // Refresh data every 5 seconds
 Timer.periodic(Duration(seconds: 5), (timer) {
  fetchData();
 });
}
void fetchData() async {
  final data = await apiService.getGlucoseData();
  setState(() {
    glucoseData = data;
  });
 } catch (e) {
  print('Error fetching data: $e');
  setState(() {
    glucoseData = [];
  });
 }
// Determine the color based on glucose range
Color getColor(int glucose) {
 if (glucose < 55) return Colors.red;
 if (glucose >= 56 && glucose <= 65) return Colors.orange;
 if (glucose >= 66 && glucose <= 80) return Colors.yellow;
 if (glucose >= 81 && glucose <= 139) return Colors.green;
 if (glucose >= 140 && glucose <= 200) return Colors.blue;
 return Colors.purple; // >201
}
@override
Widget build(BuildContext context) {
 return Scaffold(
  appBar: AppBar(title: const Text('Glucose Data')),
  body: glucoseData.isEmpty
     ? const Center(child: CircularProgressIndicator())
     : ListView.builder(
       itemCount: glucoseData.length,
       itemBuilder: (context, index) {
         final entry = glucoseData[index];
         final glucose = entry['glucose level'];
         final timestamp =
           DateTime.parse(entry['timestamp']).toLocal().toString();
         return Card(
          color: getColor(glucose).withOpacity(0.3), // light background
          child: ListTile(
           title: Text(
             'Glucose: $glucose mg/dL',
             style: TextStyle(
              fontWeight: FontWeight.bold,
              color: getColor(glucose), // text color
            ),
           ),
           subtitle: Text('Time: $timestamp'),
          ),
        );
       },
      ),
 );
```

} }

added features: auto updates every 5 seconds

better error handling

colors diplayed

*still pulling from fake data right now



I started the connection to Dr. P's pydexcom server and I think I unauthorized the login for my browser. Will connect again on Friday to discuss next steps.

Conclusions/action items:

I updated the flutter app to be more user friendly. Now we are displaying colored boxes that will be easy to test our bracelet against in the future. I need some help connecting the pydexcom information as the backend to the frontend (my flutter app) but that will be the next step.



2025/11/20 Dexcom Front End API Code - glucose_reading.dart

Claudia Beckwith - Nov 20, 2025, 4:12 PM CST

Title: Dexcom Front End API Code

Date: 11/20/2025

Content by: Claudia

Present: Claudia

Goals: My front end API in its last state was pulling from fake data and displaying on a web browser application. I have made the necessary updates to get it pulling real data from the Pydexcom website and now it's its own app (through VS). I am providing updated code to all my files.

Content:

3 files in VS Code:

1. glucose_reading.dart

this is a small file, all it does is define a "datatype" of a GlucoseReading

- holds a value (the glucose reading number)
- · holds timeText (time string from website)
- · helps simplify the other files with this step, can call the datatype instead of getting messy
 - · to call in dart it's reading.value and reading.timeText

2. api_service.dart

see entry titled Dexcom Front End API Code - api_service.dart

3. main.dart

see entry titled Dexcom Front End API Code - main.dart

VS CODE FOR GLUCOSE_READING.DART

```
class GlucoseReading {
  final int value;
  final String timeText;

GlucoseReading({
    required this.value,
    required this.timeText,
});
```

Conclusions/action items:

Now that everything runs on the frontend API, we can work on establishing the BLE connection to the microcontroller. I need to do more research on this because I think we move into Arduino code next and I'm not sure how to get our VS app to the microcontroller.



2025/11/20 Dexcom Front End API Code - api_service.dart

Claudia Beckwith - Nov 20, 2025, 4:15 PM CST

Title: Dexcom Front End API Code

Date: 11/20/2025

Content by: Claudia

Present: Claudia

Goals: My front end API in its last state was pulling from fake data and displaying on a web browser application. I have made the necessary updates to get it pulling real data from the Pydexcom website and now it's its own app (through VS). I am providing updated code to all my files.

Content:

3 files in VS Code:

1. glucose_reading.dart

see entry titled Dexcom Front End API Code - glucose reading.dart

2. api_service.dart

this file is the web scraper and API helper

called my main.dart every time you request a new reading

- contains a helper class called Api Service that can talk to the Dexcom BG viewer page, log in, and scrape for the data we want (glucose and time)
- when called, gets a dexcom style username and password
- works using POST request, goes to the website, fills it out, and gets the html of a successfully logged in page
- on the website it looks like <div class="reading">84 mg/dL</div>
 - o knows how to pull the 84
- builds a GlucoseReading object with value and time scraped from page
- returns the GlucoseReading back
- · this is called by the main.dart every time you need a reading

3. main.dart

see entry titled Dexcom Front End API Code - main.dart

CODE FOR API_SERVICE.DART

```
import 'package:http/http.dart' as http;
import 'package:html/parser.dart' as html_parser;
import 'glucose_reading.dart';
class ApiService {
```

```
final String baseUrl = 'https://sharedlab.bme.wisc.edu/bg/';
final http.Client _client = http.Client();
void dispose() {
 _client.close();
Future<GlucoseReading> loginAndGetReading(
    String username, String password) async {
  final uri = Uri.parse(baseUrl);
  final response = await _client.post(
    uri,
    body: {
      'username': username,
      'password': password,
  print('Login+fetch status: ${response.statusCode}');
  if (response.statusCode != 200) {
    throw Exception('Login/fetch failed: ${response.statusCode}');
```

```
final html = response.body;
if (html.contains('Enter Dexcom credentials')) {
  throw Exception('Login appears to have failed - check username/password.');
final document = html_parser.parse(html);
final readingDiv = document.querySelector('div.reading');
if (readingDiv == null) {
  throw Exception('Could not find <div class="reading"> in page.');
final readingText = readingDiv.text.trim(); // e.g. "84 mg/dL"
final match = RegExp(r'(\d+)\s*mg/dL').firstMatch(readingText);
if (match == null) {
  throw Exception('Could not parse glucose value from "$readingText".');
final value = int.parse(match.group(1)!);
final timeDiv = document.querySelector('div.time');
```

```
final timeText = timeDiv?.text.trim() ?? 'Time not available';

return GlucoseReading(
    value: value,
    timeText: timeText,
    );
}
```

Conclusions/action items:

Now that everything runs on the frontend API, we can work on establishing the BLE connection to the microcontroller. I need to do more research on this because I think we move into Arduino code next and I'm not sure how to get our VS app to the microcontroller.



2025/11/20 Dexcom Front End API Code - main.dart

Claudia Beckwith - Nov 20, 2025, 4:16 PM CST

Title: Dexcom Front End API Code

Date: 11/20/2025

Content by: Claudia

Present: Claudia

Goals: My front end API in its last state was pulling from fake data and displaying on a web browser application. I have made the necessary updates to get it pulling real data from the Pydexcom website and now it's its own app (through VS). I am providing updated code to all my files.

Content:

3 files in VS Code:

1. glucose_reading.dart

see entry titled Dexcom Front End API Code - glucose_reading.dart

2. api_service.dart

see entry titled Dexcom Front End API Code - api service.dart3. main.dart

this is the app and the screens the user interacts with

- · MyApp: the app shell
 - · sets up flutter
 - · shows login screen upon running
- · LoginScreen: shows a spot for dexcom login
 - o error page set up if it doesn't work
 - once you hit login
 - calls apiService to fetch data
 - if it works, moves to Glucose Screen
 - reuses the login for each open instance, discards once closed
- · GlucoseScreen: displays glucose
 - right now, one big colored card with the value in big text
 - recorded at... info
 - refresh now button (will eventually be manually updating)
 - initState()
 - calls fetchData()
 - calls apiService
 - gets glucose reading
 - stores in variable currentReading
 - sets a timer to pull again every 5 seconds
 - getColor(int glucose)
 - helper function relating to the PDS values of the color
 - right now this is our color for the block
 - eventually it will be the bracelet color

VS CODE FOR MAIN.DART (note that much of this code was pre built by flutter as the general app framework)

// lib/main.dart

import 'package:flutter/material.dart';

```
import 'dart:async';
import 'api_service.dart';
import 'glucose_reading.dart';
void main() {
 runApp(const MyApp());
class MyApp extends StatelessWidget {
 const MyApp({super.key});
 @override
 Widget build(BuildContext context) {
   return MaterialApp(
      title: 'Dexcom Mock App',
      theme: ThemeData(
        colorScheme: ColorScheme.fromSeed(seedColor: Colors.blue),
       useMaterial3: true,
     home: const LoginScreen(),
```

```
class LoginScreen extends StatefulWidget {
 const LoginScreen({super.key});
 @override
 State<LoginScreen> createState() => _LoginScreenState();
class _LoginScreenState extends State<LoginScreen> {
 final _usernameController = TextEditingController();
 final _passwordController = TextEditingController();
 bool _isLoggingIn = false;
 String? _error;
 @override
 void dispose() {
   _usernameController.dispose();
   _passwordController.dispose();
   super.dispose();
 void _handleLogin() async {
```

```
final username = _usernameController.text.trim();
final password = _passwordController.text;
if (username.isEmpty || password.isEmpty) {
  setState(() {
   _error = 'Please enter both username and password.';
 });
setState(() {
 _isLoggingIn = true;
});
final apiService = ApiService();
  await apiService.loginAndGetReading(username, password);
  apiService.dispose();
  if (!mounted) return;
```

```
Navigator.pushReplacement(
      context,
      MaterialPageRoute(
        builder: (_) => GlucoseScreen(
          username: username,
          password: password,
    apiService.dispose();
    setState(() {
     _isLoggingIn = false;
     _error = e.toString();
   });
@override
Widget build(BuildContext context) {
```

```
return Scaffold(
 appBar: AppBar(title: const Text('Dexcom Login')),
 body: Padding(
   padding: const EdgeInsets.all(16.0),
   child: Center(
     child: ConstrainedBox(
       constraints: const BoxConstraints(maxWidth: 400),
       child: Column(
         mainAxisSize: MainAxisSize.min,
         children: [
            TextField(
              controller: _usernameController,
              decoration: const InputDecoration(
                labelText: 'Dexcom Username',
                border: OutlineInputBorder(),
            const SizedBox(height: 12),
            TextField(
              controller: _passwordController,
```

```
obscureText: true,
 decoration: const InputDecoration(
   labelText: 'Dexcom Password',
   border: OutlineInputBorder(),
const SizedBox(height: 16),
if (_error != null)
 Padding(
   padding: const EdgeInsets.only(bottom: 8.0),
   child: Text(
     _error!,
     style: const TextStyle(color: Colors.red),
SizedBox(
 width: double.infinity,
 child: ElevatedButton(
   onPressed: _isLoggingIn ? null : _handleLogin,
   child: _isLoggingIn
```

```
height: 18,
                            width: 18,
                            child: CircularProgressIndicator(strokeWidth: 2),
                        : const Text('Login'),
class GlucoseScreen extends StatefulWidget {
 final String username;
 final String password;
```

```
const GlucoseScreen({
    super.key,
    required this.username,
    required this.password,
 });
 @override
 State<GlucoseScreen> createState() => _GlucoseScreenState();
class _GlucoseScreenState extends State<GlucoseScreen> {
 final ApiService apiService = ApiService();
 GlucoseReading? currentReading;
 Timer? _timer;
 bool _isLoading = true;
 String? _error;
 @override
 void initState() {
    super.initState();
    fetchData();
```

```
_timer = Timer.periodic(const Duration(seconds: 5), (_) => fetchData());
@override
void dispose() {
 _timer?.cancel();
  apiService.dispose();
  super.dispose();
Future<void> fetchData() async {
    final reading = await apiService.loginAndGetReading(
     widget.username,
     widget.password,
    setState(() {
      currentReading = reading;
     _isLoading = false;
     _error = null;
    });
```

```
} catch (e) {
    setState(() {
      _error = e.toString();
      _isLoading = false;
      currentReading = null;
   });
Color getColor(int glucose) {
  if (glucose < 55) return Colors.red;</pre>
  if (glucose >= 56 && glucose <= 65) return Colors.orange;</pre>
  if (glucose >= 66 && glucose <= 80) return Colors.yellow;</pre>
  if (glucose >= 81 && glucose <= 139) return Colors.green;
  if (glucose >= 140 && glucose <= 200) return Colors.blue;
  return Colors.purple; // >201
@override
Widget build(BuildContext context) {
```

```
return Scaffold(
 appBar: AppBar(
   title: const Text('Glucose Data'),
   actions: [
       tooltip: 'Logout',
       icon: const Icon(Icons.logout),
       onPressed: () {
         Navigator.pushAndRemoveUntil(
           context,
           MaterialPageRoute(builder: (_) => const LoginScreen()),
           (route) => false,
 body: _isLoading
     ? const Center(child: CircularProgressIndicator())
     : _error != null
```

```
? Center(child: Text('Error: $_error'))
: currentReading == null
    ? const Center(child: Text('No reading available'))
    : Column(
        mainAxisAlignment: MainAxisAlignment.center,
        children: [
          Card(
            color: getColor(currentReading!.value).withOpacity(0.2),
            margin: const EdgeInsets.all(16),
            child: Padding(
              padding: const EdgeInsets.all(16.0),
              child: Column(
                mainAxisSize: MainAxisSize.min,
                children: [
                    '${currentReading!.value} mg/dL',
                    style: TextStyle(
                      fontSize: 32,
                      fontWeight: FontWeight.bold,
                      color: getColor(currentReading!.value),
```

```
const SizedBox(height: 8),
          currentReading!.timeText,
          style: const TextStyle(fontSize: 16),
const SizedBox(height: 16),
ElevatedButton(
  onPressed: fetchData,
  child: const Text('Refresh Now'),
```

Conclusions/action items:

Now that everything runs on the frontend API, we can work on establishing the BLE connection to the microcontroller. I need to do more research on this because I think we move into Arduino code next and I'm not sure how to get our VS app to the microcontroller.



2025/12/06 Final main.dart Code Upload

Claudia Beckwith - Dec 06, 2025, 10:19 AM CST

Title: Final main.dart code

Date: 12/06/2025

Content by: Claudia beckwith

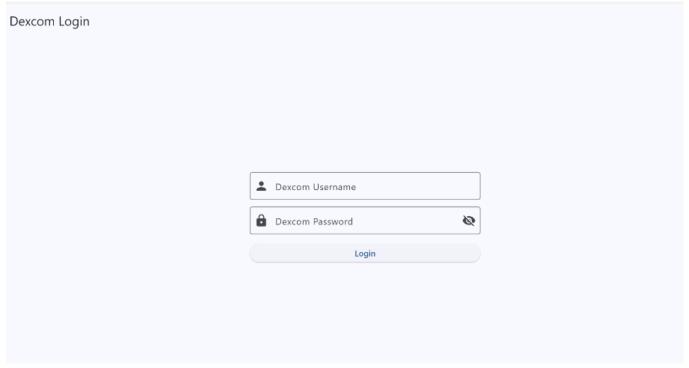
Present: Claudia

Goals: I want to upload my final code for main.dart. Since the last update, I have added code to facilitate the upload onto the arduino so the led would be correctly programmed. This is the code that we used for our final presentation and updates the microcontroller via usb-c connection.

Content:

The following code is the main framework for the app. highlights include:

- · login page
 - o prompts user for dexcom login
 - o icons for username and password
- · option to show password



- main page
 - o displays updated glucose levels
 - o timestamp of last update
 - o formatted in a color coded box (related to PDS values)
 - time since last update
 - o button to send to microcontroller: used once upon logging in
 - o force refresh button
 - programmed to auto refresh every 5 minutes
 - pulls new value from backend API
 - pushes value to microcontroller via COM7 port

87 mg/dL

Recorded at 8:00 pm (3 min ago)

Send to Microcontroller

Refresh Now

Code:

```
import 'package:flutter/material.dart';
import 'dart:async';
import 'api_service.dart';
import 'glucose_reading.dart';
import 'ble_glucose_sender.dart';
void main() {
 runApp(const MyApp());
class MyApp extends StatelessWidget {
 const MyApp({super.key});
 @override
```

```
Widget build(BuildContext context) {
   return MaterialApp(
     title: 'Dexcom Mock App',
     theme: ThemeData(
       colorScheme: ColorScheme.fromSeed(seedColor: Colors.blue),
       useMaterial3: true,
     home: const LoginScreen(),
class LoginScreen extends StatefulWidget {
 const LoginScreen({super.key});
 @override
 State<LoginScreen> createState() => _LoginScreenState();
class _LoginScreenState extends State<LoginScreen> {
 final _usernameController = TextEditingController();
 final _passwordController = TextEditingController();
 bool _isLoggingIn = false;
 bool _obscurePassword = true;
```

```
@override
void dispose() {
 _usernameController.dispose();
  _passwordController.dispose();
  super.dispose();
void _handleLogin() async {
  final username = _usernameController.text.trim();
  final password = _passwordController.text;
  if (username.isEmpty || password.isEmpty) {
    setState(() {
     _error = 'Please enter both username and password.';
  setState(() {
    _isLoggingIn = true;
    _error = null;
  final apiService = ApiService();
```

```
await apiService.loginAndGetReading(username, password);
apiService.dispose();
if (!mounted) return;
Navigator.pushReplacement(
  MaterialPageRoute(
   builder: (_) => GlucoseScreen(
     username: username,
     password: password,
apiService.dispose();
setState(() {
  _isLoggingIn = false;
 _error = e.toString();
```

```
@override
Widget build(BuildContext context) {
    appBar: AppBar(title: const Text('Dexcom Login')),
    body: Padding(
      padding: const EdgeInsets.all(16.0),
      child: Center(
        child: ConstrainedBox(
          constraints: const BoxConstraints(maxWidth: 400),
            mainAxisSize: MainAxisSize.min,
            children: [
                controller: _usernameController,
                decoration: const InputDecoration(
                  labelText: 'Dexcom Username',
                  border: OutlineInputBorder(),
                  prefixIcon: Icon(Icons.person),
```

```
const SizedBox(height: 12),
  controller: _passwordController,
  obscureText: _obscurePassword,
  decoration: InputDecoration(
    labelText: 'Dexcom Password',
    border: OutlineInputBorder(),
    prefixIcon: const Icon(Icons.lock),
    suffixIcon: IconButton(
      icon:Icon(_obscurePassword ? Icons.visibility_off : Icons.visibility,),
      onPressed:() {
        setState((){
          _obscurePassword = !_obscurePassword;
const SizedBox(height: 16),
if (_error != null)
  Padding(
    padding: const EdgeInsets.only(bottom: 8.0),
```

```
style: const TextStyle(color: Colors.red),
width: double.infinity,
child: ElevatedButton(
 onPressed: _isLoggingIn ? null : _handleLogin,
  child: _isLoggingIn
          height: 18,
          width: 18,
          child: CircularProgressIndicator(strokeWidth: 2),
```

```
class GlucoseScreen extends StatefulWidget {
 final String username;
 final String password;
   super.key,
   required this.username,
   required this.password,
 @override
 State<GlucoseScreen> createState() => _GlucoseScreenState();
class _GlucoseScreenState extends State<GlucoseScreen> {
 final ApiService apiService = ApiService();
 GlucoseReading? currentReading;
 Timer? _timer;
 Timer? _sendTimer;
 bool _isLoading = true;
 String? _error;
```

```
@override
void initState() {
  super.initState();
  fetchData();
 _timer = Timer.periodic(const Duration(minutes: 1), (_) => fetchData());
 _sendTimer = Timer.periodic(const Duration(minutes: 5), (_) => sendToMicrocontroller());
@override
void dispose() {
  _timer?.cancel();
 _sendTimer?.cancel();
  apiService.dispose();
  BleGlucoseSender.dispose();
  super.dispose();
Future<void> sendToMicrocontroller() async {
  if (currentReading == null) return;
    await \ BleGlucoseSender.sendGlucose(currentReading!.value);\\
    print('Glucose sent to microcontroller: ${currentReading!.value} mg/dL');
```

```
print('Failed to send glucose to microcontroller: $e');
Future<void> fetchData() async {
    final reading = await apiService.loginAndGetReading(
     widget.username,
     widget.password,
    setState(() {
      currentReading = reading;
      _isLoading = false;
    setState(() {
     _error = e.toString();
      _isLoading = false;
      currentReading = null;
```

```
Color getColor(int glucose) {
  if (glucose < 55) return Colors.red;</pre>
  if (glucose >= 56 && glucose <= 65) return Colors.orange;</pre>
  if (glucose >= 66 && glucose <= 80) return Colors.yellow;</pre>
  if (glucose >= 81 && glucose <= 139) return Colors.green;</pre>
  if (glucose >= 140 && glucose <= 200) return Colors.blue;</pre>
  return Colors.purple; // >201
@override
Widget build(BuildContext context) {
    appBar: AppBar(
      title: const Text('Glucose Data'),
          tooltip: 'Logout',
          icon: const Icon(Icons.logout),
          onPressed: () {
            Navigator.pushAndRemoveUntil(
              MaterialPageRoute(builder: (_) => const LoginScreen()),
```

```
body: _isLoading
   ? const Center(child: CircularProgressIndicator())
    : _error != null
        ? Center(child: Text('Error: $_error'))
        : currentReading == null
            ? const Center(child: Text('No reading available'))
                mainAxisAlignment: MainAxisAlignment.center,
                children: [
                    color: getColor(currentReading!.value).withOpacity(0.2),
                    margin: const EdgeInsets.all(16),
                    child: Padding(
                      padding: const EdgeInsets.all(16.0),
```

```
mainAxisSize: MainAxisSize.min,
      children: [
          '${currentReading!.value} mg/dL',
          style: TextStyle(
            fontSize: 32,
            fontWeight: FontWeight.bold,
            color: getColor(currentReading!.value),
        const SizedBox(height: 8),
          currentReading!.timeText,
          style: const TextStyle(fontSize: 16),
const SizedBox(height: 16),
 onPressed: () async {
```

```
if (currentReading == null) return;
      await BleGlucoseSender.sendGlucose(currentReading!.value);
      if (!mounted) return;
      ScaffoldMessenger.of(context).showSnackBar(
      if (!mounted) return;
      {\tt ScaffoldMessenger.of(context).showSnackBar(}
  child: const Text('Send to Microcontroller'),
const SizedBox(height: 16),
  onPressed: fetchData,
```

```
],
);
);
}
```

Conclusions/action items:

The app is in a good state for what I wan to accomplish at the moment. Future work will include making the connection run via bluetooth. I would also like to get this app running on a smartphone app instead of just locally.



2025/12/06 Final api_service.dart upload

Claudia Beckwith - Dec 06, 2025, 10:27 AM CST

Title: Final api_service.dart code upload

Date: 12/06/2025

Content by: claudia

Present: claudia

Goals: I want to record the final code we used for api_service.dart. This code block is what actually pulls data from the backend API. It is run automatically every 5 minutes.

Content:

code features

- · sends a POST request to the bme sharedlab pydexcom server
 - uses the username and password from the user
- · recieves and HTML page
- checks for login errors
- · parses glucose values and timestamp
 - · HTML scraping
- · returns the object to flutter UI
- · maintains own HTTP client and terminates at the end

final code:

```
import 'package:http/http.dart' as http;
import 'package:html/parser.dart' as html_parser;
import 'glucose_reading.dart';

class ApiService {
    final String baseUrl = 'https://sharedlab.bme.wisc.edu/bg/';
    final http.Client _client = http.Client();

    void dispose() {
        _client.close();
    }
}
```

```
Future<GlucoseReading> loginAndGetReading(
   String username, String password) async {
  final uri = Uri.parse(baseUrl);
  final response = await _client.post(
   uri,
    body: {
      'username': username,
      'password': password,
 print('Login+fetch status: ${response.statusCode}');
 if (response.statusCode != 200) {
    throw Exception('Login/fetch failed: ${response.statusCode}');
  final html = response.body;
 if (html.contains('Enter Dexcom credentials')) {
```

```
throw Exception('Login appears to have failed - check username/password.');
final document = html_parser.parse(html);
final readingDiv = document.querySelector('div.reading');
if (readingDiv == null) {
  throw Exception('Could not find <div class="reading"> in page.');
final readingText = readingDiv.text.trim(); // e.g. "84 mg/dL"
final match = RegExp(r'(\d+)\s*mg/dL').firstMatch(readingText);
if (match == null) {
  throw Exception('Could not parse glucose value from "$readingText".');
final value = int.parse(match.group(1)!);
// grabs time
final timeDiv = document.querySelector('div.time');
final timeText = timeDiv?.text.trim() ?? 'Time not available';
return GlucoseReading(
 value: value,
  timeText: timeText,
```

```
);
}
```

I think it would be interesting in the future if I could combine this code with the pydexcom initialization so we could bypass that stage and make a more seamless experience. I ran into issues earlier where I was pulling too often and crashing the webpage, which just goes to show that if something were to happen to that site out of my control is would mess up my whole program.



2025/12/06 Final ble_glucose_sender.dart code

Claudia Beckwith - Dec 06, 2025, 10:49 AM CST

Title: final ble_glucose_sender.dart

Date: 12/6/2025

Content by: claudia

Present: claudia

Goals: I want to provide my final code block for my ble_glucose_sender.dart. This block was originally for the BLE connection between the microcontroller and the app, but a shift of plans led to us using the serial port for communication again. Unfortunately, I had the name "ble glucose sender" hard coded into my other programs so many times that when I adapted the function of this code it didn't make sense to rename.

Content:

The functions of this code block are the following:

- finds all available serial ports on the computer (com3, com4, com7)
- · find the port with attached microcontroller (from arduino)
- · opens serial port at 115200 baud so the flutter app can talk to the microcontroller
- · formats glucose data into message for microcontroller
 - format: <glucose>,<timestamp>\n
- · sends message to microcontroller over port
 - o string into bytes
- · prints debug output to powershell
 - o confirms send
 - · displays sent value and timestamp
- · controls connection and closes it upon termination

Final code:

```
import 'dart:typed_data';
import 'dart:async';
import 'package:flutter_libserialport/flutter_libserialport.dart';

class BleGlucoseSender {
    static const String _portName = 'COM7';

    static SerialPort? _port;

    static SerialPortReader? _reader;

    static bool _initialized = false;
```

```
static bool _firstOpen = true;
static Future<void> init() async {
 print('BleGlucoseSender.init() called');
  final ports = SerialPort.availablePorts;
 print('Available serial ports: $ports');
 if (!ports.contains(_portName)) {
    throw Exception('Configured port $_portName not found. Available: $ports');
 if (_initialized && _port != null && _port!.isOpen) {
   print('Port $_portName already open');
   _reader?.close();
 } catch (_) {}
 _reader = null;
```

```
_port?.close();
} catch (_) {}
_port = null;
final port = SerialPort(_portName);
print('Attempting to open $_portName...');
if (!port.openReadWrite()) {
  final err = SerialPort.lastError;
  print('Failed to open $_portName. Last error: $err');
  throw Exception('Failed to open $_portName: $err');
final config = SerialPortConfig()
..baudRate = 115200
..bits = 8
..stopBits = 1
..parity = SerialPortParity.none
..rts = 1
..cts = 0
..dtr = 1
..dsr = 0
```

```
..xonXoff = 0;
port.config = config;
  _reader = SerialPortReader(port);
 _reader!.stream.listen((data) {
    final text = String.fromCharCodes(data);
   print('From MCU: $text');
  });
  _port = port;
  _initialized = true;
  print('Serial port $_portName opened.');
  if (_firstOpen) {
   _firstOpen = false;
    print('Waiting 1.5s for MCU reset...');
   await Future.delayed(const Duration(milliseconds: 1500));
    print('Done waiting for MCU.');
```

```
static Future<void> sendGlucose(int glucoseValue) async {
 print('BleGlucoseSender.sendGlucose($glucoseValue) called');
 await init();
  final timestampSec = DateTime.now().millisecondsSinceEpoch ~/ 1000;
  final payload = '$glucoseValue,$timestampSec\n';
  final bytes = Uint8List.fromList(payload.codeUnits);
 print('Writing payload: $payload');
  final written = _port!.write(bytes);
 print('Bytes to write: ${bytes.length}, written: $written');
 if (written != bytes.length) {
    throw Exception(
      'Failed to write all bytes to $_portName. '
      'Expected ${bytes.length}, wrote $written.',
 print('Payload sent successfully.');
static void dispose() {
```

```
print('BleGlucoseSender.dispose()');
 _reader?.close();
} catch (_) {}
_reader = null;
  _port?.close();
} catch (_) {}
_port = null;
_initialized = false;
_firstOpen = true;
```

In the future, this code will be adapted to control the BLE connection. Because of the trouble with our microcontroller and battery incompatibility, we had to adapt to the current configuration.

Claudia Beckwith - Dec 06, 2025, 10:58 AM CST

Title: Arduino Code for on-board LED (testing)

Date: 12/6/2025

Content by: claudia

Present: claudia

Goals: This code is used to confirm the connection between Flutter and Arduino. I want to see if I can control the on-board LED using my app (at this point, the external LED was not functional. I wanted to get proof that my code was in fact still updating.

Content:

The code accomplishes the following:

- sets baud rate to match flutter 9115200)
- · initialized on board led with pins ledr, ledg, ledb
- prints debug code to the serial monitor with glucose value and timestamp
- · color codes the value to 3 color ranges (all I had capacity for)

```
• // < 75 → red
// 76-139 → green
// > 139 → yellow (red + green)
```

Code for "arduino_glucose_send_version1"

```
#define LED_R LEDR

#define LED_G LEDG

#define LED_B LEDB

int latestGlucose = 0;

void setup() {
    Serial.begin(115200);

    while (!Serial) {
      ;
}
```

```
}
 pinMode(LED_R, OUTPUT);
  pinMode(LED_G, OUTPUT);
  pinMode(LED_B, OUTPUT);
  digitalWrite(LED_R, HIGH);
  digitalWrite(LED_G, HIGH);
 digitalWrite(LED_B, HIGH);
 Serial.println("Ready to receive glucose data...");
}
void loop() {
 if (Serial.available()) {
    String line = Serial.readStringUntil('\n');
    line.trim();
    if (line.length() == 0) return;
    int commaIndex = line.indexOf(',');
    if (commaIndex == -1) {
```

```
Serial.print("Invalid line: ");
 Serial.println(line);
 return;
}
String glucoseStr = line.substring(0, commaIndex);
String timestampStr = line.substring(commaIndex + 1);
int glucose = glucoseStr.toInt();
String timestamp = timestampStr;
latestGlucose = glucose;
updateLED(latestGlucose);
// Debug prints
Serial.println("---- Glucose Update ----");
Serial.print("Received glucose: ");
Serial.print(glucose);
Serial.println(" mg/dL");
Serial.print("Timestamp (raw): ");
Serial.println(timestamp);
```

```
Serial.println("----");
 }
}
void setColor(bool red, bool green, bool blue) {
 digitalWrite(LED_R, red ? LOW : HIGH);
 digitalWrite(LED_G, green ? LOW : HIGH);
 digitalWrite(LED_B, blue ? LOW : HIGH);
}
void updateLED(int glucose) {
 if (glucose < 75) {</pre>
   setColor(true, false, false);
 } else if (glucose <= 139) {</pre>
   setColor(false, true, false);
 } else {
   setColor(true, true, false);
 }
}
```

This code successfully confirmed that Flutter and the microcontroller could talk. Next step is to focus on the programming with the external LED and get those to our intended ranges too.

2025/12/01 Arduino Code for troubleshooting on board LED pins - arduino_glucose_sender_version2.ino

Claudia Beckwith - Dec 06, 2025, 11:03 AM CST

Title: Arduino code for troubleshooting on board LED pins

Date: 12/01/2025

Content by: claudia

Present: claudia

Goals: I am having trouble matching the on board LED pins with their function because sometimes they're on when HIGH and sometimes on when LOW. I am changing too much in the other code so this file is to confirm which pin cooresponds to which light.

Content:

this code just runs through every possible led configuration. I am using it to troubleshoot

code:

```
#define LED_R LEDR
#define LED_G LEDG
#define LED_B LEDB
void setup() {
  pinMode(LED_R, OUTPUT);
  pinMode(LED_G, OUTPUT);
  pinMode(LED_B, OUTPUT);
}
void loop() {
  // Red only
  digitalWrite(LED_R, LOW);
  digitalWrite(LED_G, HIGH);
```

```
digitalWrite(LED_B, HIGH);
delay(1000);
// Green only
digitalWrite(LED_R, HIGH);
digitalWrite(LED_G, LOW);
digitalWrite(LED_B, HIGH);
delay(1000);
// Blue only
digitalWrite(LED_R, HIGH);
digitalWrite(LED_G, HIGH);
digitalWrite(LED_B, LOW);
delay(1000);
// Yellow (red + green)
digitalWrite(LED_R, LOW);
digitalWrite(LED_G, LOW);
digitalWrite(LED_B, HIGH);
delay(1000);
```

```
digitalWrite(LED_R, HIGH);

digitalWrite(LED_G, HIGH);

digitalWrite(LED_B, HIGH);

delay(1000);
}
```

I learned which pins correspond to which colors and the needed settings. Used this info for my arduino code version 1, 3 and 4.



Claudia Beckwith - Dec 06, 2025, 11:12 AM CST

Title: Arduino code to test external LED

Date: 12/04/2025

Content by: claudia

Present: claudia

Goals: Now that the circuit is connected to the led, I need to test to see if I can program the external led like I did the on board. This pretty closesly mirrors what I want my final code to do with a few minor changes.

Content:

This code does the following:

- initializes the WS2812B led ring light (7 leds) using the adafuit neopixel library
- · waits for input from flutter app in expected format
- · choses rgb color based on glucose range

#include <Adafruit_NeoPixel.h>

code here:

```
#define LED_PIN 8

#define NUM_PIXELS 7

Adafruit_NeoPixel ring(NUM_PIXELS, LED_PIN, NEO_GRB + NEO_KHZ800);

int latestGlucose = 0;

void setup() {
    Serial.begin(115200);
    ring.begin();
    ring.setBrightness(255);
    ring.show();
```

```
Serial.println("Ready to receive glucose data...");
}
void loop() {
 if (Serial.available()) {
   String line = Serial.readStringUntil('\n');
    line.trim();
   if (line.length() == 0) return;
   int commaIndex = line.indexOf(',');
   if (commaIndex == -1) {
     Serial.print("Invalid line: ");
     Serial.println(line);
     return;
   }
   String glucoseStr = line.substring(0, commaIndex);
   String timestampStr = line.substring(commaIndex + 1);
   int glucose = glucoseStr.toInt();
    latestGlucose = glucose;
```

```
setRingColorForGlucose(glucose);
 }
}
void setRingColor(uint8_t r, uint8_t g, uint8_t b) {
 uint32_t color = ring.Color(r, g, b);
 for (int i = 0; i < NUM_PIXELS; i++) {</pre>
    ring.setPixelColor(i, color);
 }
 ring.show();
}
void setRingColorForGlucose(int glucose) {
 if (glucose < 55) {</pre>
    // RED
    setRingColor(255, 0, 0);
 } else if (glucose >= 56 && glucose <= 65) {</pre>
    // ORANGE
    setRingColor(255, 128, 0);
```

```
} else if (glucose >= 66 && glucose <= 80) {</pre>
    // YELLOW
    setRingColor(255, 255, 0);
 } else if (glucose >= 81 && glucose <= 139) {</pre>
    // GREEN
    setRingColor(0, 255, 0);
 } else if (glucose >= 140 && glucose <= 200) {</pre>
    // BLUE
    setRingColor(0, 0, 255);
 } else {
    // PURPLE
    setRingColor(180, 0, 180);
 }
}
```

Now that I know we can program the LED, I will clean up this code, find our final brightness level desired for successfull visibility, and make the final version.



2025/12/06 Final Arduino Microcontroller Code

Claudia Beckwith - Dec 06, 2025, 11:17 AM CST

Title: Final Arduino Microcontroller Code

Date: 12/6/2025

Content by: Claudia

Present: claudia

Goals: Now that I know I can connect the microcontroller to the LED, I want to make our final code we can program to the seeed for light display. I want colors to be solid and clear, and we settled on a brightness level of 140 out of 255.

Content:

Code recieves data from Flutter, matches range, pushes rgb code to led on pin D8, and prints a debug statment.

Code:

```
#include <WS2812-SOLDERED.h>
#define LED PIN
#define NUM_LEDS
                 7
#define BRIGHTNESS 140
WS2812 ring(NUM_LEDS, LED_PIN);
// ============
// SETUP
// ===========
void setup() {
   Serial.begin(115200);
   while (!Serial) { ; }
   ring.begin();
```

```
ring.setBrightness(BRIGHTNESS);
    ring.clear();
    ring.show();
    Serial.println("Ready to receive glucose data...");
}
void loop() {
    if (Serial.available()) {
        String line = Serial.readStringUntil('\n');
        line.trim();
        if (line.length() == 0) return;
        int commaIndex = line.indexOf(',');
        if (commaIndex == -1) {
            Serial.println("Invalid line");
            return;
        }
        int glucose = line.substring(0, commaIndex).toInt();
        updateLED(glucose);
```

```
Serial.print("Glucose received: ");
        Serial.println(glucose);
    }
}
void setRingColor(uint8_t r, uint8_t g, uint8_t b) {
    // Set ALL LEDs to the same color
    for (int i = 0; i < NUM_LEDS; i++) {</pre>
        ring.setPixelColor(i, ring.Color(r, g, b));
    }
    ring.show();
}
void updateLED(int glucose) {
    if (glucose < 55) {</pre>
        // RED
        setRingColor(255, 0, 0);
    } else if (glucose >= 56 && glucose <= 65) {</pre>
        // ORANGE
```

```
setRingColor(255, 65, 0);
} else if (glucose >= 66 && glucose <= 80) {</pre>
    // YELLOW
    setRingColor(255, 255, 0);
} else if (glucose >= 81 && glucose <= 139) {</pre>
    // GREEN
    setRingColor(0, 255, 0);
} else if (glucose >= 140 && glucose <= 200) {</pre>
    // BLUE
    setRingColor(0, 0, 255);
} else {
    // PURPLE
    setRingColor(180, 0, 180);
}
```

}

This code works verywell with our current app. I will update in the future when we move to BLE connection but for now it is perfectly serving its purpose and updating every 5 minutes or upon the refresh microcontroller button in the flutter app.

Claudia Beckwith - Dec 07, 2025, 11:52 AM CST

Title: CITI Training

Date: 10/31/25

Content by: Claudia Beckwith

Present: Claudia beckwith

Goals: Complete citi training to learn about practices in testing protections regarding human subjects.

Content: PDF below

Conclusions/action items:

I will use this training as a consideration going forward with design projects. I don't think our training on human subjects in this semester but in the case that we do one day it would be helpful to know.

Claudia Beckwith - Dec 07, 2025, 11:52 AM CST



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citiCert_claudia.pdf (77.6 kB)

Claudia Beckwith - Dec 07, 2025, 11:52 AM CST





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citiReport_claudia.pdf (78.6 kB)

Claudia Beckwith - Sep 10, 2025, 2:05 PM CDT

Title: BME Career Prep

Date: 09/10/2025

Content by: Claudia Beckwith

Present: BME 300s

Goals: I want to learn about different resources that can assist me at the engineering career fair next week. Engineering Career Services is presenting and I want to familiarize myself with their advice and tips for my resume, career fair, and job search. My goal is to be as prepared as possible for the career fair next week.

Content:

Job searching tips:

- keep track of where and how I've applied
- connect before applying if I can, using my resources/network
- esc.wisc.edu has a job tracker spreadsheet
- quality of sources matter (aggregator sites like indeed, google jobs, etc are NOT worth the time. Apply at source (company website best, handshake 2nd, linkedin 3rd)
- after initial application, follow up. meet the people at the career fair to learn their names/face/contacts. elevates opportunity when it comes to the application
- for companies not coming to career fair, still find a contact and make sure someone is actually looking at my application
- career fair process can take awhile, patience is key

Resume tips:

- tailor resume to the position, look at key words in the job description and include it on the resume
- show the full picture of the academic projects and outside school
- ATS proofread
 - MS word
 - · no colors columns or charts
 - don't include years or semester in design projects
 - jobs org + location, position title + dates (no duration for anything but a job)
 - · try to avoid templates, content first and format later
- resume it always under construction, update every few months
- objective statements are good for unaccompanied applications, good for the career fair
- no objective statement when applying for direct positions
- soft skills worked into the descriptions from jobs, add real, relevant, tech skills (excel, python, solidworks, etc)

Cover letter tips:

- always tailored to the job posting, custom
- amplify greatest strengths
- address to person
- if optional, ask if it would add something to the application

- outline
 - intro: who you are, applying for, found where, "thesis statement"
 - · Based on my experience in A and B, I believe I would be able to make a difference in the X role at Y company.
 - · paragraph about A
 - paragraph about B
 - why this employer/role + closing/next ssteps

Career Fair advice for BME:

- identify purpose, more than just an internship
- research the employer
- develop your "value added" statement, why me?
- for jobs in EE for example, talk about how background in BME makes me a better applicant than the traditional EE applicant pool
- if expiration for job posting is before the career fair, apply before. if not, apply after (might get more information). good to start/research before

Handshake notes:

- algorithm added a lot of extra majors in the groups
- don't limit to jobs specifically set for BME
- the more you use Handshake the better tailored the algorithm will be

Career Fair Info:

- 302 employers!!
- Sept 15-18, 2025
- EH, ME, ECB
- Nametags
- Different employers for each day

Conclusions/action items:

I learned some advice pertaining to resume building, career fair advice, and cover letter tips. Specifically, I have to update my projects to not include dates and change my soft skill section to be reflected in my job descriptions to show vs tell my strong suits. Between now and next week, I need to update my resume with some of these tips in mind, research the companies I am interested in working for, and create a tracker for applications. I feel better prepared for what I need to accomplish to be the most successful in the job search.

Claudia Beckwith - Sep 17, 2025, 2:02 PM CDT

Title: Exploring your Leadership Style

Date: 09/17/2025

Content by: Claudia Beckwith

Present: Claudia Beckwith

Goals: I want to learn more about my leadership styles to help me learn more about myself and how to succeed in this project. I am one of the coleads of my project so it's important to me that I learn about myself and others. I also have a leadership position in SWE and I think I could have a lot to learn here.

Content:

Word Cloud: important qualities of a leader

- communication
- listening
- organization
- confidence

Anatomy of a good leader:

- self-awareness: understanding strengths and weaknesses
- vision: provide purpose, set goals
- decision making: decider
- transparent: communication and feedback
- empathy: connect with people you're leading

Levels of leadership:

personal (leading self) - self awareness, personal goals

interpersonal (leading against other people) - active listening, building trust, responding to others

team (leading team) - facilitate team interactions, support and empower, design and improve processes

organizational leader (ceo) - collab beyond individual teams, contribute to org culture

Self assessments:

my clifton strengths

- 1. learner
- 2. arranger
- 3. competition
- 4. achiever
- 5. empathy

I had strengths in each of the categories (people, process, thought, and impact oriented)

I think this helps me adapt to other peoples learning styles. That being said, I probably lean towards process

Leadership models

Power model

- "someone should take control and it should be me"
- · hierarchy, authority, command
- · believe you need a specific set of traits to lead
- · being in control is most important

Servant model

- · "its not about me, needs of the followers"
- · sharing power
- · listening and understanding
- · empathy, empowering, deveoping others

Authentic leadership

- · "being myself will gain and build trust"
- · building self-esteem and awareness
- · transparency, genuine, honesty

reflecting on authentic leadership:

the former SWE president was very much an authentic leader, she valued building relationships with everyone but was still was authoritative and made decisions based on what she thought was best for the club. I really admired how she lead the club and wanted to embody some of the same qualities.

Goal Setting - Personal

My goal for this semester as a leader is to learn more about each person I lead as an individual. I have 22 people on my leadership team for SWE, and I want them all to know I am a great resource for any help they may need and feel like they can come talk to me. I think getting to know everyone personally will also let me know their learning/communication/leading styles so I can best be of support to them. For example, some people like to talk about their event logistics a lot and others do not. I would like to understand what type of person everyone is so I don't need to worry if I don't hear too much from someone and assume they're either not doing their work or are stuck on their own.

Conclusions/action items:

In choosing on what kind of leader I want to be, I need to observe and reflect on my strengths and weaknesses. I am willing to seek out feedback from mentors or leaders to learn about myself as well. I have set a goal to learn about each of the people I lead on a personal level and hope that I can continuously reflect on my goal through the semester and notice myself making progress.



Claudia Beckwith - Sep 24, 2025, 2:07 PM CDT

Title: Near Peer Mentoring by Tracy Jane Puccinelli

Date: 09/24/2025

Content by: Claudia Beckwith

Present: 300s

Goals: I want to learn how to become a better mentor for the 200s in my group. My 300s last year helped answer a lot of questions for me and set me up for success in 201/300 and I want to do the same for my 200s. This will also put our team in the best possible position to succeed.

Content:

Purpose of mentoring BME 200 students:

The best way to demonstrate profiecency is the ability to teach others.

Also its nice for 200s to have a designated peer group to help answer questions as they arise.

We can be helpful, relatable, and approachable to someone when the age gap is only 1 year.

Increases a sense of belonging in BME

Transferrable Skills:

- · Leadership
- · Communication
- · Active Listening
- · Study practices
- Self Awareness (identify gaps in knowledge)
- Interpersonal skills

What does it mean to be a good mentor:

- Patient
- · Encouraging
- · Good listening
- · Building trust
- Support
- · Being available

Skills of active listening:

- · Remove distractions
- · stop talking
- · show interest
- · ask questions
- · show understanding

Topics I wish I knew as a 200:

- · Solidworks resources (how to make a drawing)
- · deliverables rubrics outlined clearly
- how to get a .stl file onto the 3D printers
- BME design resource page on the website
- · course reccommendations for track

our mentor map



Additional ideas:

- · writing center
- · how to write emails to advisors
- · career fair
- · giving constructive criticism instead of just rewriting
- · alumni connections
- job link sponsorship emails
- lab Pl's
- · club fairs
- · academic conferences
- TJP for outreach opportunities
- · networking within our groups
- · solidworks resources
- ULC
- · Office hours

Conclusions/action items:

After this lecture, I have a much better understanding of the steps I need to take to be a better mentor for my BME 200s. I have an idea of the specific resources I want to share with them and this is helping me remember how I felt as a sophomore. I want to make sure my 200s are best set up for success for the benefit of our team and the BME department.

Claudia Beckwith - Oct 01, 2025, 1:52 PM CDT

Title: Sustainability in BME by Andrea Hicks

Date: 10/1/2025

Content by: Claudia

Present: 300s

Goals: I want to understand what sustainability and how it relates to to BME. I know it's important to practice sustainability, but it doesn't come up much in our projects. I want to know how I can implement some of these practices to my project and my life in the future.

Content:

Sustainability: everything we need for our survival and well being depends on natural environment.

3 pillars of sustainability

- social
- environmental
- economic

main idea is to keep resources in the economy, this is beneficial to the environment and economy

- ex. aluminum is expensive to refine so recycling centers pay for people to bring it in
- ex. glass is not as easy to recycle and is less common

carbon footprint comes from a lifecycle assessment

- quantitave analysis, used for making decisions
- ex. looking at coffee pot vs keurig
- assess from ag standpoint, electric standpoint, and plastic

coffee pot is less efficent, wastes more grounds, uses more electricity but the k cups uses plastic. Together they balance out to be mostly the same

both have issues with microplastics

life cycle assessment answers things without being bias

example in medicine:

paper on tables in doctors' offices:

- not using the white paper between patients
- found if you're disenfecting the table between patients you don't need paper
- cheaper and better for the planet

speculums:

- plastic (single use) vs metal (multi use) speculums
- stainless steel is heavier and needs to be autoclaved, uses labor, nitrile gloves, a gown, water, detergent, autoclave electricity, autoclave maintance
- assessing in the long term vs short term yields different results
 - · clinic doing multiple exams, makes more sense to get stainless steel ones
 - · stainless steel better for scarcity
- environmental impact of washing
 - · electricity comes from burning hard coal, bad for the environment

· different surfactants may be better or worse for the environment

anesthesia:

- effictiveness and cost are factors, so is environmetal impact
- emissions come from manufacturing, packaging, transport, deliver, and management.
- also release different amounts of N2O during use

(N2O has 300x the global warming potential of CO2)

cleaning and reusability:

- how easy is something to clean? does it stop spread of infection?

Conclusions/action items:

I realized there is a lot more to testing the lifecycle/carbon footprint than I originally thought. I understand that for many companies there is the financial/economic solution, and it's frusterating to me that often time the environmental solution is not the chosen one unless it also makes sense economically. I didn't consider the resources used for cleaning/reusing med devices and it makes me think of other areas that I can be more concious about. I plan on being more cautious with my material usage in design projects and in my everyday life.

Claudia Beckwith - Oct 08, 2025, 2:07 PM CDT

Title: Introduction to WARF, IP, Disclosing, and Licensing

Date: 10/8/2025

Content by: Claudia

Present: 300s

Goals: I want to learn more about WARF, what they do, and how they can help me in this project. Eventually, our project might eventually go down this path. I also want to learn more about the different types of IP and what we might be dealing with. I am unfamiliar with the process of filing a patent, so I am looking for a generalized understanding.

Content:

Technology transfer: moving research results from campus into market.

WARF: works at this interface, helps secure IP rights and licenses

ex.

- IP licenses
- industry sponsored research
- consulting arrangements
- fee for service

4 trademarks of IP:

1. patents

- traditional type of IP
- property right, granted by a governmental agency
 - · US Patent and Trademark Office
- patent holder has a time of monopoly of the patented item/idea/device
- types of patents:
 - Design (15 year term)
 - · Plant (20 year, asexually reproducing)
 - Utility
 - o provisional (effectively a 1 year placeholder)
 - Non-Provisional (20 year term, can claim priority to a provisional)
 - issued for the invention of a new and useful process, machine, manufacture, or compositon of matter
 - quid pro quo with the USPTO and the public
 - often takes 2-5 years to issue after filing (patent examination)
 - costs on average \$30k (mostly attorneys' fees)
 - ~90% of patents issued by USPTO are non-provisional utility patents
 - others can see what you've claimed in the file
- outlines in detail what the idea/product/device is in exchange of keeping to themselves for a time period

2. copyrights

- protection for creative works that are expressed in a tangible medium
- wide range of subject matter, including software code

- not as time sensitive at patents, attaches right at creation and can be registered at any time
- 3. trademarks
- attaches when an invention or service is provided in commerce
- protects names, marks, logos, dress
- source-identifying function
- ideally "protects the consumer" by letting the consumer trust the logo

4. trade secrets

- publishing work, sharing work, puts trade secrets at risk
- protect anything of value
- protection is good so long as the concept is not generally know
- ex. Coca Cola recipe

Other, WARF IP:

- Biomaterials
- ex. cell lines, mouse models
- Technique and know how (similar to trade secrets)
- ex. additional research or insight in tech development
- Data
- ex. data sets, research results, observed facts, highly valuable

Patent requirements and considerations

- 101 eligible, cannot be a product of nature, abstract idea, or natural phenomenon
- 102 novel, it must be new
- 103 non-obvious, it can't be simple modifications or combinations of existing products
- 112 enabled and described, must provide enough details to teach others how to make or use the invention

patent examiners: scientists hired and trained by USPTO to review patent applications for these requirements

WARF notes

receives ~400 new innovation ideas a year

- disclosing:
- describe innovation
- · identify pro and potential applications
- name contributors
- · provide funding and public disclosure details

meeting:

- · discuss innovation in more detail
- · ask questions about WARF and patenting processes
- · discuss next steps

IP considerations

- · type of IP protection
- · potential breadth and strength of IP protection
 - · more broad is better
- public disclosure
- · stage of development

licensing considerations:

- · applications
- · likelihood of identifying a commercial partner
- · likely return from licensing

Marketing and licensing

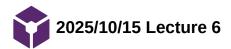
- licensing the IP is the next step in transferring the technology
- market analysis
 - o established, emerging, new
 - o size and type, ex. large and growing, medium and contracting, etc
 - o potential licensees, companies in the market
- · license negotiation
 - type and terms, exclusive and field limited, sublicensing
 - o consideration, ex upfront payment, royalties, reimbursement
- ongoing
 - · tech development, enforcement, amendment, termination if necessary
- · value of licensing
 - · benefits to company
 - reduced R&D costs
 - improved time to market
 - opportunity to enter new markets and expand quickly
 - new features
 - o determining the value
 - tech application
 - key selling points, features, benefits
 - tech trends
 - market size, trend, competition
 - industry standards

AI and IP

- Patents
 - · Al can't be an inventor
 - · Al may assist in inventing
- Copyright
 - o original works of human authorship
 - Al must be incidental to conception and creation
 - o original conception by human master mind

Conclusions/action items:

After this lecture I have a generalized idea of what the patenting process would look like for us. I did not know much about WARF or any of their resources for students of campus, so I am in a much better position now if we decide to move forward with patenting and securing IP. I am interested in the discussion around AI and the release of IP in that context, but we have been careful about not prompting AI with anything related to our project.



Claudia Beckwith - Oct 15, 2025, 2:11 PM CDT

Title: bioengineer it. protect it

Date: 10/15/2025

Content by: Claudia Beckwith

Present: 300s

Goals: I want to get an understanding of

Content:

See photo

Conclusions/action items:

See photo.

Claudia Beckwith - Oct 15, 2025, 2:11 PM CDT

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Claudia Beckwith - Oct 15, 2025, 2:11 PM CDT

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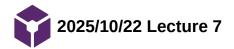
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Claudia Beckwith - Nov 05, 2025, 1:32 PM CST

Title: Advising Day 2: post grad plans

Date: 10/22/2025

Content by: Claudia Beckwith

Present: 300s

Goals: I want to explore some of the new and available options for post graduation. There are many tracks BMEs can take as this degree opens many doors, and I'd like to learn more about what there is out there. I think typically BMEs are either categorized into research or industry but I'd like to explore other options.

Content:

- · important to use undergrad experience to build a story
 - o gain experience from classes, homework, research, etc and tie it all together to create the vision of what I want to be
 - research will be important in all paths
- · do your homework: what does ideal career look like?
 - · explore programs that have opportunities I'm looking for
 - location
 - career development
 - people
 - disease
 - research
 - course work
 - linkedin can be super helpful connect with people who are in the place I want to be someday
 - think about strong references (3) that can help in the future
- school: prepare for MCAT before senior year

Grad school

- · stepping stone to new opportunities and directions
- MS
- o generally one year of study and then move to industry
- helps with candidate desireability
- o fills resume gaps
- helpful when combined with industry experience
- · higher starting salary
- PhD
 - desire to be an independent researcher, write grants, work in academia, some startup/consulting opportunities
- · 3 masters programs within BME at UW
 - 1- research 1.5 to 2 years
 - for those continuining onto phd
 - can be funded as RA/TA/PA
 - thesis required
 - o accelerated program 1 year
 - funding (TA only) stipend only (no tuition remission)
 - no co-op allowed
 - 2 accelerated
 - coursework only
 - ind study
 - 3 biomedical innovation, design, entrepeneurship (BIDE)
 - project based

- partnership with B school
- · applying for BME programs
 - o online, fee, fall and spring start
 - statement of purpose: the "why"
 - · research MS: need PI support
 - special consideration to BME undergrad, need at least a 3.0 and then get streamlined admission
 - o other MS in engineering, global health, MBA, etc
 - o find faculty or labs researching something you're interesed in
- · research shows you can apply life skills outside a classroom environment

Conclusions/action items:

From this presentation, I learned about some of the other pathways post grad. I didn't know about the different tracks for masters program and I like that the process is very streamlined for BME undergrads. Also, it was interesting to gain some perspective on the advantages of getting a MS even if the goal is to end up in industry.

Claudia Beckwith - Nov 05, 2025, 2:27 PM CST

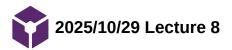


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Timeline Justification for 300 Lecture.pdf (226 kB)

Claudia Beckwith - Nov 05, 2025, 2:29 PM CST

Accidentally updated the text today when adding attachment of the email so the date updated!



Claudia Beckwith - Oct 29, 2025, 2:10 PM CDT

Title: To regulate or not to regulate... that is the question

Date: 10/29/2025

Content by: Claudia Beckwith

Present: 300s

Goals: I want to learn about different regulatory policies and processes that may pertain to my project. Kip Ludwig is speaking about relation in terms of the FDA and educate myself about the different centers and offices. I am also interested to learn about how regulation is achieved in industry and potential issues with the existing system.

Content:

CDRA: center for devices and radiological health

Devices and drugs are handled much differently in the FDA

- · Assisting drugs is more of a uniform process
 - · assessing receptor engagement, ligand binding
 - · involves certain prescribed testing that is uniform across drugs
 - o diagnostic and therapeutic drugs assessed differently
 - phases (1, 2, 3)
- · Different device pathways, US pathways only relevant here and seperate from global pathways
- · FDA doesn't determine safety, but determines if the benefits outweigh the risks

Classes of Devices:

- · Class 1: low risk
 - o ex. tongue depressor
 - · mostly exempt from clearance
 - o doesn't mean safe, doesn't count something like contamination in transport
- · Class 2: moderate/controlled risk
 - 510(k) pathway
 - device that is has already established competitors can skip some testing and focus more on the difference (ex, is the device more efficient, etc)
 - De Novo 510(k) pathway
 - no predicate existing, future companies can use this device as a reference
- · Class 3: high risk
 - · HDE pathway
 - probable benefit outweighs risk
 - PMA (pre market approval) path
 - reasonable assurance of safety and efficacy
 - post market surveillance often required to prove working in the real world
 - · important for traceability
 - issue doesn't always present itself right away

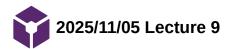
Presence of FDA

- med device regulation started in 1976
- presence of FDA is debated: argument that no one would want to make a product that doesn't work, esp considering financial considerations
 - study conducted on recalls and the impact on startups, big companies with big project scope, firms with lower sales, and firms with high debt to equity ratio (like startups)
 - key findings showed that while recalls cause discomfort for the consumers, they don't actually hurt the company much in the long run

- not a lot of market consequence because not often advertised
- "regulations are added in blood", oftentimes events occur that increases the regulations necessary to get a product to parket
- Dalkon shield: implantable contraceptive no federal oversight, post market research showed that the device wasn't really working, often got dislodged, and added a high risk of death, septic pregnancy, etc
- importance is comparing the existing rate of occurrence (ex of septic pregnancy) with the occurrence using the device. need a regulatory body to be monitoring this event because an individual will not be able to assess that on their own
- FDA was assigned to regulate without much direction on the regulation
- important for a device to be highly traceable so that in the event of a defect/post market problem, FDA can help find root cause and alert other similar devices of the problem
- one role of the FDA is determining causality. ex, device causing death or injury, must look at source and be the connection between cause (even "unrelated" side effects) and effects down the line that may be causing harm
- example study between the presence of injected sticky proteins in patients with alzehiemers, effects not observed until 15 years later
 - question becomes: do you ask a company to do a 15 year animal study? they would never be able to support that
- FDA makes companies go through every possible thing that could go wrong at every level, determine the risk and outcome, then look at ways to mitigate, combat, treat, etc

Conclusions/action items:

I have a much better understanding of the presence of the FDA in the medical device industry. I had no idea about all of the different routes of approval and the reliance of compounded/previous devices. I have some experience from this summer with risk mitigation and FMEA charts along with shadowing in an FDA audit, and it's really interesting to learn about the thorough nature of these studies.



Claudia Beckwith - Nov 05, 2025, 2:37 PM CST

Title: Regulatory Strategy

Date: 11/5/2025

Content by: Claudia Beckwith

Present: 300s

Goals: I want to understand the structure of the FDA (law framework, guidelines) as they relate to therapeutics. I want to be able to understand how these regulations guide product development. I also want to learn what a "quality" mindset is and how that can be advantageous in a career.

Content:

FDA structure and advanced therapeutics:

- device (CDRH)
 - o last week, PMA, 510(k), IDE
- drug (CDER)
 - NDA new drug application
 - post trial, allows marketing to broader community
 - · IND investigational new drug applications
 - submit when you want to start a new clinical trials
- biologic (CBER)
 - IND for clinical trials
 - o BLA (biologics license application) marketing approval

Advanced therapeutics

- · genome editing
- · gene delivery
- · cell therapy

Structure of FDA guidelines

- · US laws from congress
 - · ex. coronavirus aid, relief, and economic security act (CARES)
 - response to COVID-19 outbreak, gives FDA greater responsibility for managing interruptions and disruptions in drug manufacturing
- · FDA makes laws based on guidelines
- FDA makes guidelines with help from the public
 - o giving info to help structure a study
 - · FDA guidelines come out as the presence of the durg/theraputic increases and hence the need for guidance
 - not step-by-step, but general framwork for how to put together clinical or pre clinical studies

Classes

- 361 product: things that go out of the body and go back
 - · ex liposuctioning fat out and using it for cosmetic uses
 - · homologous use
 - o purpose is mechanical in nature, not biologic (adipose tissue isn't causing a major biologic response)
 - "eye of the beholder" lines can be blurred
 - · can be done in the clinic immediately
- 351 products: not homologous
 - full scale products

- o need a BLA
- · biologic class
- · FDA approval required for marketing
- if first of its kind, gets market protection for 12 years

"each stage of the product development cycle faces its own risks and challenges, and proper management of these risks is vital for successful commercialization"

research steps aren't always on the critical path, takes steps and understanding from the academia side to get there

when therapy is reaching the stage of clicials, need a lot of research in safety and toxolgy. Composition of the molecule is locked in

Target Product Profile (TPP)

- "PDS" for a theraputic product
- · start with what you know
- · running document, add as you go
- all the information you know
 - core
 - dose
 - route of adminsitration
 - dose form
 - safety
 - efficacy
 - · clinical development
 - clinical pathway
 - risk
 - cost
 - timelines
 - regulatory pathway
 - CMC
 - product attrubutes
 - purity
 - degradants
 - biocompatibility
 - storage
 - stability
 - container
- · general questions when working through TPP
 - · will patients and prescribers want it
 - · will regulators accept is
 - o will payers reimburse for it
 - · why should I fund development

subsequent development

· refining the drug for manufacturability

quality is highly important in terms of traceability

ex. if pH is a measured factor, how do you know it is still reading accurately?

Conclusions/action items:

From the speaker, I learned a lot about the stages and processes of getting a drug or pharmaceutical onto market. It was interesting to me how the FDA is involved on varying levels and provides assistance in terms of how to run trials, but also has some degree of legislative authority in terms of setting hard regulations that companies must follow. I also liked the connection between the TPP and out PDS as that's already something we have a ton of familiarity with.

Claudia Beckwith - Nov 07, 2025, 12:48 PM CST

Title: Building a Career of Impact - why healthcare needs more engineers

Date: 11/7/2025

Content by: Claudia Beckwith

Present: 200s, 300s, 400s

Goals: I want to learn about the impacts of a career in healthcare from the standpoint of an engineering background. I am especially interested to learn about her story as a woman in stem. She has been incredibly successful and worked in many different environments, from big companies to small startups.

Content:

Kristin Myers

- actively COO at Blue Cross Blue Shield

"Run towards the hard problems... they are the ones that change the world"

· make the biggest impact from taking new challenges

Chapter 1: the foundation

- · college, education, finding jobs here and there, learning new things and exploring what is interesting
- · 4 internships/co-ops
- · MBA at harvard
- · venture capital in california
 - · investing money in startups in healthcare
 - o arboretum ventures in MI, support from the midwest
- · overall about showing the world what she could do, learning, growing

Chapter 2: the growth curve

- · combinding EQ with IQ to multiply impact and reach
- · Aetna: starting to use more of a business background
 - big overnight transformation
 - · running large team, opened more doors in the future
 - · chief of staff to CEO: similar to a medical residency in the sense you oversee things and start to anticipate whats next
- opened cycling studio as a side quest?? super cool
- · unified women's healtcare
 - · difficult during covid, protections for OBGYN became difficult, shortages of medical supplies
 - $\circ \;\;$ educating doctors in the south on importance of wearing masks
- · this chapter was about working in teams, becoming aleader, etc

Chapter 3: Build and transform

- · drive system-level impact through innovation and scare
- · she has a strong network and still recognizes limitations in her accessability
 - goal to make healthcare affordable, accessable, and a positive experience for all
- healthcare overall is very far behind in the US vs other industries (tech for example)

The healtcare system:

- · improved provider experience
 - about 50% of people in her husbands graduating class (~15 years out of residency) say they would want to become a
 physician again
 - more time about charting, filling out EHR, hospital/admin policies, etc

- less emphasis on patient care which was the original passion in the field
- · improved patient outcomes
- · lower cost of care
 - 18% of the GDP is in health
 - o compared to other countries, we spend ~2x more
 - · US still ranks last on equity, access and outcomes
 - · lower life expectancy
 - system for EHR, insureres, admins, etc make the process very complicatied
 - IT structure and data flow is a large limitation
 - patent system is a limitation
 - · misaligned incentives across the medical field
 - pay-per-service system. drive up payment and care is less personalized in ways
- · improved patient experience

Goals

- · rewarding doctors to provide complete care, referrals when necessry
- · telehealth and at home care majorly helps with accessability
 - o wifi is still a limitation
- · rewarding doctors for outcomes, ot activity
 - primary care physician makes 1/2 to 1/4 of a specialist
 - · less inclined to go into primary care, still very important to have
- · transparent performance
- · real time data integration, help connect care
- running admin tasks (billing, etc) automatically and accurately
- · curretntly, the zip code you are born into greatly affects life expectancy and project income for the future

Advice:

- · work hard and build range
 - take on harder projects, classes, and experiences
 - · effort and range are your foundation
 - look for being in an office, more meaningful collaborative events, more opportunities to jump into new experiences
 - · exploring new locations, types of sites,
 - she mentions it's much easier to get jobs after the first professional experience
- · seek diverse exposure
 - o explore different sectors, teams, ad geographies
 - o gain perspective and learn how systems connect, not just how parts work
 - o enjoyed personal training, next job was more aligned with these interests
 - worked in the OR as a company rep that helped with guidance of the device
 - o networking all the time, meeting new people to help guide the next step
- · choose your people wisely
 - o surround yourself with curious, driven, high-integrity people
 - they shape who you become
 - · being around positive experiences helps keep you moving forward
- · know your values and protect them
 - o define what matters most
 - family/friends
 - health
 - career/impact values
 - always making decisions that align with these values
 - o early on, she mentions career being more a focus and drove her decisions
- · Embrace Challenge and Keep Growing
 - run towards the hard problems
 - · growth lives of the edge of discomfort

Conclusions/action items:

I really enjoyed learning about her career path and seeing how many different paths she was able to explore. I am super inspired by how she holds to her values and really works to make a difference in her roles. She has a really strong balance in life with caring for her physical and mental health while still working to be successful. She works hard to protect her peace and her energy and I really respect that and think it greatly contributed to her success.

Claudia Beckwith - Nov 12, 2025, 2:02 PM CST

Title: IRB Process

Date: 11/12/2025

Content by: Claudia Beckwith

Present: 300s

Goals: I want to learn about what IRB is and the resources offered to me as a BME student. I completed the CITI training a few weeks ago and this is a continuation of some of those concepts and ideas. There are a few very prevalent examples of problematic experiments and I would like to learn from the mistakes of the past.

Content:

Common trend of historical problematic research: using techniques to target vulnerable populations who are unable to object

- mental disabilities
- children
- withholding information
- prisoners as subjects

ethical research frameworks

- nuremberg code: emphasis on voluntary concent
- declaration of helsinki: hippa oath, do no harm
- national research act: response to US public health servuce untreated syphilis study

Belmont report ethical principles

- 1. respect for persons/autonomy
 - 1. protecting those with diminished autonomy (children, prisoners, mentally disabled, cognitively impaired)
- 2. beneficence
 - 1. maximize possible benefits, minimizing possible harms
- 3. justice
 - 1. who out to receive benefits and burdens of the research

application of belmont principles

- · criteria for approving research
- · protection for vulnerable groups
 - pregnant women
 - unborn fetuses
- · requirements for IRB operations

IRB composition

- · diversity required within group
 - background
 - · expertise (including one non scientist)
- · group of 9 people

IRB purpose

- · protect rights and welfare of people enrolled in research
- · IRBs review human research according to
 - · eithical principles

- federal regulations (common rule, HIPAA, FERPA)
- · Reviews all research including human subjects, including exempt human subject research
- · no retrospective approval of research

Common rule criteria

- · risk: nothing unreasonable, monitoring
- benefits
- · risk/benefit ratio
- · equitable selection of subjects: appropriate recruitment strategies, safeguards for vulnerable participants
- · informed consent: participants make and informed choice
- · privacy and confidentiality: adequat eprotections for patient privacy and data confidentiality

common rule definitions:

- · research: systematic investigation
- · human subject: living individual about whom an investigator gets info or interacts with or studies

data identifyability:

- · directly identifiable: identifiers included with data
- · coded/indirectly identifiable: identifiers removed from data but linked via study ID code
- · anonymized: all identifiers removed

sometimes there are "shortcuts" for using research data that has already been collected

medical devices have specifications to help protect the study participants

after approval:

- · cleared to start research
- · must submit change of protocol if any changes are to be made
- · reportable events
 - when something unexpected happens
- · continuing reviews
 - o annual progress report for some non-exempt studies

Conclusions/action items:

I learned a lot about the processes in place when you start a study for anything. This is a continuation of the citi training and builds off of the concepts of protection for more vulnerable groups or people that can't consent for themselves. I understand now the process and people involved in the IRB process.

Claudia Beckwith - Nov 19, 2025, 1:58 PM CST

Title: How New Product Development works in the medical device industry

Date: 11/19/2025

Content by: Claudia Beckwith

Present: 300s

Goals: I want to learn about the process with new product development as it applies to the medical device industry. I am working with new medical devices in my internship this next summer and I think it would be helpful to have some background. I understand it is a complex process and I think an overview would be beneficial.

Content:

NPD in the medical device industry:

- · selecting and prioritizing projects
 - o strategy: looking 3-5 years out
 - political environment
 - demand
 - market
 - · product portfolio review
 - define product categories to develop, sustain, eliminate
 - project review
 - select and prioritize projects to support over the next 1-3 years
 - · budgeting and resource allocation
- types of NPD projects (in order of increasing cost and risk)
 - line extensions: additions, new upgrades
 - · improvements: based on market feedback
 - new-to-company: not new to market though
 - o new-to-world: innovative, create new markets
 - lots of resources needed for this
 - bigger teams
- stage-gate process
 - stage 0: ideation, brainstorming the new ideas, area of opportunities, starts with an idea/goal
 - stage 1: narrowing down ideas, exploration, lots of background work, market research, talking to customers, <u>define</u>
 <u>problem</u> to be solved and customer requirements, create concepts for 8-10 design ideas, develop high-level business case, conduct preliminary technical scouting and research
 - stage 2: concept development, narrowing down further, go down to one leading concept, develop robust business case, decide on one leading concept
 - Go/no go decision
 - stage 3: design development, "real engineering start", bringing functional prototypes to life, continue iterative design process, cyclical testing and reviews, confirm regulatory pathways (usually form existing processes)
 - stage 4: design confirmation, longest stage, testing, verification and validation, goal is to develop a "frozen design" for an FDA submission
 - design freeze
 - stage 5: design transfer and commercialization, transferring the design to manufacturing (either in house or OEM),
 develop instructions or service plans
 - launch
 - post market surveillance, fda compliance
 - tracking product sales
 - addressing complaints
 - product and process improvement opportunities

Conclusions/action items:

- medical device development is expensive, complex, and highly collaborative
- market dynamics can change super fast, sometimes the customer isn't ready for the product
- good product design and development is necessary for commercial success but not sufficient
- I really liked learning about the stage gate process and where different roles come into play
- I kind of liked hearing about an example when a project didn't work as intended, it was realistic and a good reminder to see that not everything goes as planned.

Lauren Klein - Sep 08, 2025, 3:36 PM CDT

Title: Type 1 Diabetes & Treatments Background

Date: 09/08/25

Content by: Lauren

Present: Individual

Goals: To get a general idea of how Type 1 Diabetes affects children and the treatment involved

Search Engine: Google Scholar

Search Term: Pediatric Type 1 Diabetes & Treatments

Citation: Mayo Clinic, "Type 1 diabetes in children - Diagnosis and treatment - Mayo Clinic," *Mayoclinic.org*, 2023. https://www.mayoclinic.org/diseases-conditions/type-1-diabetes-in-children/diagnosis-treatment/drc-20355312

Content:

- -To monitor and diagnose diabetes, there are several tests used in today's medical practices
- -"Random blood sugar test. This is the primary screening test for type 1 diabetes. A blood sample is taken at a random time. A blood sugar level of 200 milligrams per deciliter (mg/dL), or 11.1 millimoles per liter (mmol/L), or higher, along with symptoms, suggests diabetes."
- -"Glycated hemoglobin (A1C) test. This test indicates your child's average blood sugar level for the past 3 months. An A1C level of 6.5% or higher on two separate tests indicates diabetes."
- -"Fasting blood sugar test. A blood sample is taken after your child hasn't eaten (fasted) for at least 8 hours or overnight. A fasting blood sugar level of 126 mg/dL (7.0 mmol/L) or higher suggests type 1 diabetes."
- -Typical treatments include: 1) Taking insulin 2) Monitoring blood sugar 3) Eating healthy foods 4) Exercising regularly
- -There are multiple types of insulin as well:
- 1) Rapid-acting insulin. Works for 4 hours (peak at 60) usually used 15 mins before meals.
- 2) Short-acting insulin aka regular insulin starts working 30 mins post injection (peak at 90-120mins) lasts about 4-6hrs
- 3) Intermediate-acting insulin aka NPH Insulin starts working in 1-3hrs (peak at 6-8hrs) and lasts 12-24hrs
- 4) Long- and ultra-long-acting insulin lasts 14-40hrs
- -There are also many delivery options: Fine needle and syringe, Insulin pen with fine needle, An insulin pump (CGM/Dexcom), and a tubeless pump option
- -Blood sugar needs to be checked and recorded atleast 4 times a day and usually before every meal and at bedtime even with a CGM or more often without one
- -"Continuous glucose monitoring (CGM) devices measure your blood sugar every few minutes using a temporary sensor inserted under the skin."
- -"A closed loop system is a device implanted in the body that links a continuous glucose monitor to an insulin pump. The monitor checks blood sugar levels regularly. The device automatically delivers the right amount of insulin when the monitor shows that it's needed."
- -"The Food and Drug Administration has approved several hybrid closed loop systems for type 1 diabetes."
- -"A closed loop system that doesn't need any user input isn't available yet. But more of these systems currently are in clinical trials."
- -"Food is a big part of any diabetes treatment plan, but that doesn't mean your child has to follow a strict "diabetes diet."
- -"Physical activity can affect blood sugar. This effect on blood sugar levels can remain for hours after exercise, possibly even overnight. You or your child might need to adjust your child's meal plan or insulin doses for the increased activity."

Lauren Klein - Sep 10, 2025, 2:57 PM CDT

- -Blood sugar can sometimes change unpredictably. Frequent challenges include: Picky eating, illness, growth spurts/puberty, sleep, and routine changes
- -"Despite your best efforts, sometimes problems will arise. Certain short-term complications of type 1 diabetes require immediate care or they could become very serious, including: Low blood sugar (hypoglycemia), High blood sugar (hyperglycemia), Diabetic ketoacidosis (DKA)"
- -Hypoglycemia quick solutions: Fast acting carbs, retesting blood sugar, following up with a snack or meal
- -DKA = "A severe lack of insulin causes your child's body to break down fat for energy. This causes the body to produce a substance called ketones. Excess ketones build up in your child's blood, creating a potentially life-threatening condition known as diabetic ketoacidosis."
- -"Following a diabetes treatment plan requires 24-hour care and significant lifestyle changes."
- -"Diabetes can affect your child's emotions both directly and indirectly. Poorly controlled blood sugar can cause behavior changes, such as irritability. People with diabetes have an increased risk of depression, anxiety and diabetes-related distress."

Conclusions/action items: We have our first client meeting this evening where I will integrate this information in asking important questions. There are going to be many human factors to work around with improving current CGMS which have been highlighted by this article. I will continue to research and increase my knowledge on the disease

Type I diabetes in children

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Type_1_diabetes_in_children_-_Diagnosis_and_treatment_-_Mayo_Clinic.pdf (479 kB)

09/22/25 - Lithium Ion Batteries in Microelectronics

Lauren Klein - Sep 24, 2025, 11:50 AM CDT

Title: Lithium Ion Batteries in Microelectronics

Date: 09/22/25

Content by: Lauren

Present: Individual

Goals: To gain knowledge about lithium ion batteries and how they charge in order to create our team's battery & charging design matrix as well as

conceptualize design ideas

Search Engine: Google Scholar

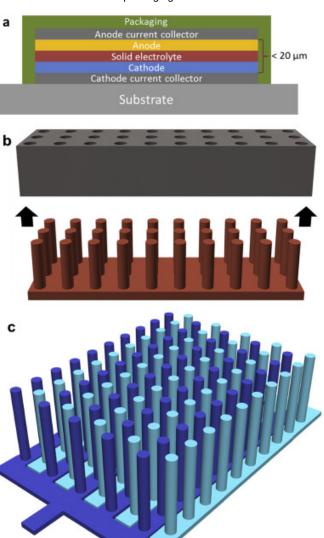
Search Term: Lithium Ion Batteries & Charging

Citation: Y. Wang *et al.*, "Lithium and lithium ion batteries for applications in microelectronic devices: A review," *Journal of Power Sources*, vol. 286, pp. 330–345, Jul. 2015, doi: https://doi.org/10.1016/j.jpowsour.2015.03.164.

Content:

- -"High energy lithium and <u>lithium ion batteries</u> are playing a key role in the advent of the information age and will continue to expand their applications in many different aspects in the foreseeable future"
- -"Batteries based on lithium chemistry are categorized in two groups, primary <u>batteries</u> and secondary (rechargeable) batteries. For primary batteries, metallic lithium is directly adopted as the anode whereas a variety of <u>cathode materials</u> have been used including manganese dioxide [2], carbon fluoride (CFx) [3], and silver vanadium oxide (SVO) [4]."
- -"A typical <u>secondary lithium battery</u>, or so called lithium-ion battery employs <u>intercalation compound</u> such as graphite as the anode. <u>Cathode side</u> also uses intercalation materials such as lithium cobalt dioxide (LiCoO2), while Li+ ions transport back and forth between <u>cathode and anode</u> during operating. The most commonly used electrolyte is LiPF6 dissolved in EC/DMC. Depending on the specific application, the solutes and solvents can be tuned to meet energy/power ratio and operation temperature requirements."
- -"Compared to other battery chemistries, lithium chemistry provides much higher power and <u>energy densities</u> in both gravimetric and volumetric terms, which are the most important parameters for applications in portable electronics such as smart phones, digital cameras and laptops. In addition, many <u>lithium batteries</u> have lower self-discharge rates and hence longer shelf lives."
- -"The most common commercial LIBs used in the aforementioned applications are in the forms of cylindrical cells, pouch cells or coin cells. These batteries are generally bulk in size. For instance, the 18650 cylindrical cell is 65.2 mm long and 18.6 mm in diameter. The smallest coin cell (ML421) is about 5 mm in diameter. A much less discussed area of lithium-based batteries is microbatteries. The rapid development of electronic and information technology towards the directions of multifunctionality, high integration and high power drives the electronic devices towards miniaturization. Lithium microbatteries are the ideal energy storage devices for biological/medical devices (pacemaker, hearing aid, defibrillator, in vivo imaging, etc.) and self-powered microelectronics (miniature transmitters, sensors, actuators, etc.)"
- -"Panasonic commercialized industry's smallest pin-type batteries (bottom-right figure in Fig. 1) with similar design in 2014 for targeted applications in wearable devices, electronic pens and medical devices."
- -"Bulk-size lithium ion batteries normally consist of composite electrodes and liquid electrolytes. As the size of the battery shrinks, the fabrication process for composite electrodes and the use of liquid electrolyte become increasingly incompatible with the required microfabrication process. The parasitic weight in the downsized batteries also increases at the same time. As a result, microbatteries differ greatly from bulk-size LIBs in their architecture design and material choices. Since the composite electrode design works well with a wide range of electrode materials, the research focus of bulk-size batteries is on materials development, i.e. optimizing the electrochemical couples, improving the stability of electrolytes and developing new lithium chemistry (lithium sulfur, Si anode, etc.)"
- -"Thin-film batteries adopting two-dimensional (2D) planar design are the most popular traditional batteries for micro-applications. An individual cell consists of thin, dense layers of battery components fabricated by various <u>deposition methods</u> (Fig. 2a). The operating principle of thin-film batteries is similar to bulk-size batteries with composite electrodes, except that the <u>diffusion paths</u> are much shorter."

-"The overall thickness of the <u>active layers</u> (electrodes and electrolyte) generally does not exceed 20 µm, although the overall cell will be much thicker due to the need for robust packaging."

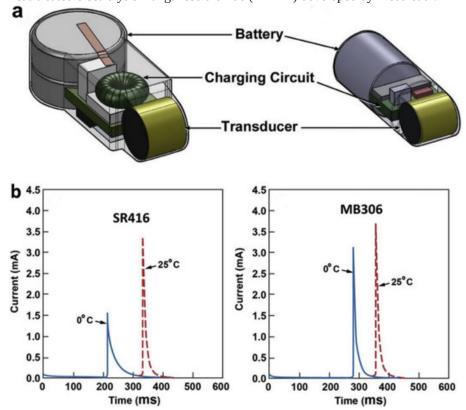


- -"As the intrinsic transport properties of electrode materials limit the effective energy and power densities of thin-film batteries, cathode materials with both high electronic and ionic conductivities are highly desirable. LiCoO2 is the most commonly used cathode material for thin-film batteries"
- -"The most commonly used anode is Li metal, although Li-ion or Li-free anodes may be used to accommodate high-temperature processes required by solder reflow conditions [20]. For the electrolyte layer, several inorganic lithium ion conductors of a wide range of chemical compositions and crystal structures such as Li4SiO4 derivatives [21], NASICON [22], LISICON [23], perovskite-type LLTO [24], lithium phosphorus <u>oxynitride</u> (Lipon) [25], [26], have been under investigation."
- -"In addition, thin-film batteries are much more resistant to degradation at high temperatures and operation at temperatures as high as 150 °C has been demonstrated"
- -"Due to the stability of solid-state electrolyte and uniform current and charge distribution, thin-film batteries have much better rechargeability than liquid-electrolyte-based lithium ion batteries"
- -"Thin-film batteries have very limited areal energy density (10–2 J mm–2) because the electrode thicknesses cannot be increased without compromising the power density."
- -"It can be seen that the energy density of commercial lithium batteries decrease with reducing sizes and there exists no commercial microbatteries that could combine small sizes and high energy densities. Further enhancement of microbattery performance requires the use of out-of-plane dimension through 3D design of battery components. Furthermore, there has been a strong demand for flexible batteries to power wearable and flexible gadgets. Major electronic devices manufacturers including Apple, LG and Nokia, already have

plans to produce flexible batteries. Increasing demand by microelectronics for capacity, design flexibility and functionality drives the development of microbatteries towards 3D architecture and mechanical flexibility."

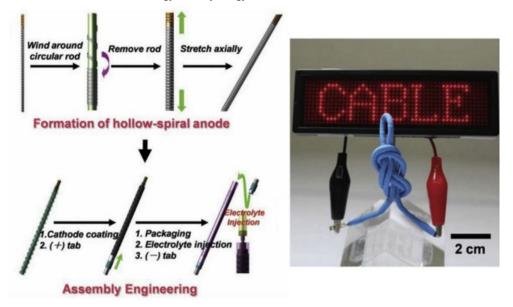
-"Recently, there has been a surge of interest in making lithium ion batteries mechanically flexible to keep pace with the development of flexible electronic components (OLED, memories, sensors, etc.) and to meet the demand of roll-up displays, <u>wearable electronics</u>, medical transplant devices, etc. Conventional LIBs are rigid mostly due to the <u>rigidity</u> of the <u>packaging materials</u> as liquid electrolytes pose stringent sealing requirements."

-"Most prominent rechargeable systems include spinel LixMn2O4 , layered Li2MnO3 and α -MnO2 . For non-rechargeable systems, the heat-treated electrolytic manganese dioxide (HEMD) developed by Ikeda et al."



-"3D printing technology has attracted more and more attention, especially after the printers became commercially available in recent years. 3D solid objects of any desired shape can be produced which makes 3D printing a low-cost and flexible tool for producing 3D microbatteries as compared to other processes such as deposition and lithographic masking/etching. Sun et al. recently constructed working 3D printed microbatteries (3D-IMA) which have exceptionally high areal energy density and power density [34]. The batteries are based on LiFePO4(LFP)/Li4Ti5O12(LTO) chemistry."

-"Conventional Li batteries with layered architecture cannot withstand external mechanical distortion so the shape of batteries is a limiting factor to the design of portable electronic devices. The rapid growth of flexible electronics such as OLED displays and <u>wearable devices</u> demands greater flexibility in their power sources. Recently, a cable-type lithium ion battery was developed by LG Chem, Ltd., which can sustain normal operation under bending or twisting conditions"



- -"Lithium and lithium ion batteries are adopted in an extensive range of applications. The continuous downscaling of microelectronics, especially the rapid growth of <u>MEMS</u> devices, has created a large demand for high-performance energy storage devices on the millimeter scale or less. Microbatteries differ greatly from conventional cells regarding the architecture and material selections."
- -"The planar design adopted by traditional microbatteries limits areal power and energy densities. Research on lithium microbatteries has focused on innovative <u>fabrication methods</u> and novel cell designs in order to utilize the out-of-plane space and enhance areal power and energy densities. 3D Concepts such as electrodes with arrays of microrods synthesized by templating method and interdigitated electrodes have been proposed. There also has been a surge of interest in flexible (mechanically) design recently."
- -"The realization of these new concepts requires the identification of innovative <u>packaging materials</u> and appropriate selection of materials and fabrication methods. The future directions of microbattery development are towards further enhancement of energy/power densities and applications in micro <u>energy harvesting</u>."

Conclusions/action items: There has been a lot of adaptations in microbatteries as the market needs have changed and increased. It is possible to 3D print one but might not make the most sense for our needs. Either a cable battery or a thin film would be our best bet if we want to make/buy it off the market.

Lauren Klein - Sep 22, 2025, 12:24 PM CDT



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1-s2.0-S0378775315005984-main.pdf (3.04 MB)

09/22/25 - Wearable Devices and Lithium Ion Batteries

Lauren Klein - Sep 22, 2025, 9:11 PM CDT

Title: Wearable Devices and Lithium Ion Batteries/Charging Systems

Date: 09/22/25

Content by: Lauren

Present: Individual

Goals: To gain knowledge about lithium ion batteries in wearable devices (like an Apple Watch) and how they charge in order to create our team's battery & charging design matrix as well as conceptualize design ideas

Search Engine: Google Scholar

Search Term: Lithium Ion Batteries wearable devices

Citation: Y. Zhang, Y. Zhao, J. Ren, W. Weng, and H. Peng, "Advances in Wearable Fiber-Shaped Lithium-Ion Batteries," *Advanced Materials*, vol. 28, no. 22, pp. 4524–4531, Dec. 2015, doi: https://doi.org/10.1002/adma.201503891.

Content:

- -"It is highly desirable to develop flexible and efficient energy-storage systems for widely used wearable electronic products. To this end, fiber-shaped lithium-ion batteries (LIBs) attract increasing interest due to their combined superiorities of miniaturization, adaptability, and weavability, compared with conventional bulky and planar structures."
- -"Recent advances in the fabrication, structure, mechanism, and properties of fiber-shaped LIBs are summarized here, with a focus on the electrode material. Remaining challenges and future directions are also highlighted to provide some useful insights from the view-point of practical applications."
- -"Wearable electronic products such as smart clothes, the Apple Watch, and the Samsung bracelet are emerging in the main-stream and represent promising directions for future life-styles.[1–3] Conceivably, these products would be directly worn on the human body and work stably under complex deformation in use, such as bending, folding and even stretching."
- -"The rapid development of flexible and wearable electronic products strongly demands indispensable power systems that can be miniaturized, flexible, and adaptable. Lithium-ion batteries(LIBs) have been used as one of the most ubiquitous types of power supplies due to their superior features such as high energy density, no memory effect, long life cycle, high working voltage, and environmental benignity.[4–9] However, commercially available LIBs are typically rigid and cannot effectively satisfy the above requirements, which has become a bottleneck for the further development of wearable electronics."
- -" a description is given of the fabrication, structure, mechanism, and properties of wearable fiber-shaped LIBs with a focus on the electrode material, reflecting the key achievements at each step."
- -"An LIB is typically composed of a cathode, an anode, and an electrolyte. While they are discharging, Li+ ions are removed from the anode, transferred into the electrolyte and inserted into the cathode, along with the electrons flowing from the anode to the cathode at the external circuit. The above process is reversed during charging. The LIB realizes energy delivery and storage through the reversible movement of Li+ ions between the cathode and anode."
- -"Conventionally, lithium metal oxides such as LiCoO2,LiFePO4 and LiMn2 O4 and carbonaceous materials such as graphite are used as the cathode and anode materials, respectively.[14,15] These active materials are made into a slurry and coated on the surfaces of copper or aluminum foils to work as electrodes that are not flexible. An organic solution dissolved with lithium salt is typically used as an electrolyte. When the liquid electrolyte is assembled with the rigid electrode, it may give rise to leakage or produce a short circuit in the resulting LIB under deformation. In other words, the LIBs are not flexible and should be carefully protected during application."
- -"flexibility has been found to be mainly deter-mined by the electrode"
- -"Currently, flexible electrodes are typically prepared by incorporating electrochemically active materials onto flexible and conductive substrates. [29,30] A strong interaction between the active material and the substrate is generally required to maintain the structural integrity during deformation."
- -"Based on a similar fabrication process, the mechanical properties of the LIB were further enhanced by first embedding active mate-rials into a porous membrane and then coating a CNT layer to prepare the hybrid electrode (Figure 1a).[35] The resulting electrode showed increasing tensile strengths of ca. 5.5–7.0 MPa and maintained a high storage capability after repeated bending at a radius of 4 mm (Figure 1 b)."
- Details are in the caption following the image

- -"Li4Ti5O12 and LiFePO4 were incorporated to act as an anode and cathode, respectively, through an in situ hydrothermal deposition (Figure 1c).34 Because of the high contact area between the active material and the graphene foam, these hybrid electrodes demonstrated remarkable electrical and mechanical properties. The resulting LIB had an energy density of 110 W h kg-1 and a specific capacity of 117 mA h g-1 at a rate of 10 C. In addition, the specific capacity of the LIB varied by less than 1% after bending to a radius of 5 mm for many cycles (Figure 1d)."
- -"Electrolytes, which are also a key component of flexible LIBs, can be divided into liquid and solid electrolytes. For a liquid electrolyte, good contact between the electrode and electrolyte with high ionic conductivity offers a flexible LIB with a relatively high storage capability. However, the liquid nature may give rise to leakage or short-circuit under deformation. In contrast, a solid electrolyte can effectively prevent both leakage and short-circuiting, but the poor contact between the electrode and electrolyte and the low ionic conductivity lowers the storage capability."
- -"To realize good flexibility, planar LIBs are made to be as thin as possible. Punctures and cracks often occur in such a thin-film structure, which leads to a decrease in electrochemical performance or even the destruction of the LIB, with severe safety issues. Many efforts have been made to enhance the flexibility and stability of thin-film LIBs by improving the sealing process."
- -"Fiber-based clothes have been used by human beings for many years because they are soft, flexible, breathable, deformable, washable, and durable, which also represents an ideal paradigm for the development of wearable electronic products."
- -"Compared with the conventional planar structure, the fiber shape offers many unique and promising advantages. i) In addition to the typical bending deformation, a fiber-shaped LIB can effectively work under twisting and even stretching, which are critically important for flexible devices. ii) The LIB fiber can be woven into textiles with porous structures to allow water vapor and air to transport through them, which is highly desirable for wearable applications. iii) Both LIB fibers and textiles can effectively adapt to a variety of soft or curved substrates."
- -"Currently, a fiber-shaped LIB is generally constructed by twisting two fiber electrodes. In other words, the realization of a fiber-shaped LIB with high performance requires the use of effective fiber electrodes. It is well recognized that an electrode in a planar LIB typically includes four components: an electrochemically active material, a current collector, a binder, and a conductive additive. Therefore, several key parameters should be carefully considered to prepare effective fiber electrodes. i) They are expected to exhibit high electrical conductivities to rapidly transfer electrons. ii) The electrochemically active materials can be stably anchored on the supporting substrate. iii) They should be highly flexible and stable to satisfy both fabrication and application."
- Details are in the caption following the image
- -"To further improve the electrochemical performance, silicon, which is widely studied because of its high theoretical capacity of 4200 mA h g-1, has also been incorporated to prepare hybrid fiber electrodes.44 The silicon was first deposited onto the aligned CNT sheet through an electron-beam evaporation method, and the weight percentage of the silicon was controlled by varying the deposition time. The amorphous silicon was coated on the outer surfaces of aligned CNTs with a core–sheath structure (Figure 2d,e). The resulting hybrid sheet was then scrolled into a hybrid fiber electrode."
- -"Current fiber-shaped LIBs include two typical structures: helically coaxial and parallel structures (Figure 3). A cable-type LIB was made into a helically coaxial structure with five main parts: a Ni–Sn hollow-spiral anode, a separator, a LiCoO2 cathode, liquid electrolytes, and a packaging insulator (Figure 3a).50 For a typical fabrication, the Ni–Sn active materials are first deposited on a hollow-spiral Cu wire to act as the anode; a modified poly(ethylene terephthalate) separator and an aluminum wire are then wound on the anode, followed by coating with LiCoO2 slurry to form the cathode. The cable-type LIB had to be sealed in a heat-shrinkable tube and finally injected with a liquid electrolyte. It was relatively too large, with a diameter in the millimeter range, and cannot effectively meet future requirements regarding weavability. It also had a low specific capacity of 1 mA h cm–1 (Figure 3b). Fortunately, this cable-type LIB was flexible and exhibited stable discharge characteristics with increasing bending angle (Figure 3c)."

Details are in the caption following the image

- -"To further meet the application requirements for wearable electronics, the metal current collector was removed to reduce the weight and volume of the LIB. As a result, a helically coaxial fiber-shaped battery was developed with an aligned CNT/Si hybrid fiber as an anode and an aligned CNT/LiMn₂O₄ hybrid fiber as the cathode. 10 The fiber electrodes were sequentially wound on a cotton fiber while separated by a layer of electrolyte gel, followed by covering with a shrinkable tube as a protective layer (Figure 3d). "
- -"Fiber-shaped LIBs can be further woven into various flexible textiles (Figure 5).10, 42, 51 An areal energy density of 4.5 mW h cm-2 can be achieved from these LIB textiles.10 Moreover, stretchable fiber-shaped LIBs can be easily woven into

a knitted sweater to achieve better adaptability to the movement of the human body (Figure 5d–f).51 For instance, the resulting LIB in the sweater can be well accommodated with severe deformations such as folding and stretching."

- Details are in the caption following the image
- -"It is expensive to continuously prepare aligned CNT fibers based on current technology, and the electrical conductivity must be further enhanced as it is relatively low for use in LIBs. For instance, fibrous LIBs cannot be made with an applicable length because the electrical resistance is too high and the electrical performance drops even at a length comprising tens of centimeters. Therefore, a number of new fiber electrodes should be investigated and compared for large-scale applications."
- -"The power and energy densities of fiber-shaped LIBs must be increased by a large amount as well. Silicon has been introduced to improve the fiber anode, but the current cathode cannot effectively match it in capacity. Sulfur may be proposed as a promising cathode candidate because of the superiority its high theoretical capacity and working voltage, but this has not been attempted yet."
- -"Safety is also a critical issue for practical applications, particularly in wearable electronic devices that are in direct contact with the human body. The materials used should be nontoxic, biocompatible, and safe, and the fiber-shaped LIB should be able to stably work even under severe deformations and strict weather conditions. A major concern comes from the flammability and toxicity of the organic electrolyte. In addition, the use of liquid electrolytes may cause leakage and short-circuit during use, and appropriate gel or solid electrolytes with high performance are urgently needed to solve these problems."

Conclusions/action items: There can definitely be some safety and cost constraints with using lithium-ion batteries. They are the preferred option by our client. The biggest issue will be finding one that is small enough for our purposes that doesn't cost a fortune.

Advances in Wearable Fiber-Shaped Lithium-Ion Batteries

To Zhong, Yang Zhou, Jing Ree, Wei Wong * and rividing Peng*

To Zhong, Yang Zhou, Jing Ree, Wei Wong * and rividing Peng*

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Lauren Klein - Sep 22, 2025, 12:23 PM CDT

Download

Advanced Materials - 2015 - Zhang - Advances in Wearable Fiber Shaped Lithium Ion Batteries.pdf (5.84 MB)

09/29/25 - Sources of Error for Prelim Report

Lauren Klein - Oct 16, 2025, 12:20 PM CDT

Title: WGAS Potential Sources of Error

Date: 09/29/25

Content by: Lauren

Present: Individual

Search Engine: Google Scholar

Search Term: common sources of error in wearable electronic devices that display data

Citation: V. Vijayan, J. P. Connolly, J. Condell, N. McKelvey, and P. Gardiner, "Review of Wearable Devices and Data Collection Considerations for

Connected Health," Sensors (Basel, Switzerland), vol. 21, no. 16, p. 5589, Aug. 2021, doi: https://doi.org/10.3390/s21165589.

Goals: To learn what typically goes wrong in wearable electronic devices

Content:

Background/Intro:

- -"Wearable sensors are widely used in healthcare, due to their hardware capacity, small footprint and lower cost compared to equivalent medical instruments capable of monitoring the same vital signs"
- -"Wearable sensors are widely used in healthcare, due to their hardware capacity, small footprint and lower cost compared to equivalent medical instruments capable of monitoring the same vital signs"
- -"According to recent estimates, wearable technology will flourish over the next 25 years, resulting in a global cost savings of over \$200 billion in the healthcare industry and a considerable reduction in clinician/patient interaction time. Reports suggest that the number of wearable devices in use in 2020 was approximately 600 million, and current trends predict the number to increase to 928 million in 2021, and to reach 1100 million in 2022"
- -"Wearable EMG sensors containing a sensor, electrodes, and Bluetooth Low Energy (BLE) communication technology can be used to assess nerve conduction, activation frequency, quantify and monitor electrical activity associated with muscle contractions and muscle response in injured tissue."
- -"Optical sensors that use a light-based technique to quantify the delicate magnetic fields produced by neurons firing in the brain may be used instead of MRI machines to create similar imaging, eliminating the expensive cooling or electromagnetic shielding required when patients require an MRI scan"
- -"Apple has FDA approval for its ECG, as well as clearance in the European Economic Area, with more than 20 countries now able to make use of the health feature. Remote patient monitoring provided by wearable technology has also become an important tool throughout the Covid-19 pandemic. Wearables have been used in the UK to remotely monitor people with chronic disease or post-covid symptoms, and clinicians can remotely examine, regularly view vital sign data and provide adequate remote consultations"
- -"Wearable devices are typically placed either directly on the wearer's body, within clothing, or in semi-rigid structures, such as gloves, insoles, headwear and smartwatches. They can inter-communicate using the human body as a transmission channel [11] or through an appropriate transmission medium, such as BLE, Zigbee or Wi-Fi. Wearable devices capture, filter, and archive long-term physiological and activity data from the wearer."

Sensors 21 05589 g003

- -"Clinical studies show that wearable devices are now being widely used to monitor activity at home to assess patients' lifestyle concerns, obesity and disease symptoms, such as pulmonary conditions, diabetes, hypertension and cardiovascular disease. These are monitored by a suitably relevant wearable device which is commonly integrated with an IMU sensor and controlled with a smartphone application"
- -"The concept "quantified self" refers to the process of collecting personalised data about one's own life and wellbeing using wearable devices and other advanced technology. Due to the prevalence of smartphones and sensor-rich wearable devices, data collection and analysis approaches are becoming more commonplace. Hence, the area of life logging and QS is rapidly expanding"

- -"Wearable devices solve many of these limitations by using sensors for precise data acquisition, interpretation and prediction."
- -"Accuracy refers to a sensor's ability to produce a reading comparable to a "gold-standard" measuring device. The reproducibility of a calculation is referred to as its reliability. It denotes a sensor's ability to detect and produce the same measurement multiple times, although the measurement may not be precise"
- -"Wearable device validation entails demonstrating material validity, consistency, reliability and responsiveness to change. Technical requirements for wearable technology in healthcare applications include that they are fit-for-purpose for various use cases within the specific domain, can collect data in real-life environments, and are precise, consistent and tested in the healthcare community in which they would be utilised"
- -"Many wearable sensors, such as headbands and textile sensors, are effective in the short-term for activity tracking inside a controlled environment, but are inaccurate in the long-term"
- -"Data privacy and security must be considered within the context of wearable technology. Many wearable devices store data in local storage without encryption or data protection. As a result, there could be a high risk of losing confidential and personal health data. Wearable devices commonly connect to a smartphone using Bluetooth, NFC, or Wi-Fi. Unsecure wireless connectivity channels are insufficient to guard data against a brute-force attack"
- -"There are two types of data protection threats involved with wearable devices: Passive and active attacks. Passive attacks attempt to obtain the user's password and personal information from the smart device. This technique does not damage or disrupt the target device."
- -"Active attacks, on the other hand, attempt to change or destroy the device. In a passive attack, a possible intruder can easily obtain data without the users' knowledge, due to a lack of security on the wearable device communication pathway. Recent research indicated how a Fitbit device was subjected to data injection attacks, battery drain hacks and denial-of-service attacks"
- -"Research demonstrates that most wearable device owners are concerned about the privacy of data stored within a wearable device"
- -"Since health information is sensitive or confidential in nature, data privacy and security are critical in healthcare applications that use wearable devices. To improve data protection and safety, users should be aware of the kind and volume of data captured by devices, as well as their potential significance."
- -"Human movement analysis is an interesting area of research and is growing in popularity, due to the increase in the implementation of wearable technology within ambulatory and home care environments. Wearable devices can enable users to assess their own health. Analysing and identifying specific types of activity within sensor data can further enhance the assessment of the patient's quality of daily life. This can be achieved by analysing a wide variety of sensor variables using various techniques."
- -"Wearable sensors can passively collect information about a patient's daily activities, and hence. These data are rich in objective detail when compared to clinical assessment data. The increased availability of sensor data allows clinicians to gain closer insights into a patient's health than is possible using traditional subjective methods."
- -"One of the main purposes of wearable devices is to create and develop precise, accurate and unambiguous results. Research in this area requires completing explicitly quantifiable work packages, including hardware validation assessment, development and testing of a clinical protocol, and implementation and evaluation of a feasibility study."
- -"Future advancements in this area will provide clinicians with more detailed information on various movements contained in data recorded at home. This data will provide users with a better awareness of their health and clinicians with a more granular assessment of the patient's fitness, as well as specific insights into physical mobility."

Conclusions/action items: Wearable Devices must be continuously conscious of data breaches. With our device, it is critical that we have security with the data upload as otherwise hackers could access the children's data. While this is definitely one source of error to watch, more come into play with potential device malfunctions.



Download

sensors-21-05589-v2.pdf (2.07 MB)

Lauren Klein - Oct 16, 2025, 12:43 PM CDT

Title: Dexcom G7 Summary

Date: 10/01/25

Content by: Lauren

Present: Individual

Search Engine: Google Scholar

Search Term: dexcom g7 for type 1 diabetes

Citation: L. M. Laffel, T. S. Bailey, M. P. Christiansen, J. L. Reid, and S. E. Beck, "Accuracy of a Seventh-Generation Continuous Glucose Monitoring System in Children and Adolescents With Type 1 Diabetes," *Journal of Diabetes Science and Technology*, p. 193229682210918, Apr. 2022, doi: https://doi.org/10.1177/19322968221091816.

Goals: To learn more about the Dexcom G7 and how it differs from previous versions

Content:

- -"Continuous glucose monitoring (CGM) systems are approved in many countries to inform diabetes treatment decisions in children 2 years and older. Advancements in CGM technology over the past decade (eg, better accuracy, predictive alerts, automated insertions, data sharing capabilities, resistance to acetaminophen interference, optional calibrations)¹ have likely contributed to increased CGM use in the pediatric population."
- -"The CGM technology has helped children and adolescents with type 1 diabetes (T1D) improve their glycemic control, ²⁻⁴ and studies have demonstrated the importance of early CGM initiation⁵ and frequent sensor usage⁶ on glycemic outcomes."
- -The G7 is a disposable, single-use device that features a smaller wearable profile and shorter warm-up period than the company's earlier sixth-, fifth-, and fourth-generation systems (G6, G5, and G4)."
- -"The G7 system also differs from these earlier systems in that the transmitter and sensor are provided as an integrated unit, avoiding the need to attach and remove a transmitter from different sensors during the transmitter's working life."
- -"The G7 system displays glucose values and trending information over a 10-day wear session that can be extended for an additional 12-hour "grace period," allowing users to continue monitoring their glucose levels while starting a new sensor. In this study, we evaluated the accuracy of the G7 CGM in children and adolescents 2 to 17 years of age. Accuracy metrics of G7 in adults are reported elsewhere."
- -"Study procedures and methods were similar to those used to assess G7 accuracy in adults.⁷ Briefly, a prospective, multicenter, single-arm study (clinicaltrials.gov, NCT04794478) was conducted from February to June 2021 to evaluate the accuracy and performance of G7 sensors. Participants were enrolled at six US clinical sites and included older (ages 7-17 years) and younger (ages 2-6) cohorts."
- -"Accuracy metrics included mean absolute relative difference (MARD), as well as %15/15 (the proportion of CGM values within 15% of the YSI comparator for glucose >100 mg/dL or within 15 mg/dL of the YSI comparator for glucose ≤100 mg/dL) and the analogous %20/20 and %30/30 agreement rates."
- -"The younger cohort (ages 2-6 years) wore up to two G7 sensors on the arm, abdomen, or upper buttocks and participated in one clinic session lasting approximately 4 hours that did not involve intentional glucose manipulations."
- -"A summary of baseline demographics for 164 participants is shown in Table 1, 132 of whom were aged 7 to 17 and 32 of whom were aged 2 to 6 years. Of those in the older cohort, one withdrew from the study before sensor insertion, one did not participate in any clinic sessions, and three had both arm and abdomen devices fail prior to clinic sessions. The remaining 127 participants had 122 arm and 118 abdomen devices with valid CGM readings and provided 15 809 matched pairs for accuracy analysis. Of these matched pairs, 15 437 (97.6%) included CGM values in the reportable range of 40 to 400 mg/dL and were used to calculate accuracy metrics; 8068 pairs were from arm-placed sensors and 7369 pairs were from abdomen-placed sensors."
- -"There were 32 participants aged 2 to 6 years, with 28 participants having CGM and capillary blood glucose matched pairs available from 14 arm, 5 abdomen, and 13 upper buttocks devices. A total of 343 matched pairs from this younger cohort included CGM values in the reportable range and were available for accuracy analysis."

- -"Accuracy was also good across glucose ranges for arm- and abdomen-placed sensors (Table 3). MARD is provided for glucose levels >80 mg/dL while MAD is provided for glucose ≤80 mg/dL. Of the 240 sensors used in the study, 11 (4.6%) had MARD values greater than 20 and 177 (73.8%) had MARD values 10% or less (Figure 1)."
- -"The average per-sensor MARD was $8.7\% \pm 5.8\%$. To assess G7 accuracy within biologically relevant glucose ranges, matched pairs of YSI and CGM data were analyzed. As shown in Table 4, concurrence of CGM and YSI values for CGM-based concentration ranges of <70, 70 to 180, and >180 mg/dL was 73.5%, 89.6%, and 96.2% in arm-placed sensors and 63.6%, 89.0%, and 95.5% for abdomen-placed sensors."
- -"Table 5 summarizes accuracy across rates of glucose change. Accuracy was consistent across various rate of change (ROC) categories analyzed. During rapid rates of change (RoC <-2 and >2 mg/dL/min), the %20/20 agreement rate in arm and abdomen devices was no less than 90.3%, and MARD was no more than 9.7%."





- -"For CGM versus capillary blood glucose comparisons of data from children aged 2 to 6 years, the overall MARD was 9.3%, and the %15/15, %20/20, and %30/30 agreement rates were 83.4%, 91.5%, and 95.9%, respectively."
- -"No serious adverse events were reported. Eight participants reported mild-to-moderate device-related adverse events corresponding to pain during sensor insertion, discomfort/pain during sensor removal, or skin irritation at the adhesive site. The insertion process was rated as "somewhat easy" or "very easy" by 157 (96.4%) of the 163 participants who responded to the survey question. When asked to compare G7 to their previous system, 113 (71.5%) of 158 responders rated the insertion process as "slightly easier" or "much easier," and 117 (74.5%) of 157 responders rated the comfort of G7 as "slightly better" or "much better."
- -"As described here, the G7 CGM has good accuracy in children and adolescents aged 7 to 17 across days of wear, glucose ranges, and rates of glucose change. For arm- and abdomen-placed sensors, overall G7 MARD values were 8.1% and 9.0%, respectively, and overall %20/20 values were 95.3% and 92.9%, respectively. G7 was also accurate in young children aged 2 to 6 with overall MARD and %20/20 agreement rates of 9.3% and 91.5%, respectively. These results are consistent with those of the G6 system in children and adolescents with $T1D^8$ and with an earlier study of the G5 system that evaluated accuracy at different insertion sites."
- -"The G7 system shares several features with the earlier CGM systems that have proven to be helpful in managing pediatric diabetes."

Conclusions/action items: The G7 improves on previous systems but provides more accurate glucose concentration estimates in kids with T1D. The placement of the device doesn't necessarily matter but the tables and charts above support this statement. These numbers along with increased comfort and ease-of-use correlate with higher durability and use in terms of CGM options.

Lauren Klein - Oct 16, 2025, 11:10 AM CDT



Download

laffel-et-al-2022-accuracy-of-a-seventh-generation-continuous-glucose-monitoring-system-in-children-and-adolescents.pdf (180 kB)

10/10/25 - PCBS in Medical Devices

Lauren Klein - Oct 17, 2025, 12:13 PM CDT

Title: PCBS and Their Function in Medical Devices

Date: 10/10/25

Content by: Lauren

Present: Individual

Search Engine: Google Scholar

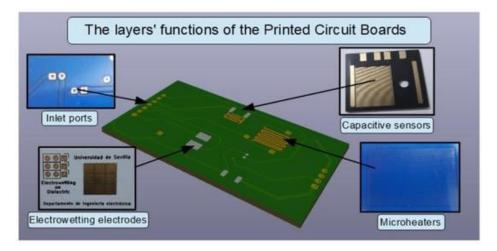
Search Term: PCBS in medical devices

Citation: F. Perdigones and J. Quero, "Printed Circuit Boards: The Layers' Functions for Electronic and Biomedical Engineering," *Micromachines*, vol.

13, no. 3, p. 460, Mar. 2022, doi: https://doi.org/10.3390/mi13030460.

Goals: To learn more about PCBS and how we can utilize them in our project

Content:



- -"The challenge of interconnection between electrical and electronic components led the development of several methods, which can be used to perform this task in a reliable and inexpensive manner."
- -"The first technique used to perform something similar to a double-side PCB was developed by Baynes in 1888 [3] using exposing and etching techniques. However, the functionality of the result was purely ornamental, far from an electronic interconnection. Several years later, Hanson (1903) [4] developed the patent "Electric cable", where an insulating substrate with integrated wires was intended for electrical purposes."
- -"After these developments, a huge quantity of PCBs were fabricated for many different applications. At present, the majority of devices include an electronic part, and this part is made of Printed Circuit Boards; for example, devices for medical applications, such as defibrillators, anesthesia machines, electrocardiogram machines, electrosurgical units and pacemakers to name a few."
- -"The devices for industrial equipment also include PCBs; for example, power supplies, computer numerical control (CNC) machines, power inverters or solar power cogeneration devices, to name a few. In addition, automotive, aerospace/satellital and maritime devices include PCBs as electronic substrates for the circuits; for instance, navigation systems, microcontrollers, conditioning electronic circuits for sensors and actuators, and communication equipment. Finally, the consumer electronics, such as videogames, electrical appliances, personal computers and smart phones, form a representative example."
- -"The use of PCB substrates for these applications is well-known and well-established. This has led the creation of many commercial companies, which offer a rapid and low-cost fabrication of PCBs with very good characteristics. These advantages, that is, their low cost and precise dimensions, together with the characteristics of the PCB, made this substrate an interesting material to perform applications for which the PCB was not intended."
- -"Regarding this, microelectromechanical systems (MEMS), which typically and historically used silicon as base material, adopted the Printed Circuit Board as an alternative material due to its advantage of having one or more copper layers to fabricate microchannels,

sensors or actuators, and the ability to include microfluidics and electronics in the same substrate at a low cost"

-"Lab-on-a-chips are biomedical, biochemical or chemical devices, including several laboratory functions in a substrate with the dimensions of a credit card, or even smaller. They could include microheating, micropumping, temperature sensors, biological parameter sensors, micromixing and different detection systems. The first LoC materials were silicon and glass. These materials are expensive when considering the typical dimensions of a lab-on-a-chip. For that reason, these materials are going to be replaced by polymers, such as polydimethylsiloxane (PDMS) and SU-8 for prototyping purposes, and thermoplastics for industrial applications."

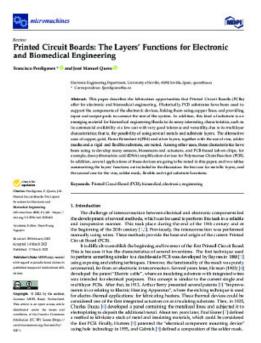
Micromachines 13 00460 g001

- -"Figure 1. Cross-sectional view of a generic structure of a Printed Circuit Board (PCB). (A) Double-side copper layer PCB, where the Flame Retardant 4 (FR4) (green) and the metal (yellow) can be seen. (B) Double-side PCB with a copper line, a plated through hole (PTH) via, and a hole (non-plated through hole (NPTH)). (C) Four layer PCB with through hole via, blind via, buried via, and a blue solder mask covering the top and bottom layers."
- -"The most common PCB is presented in **Figure 1**A. As can be seen, it comprises two copper layers (top and bottom) with an intermediate insulation material, which is typically Flame Retardant 4 (FR4). In addition, there is a simpler configuration, with only one copper layer. **Figure 1**B shows the result of the fabrication process using the double-copper layer, where vias (plated through hole (PTH)) and holes (non-plated through hole (NPTH)) have been fabricated. The vias are characterized as providing electrical and thermal connectivity between the copper layers; in this case, the top and bottom layers."
- -"Figure 1C shows a four-layer PCB. The configuration is similar to the previously noted substrates but includes two additional intermediate copper layers. In this case, the vias can link the four layers, that is, the top, bottom and the intermediate layers. Through vias link the top and bottom layers; blind vias external and intermediate layers; and buried vias link two intermediate layers."
- -"The top and bottom surfaces of the final fabricated structure are covered by a blue solder mask. This layer is used to protect the copper lines, releasing only the copper parts used to solder the electronic components. Finally, a silkscreen printing process can be used to name and locate the different components on both the top and bottom surfaces of the PCB. This PCB structure can be used to fabricate more compact electronic circuits. Similarly to this four-layer PCBs, the one- and two-layer PCB can also include solder masks and silkscreen layer."

-"

Conclusions/action items: We will need to form a circuit diagram and then send it to a PCB maker. There are several types of PCBS and we will need to decide on one. We are starting our initial circuit work this week!

Lauren Klein - Oct 16, 2025, 11:27 AM CDT



Download

micromachines-13-00460-v2.pdf (23.4 MB)

Lauren Klein - Sep 08, 2025, 3:55 PM CDT

Title: Continuous Glucose Monitors & Dexcom Background

Date: 09/08/25

Content by: Lauren

Present: Individual

Goals: To learn about current CGMs and similar devices used to treat Type 1 Diabetes in children

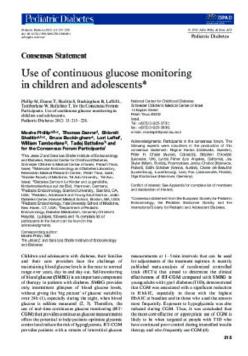
Search Engine: Google Scholar

Search Term: Dexcom Devices and Continuous Glucose Monitors in Pediatrics

Content:

- M. Phillip *et al.*, "Use of continuous glucose monitoring in children and adolescents *," *Pediatric Diabetes*, vol. 13, no. 3, pp. 215–228, Jan. 2012, doi: https://doi.org/10.1111/j.1399-5448.2011.00849.x.
- -"Self-monitoring of blood glucose (SMBG) is an important component of therapy in patients with diabetes."
- -"Therefore, the use of real-time continuous glucose monitoring (RTCGM)that provides continuous glucose measurements offers the potential to help patients optimize glycemic control and reduce the risk of hypoglycemia."
- -"A recently published meta-analysis of randomized controlled trials (RCTs) that aimed to determine the clinical effectiveness of RT-CGM compared with SMBG in young adults with type 1 diabetes(T1D), demonstrated that CGM was associated with a significant reduction in HbA1C, especially in those with the highest HbA1C at baseline and in those who used the sensors most frequently. Exposure to hypoglycemia was also reduced during CGM."
- -"All designed prototypes or commercially available systems can be divided into three groups based on the way glucose measurement is carried out: non-invasive, minimally invasive, and invasive systems."
- -"Non-invasive devices measure glucose with light or electromagnetic waves without penetrating the skin. Minimally invasive sensors are inserted through the skin and measure the glucose concentration in the interstitial fluid of the skin or subcutaneous tissue."
- -"CGM was first available in 1999 for retrospective analysis (MiniMedCGMS; 7), andRT-CGM was first available in 2001 (CygnusGlucoWatch that is no longer in use; 8)."
- -"Since their introduction, each subsequent generation of glucose sensors has brought increased accuracy and an improved user interface for the patient. Accuracy needs to be assessed in terms of the intended use of the sensor."
- -"When used with current open-loop basal/bolus insulin replacement, RT-CGM systems should provide: (i) Improved overnight control with hypoglycemia alarms and retrospective data to optimize overnight basal insulin needs. In patients using an integrated sensor-augmented pump system, the low glucose suspend (LGS) feature may help to prevent severe nocturnal hypoglycemic events. (ii) Improved daytime bolus dosing with trend arrows and hyper-and hypoglycemia alarms for real-time adjustments, and retrospective data to optimize carbohydrate ratios and correction doses. (iii) Enhanced understanding of diabetes management teaching to understand effects of different foods, exercise, stress, and menstrual cycles on glucose excursions. (iv) Improved management of acute illnesses."
- -"Inaccurate sensor glucose readings due to errors in calibration or general sensor malfunctioning should not lead to errors in insulin dosing as patients/families are instructed in the need to use data from standard SMBG before insulin administration."
- -"Unnecessary treatment of hypoglycemia from RT-CGM glucose results is also unlikely owing to routine instructions to patients/families to check blood glucose levels before treating presumed low glucose values noted by RTCGM (unless clinical symptoms dictate the need to treat before blood glucose confirmation)."
- -"Severe hypoglycemia or severe hyperglycemia with DKA rates should not be any greater than in routine care and maybe reduced with the aid of RT-CGM data and CGM alarms for high and low glucose readings."

Conclusions/action items: This study is on the older side and was prior to DexCom approval. I will be continuing initial CGM research with a more up to date document but got an idea of how CGMs have progressed in the past 13 years.



Download

phillip_et_al._use_of_continuous_glucose_monitoring.pdf (152 kB)

09/10/25 - Current Glucose Alerting Systems

Lauren Klein - Sep 12, 2025, 6:03 PM CDT

Title: Background Research on Current Glucose Alerting Systems

Date: 09/10/25

Content by: Lauren

Present: Individual

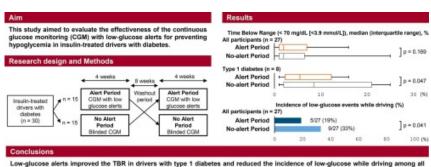
Goals: To learn what current competing designs are on the market for Glucose Alerting Systems that compare to our bracelet idea.

Search Engine: Google Scholar

Search Term: glucose alerting system

Citation: R. Maeda *et al.*, "Continuous glucose monitoring with low-glucose alerts in insulin-treated drivers with diabetes: A randomized crossover study," *Diabetes Research and Clinical Practice*, vol. 222, p. 112074, Feb. 2025, doi: https://doi.org/10.1016/j.diabres.2025.112074.

- -"Insulin-induced hypoglycemia not only reduces the patient's quality of life but could also constitute a risk factor for cardiovascular diseases in patients with diabetes"
- -"Continuous glucose monitoring (CGM), which is increasingly being used in clinical settings, allows continuous blood glucose level measurement in the subcutaneous tissue's interstitial fluid by placing a sensor on the patient's skin."
- -"Additionally, recent advancements in these devices have incorporated low-glucose alerts, which notify users via sound and vibration when glucose levels fall below a predetermined threshold."
- -"These alert features in CGM devices have been shown to effectively reduce the number of hypoglycemia episodes, particularly in patients with type 1 diabetes [9–12]. These devices are expected to be more widely adopted by a broad range of patients with diabetes compared with traditional CGMs."
- -"Therefore, we conducted this randomized crossover study targeting insulin-treated drivers to evaluate the effectiveness of the CGM with low-glucose alerts in hypoglycemia prevention, including while driving."
- -"The CGM metrics were collected and analyzed according to the international consensus statement on CGM and metrics for clinical trials [14]. Following the CGM statement, hypoglycemia was defined at two thresholds: <70 mg/dL (3.9 mmol/L) and < 54 mg/dL (3.0 mmol/L), with low glucose events classified as glucose levels remaining below these thresholds for at least 15 min. The primary outcome was the percentage of time below range (TBR) (<70 mg/dL [<3.9 mmol/L]), which was compared during the periods with and without low-glucose alerts. Secondary outcomes included the TBR (<54 mg/dL [<3.0 mmol/L]), time above range (TAR) (>180 mg/dL [>10.0 mmol/L]), time in range (TIR) (70–180 mg/dL [3.9–10.0 mmol/L]), and the incidence of low-glucose events throughout the study and when driving a car. The incidence of low-glucose events was predefined as the percentage of participants who experienced low-glucose events at least once every 2 weeks. For safety evaluation, the occurrence of severe hypoglycemia requiring assistance from others and any traffic accidents were assessed at each participant's regular visits and during data collection."



- -"This study evaluated the effectiveness of CGMs with low-glucose alerts in preventing hypoglycemia in insulin-treated drivers. Per our findings, the use of CGM with low-glucose alerts reduced the incidence of low-glucose while driving among all participants, with improvements in TBR among participants with type 1 diabetes, suggesting that these alerts may contribute to reducing the risk of hypoglycemia for insulin- treated drivers."
- -"Previous studies have demonstrated that CGMs with low-glucose alerts effectively reduce hypoglycemia and improve glycemic metrics in patients with type 1 diabetes [9–12]. The findings of this study suggest that the benefits of CGMs with low-glucose alerts extend not only to patients with type 1

diabetes but also to all insulin-treated drivers. In this study, the low-glucose alerts were set at 80 mg/dL (4.4 mmol/L), which allowed participants to take preventive action before their glucose levels dropped to hypoglycemic ranges. "

Conclusions/action items: Warning devices that deal with preventing hypoglycemia are critical in allowing for diabetics to live normally. While there aren't any super well know strict warning devices, CGMs can do the trick with low-glucose alerts. Setting the low levels to a little higher than the bare minimum is also a good preventative measure to give the T1D time to fix their levels.

Lauren Klein - Sep 10, 2025, 2:54 PM CDT



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Lauren Klein - Sep 12, 2025, 5:47 PM CDT

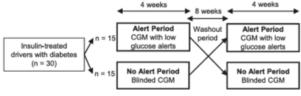


Fig. 1. Study design (a crossover interventional study).

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Lauren Klein - Sep 12, 2025, 5:47 PM CDT

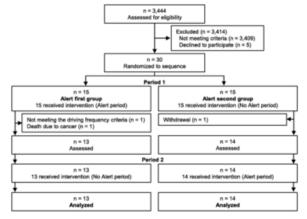
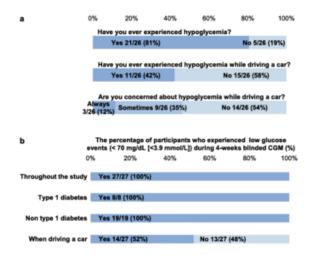


Fig. 9. Schematic Structuration of the study decises

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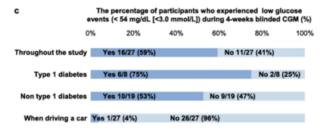
Lauren Klein - Sep 12, 2025, 5:54 PM CDT



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Lauren Klein - Sep 12, 2025, 5:54 PM CDT



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Lauren Klein - Sep 15, 2025, 4:03 PM CDT

Title: CGM Standards & Specs

Date: 09/15/25

Content by: Lauren

Present: Individual

Goals: To figure out what FDA Standards must be abided by when making a CGM for diabetes patients.

Search Engine: Google Scholar

Search Term: Standard & Specifications for Continuous Glucose Monitors

Citation: S. K. Garg and H. K. Akturk, "A New Era in Continuous Glucose Monitoring: Food and Drug Administration Creates a New Category of Factory-Calibrated Nonadjunctive, Interoperable Class II Medical Devices," *Diabetes Technology & Therapeutics*, vol. 20, no. 6, pp. 391–394, Jun. 2018, doi: https://doi.org/10.1089/dia.2018.0142.

- -"...the first continuous glucose monitoring (CGM) system was introduced by MiniMed (Northridge, CA)."
- -". In 1999, the Food and Drug Administration (FDA) approved the first real-time CGM for up to 12 h at a time (GlucoWatch G2 Biographer).2–6 Since then, many CGM systems have been introduced in the marketplace from companies including Dexcom (Short Term Sensor [STS], SEVEN, SEVEN PLUS, G4, and G5), Medtronic (Enlite 1, Enlite 2, and Guardian systems), and Abbott (Navigator).7–19 All of these systems were approved as adjunctive to self-monitoring of blood glucose."
- -"It was only in 2017 that the FDA first approved the standalone nonadjunctive factory-calibrated flash FreeStyle Libre CGM system (Abbott) for 10 days for personal use in adults only (first 12 h no data are provided to the user)."
- -"For example, about 5 years ago, CGM was used by about 7% of patients followed at 70 leading centers in the United States (representing *25,000 patients with type 1 diabetes [T1D]) as reported by the T1D Exchange data.29 Most recent data from the T1D Exchange show a nearly fivefold increase in patients using a CGM on a regular basis today.30 It is anticipated that in the next 5–10 years, the majority of the insulin-requiring patients (everyone with T1D and about 20% of people with type 2 diabetes[T2D]) will be using some CGM system for their day-today diabetes care in the United States and most of Western Europe."
- -"Part of this increased usage might have been facilitated by significant improvements in accuracy (reported as the mean absolute relative difference [MARD]) by the new CGM systems for the past decade. Now, most of the new CGMs have MARD values closer to 10%."
- -"The improvement in glucose control was achieved without any further increase in hypoglycemia (many studies showing a significant decrease in hypoglycemia), with the ability to identify hyperglycemia and hypoglycemia that would have otherwise been undetected."
- -"Recent studies highlight that time-in-range (TIR) is significantly increased with the use of CGM and, thus, reducing glucose variability (GV) and improving quality of life."
- -"The first system known as hybrid-closed loop (artificial pancreas) was approved by the FDA in September 2016."
- -On March 27, 2018, the FDA approved the G6 CGM as the first 10-day nonadjunctive factory-calibrated system for ages 2 years and older. In so doing, the FDA created a new category of Class II integrated CGM (iCGM) devices for 510(k) approval and provided the necessary guidelines for future products to avoid the lengthy premarket approval (PMA) submissions. The iCGM submission requires higher standards for 510(k) approval."
- -"There is also a requirement for mandatory shutoff after the desired approved time period; for example, in the case of the G6 or Libre, it will be 10 days."
- -"Devices found to be substantially equivalent to the G6 system may benefit from the 510(k) approval process; those that are not will be routed through the longer PMA submission pathway for Class III medical devices."
- -"As we know, most of the currently available CGMs do not allow patients to take acetaminophen. However, this G6 CGM system eliminates acetaminophen interference. The second study focuses on a subset of these patients who used the commercial ready-automated sensor applicator. In this group of insulin-requiring adults and children with T1D or T2D, the overall MARD was 9% (from 3532 CGM readings that had a temporally matched YSI reading)."

Lauren Klein - Sep 15, 2025, 3:04 PM CDT

-"This met the necessary FDA requirements for approval in addition to issuing new guidelines for iCGM for 510(k) applications (Table). The G6 system and its inclusion in a new category of Class II medical devices are important landmarks on the road toward replacing home blood glucose monitors, building precision treatment plans for people with diabetes, and creating safer and more reliable automated insulin delivery systems."

Conclusions/action items: Introducing CGMs into a new class (Class II) of medical devices has both its positives and negatives. A certain calibration period must correlate with the length of use or it does not get 510(k) approval. If they don't then they have to go through a longer pathway for Class III.

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A_New_Era_in_Continuous_Glucose_Monitoring_Food_an.pdf (190 kB)

09/15/25 - Continuous Standards for PDS

Lauren Klein - Sep 15, 2025, 4:19 PM CDT

Title: Continued CGM Standards & Specs

Date: 09/15/25

Content by: Lauren

Present: Individual

Goals: To figure out what FDA Standards must be abided by when making a CGM for diabetes patients.

Search Engine: Google Scholar

Search Term: Standard & Specifications for Continuous Glucose Monitors

Citation: Guido Freckmann, A. Baumstark, and S. Pleus, "Do the New FDA Guidance Documents Help Improving Performance of Blood Glucose Monitoring Systems Compared With ISO 15197?," *Journal of Diabetes Science and Technology*, vol. 11, no. 6, pp. 1240–1246, Jun. 2017, doi: https://doi.org/10.1177/1932296817713220.

- -"In 2016, the Food and Drug Administration (FDA) published two guidance documents for blood glucose monitoring systems (BGMS)."
- -"Requirements of the FDA guidance for BGMS for point-of-care testing (POCT) were recently discussed by Krouwer in a letter to the editor. He criticized that the guidance stipulates limits that are not stringent enough, even though they are stricter than those of other standards for BGMS. Krouwer argues that defining limits which only have to be fulfilled by 95% or 98% of results, therefore leaving results unspecified, is insufficient."
- -"However, in technical systems showing random measurement error it is hard to ensure that 100% of measurements are within acceptable limits. It is important to note that the FDA guidance for over-the-counter (OTC) BGMS2 and International Organization for Standardization (ISO) 15197:20134 include a criterion specifying 99% of results. Krouwer's letter to the editor inspired us to address further shortcomings of the FDA guidance documents and discuss different standards regarding the performance of BGMS."
- -"We focused on accuracy requirements in four different standards: the FDA guidance on POCT systems, the FDA guidance on OTC BGMS,2 ISO 15197:2013 requirements for BGMS for self-testing,4 and the Clinical and Laboratory Standards Institute (CLSI) guideline POCT12-A3. These standards describe requirements for BGMS with two different intended users: health care professionals and lay users performing self-monitoring of blood glucose (SMBG)."
- -"These BGMS are not directly comparable; however, in most cases measurement technology is similar. While the FDA guidance documents are applicable for premarket notifications (510(k)s) in the United States and ISO 15197:2013 is harmonized in Europe as EN ISO 15197:20156 and can be used to demonstrate conformity with parts of EU in-vitro-diagnostics regulations, POCT12-A3 refers to postmarket evaluation of BGMS. Each of the four documents describes procedures for the assessment of BGMS accuracy as well as accuracy criteria, but each of the respective expert committees seemed to have their own, separate opinion regarding the requirements (Table 1)."
- -See Table 1 below
- -"The two FDA guidance documents for OTC and POCT BGMS have many similarities, especially regarding general requirements. The major difference can be found in the accuracy limits and in additional tests that are required for POCT systems, such as performance evaluation in different intended patient populations and for different sample types. Both FDA guidance documents clearly state that the ISO 15197:2013 criteria are insufficient, and seem to aim at improving the ISO standard's perceived shortcomings. However, we could not find a rationale in the FDA documents."
- -"Only ISO 15197:2013 directly takes into account the clinical impact of measurement errors."
- -"Differences between the discussed standards can also be found in the testing procedures. Most obvious is the number of subjects participating in a test. While ISO 15197:2013 and the CLSI guideline require at least 100 subjects from which double measurements shall be performed, both FDA guidance documents require at least 350 subjects. This high number might be explained by the data analysis recommendations, which state that no results, not even outliers or obvious handling errors, may be excluded."
- -"For an ISO evaluation, system accuracy measurements are performed by trained personnel; however, an additional, separate lay user evaluation including at least 100 subjects is required. Both FDA guidance documents and the ISO 15197:2013 system accuracy protocol require testing of three individual reagent system lots; for an ISO user evaluation one lot is sufficient. All standards have in common that BGMS should be tested at glucose concentrations that cover the whole claimed measurement range. ISO even specifies glucose concentration categories and the percentage of samples that should be tested in each category to ensure an adequate distribution of values. To reach values in the very low and high glucose concentrations,

samples may be altered by glycolysis or spiking. FDA and ISO limit the number of altered samples, and according to the FDA the analysis of altered samples should be a separate study."

- -"All four BGMS standards demand a measurement procedure that is traceable, for example, according to ISO 175119 as referenced in ISO 15197:2013"
- -"In the context of accuracy, we would like to dedicate one remark to systems for continuous glucose monitoring (CGM). While there are discussions about whether 98% or 100% of BGMS results should be within given limits and limits are more and more tightened, standards for CGM systems are lacking acceptance criteria and requirements as clear as those of the FDA guidance documents or the ISO standard."
- -"The FDA guidance documents were expected to address shortcomings of the already established ISO 15197 standard. Efforts were made to improve on these shortcomings, but new issues came up as well: The stricter accuracy limits seem inconsistent, and the recommended procedures require extensive studies involving a lot of subjects. In addition, the importance of the reference measurement quality was not sufficiently addressed."

Conclusions/action items: In the FDA's attempt to address issues with ISO 15197, new problems arose in their language used. ISO 15197:2013 seems to still encompass enough of the logistics involved with CGMS and blood glucose monitoring devices. I will combine this knowledge with the other two sources I've found to completely address the necessary Standards & Specifications in our PDS.

Do the New FDA Guidance Documents
Help Improving Performance of Blood
Glucose Monitoring Systems Compared
With ISO 15197?

Guido Fredmann, HD¹, Amette Basmstark, PhD¹,
and Sorfan Plean, M52¹

Alastona

Alas

Lauren Klein - Sep 15, 2025, 3:14 PM CDT

Download

freckmann-et-al-2017-do-the-new-fda-guidance-documents-help-improving-performance-of-blood-glucose-monitoringsystems.pdf (186 kB)

Lauren Klein - Sep 15, 2025, 4:11 PM CDT

	50 ISH7	3913*	FDA guidance OTC ¹	FDA guidance POC ¹	CLSI guideline POCT12-A3 ⁵
Tele	In vitro diagnostic test systems- glucese monitoring systems for diabetes mellitus		test systems for over-the- counter use	Blood glucose monitoring test systems for prescription point- of-care use Guidance for industry and Food and Drug Administration staff	Point-of-care blood glucose testing in acute and chronic care facilities
Scope	SMBG, premarket	SMBG, premarket	SMBG, premarket	POCT, premarket	POCT, postmarket
Accuracy evaluation	System accuracy	User performance evaluation	Method comparison/user evaluation	Method comparison/user evaluation	Comparing results of the POCT BGMS and a laboratory instrument
Test conditions	Laboratory, controlled temperature	Reflect expected use	Refect expected use	Reflect expected use	Trained personnel, laboratory conditions
Number of subjects	As least 100	At least 100	naive, for each claimed sharmative anatomical site [eg, forearm, pain, etc])	At least 150 (for each claimed sample type (arterial, venous, capillary blood) and at least 30 from every vulnerable sub population), 100-150 recovarial samples if applicable, 50-75 per claimed anticoagulare.	Ac least 100
performed by	Study personnel familiarized with system and trained in use	Intended users provided device labeling (user manual), no other training or assistance but limited self-practice	intended users provided device labeling (user manual), no training or assistance	At least 9 intended POC operators	Personnel familiarized with system and trained in use
Sample type	Fresh capillary blood samples	Own fingertip capillary blood	Own fingertip capillary (or sitemate anatomical site(s)) blood	Claimed sample type (eg. arterial, venous, capillary, heelstick whole blood, etc)	
Text strips Text range	3 lots, at least 10 vials Defined distribution in glucose concentration categories, span the measuring interval	I lox Not specified	At least 3 lots, 10 vials Should span claimed range	At least 3 lots, 10 vials Should span claimed range	I lot Should span claimed range
Low and high glucose ranges	 At least 8 unahered 	Not required	 At least 10 unahered samples 480 mg/d, at least 10 unahered samples >250 mg/d Altered samples (or least 50 each) (spiking, glycolpris) separate study may be performed in laboratory setting 	 At least 10 unabored samples: 400 mg/dl, at least 10 unabored samples: >200 mg/dl Aboved samples (at least 50 each) (opking, glycolysis) separate study in laboratory setting but performed by intended users 	 Altered samples: spiking or glysolysis according to procedure recommended by manufacturer

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Lauren Klein - Sep 15, 2025, 4:11 PM CDT

	50 (519)	2013	FDA guidance OTC ¹	FDA guidance POC ¹	CLSI guideline POCT13-A3 ⁵
Reference measurement procedure	"measurement presenting that conforms to the macadility requirement of 500 (751); Varify traveness and precision of the macadility frequirement of the measurement require glacular concentration. At least deplace measurement. Both guilty control results in the measurement of the measurement of the measurement. Both guilty control results out of the measurement of the measurement of the measurement of the measurement. Both guilty control results out of the measurement of the measurement of the measurement. Both guilty control results out of the measurement of the measurement of the measurement. Sample out of quantifications Sample out of quantifications Sample out of q	17511" Verify trueness and precision As least displicate measurements Data exclusion criteria defined, eg: Error is measurement	"In bloomstory based glosson measurements enriched that has been well-soldened flor precision and accountry and that is troosable to a higher order." Two measurements options included the property of the property	measurement method that has been well-validated for precision and accuracy and the	"brassistis on materials and measurements procedures of a higher order." Interpretation 12 FK, blac c limpretation repaired. But acclusion orders defined, 4g of Deviation in ten procedure limpretation from profession measured is CNA might. Deviation within displacements of the control of the limpretation of the limpretation of the limpretation within displacements of the limpretation of
Accuracy criteria	massurement 195% within 115 mg/dl <100 mg/dl 115% 2 100 mg/dl 299% within CEG Zone Art	 195% within ±15 mg/d <100 mg/d ±15% >100 mg/d 	195% within ±15% 199% within ±20%	195% within ±12 mg/d <75 mg/d ±12% > 75 mg/d ±12% > 75 mg/d ×98% within ±15 mg/d <75 mg/d ±15% > 75 mg/d	195% within 112 mg/d < 100 mg/d 112.5% > 100 mg/d 115.5% > 100 mg/d 15 mg/d < 75 mg/d 20% > 75 mg/d

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09/15/25 - Specifications (ISO) for PDS

Lauren Klein - Sep 15, 2025, 9:56 PM CDT

Title: CGM Specs

Date: 09/15/25

Content by: Lauren

Present: Individual

Goals: To figure out what Specifications must be abided by when making a CGM for diabetes patients.

Search Engine: Google Scholar

Search Term: Specifications for Continuous Glucose Monitors

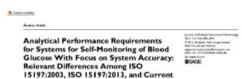
Citation: G. Freckmann, C. Schmid, A. Baumstark, M. Rutschmann, C. Haug, and L. Heinemann, "Analytical Performance Requirements for Systems for Self-Monitoring of Blood Glucose With Focus on System Accuracy," *Journal of Diabetes Science and Technology*, vol. 9, no. 4, pp. 885–894, Apr. 2015, doi: https://doi.org/10.1177/1932296815580160.

Content:

- -"In the European Union (EU), the ISO (International Organization for Standardization) 15197 standard is applicable for the evaluation of systems for self-monitoring of blood glucose (SMBG) before the market approval."
- -"This standard, which was first published in 2003,11 lists requirements for design and development, safety and reliability testing, analytical performance evaluation, information to be supplied by the manufacturer and user performance evaluation. Regarding analytical performance evaluations, particularly requirements on system accuracy are described in detail in this standard, including evaluation design and minimum accuracy criteria."
- -"Measurement Repeatability. Measurement repeatability evaluation describes the closeness of agreement between a series of measurements with an SMBG system on a blood sample over a short period of time. The evaluation shall include a minimum of 5 venous blood samples with defined glucose concentrations in the hyperglycemic, englycemic, and hypoglycemic range."
- -"Intermediate Measurement Precision. Intermediate measurement precision evaluation considers the closeness of agreement between daily measurements over at least 10 days with an SMBG system on control solution. The evaluation shall include a minimum of 3 control solutions with defined glucose concentrations."
- -"Influence Quantities An important revision in ISO 15197:2013 is the inclusion of the evaluation of influence quantities, such as hematocrit and interfering substances in blood that can affect the analytical performance of an SMBG system."
- -"However, it needs to be emphasized that ISO 15197:2013 still requires that each individual test strip lot must comply with the 95% accuracy criteria."
- -"Therefore, ISO 15197 also requires a user performance evaluation to show if patients with diabetes are able to obtain accurate measurement results with a given system. For this purpose, measurements shall be performed by the users following the instructions of use, without any training or assistance."
- -"the ISO standard describes the testing procedure for the user performance evaluation much more precisely than the 2003 version. Also some changes in the testing procedure were made (Table 3). The most important revision is the definition of acceptance criteria which follow closely the minimum criteria for system accuracy: 95% of measurement results obtained by the patients shall be within ±15 mg/dl of the reference value at BG concentrations <100 mg/dl and within ±15% at BG concentrations ≥100 mg/dl."

Conclusions/action items: ISO 15197 has had several versions but the more recent ones have brought complications when trying to fix previous issues. This paper outlined some of the testing procedures and necessary data results for it to quality under the standard. We must keep these in order when doing our final testing.

Lauren Klein - Sep 15, 2025, 3:16 PM CDT



FDA Recommendations

Guido Freckmann, MD¹, Christina Schmid, PhD¹, Annette Baumstark, PhD¹, Halte Rutschmann, PhD¹, Cornella Haug, MD¹, and Lutz Heinemann, PhD¹

Abstract

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Keywords

blood plucose monitoring, SPBG systems, ISO 15197-2003, BO 15197-2013, PDA druft guidance document, system sociumos

Titology, self-monitoring of Wheed gluctons (SMMER) is an ingraph component of deliberts management fracturedry for guident with following on intended by the Tarticularly for guident with following on intended intended theory, those montes, such as delibert of policylated glossoc estimations, identification of glucone patterns, and the supercomment of helder. "As in a pattern near on treat in theretoe, regular helder whose and resident complications, are well-onlyindeed," As in a pattern near on treat in theretoe, regular country, in representant in Belder Verlace, "To make solequate throughout subjective to the pattern (cours in our country, in representation in Belder Verlace," To make solequate throughout subjective to the pattern (cours in the country of the pattern of the pattern of the pattern of cours in the country of the pattern of the pattern of the pattern of the pattern of an exercise of the country of the pattern of the pattern of a mean visible in the complete for a regular visible through the control of the pattern of

ion of a meter with the respective test strips i have provide counter and edulate BG readings."

In the European Union, medical devices such as SMBG notices much as SMBG notices must have a Conformid Europhenne (CE) mark for

declares with the application of the CE mark that its prednat is in compliance with the assertial requirements of the in-vite diagnostics directive (VDD) (insepone directive 90/10/15), Annue 17° with regard to health protection, safety and on insensent protection. These equirements can be controlled.

Institut for Dateste-Technologie Krischung- und Groeckingspellsstatt stillt. Um, Germany Schiger-Nederlauser. Germany

Corresponding Action: Gents Fredmann, 190, herost for Disboon-Federologic Foredways unclined design postschot ethil, Helmheltscross 24, 89881 URs., Gentsele.

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Lauren Klein - Nov 27, 2025, 5:21 PM CST

Title: PLA Material in Medicine and Properties of it

Date: 10/17/25

Content by: Lauren

Present: Individual

Goals: To learn about PLA in medical devices and its properties

Search Engine: Google Scholar **Search Term:** PLA in Medicine

Citation: J. S. Bergström and D. Hayman, "An Overview of Mechanical Properties and Material Modeling of Polylactide (PLA) for Medical Applications," *Annals of Biomedical Engineering*, vol. 44, no. 2, pp. 330–340, Sep. 2015, doi: https://doi.org/10.1007/s10439-015-1455-8.

- -PLA (polylactide) especially PLLA is now widely used in bioresorbable medical devices because it provides structural support and then gradually resorbs in the body.
- -PLA's properties can be tuned by controlling its microstructure, including molecular weight, crystallinity, orientation, and physical aging.
- -Manufacturing processes (extrusion, molding, stretching, heat treatments) strongly influence PLA stiffness and ductility by altering molecular alignment and crystallinity.
- -PLA's mechanical behavior is non-linear and time-dependent, involving viscoplasticity, strain-rate dependence, creep, and residual stresses.
- -Because body temperature is close to PLA's glass transition temperature, small thermal changes can dramatically affect stiffness and brittleness.
- -Physical aging increases modulus and yield strength but reduces ductility, which means device properties continue changing during storage and after implantation.
- -PLA components under constant loads may undergo creep and premature failure, even if stresses are below the yield strength.
- -Degradation occurs primarily via hydrolysis; crystallinity, molecular weight, and mechanical loading significantly influence degradation rate.
- -During degradation, yield stress, yield strain, and elongation to failure decrease, which can compromise long-term device performance.
- -In stents, PLLA requires thicker struts than metal stents to achieve similar radial strength, which can reduce deliverability and increase vessel injury risk but avoids permanent metallic implants and late thrombosis complications.
- -Orthopedic PLLA devices aim to provide temporary mechanical support to allow natural tissue growth and avoid stress shielding from permanent metal implants.
- -Because PLA behavior evolves over time and varies with loading conditions, accurate computational material models are increasingly important for device design and safety.
- -Several constitutive models exist; recent approaches incorporate viscoplasticity, anisotropy, strain-rate effects, and degradation, enabling more realistic simulations of PLA performance.
- -Continued development in material modeling and computational simulation will enhance design optimization, reduce bench testing, and improve implant safety.

333

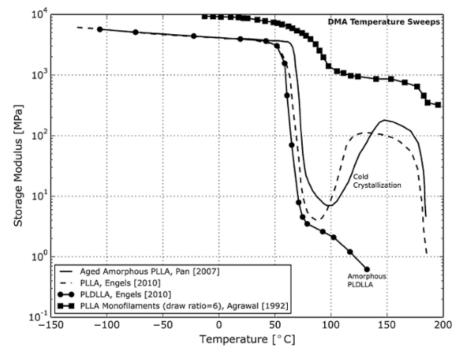


FIGURE 1. Storage modulus of PLLA monofilaments as a function of temperature and draw ratio. The materials characterized by Pan *et al.*⁴⁰ and Engels *et al.*⁸ have a draw ratio of 4 while the materials characterized by Agrawal *et al.*¹ have a draw ratio of 6.



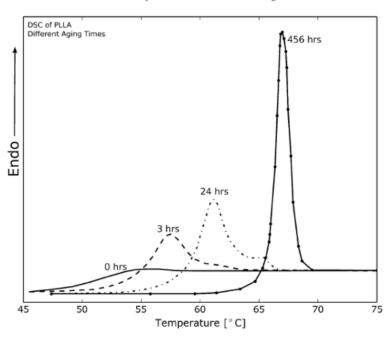


FIGURE 2. DSC heating scans of PLLA (10 °C/min). The curves in the figure are for different aging times at 40 °C. ⁴⁰ The presence of endothermic peaks and shift in the endotherms to higher temperatures is correlated to the degree of physical ageing.

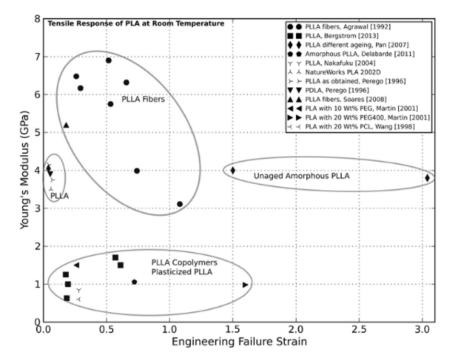


FIGURE 3. Young's modulus and engineering strain to failure for different PLA materials. The data are from the following references: 1,6,18,32,35,40,41,46,53

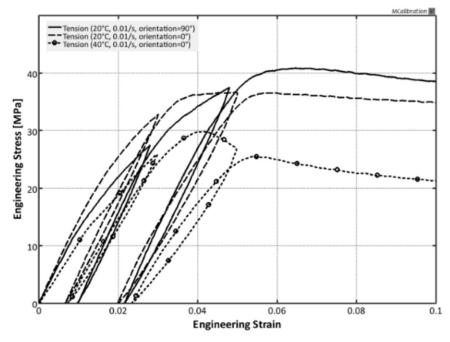


FIGURE 4. Uniaxial tensile behavior of a PLLA tested at a strain rate of 0.01/s in two orthogonal directions, and at two temperatures. ¹⁸ The material response is non-linear viscoplastic.

Conclusions/action items: PLA will serve a very useful purpose for our first level of box testing! We already have multiple versions of our physical component 3D printed and they have worked well with attaching our band as well. We will need to perform a compression test on it in the lab to get a Stress Strain curve.



An Overview of Mechanical Properties and Material Modeling of Polylactide (PLA) for Medical Applications

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Lauren Klein - Nov 28, 2025, 12:11 PM CST

Title: Data Access with Dexcom and Related Devices for Third Party Applications

Date: 10/17/25

Content by: Lauren

Present: Individual

Goals: To learn how we could potentially access and use Dexcom/Omnipod Cloud data for our project

Search Engine: Google Scholar

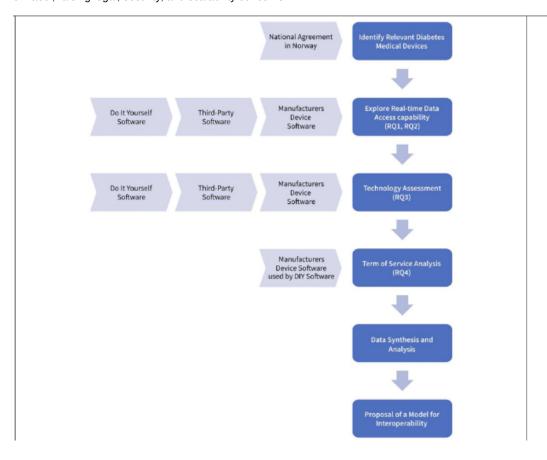
Search Term: Dexcom Data Cloud

Citation: Pietro Randine, M. K. Wolff, Matthias Pocs, Ian, J. A. Cafazzo, and Eirik Årsand, "Unlocking Real-Time Data Access in Diabetes

Management: Toward an Interoperability Model," Journal of Diabetes Science and Technology, Mar. 2025, doi:

https://doi.org/10.1177/19322968251327602.

- -Modern diabetes management depends on real-time data from devices like CGMs, insulin pumps, and hybrid closed-loop systems so that treatment adjustments can be made rapidly.
- -Most medical devices and their associated software do not provide public APIs, creating barriers for both treatment and research data access.
- -The researchers evaluated seven diabetes medical devices and nine regulated software solutions used in Norway, and found only one that offers a publicly accessible API (Dexcom G6).
- -Limited real-time data access impacts patients, caregivers, clinicians, and researchers, and increases manual data entry into EHRs.
- -DIY (Do-It-Yourself) diabetes solutions such as OpenAPS, Loop, and AndroidAPS can enable real-time data access and automation, but they operate off-label, raising legal, security, and scalability concerns.



- -DIY systems often require reverse engineering or cloud-workarounds and introduce security risks such as lack of 2FA and plain-text credential access.
- -Manufacturers legally restrict access to data in their Terms of Service, and while exceptions exist in EU copyright law for "achieving interoperability," the interpretation varies across countries.
- -Technology for secure real-time diabetes data access already exists, but governance, standardization, and accessibility are lacking.
- -The study proposes an interoperability model based on REST APIs, OAuth 2.0 authorization, OpenID authentication, 2FA, FHIR (Fast Healthcare Interoperability Resources), and clinical terminology (SNOMED CT, LOINC) to support both clinical and research use.

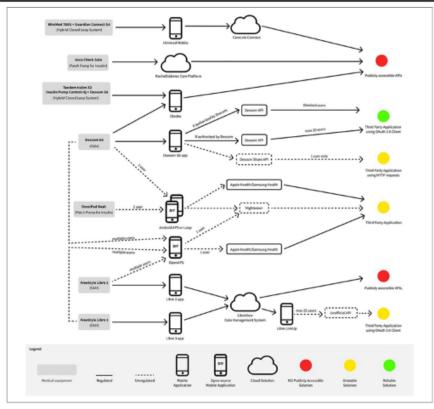


Figure 2. Technological assessment overview of regulated and DIY software

- -The model aims to allow real-time data sharing across medical devices, EHR systems, end-users, caregivers, researchers, and industry, while ensuring privacy and security.
- -Without interoperability requirements, patients' GDPR "right to data portability" becomes impractical because CSV downloads are too complex for non-technical users.
- -Regulatory intervention—rather than purely technical innovation—is needed to require publicly documented APIs for diabetes devices.
- -A shift toward interoperability could significantly reduce HCP workload, improve patient care, increase transparency, and accelerate research and innovation.
- -The authors conclude that the technology is available, but governance and policy must catch up before real-time diabetes data can be used widely for treatment and research.

Conclusions/action items: How current third parties access real-time data can be hard to access and also raises security concerns. In order to treat patients, this method might not be the best as governance can get in the way as well. We will have to attempt to look further into accessing user data.



Download

randine-et-al-2025-unlocking-real-time-data-access-in-diabetes-management-toward-an-interoperability-model.pdf (762 kB)

10/18/25 Useful LEDs & other Components

Lauren Klein - Nov 28, 2025, 12:02 PM CST

Title: Useful LEDs for medical/small wearable device application

Date: 10/18/25

Content by: Lauren

Present: Individual

Goals: To learn what LEDs we could potentially use to display a spectrum of colors

Search Engine: Google Scholar
Search Term: Color Ranging LEDs

Citation: J. Zhang, M. Han, M. Xu, L. Zhang, S. Liu, and W. Xie, "Color-tunable organic light-emitting devices and their applications," *Cell Reports Physical Science*, vol. 5, no. 1, p. 101764, Jan. 2024, doi: https://doi.org/10.1016/j.xcrp.2023.101764.

- -Rapid population aging and increased prevalence of disabilities have created a rising need for assistive technologies (AT) that support independence, safety, and quality of life for elderly people and individuals with physical/cognitive impairments.
- -The emergence of the Internet of Things (IoT) has enabled new generations of AT systems that combine sensors, wearables, smart environments, mobile apps, and cloud platforms.
- -IoT-based AT solutions support continuous monitoring, fall detection, vital-sign tracking, medication reminders, indoor navigation, emergency alerts, and remote caregiving.
- -Healthcare, smart homes, rehabilitation, mobility, and communication assistance are identified as the five dominant application areas.
- -Wearable devices serve as major data sources for physiological and movement monitoring; environmental sensors support safety and automation (e.g., gas detection, stove shutoff, door sensors).

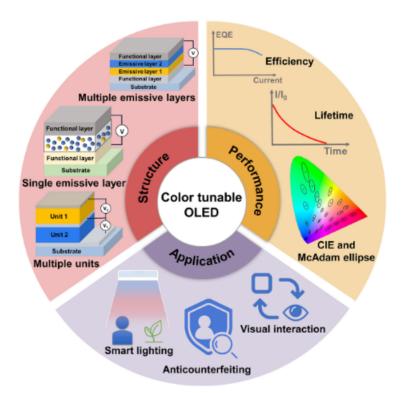


Figure 1. Schematic illustration of structure, performance, and application of CTOLED

- -Smartphones and tablets play a central role as assistive hubs due to affordability, accessibility features, and user familiarity.
- -Cloud computing, edge computing, and real-time analytics enhance IoT AT by allowing low-latency alerts, pattern detection, and caregiver dashboards.
- -Machine learning improves personalization, activity recognition, fall-risk prediction, and detection of anomalies in daily routines.
- -Security and privacy remain major challenges given the sensitivity of health and behavioral data collected from vulnerable users.
- -Key barriers to adoption include high cost, lack of interoperability, limited battery life of wearables, network reliability constraints, and technology acceptance issues among older adults.
- -User involvement in design is crucial; co-design with seniors and caregivers significantly improves usability, comfort, and trust.
- -Market fragmentation and absence of standardized frameworks hinder scalability and cross-vendor platform compatibility.
- -Future AT systems should combine IoT + AI + robotics + ambient assisted living ecosystems, supporting fully integrated home-to-clinic monitoring.
- -Ethical considerations, including autonomy, consent, dignity, and algorithmic fairness, must be prioritized as automation increases.
- -The review stresses the importance of hybrid solutions—systems that work online and offline, with cloud + edge computing to ensure safety during connectivity loss.
- -Research trends show a shift from single-function AT devices toward holistic, multimodal assistive ecosystems that address physical + cognitive + emotional needs.

Conclusions/action items: I have attached the datasheet for the LED we have decided on. The article itself was very helpful on understanding the different aspects of LEDs, especially for wearable device functions. The main concern is size and battery life from the actual device affecting the LED.

SMART LED WS2812B RING7

Weight 5g

DESCRIPTION

WISSBLB is an extremely let emoting LED that can emit light in red, gream or blue- or any combination of these three colors, able to show a total of approximately 5g million different colors. On this board, clodes are arranged and of the Tray accountal day by adequate provide may a few lines of onde from Andrian (IEC. That's possible thanks to the integrated cost roler winder the LED boats

FEATURES

• Runnber of LEDs?
• Woltage 5g
• LED type: WSBLIDB
• Current Elimb per LED
• Circle of amster. 23 mm/ 69 inch

USEFUL LINKS
• Andrian Blancy
• Direct
• Open Source Hardwood Firs

OTHER IMAGES

Lauren Klein - Nov 28, 2025, 11:56 AM CST

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333055 Smart LED WS2812B Ring7 datasheet.pdf (196 kB)



Download

1-s2.0-S2666386423006094-main.pdf (8.78 MB)

10/21/25 - BLE Connections in Circuits

Lauren Klein - Nov 27, 2025, 5:25 PM CST

Title: BLE Connections in Medical Devices

Date: 10/21/25

Content by: Lauren

Present: Individual

Goals: To learn how BLE connections work and can be used in medical devices

Search Engine: Google Scholar
Search Term: BLE connections

Citation: A. Del Campo, L. Cintioni, S. Spinsante, and E. Gambi, "Analysis and Tools for Improved Management of Connectionless and Connection-Oriented BLE Devices Coexistence," *Sensors*, vol. 17, no. 4, p. 792, Apr. 2017, doi: https://doi.org/10.3390/s17040792.

- -Bluetooth Low Energy (BLE) enables low-power wireless communication for markets such as home automation, healthcare, fitness, automotive, and consumer electronics.
- -Many ambient-assisted-living (AAL) systems require multiple sensor types operating together, including event-driven sensors (rare/unpredictable events) and streaming sensors (continuous health/environment data).
- -Event-driven sensors typically use connectionless mode (advertising) to save power, while continuous sensors use connection-oriented mode (persistent BLE connections).
- -Both communication types sometimes need to share a single central node to reduce network complexity and avoid having multiple gateways in the same home.
- -Improper scheduling by the central node can cause packet collisions, increased discovery latency for advertisers, and lost packets from connected devices.
- -The paper models medium-access control of the central node to manage both communication types efficiently.
- -The proposed system provides a tool to configure BLE parameters (scan interval, scan window, connection interval, advertising interval) during the network design phase.
- -A discovery latency model shows how long an advertising tag takes from event detection to the successful delivery of its packet to the central node.
- -A connection-oriented scheduling model specifies how the master must choose connection offsets and intervals to prevent overlaps between persistent connections.
- -The two models are merged into Algorithm 2, which selects values of Tsi (scan interval) and dsw (scan window) such that: tag discovery latency remains practical, and packet-loss probability for connected sensors stays below the desired threshold.
- -Results show discovery latency grows linearly with advertising interval when scan settings are fixed.
- -When two slaves have equal or multiple connection intervals, the system maximizes scan-time availability and minimizes discovery latency.
- -Increasing the number of connected slaves reduces allowed scan-window duration, increasing discovery latency for advertisers.
- -Case studies show that too many persistent connections can force event-based sensors to transmit for seconds before discovery, increasing energy consumption and slowing safety-critical alerts.
- -The tool therefore enables designers to balance energy, latency, and reliability by selecting hardware parameters before deployment.
- -This solution is particularly applicable to home automation and healthcare, where wearables and in-home sensors coexist and may need to share one central node (e.g., smart shoes + PIR sensors + door sensors).
- -"In connectionless networks, the devices are generally battery-powered; therefore, limiting the duration of transmission is necessary to save energy. An important metric to consider is the *discovery latency*, which is the time the tag spends in active state, from the start of transmission to the successful delivery of data to the central node. High *discovery latency* leads to increased energy consumption; therefore, limiting it is good practice.

The proposed model for discovery latency estimation is based on [18], but it differs for the ability to reduce the algorithm computational complexity, and for an extensive stochastic approach to the problem description"

Conclusions/action items: We will attempt to use a connectionless BLE for our device. We plan to power it with the 3.7V battery. Worst case we will develop the BLE connectionless aspect next semester and focus on just getting the data to the device with a cord attachment instead.

Lauren Klein - Nov 27, 2025, 5:19 PM CST



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sensors-17-00792.pdf (660 kB)

Lauren Klein - Nov 28, 2025, 11:40 AM CST

Title: Resin Material in Medicine and Properties of it

Date: 10/28/25

Content by: Lauren

Present: Individual

Goals: To learn about Resin in medical devices and its properties

Search Engine: Google Scholar
Search Term: Resin in Medicine

Citation: L. Wang, Y. Ju, H. Xie, G. Ma, L. Mao, and K. He, "The mechanical and photoelastic properties of 3D printable stress-visualized materials," *Scientific Reports*, vol. 7, no. 1, Sep. 2017, doi: https://doi.org/10.1038/s41598-017-11433-4.

- -The study explores using 3D-printed transparent materials to visualize and quantify internal stress fields in geological structures.
- -The material investigated is VeroClear, a transparent, UV-cured, photosensitive polymer suitable for PolyJet 3D printers.
- -Researchers aim to improve mechanical similarity between printed models and real rock masses, not only geometric similarity.
- -Chemical analysis (IR, XRD, and pyrolysis–GC/MS) shows VeroClear is primarily an acrylate-based polymer, with isobornyl-acrylate (IBOA) as the main component.
- -Mechanical performance of printed models depends strongly on printing orientation and post-heat treatment.
- -Horizontal build (S-Z orientation) results in higher compressive strength and stiffness than vertical orientations (S-X, S-Y).
- -Orientation effects arise from differences in UV exposure duration per layer and support-material shielding, rather than layering alone.
- -Post-processing heat treatment significantly enhances material properties, especially when heated to 150 °C.
 - · Heat treatment increases:
 - · compressive strength,
 - · direct tensile strength,
 - · strain at peak stress,
 - · Young's modulus, and
 - o tensile modulus.
- -The improvement above 120 °C is linked to the glass transition temperature (Tg) and the increased mobility and crosslink density of polymer chains.
- -VeroClear exhibits strong photoelasticity and birefringence, enabling visual mapping of stress—verified through fringe patterns under compression.
- -Stress-freezing behavior is observed at ~60 °C, allowing frozen-stress visualization after cooling.
- -Print-and-photoelastic techniques can reveal 3D full-field stress distributions, useful for geomechanics challenges (e.g., hydraulic fracturing, CO₂ sequestration, nuclear-waste disposal, seismic activity, and deep mining).
- -While modified printing and post-processing improve accuracy, natural rocks still differ in brittleness, heterogeneity, and inherent micro-defects.
- -Future improvements suggested: developing new printable materials with adjustable strength and brittleness, introducing micro-pores and fractures into prints to simulate real-rock imperfections, lowering Tg so stress-freezing occurs near room temperature, freezing treatments to increase brittleness.

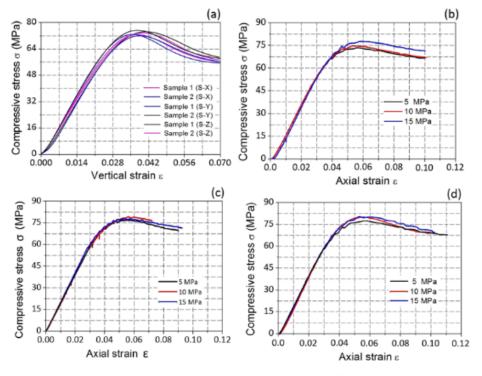
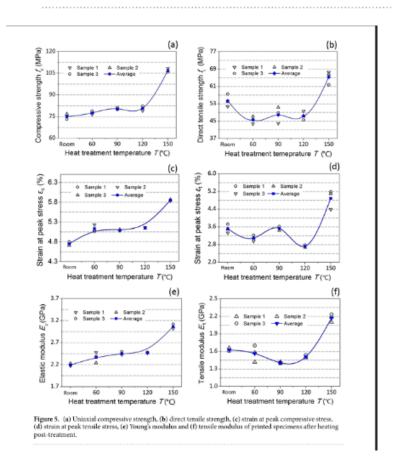


Figure 4. Stress-strain curves of 3D printed cylindrical samples built up by different methods under (a) uniaxial compressive conditions and (b-d) triaxial compressive conditions. Images b, c and d represent the building types S-X, S-Y and S-Z, respectively.



Conclusions/action items: We will make our final box out of resin due to its increased durability and heat withstanding. It's a little more dependable than PLA but is more expensive. We will need to get a stress-strain curve for our Resin box using the compression machine in the lab as well.



OPEN The mechanical and photoelastic properties of 3D printable stressvisualized materials

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s41598-017-11433-4.pdf (3.38 MB)

Lauren Klein - Nov 27, 2025, 5:15 PM CST

Title: Flutter App Making in Medicine

Date: 10/30/25

Content by: Lauren

Present: Individual

Goals: To learn how to use Flutter in a medical application

Search Engine: Google Scholar

Search Term: Flutter app making using health data

Citation: R. Mamoun, M. Nasor, and S. H. Abulikailik, "Design and Development of Mobile Healthcare Application Prototype Using Flutter," *IEEE Xplore*, Feb. 01, 2021. https://ieeexplore.ieee.org/abstract/document/9429595 (accessed Jun. 18, 2022).

- -Hospitals in Sudan are overwhelmed by patient volume, long wait times, medication shortages, and limited ambulance access creating a need for remote digital healthcare solutions.
- -A telemedicine mobile healthcare prototype was developed, installed, and tested on an Android smartphone.
- -The app enables online medical consultations, where patients can communicate with specialists via text, images, medical scans, and real-time video calls.
- -Users can order prescribed medications from connected pharmacies, pay electronically, and receive home delivery.
- -In emergencies, the app offers a fast ambulance-calling feature with medical advice for stabilizing the patient while waiting.
- -Doctors and nurses can monitor patients' health remotely, improving continuity of care.
- -Pharmacies and medical suppliers can advertise and distribute medical products directly to patients and healthcare providers.
- -An expert-system database is planned to store anonymized patient cases for training and Al-driven decision support.
- -The prototype was built using: Flutter SDK (cross-platform development with a single codebase), Dart programming language, Android Studio IDE, Flutter and Dart plugins for native functionality.
- -The app's architecture incorporates: secure login, profile management, symptom reporting, consultation history, medicine ordering, doctor directory, appointment booking.
- -Installation involved generating an APK file, enabling developer mode on the phone, and deploying via USB debugging.
- -Screenshots in the paper demonstrate successful implementation of core features, such as login, symptom submission, patient profile, consultation history, medical ordering, and doctor scheduling (pages 3–5).
- -The prototype successfully functioned on Android, but data privacy and encryption were not yet implemented and will be added in the full release.
- -Planned improvements include: an administrative portal for doctors and system managers, full support for iOS + Android, offline mode for low-connectivity areas, Al and augmented-reality tools for clinical decision support, supplier–pharmacy–doctor interface, wide-scale performance testing after deployment.

The following diagram shows the main components of the proposed healthcare delivery application.

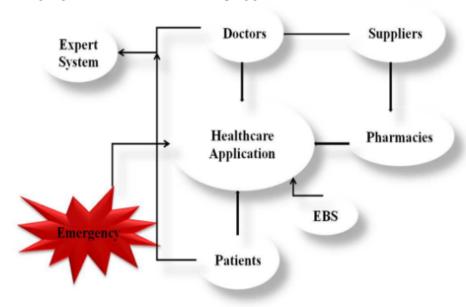
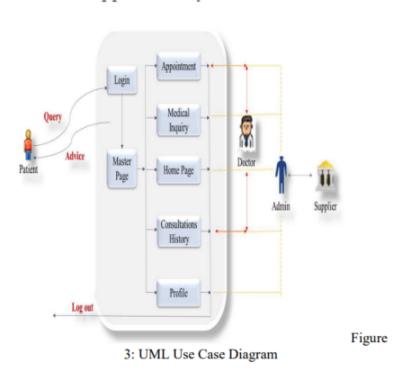


Figure 1: The Concept of the Proposed Mobile Healthcare
Application



In Figure 3, the unified modeling language (UML) Use Case Diagram for the prototype is shown, where the patient

Conclusions/action items: This is a really good example of using Flutter and Dart in a medical app making application. Although, the catch that we have to connect using BLE and we aren't sure how to do that. The flow diagrams will be helpful for a general guide.

2000 International Condense a on Computer, Control, Electrical, and Electronics Engineering (ICCCEEE)

Design and Development of Mobile Healthcare Application Prototype Using Flutter



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11/07/25 - Microcontrollers in Medicine

Lauren Klein - Nov 28, 2025, 12:32 PM CST

Title: Microcontrollers in Medicine

Date: 11/07/25

Content by: Lauren

Present: Individual

Goals: To learn how microcontrollers can be used in medicine and for wearable devices

Search Engine: Google Scholar

Search Term: Microcontrollers in medicine

Citation: Chinmay Pawase and S. D'Souza, "Revolutionizing Biomedical Engineering with Microcontroller Applications: A Comprehensive

Review," Lecture notes in electrical engineering, pp. 239-250, Dec. 2024, doi: https://doi.org/10.1007/978-981-97-8429-5 19.

Content:

- -The chapter focuses on IoT-enabled wearable and mobile health monitoring systems, especially for chronic disease prevention and management.
- -Health monitoring has shifted from hospital-centered care to patient-centered home- and community-based care, made possible by IoT, AI, and wireless sensors.
- -Wearables collect real-time physiological data, such as heart rate, ECG, SpO2, blood glucose, body temperature, sleep patterns, and activity levels.
- -Mobile-health (m-health) apps serve as the user interface layer, enabling patients to visualize biometric trends, receive reminders, and communicate with healthcare providers.
- -Cloud computing and edge computing platforms analyze collected data to detect anomalies, predict risk, and support early interventions.
- -Remote health monitoring improves diagnostic accuracy, continuous treatment tracking, and medical follow-up, especially for elderly and at-risk populations.
- -IoT-health architecture typically includes sensors → smartphone gateway → wireless transmission → cloud/edge analytics → doctor/caregiver dashboard.
- -AI and machine learning allow pattern recognition, early warning systems, and personalized recommendations for preventive care.
- -Data security, privacy, and user consent are essential issues because systems collect sensitive continuous biometric data.
- $-Interoperability\ problems\ --different\ vendors,\ data\ formats,\ and\ platforms\ --remain\ barriers\ to\ large-scale\ IoT-health\ deployment.$
- -Battery constraints and sensor miniaturization remain key engineering challenges for long-term wearable use.
- -Successful adoption depends on usability, requiring simple app interfaces, comfort, accessibility features, and adaptation to patients with low technical literacy.
- -Real-world deployment must address regulatory compliance, long-term data storage management, cybersecurity, and ethical risks related to surveillance.
- -Future directions include smart textiles, implantable sensors, nanotechnology, human-digital twin systems, and full digital-hospital integration.
- -The long-term goal is continuous preventative healthcare, reducing hospital visits, lowering costs, and enabling patients to manage conditions independently.

Chapter Specific:

- Microcontrollers serve as the **core technology** enabling modern biomedical devices by integrating processing units, memory, and peripherals into small embedded platforms.
- Their computational capability allows real-time data processing and physiological monitoring, supporting rapid clinical decision-making and intervention.

- Applications range widely, including wearable medical devices, implantable drug-delivery systems, prosthetic limb control, telemedicine systems, and diagnostic equipment such as MRI systems.
- Microcontrollers enable continuous remote patient monitoring, empowering patients to track their own health while reducing demand on hospitals and clinics.
- · Their versatility has expanded what is medically possible, improving treatment precision and overall patient quality of life.
- Evidence gathered from multiple research papers demonstrates how microcontrollers bridge the gap between theoretical biomedical design and practical clinical implementation.
- Examples discussed in the chapter include:
 - Prosthetic limb systems using microcontroller-based motion control
 - Cardiac monitoring systems capturing ECG signals in real time
 - Advanced telemedicine platforms integrating sensors, wireless modules, and smartphones
- A highlighted telemedicine prototype uses an ARM-7 LPC2148 processor to integrate MEMS, ECG, GPS, and GSM modules for remote transmission of vital parameters to doctors and relatives.
 - Modular hardware design is emphasized to support **flexibility**, **scalability**, **and future system expansion**, including the ability to add new monitoring modules as needed.
- The reviewed research collectively shows that microcontroller-driven systems are transforming healthcare accessibility, particularly for remote and underserved regions.

Conclusions/action items: There are vast applications of microcontrollers in medicine as we've been learning from Dr. N and our projects. Dr. N also has a similar book on these real world project applications but this book looks into how microcontrollers can help patients and improve wearable devices. Continuous care is taking on a new horizon.

Lauren Klein - Nov 28, 2025, 12:33 PM CST

Anshuman Tripathi · Amit Soni · Manish Tiwari · Anil Swarnkar · Jagrati Sahariya Editors

Intelligent Computing Techniques for Smart Energy Systems
Proceedings of ICTSES 2023, Volume 2

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Lauren Klein - Nov 28, 2025, 11:48 AM CST

Title: XIAO nRF52840 Series Information & Summary

Date: 11/07/25

Content by: Lauren

Present: Individual

Goals: To learn about the different versions in the XIAO nRF52840 Series

Search Engine: Google

Search Term: XIAO nRF52840

Citation: "Getting Started with Seeed Studio XIAO nRF52840 (Sense) | Seeed Studio Wiki," wiki.seeedstudio.com.

https://wiki.seeedstudio.com/XIAO BLE/

- -XIAO BLE is part of the Seeed Studio XIAO microcontroller family a collection of "thumb-sized" (very small) MCUs designed for projects where space, power, and size are constrained.
- -"BLE" indicates it has built-in wireless connectivity (Bluetooth Low Energy). Specifically, XIAO BLE uses the Nordic Semiconductor nRF52840 chip, giving it Bluetooth 5.x + NFC capability.
- -Its form-factor is tiny: roughly 21 mm × 17.5 mm, making it ideal for wearable devices, compact IoT gadgets, or embedded projects where space is limited.
- -CPU & SoC: ARM Cortex-M4 32-bit processor (nRF52840) 64 MHz with FPU.
- -Wireless Connectivity: Bluetooth LE 5.0 / 5.2, NFC (onboard antenna).
- -Memory: 256 kB RAM + 1 MB (on-chip) flash, plus 2 MB external QSPI flash (on "Plus" / "Sense" variants).
- -I/O & Interfaces:
- -Up to 11 digital I/O pins (PWM), 6 analog (ADC) pins (on base XIAO BLE)
- -Common serial interfaces: UART, I2C, SPI sometimes more on expanded variants.
- -On variants: NFC, SWD debugging pins, power/battery management pins, etc.
- -Power & Size: Ultra-low-power design: deep-sleep current under ~5 μA.
- -On-board extras (on "Sense" variants): Some versions include a 6-axis IMU and a PDM microphone useful for sensor, motion, or audio-based projects (gesture detection, voice, etc.)
- -Programming & Software: Compatible with popular platforms Arduino, MicroPython, CircuitPython; also usable with RTOS or embedded frameworks.
- -Tiny size + BLE/NFC + low power \rightarrow great for wearables, portable IoT devices, battery-powered sensors, or any embedded system where space and power matter.
- -Good for projects combining wireless communication + on-board sensing (e.g., motion tracking, wearable health sensors, TinyML with IMU/microphone).
- -Because it supports standard MCU programming environments (Arduino, MicroPython, etc.), it's accessible for learners, hobbyists, and rapid prototyping not just advanced embedded engineers.
- $-When you don't need a fully custom PCB yet \\ -- XIAO BLE can serve as a flexible "core board" for prototypes or small-batch products.$

Board	MCU / CPU / Speed	Wireless / Connectivity	Memory / Flash / I/O	Best Use Case / Strengths
XIAO nRF52840 BLE	ARM Cortex-M4F (nRF52840), ~ 64 MHz	Bluetooth 5 / BLE (plus NFC on some variants)	~256 kB RAM + 1 MB flash (on- chip), typical XIAO I/O config (11 GPIO / 6 analog)	Low-power wireless devices, BLE-only IoT, embedded sensors, small devices where WiFi isn't needed
XIAO ESP32C3 — Seeed Studio XIAC ESP32C3	32-bit RISC-V, up to 160 MHz	WiFi + Bluetooth 5 (BLE)	~400 kB SRAM, 4 MB Flash, 11 GPIO / 4 ADC channels	Projects needing small-board WiFi + BLE — e.g. IoT devices with internet connectivity, remote sensors, home automation
XIAO ESP32S3	Dual-core Xtensa 32-bit (~240 MHz)	WiFi + Bluetooth 5 / BLE, sometimes with advanced features (for camera/sensor expansions)	Larger memory (PSRAM/Flash) on "Sense/Plus" variants; more I/O, more power — varies by sub- variant	More demanding embedded applications: ML/AI-enabled IoT, camera/sensor modules, projects needing heavier CPU + memory
(Others — e.g. XIAO RP2040, XIAO SAMD21, etc.)	Various (dual-core, lower-power, lower- freq)	Typically no wireless (unless variant adds)	Varying RAM/Flash, modest I/O — good for basic MCU tasks	Ideal for simple control tasks, sensor reading, cheap embedded control without wireless overhead

Conclusions/action items: The XIAO ESP32C3 or ESP32S3 have built in Wi-fi and would be good to look into for next semester! Overall, the nRF52840 will do what we need for now. The BLE connection aspect of our code will be the toughest part.

11/18/25 - Soldering and Desoldering

Lauren Klein - Nov 28, 2025, 12:22 PM CST

Title: Soldering and Desoldering How-to

Date: 11/18/25

Content by: Lauren

Present: Individual

Goals: To learn how to solder and desolder

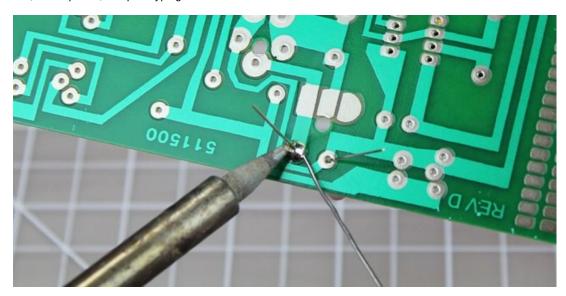
Search Engine: Google

Search Term: Soldering and desoldering

Citation: I. #electronics • 6 Y. Ago, "SOLDERING AND DESOLDERING BASICS," Steemit, Jan. 22, 2018.

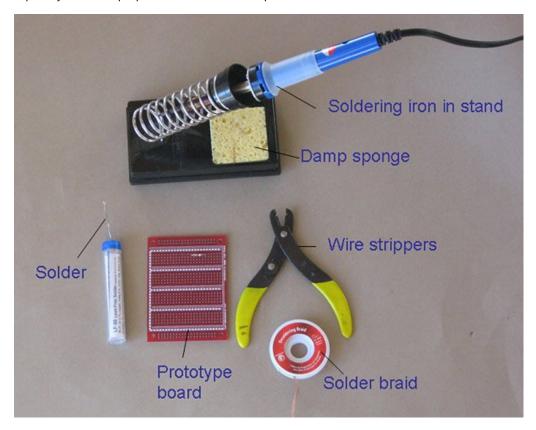
https://steemit.com/electronics/@ivancuyag/soldering-and-desoldering-basics

- -Definition of soldering: Soldering is the process of joining two or more metal parts by melting a filler metal (solder) so it flows into the joint and creates a permanent conductive connection.
- -Definition of desoldering: Desoldering is the opposite it's the process of removing solder to separate components or undo soldered connections.
- -Common uses: Handy for prototyping, repairing electronics, modifying existing circuits, or salvaging components.
- -Basic requirement: A soldering iron (or soldering tool) plus solder. For desoldering, additional tools may be needed (see below).
- -Manual wiring & prototyping contexts: The article highlights soldering/desoldering as basic but essential skills for small-scale electronics work breadboards, perf-boards or PCBs where components are soldered manually.
- -Core idea: reversible connections soldering allows assembly, while desoldering allows rework or modification, making the approach versatile for DIY, development, and prototyping.



- -From broader electronics-guidance sources, these practices help ensure reliable solder/desolder work.
- -Cleanliness matters: Before soldering clean component leads, PCB pads, and soldering-iron tip. Oxidation or contaminants reduce solder wetting and produce weak joints.
- -Proper heating technique: Heat the components (pad + lead) not just the solder. Place the soldering iron tip such that it contacts both surfaces, then touch solder to the joint (not the iron tip). This ensures solder flows properly.
- -Use flux / rosin-core solder: Flux helps remove oxidation and improves wetting, ensuring stronger, more consistent solder joints.

- -Avoid common mistakes:
- -Cold joints: result of insufficient heat or moving the joint too soon they tend to look dull instead of shiny.
- -Excessive solder / blobs: too much solder can bridge adjacent pads/pins or create weak mechanical joints. Proper fillet (concave, smooth) is preferred.
- -Overheating: too much heat or prolonged heating can damage components, lift PCB pads/traces, or degrade solder mask.
- -Desoldering techniques: Common tools/methods:
- -Desoldering braid (solder wick) braided copper wire, rosin-coated, placed over molten solder to wick it away via capillary action.
- -Desoldering pump (solder sucker) melt solder with iron, then use suction to draw molten solder away.
- -For surface-mount components or dense PCBs, one may use hot-air rework stations / hot-air guns to uniformly heat all solder joints and remove parts, especially when multiple pins or heat-sensitive components are involved.



- -Work safely: Soldering irons get very hot (hundreds of °C). Use a stand when not heating; ventilate the workspace to avoid inhaling fumes (especially with lead-based solder); wear eye protection when needed.
- -Practice makes perfect: Good soldering/desoldering takes manual skill. It's often recommended to practice on scrap boards or unused components before committing to a real project.
- -Use soldering when you want to permanently (or semi-permanently) attach components to a PCB (or perf-board), e.g. building circuits, repairing electronics, making custom modules.
- -Use desoldering when you need to replace components, fix errors, salvage parts, or modify a circuit.
- -This flexibility soldering for build, desoldering for rework/repair makes solder–desolder skills fundamental for prototyping, development, and maintenance in electronics projects.

Conclusions/action items: Overall, soldering and desoldering do not seem too difficult. We are going in tomorrow to work on our circuit and hopefully will find someone to give us a demo as well. If we mess up, desoldering the item shouldn't be hard but we need to watch out for overheating.



Download

SOLDERING_AND_DESOLDERING_BASICS_Steemit.pdf (1.08 MB)

Lauren Klein - Nov 28, 2025, 11:36 AM CST

Title: Perf Boards and what they are used for

Date: 11/20/25

Content by: Lauren

Present: Individual

Goals: To learn about perf boards and how we could use one in our project

Search Engine: Google Scholar

Search Term: Perf Boards

Citation: "What is Perf Board Printed Circuit Boards PCBs? Perf Board vs Breadboard - PCB & MCPCB - Best Technology," *PCB & MCPCB - Best Technology - More Technical Details & News on PCB, MCPCB & Ceramic PCB from Best Technology*, May 28, 2025. https://www.bestpcbs.com/blog/2025/05/what-is-perf-board-printed-circuit-boards-pcbs-perf-board-vs-breadboard/ (accessed Nov. 27, 2025).

- -A Perfboard (perforated board) is a type of prototyping board: a rigid substrate with a regular grid of holes (usually 0.1 in spacing), each (often) surrounded by a copper pad or ring.
- -Components resistors, capacitors, ICs, etc. are placed through the holes and soldered to the pads. Connections between pads are created manually (wires, solder bridges, etc.), because the copper pads are isolated by default.
- -Perfboard's substrate is often fiberglass-epoxy (FR-4) or phenolic paper-resin, similar to many standard PCBs.
- -Use-cases of perfboard: small or custom circuits; semi-permanent or permanent builds when a full PCB isn't justified; hobby / DIY or small-batch electronics projects.
- -Relative to a Breadboard (solderless prototyping board):
- -Breadboards allow you to plug in components without soldering, making them fast and reusable, ideal for rapid prototyping or early experiments.
- -But breadboards have weaker mechanical stability, and connections are less reliable (more likely to fail under movement / vibration), and often unsuitable for high-power or high-frequency circuits.
- -Perfboard requires soldering (so less convenient for quick changes), but yields much stronger, more durable, and stable circuits better suited for permanent or longer-term builds.
- -Compared to a full Printed Circuit Board (PCB): 1) PCBs are manufactured with pre-etched copper traces and optimized layouts offering compactness, reliability, professional-grade stability, and are ideal for complex or final-product circuits. 2) Perfboard offers a middle ground: more permanent than breadboard but simpler (and usually cheaper) than full PCB fabrication useful when you don't need or can't justify a custom PCB.
- -Trade-offs / Pros & Cons:
- -Perfboard Pros:
- 1) Strong mechanical stability once soldered.
- 2) Good for custom or small-scale circuits without manufacturing a full PCB.
- 3) Flexible layout you design wiring manually, so you're not constrained by predefined traces.
- -Perfboard Cons
- 1) Requires soldering and manual wiring more labor-intensive, especially for dense or complex circuits.
- 2) Less convenient for redesigns once soldered, it's harder to rework compared to breadboard.
- 3) Routing manually can be messy / messy-looking, and there's a risk of unintended shorts if wiring isn't careful.
- -When to use which board:

- 1) Use breadboard → for prototype, early testing, learning, quick experiments, circuits likely to change.
- 2) Use perfboard \rightarrow for semi-permanent or small custom circuits, when you want more reliability than breadboard but don't need a full PCB yet. Good for hobby or small-scale builds.
- 3) Use PCB → for final designs, commercial-level production, compact or complex circuits, or high-reliability requirements.

Conclusions/action items: Perfboards are very useful when making small circuits that are relatively simple and permanent. Since we are unsure if the circuit will work fully once created, a perfboard wouldn't serve our best purpose in the case we might need to change a component. If we decide to look into a PCB again next semester, we could test the component skematic on a perfboard.

Lauren Klein - Nov 27, 2025, 5:29 PM CST



Download

What_is_Perf_Board_Printed_Circuit_Boards_PCBs__Perf_Board_vs_Breadboard_-_PCB_MCPCB_-_Best_Technology.pdf (2.77 MB)

11/23/25 - Common Circuit Error Sources

Lauren Klein - Nov 28, 2025, 12:44 PM CST

Title: Common Sources of Error in Electronic Devices

Date: 11/23/25

Content by: Lauren

Present: Individual

Goals: To learn what common sources of error typically happen in electronic devices and how those line up with issues we've had.

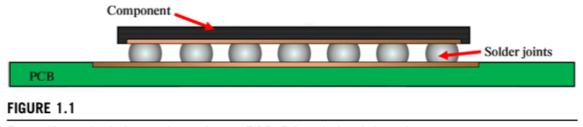
Search Engine: Google Scholar

Search Term: Common Sources of Error in Circuits and Soldering

Citation: Abdel Salam Hamdy Makhlouf and Mahmood Aliofkhazraei, *Handbook of materials failure analysis : with case studies from the electronic and textile industries*. Oxford, United Kingom; Cambridge, Ma: Butterworth-Heinemann, 2020.

Content:

- -Modern electronics are becoming smaller, thinner, and lighter, increasing the importance of solder joint reliability in maintaining electrical function across PCB components.
- -About 70% of electronic equipment failures are caused by solder-joint failures, making it the dominant failure source in modern devices.
- -A typical electronic package contains three critical parts: PCB, component, and solder joints solder joints enable electrical and mechanical interconnection between them.



Parts of a typical electronic package. PCB, Printed circuit board.

Thermal Cycling

- -Electronics undergo repeated temperature swings from high to low and back (e.g., -40 °C to 125 °C), causing cyclic strain in solder due to coefficient of thermal expansion (CTE) mismatch between PCB and component.
- -Strain localizes in solder joints \rightarrow plastic deformation \rightarrow recrystallization \rightarrow grain coarsening \rightarrow crack initiation \rightarrow crack propagation \rightarrow complete joint failure.
- -Failures typically occur inside the solder matrix near intermetallic layers and parallel to imposed shear strain.

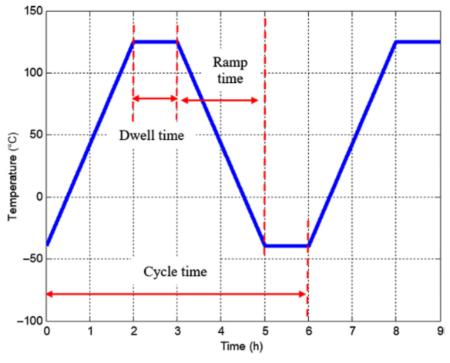


FIGURE 1.3

One thermal cycle profile.

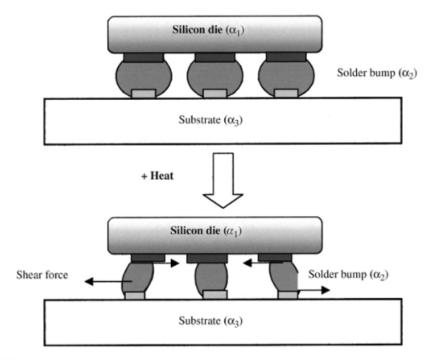


FIGURE 1.4

Deformation of solder joint subjected to shear strain during thermal cycling due to coefficient of thermal expansion mismatch [4].

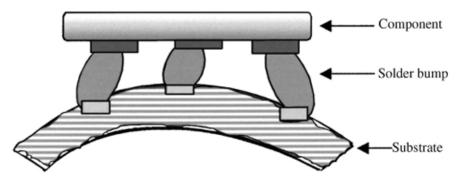


FIGURE 1.5

Deformation of solder joint subjected to tensile due to printed circuit board flexing [4].

Shock / Drop Loading

- -Drop/impact causes high strain at low frequency, generating sudden mechanical bending of the PCB and inducing failure.
- -Failure mode is typically interfacial cracking on the package or board side, with little bulk solder deformation due to solder strengthening under high strain rate.

Mechanical Vibration

- -Vibration during shipping and service life produces low strain at high frequency, stressing solder balls repeatedly.
- -Harmonic vibration (cyclic sinusoidal) and random vibration both lead to fatigue accumulation and interconnect damage driven by PCB flexing.
- -Solder cracking is commonly detected via continuous electrical resistance monitoring, assuming that cracks cause discontinuity or abrupt resistance increases.
- -Four major international standards define solder-failure criteria in reliability tests:

IPC-SM-785

IPC-9701

JESD22-B111

IPC/JEDEC-9702

- -These standards use thresholds such as 1000 Ω spike of ≥ 1 μ s, 20% increase in initial resistance, or multiple recurrent electrical events within set cycles/drops, depending on test type.
- -Increase PCB stiffness using thicker boards, smaller board size, stiff laminates, or adding stiffeners (e.g., heat sinks) improves fatigue life.
- -Use rigid IC packages thicker and smaller components reduce deformation mismatch between component and PCB.

Optimize solder joint geometry:

- -Shorter/interconnects (LGA) perform better under thermal cycling.
- -Taller interconnects (BGA) perform better under bending and vibration.
- -Slim/cylindrical shapes are advantageous in bending-dominated environments.
- -Solder joints are the weakest mechanical link in electronics, and failure is driven primarily by thermomechanical fatigue, mechanical shock, and vibration-induced stresses.
- -Reliability depends heavily on solder material properties, geometric design, PCB/component stiffness, and operating environment.
- -Proper design, testing, and monitoring drastically reduce failure rates and extend product lifetime.

Conclusions/action items: Since 70% of circuits usually fail due to soldering issues, the problems we've experienced are very much normal. There are standards we must follow if we use a soldered circuit in the future as well. I will touch on these when I discuss issues and future

work in the poster and report.

Lauren Klein - Nov 28, 2025, 12:36 PM CST



Download

3-s2.0-B9780081019375000014-main.pdf (3.02 MB)



09/25/25 Design Idea #1 - Lithium Ion with USB insert

Lauren Klein - Sep 25, 2025, 9:03 PM CDT

Title: Design Idea #1 - Lithium Ion with USB Insert

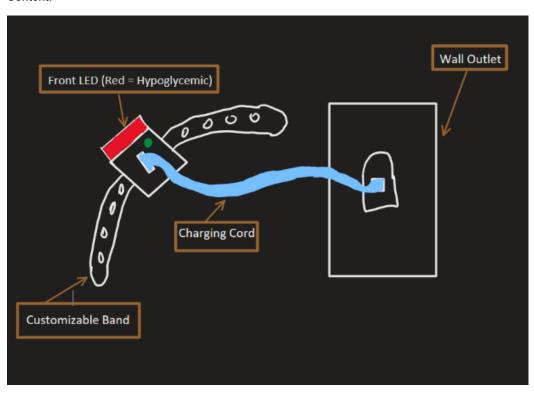
Date: 09/25/25

Content by: Lauren

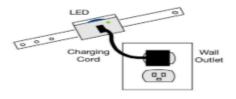
Present: Individual

Goals: To display my first/initial design idea regarding the lithium ion battery option

Content:



redrawn by Isabel:



Conclusions/action items: I have attached this design idea to the Design Matrix for our Battery & Charging system. It is missing dimensions as we don't know what size we want it to be yet.



09/25/25 - Design Idea #2 - Lithium Ion with Wireless Charging

Lauren Klein - Sep 25, 2025, 9:03 PM CDT

Title: Design Idea #2 - Lithium Ion with Attachable Charging

Date: 09/25/25

Content by: Lauren

Present: Individual

Goals: To display my second design idea which is a variation on Design #1 but more similar to an Apple Watch as it takes away the insertion point...

Content:

Conclusions/action items:This charging cord attached onto the back and does not insert. Very similar to an Apple Watch charger!

Lauren Klein - Nov 27, 2025, 12:02 PM CST

Title: Circuit Soldering Pt 1

Date: 11/19/25

Content by: Lauren

Present: Isabel & Lauren

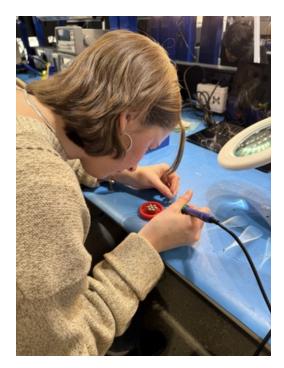
Goals: To learn how to solder and start soldering the basic components on our circuit.

Content:

- -We soldered the headers onto the LED and Microcontroller
- -Need to figure out if we for sure need the headers on, otherwise we will just desolder them later
- -Worse comes to worse we will just make the circuit on a really small breadboard with the pre-soldered XIAO

Conclusions/action items: We soldered headers onto the LED and Microcontroller for our circuit. The general learning of how to solder went really well! There were multiple people in the Makerspace who helped, including Lizzie, which set us up for success. We have a pre-soldered microcontroller coming.

Lauren Klein - Nov 27, 2025, 12:00 PM CST



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IMG_9034.jpg (5.22 MB)

Lauren Klein - Nov 27, 2025, 12:00 PM CST





Download

IMG_9040.jpg (3.67 MB)

11/21/25 - 2nd Circuit Soldering Session

Lauren Klein - Nov 27, 2025, 12:06 PM CST

Title: Circuit Soldering Pt 2

Date: 11/21/25

Content by: Lauren

Present: Isabel & Lauren

Goals: To desolder the header pins from the LED and Microcontroller as well as start connecting the XIAO to the LED.

Content:

Rather than having the header pins, we decided to just solder wires onto the Microcontroller and attach it to the LED

- -We cut off the headers we previously attached
- -A Electrical Engineering student friend of mine came over and assisted us
- -We learned from him that the Microcontroller we have will not charge our battery which we weren't aware of until then
- -We successfully got the wires attached to the LED and XIAO
- -The circuit is still not perfect and has a lot of room for improvement
- -We also were told we don't need a capacitor

Conclusions/action items: We now have soldered wires connecting the LED to the XIAO. It was really difficult due to the small nature of both components. We have to figure out how to adjust the other components of our circuit though as we currently cannot charge the battery and the capacitor is way too big for the box.

Lauren Klein - Nov 27, 2025, 11:59 AM CST



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IMG_9072.jpg (4.04 MB)

Lauren Klein - Sep 12, 2025, 11:48 AM CDT

Title: BSAC General Meeting

Date: 09/12/25

Content by: Lauren

Present: Individual

Goals: To better the student experience in BME

Content:

- -BSAC Executive Committee again
- -Went through intros
- -Struggles with client communication
- -Project Selection went smooth-ish
- -Need clarification on research entries maybe a uniform number
- -Want into on how clients propose projects
- -Stressed about career fair
- -Training throughout the curriculum = 1 new training per semester
- -See doc for a list
- -More expansion with the listed options for trainings
- -Project Selection last on the random list get jipped
- -Get the BME class sheet out earlier (once past progression)
- -BME Canvas course advising page
- -Do your LabArchives on time
- -Be intentional about what your client want sooner than later
- -See what communication form works best for them
- -Set a budget!

Conclusions/action items: Overall, things are going well so far! Need some clarification on a few things like trainings and notebook entry numbers. I will be attending BSAC Executive next week.

Lauren Klein - Sep 19, 2025, 11:48 AM CDT

Title: BSAC Executive Meeting

Date: 09/19/25

Content by: Lauren

Present: Individual

Goals: To plan next week's general BSAC Meeting and summarize the points made last week

Content:

Last Meeting:

- -Went into Introductions on members at each table
- -Talked a little bit about project/client hold-ups
- -Training throughout the curriculum
- -Project Selection Feedback Response
- -General Feedback
- -What topics should the focus of the next BSAC meeting w faculty
- -Maybe send minutes to the entire BME program?
- -Advisors should be discussing the trainings as well
- -Maybe a more expansive list of training options or a submission form on outside source
- -Classes are designated by 3 or 2 credits (should be 6 hours outside of class) and should be seen through your notebook
- -Some weeks have more work for prototyping or like a PDS week
- -Disconnect via inconsistency tho
- -Suggestions to push resources about courses and other sheets earlier but Puch said it is sent automatically with progression
- -Email goes out during summer and no one really checks it, maybe send out beginning of school or around course scheduling
- -Purposely don't list to avoid discouraging
- -Talked a lot about project proposals

Next Meeting w Faculty:

- -Bring up Lab Archives
- -Course Advising
- -Training throughout the curriculum with advisors?
- -Mentor stuff
- -Discrepancies in advisor's gradings
- -Standardize grading?
- -Automatic Client Meeting scheduled?
- -Do advisors choose what projects to work on?

Conclusions/action items: I need to make sure I'm sharing what we discuss in BSAC to my team in order to keep them in the loop. We will meet next Friday with faculty to discuss the topics and questions we set up today.

Lauren Klein - Sep 26, 2025, 11:42 AM CDT

Title: BSAC General Meeting w/ Faculty

Date: 09/26/25

Content by: Lauren

Present: Individual

Goals: To discuss current pressing matters in design

Content:

- -Went through faculty introductions
- -Discussion reminders
- -Student intros

Drafting and Submitting PDS: Had a little bit of trouble with 170 not teaching PDS for some stuff, have to roll with the punches, client helped with information

Client Communication: some client's won't respond to emails, but others are helpful during meetings and respond timely,

Project Stage: Getting into prototyping and getting ready for prelim presentations, prototyping doesn't need to be elaborate, some trouble with design matrices with unique projects and their materials

Expectations w Advisor: Yes, we talked about it with Dr. P! Some groups aren't, has been biggest struggles for some, reliant on juniors! PUT EVERYTHING IN THERE

Thoughts on a suggestion form for training throughout the curriculum: LOOK AT CITY (IRB) TRAINING, the required one for juniors, having an individualized sheet for each track too with good suggestions

Whole group:

- -Theme across years of BSAC: not always a set number of entries (maybe advisors should make a set expectation)
- -Some people don't know how to effectively use their advisor
- -Progress Report each week has goals, so that should be a topic of discussion
- -Putting everything in LabArchives is better than nothing to show your efforts
- -Internships want everything documented for FDA
- -More mentor expectations as 300s?
- -Want to change "training throughout the curriculum" to a filterable sheet!
- -Need to write IRBs = DO CITY TRAINING

Conclusions/action items: Juniors need to complete the CITY Training for writing IRBS. Don't forget you are the voice for your team and make sure to tell them what you talk about since we are "representatives."

Lauren Klein - Oct 26, 2025, 10:54 AM CDT

Title: Mentee Initial Meetings

Date: 09/29/25

Content by: Lauren

Present: Individual

Goals: To get to know my 3 mentees and answer the first list of topic questions.

Content:

Mentee 1: Elizabeth

TOPICS FOR DISCUSSION

In your meetings this semester, it would be valuable to discuss the following:

- Ask them why they chose BME and if their plans have changed to another discipline.
 - · Likes math and AP Bio, dad's a doctor but doesn't wanna be a doctor but like the direct impact on patients
 - o Master's or maybe PhD, BIDE interest! Wants to go abroad.
- · Ask about their first few weeks here on campus (so we can gather info about the "Freshman" experience).
 - Lives in Kronsage! Had a similar workload in high school which has been helpful. Is taking Chem 109 (AP Chem in high school)
- · Tell them about your research/design project/extracurricular activities.
 - Talked about me!
- Ask them if they have attended any BMES events, perhaps invite them to attend with you.
 - Is in SWE, BMES, Italian Club, Hoofers? Thinking about ULC tutoring? Also does choir!
- · Find out about other activities they would like to be involved in within the mentorship program, BME, and UW in general.
 - o Is thinking about research! Will be forwarding to Dr. P
- · Bring these thoughts and your experience back to BSAC and BME.
- · Ask them why they chose BME and if their plans have changed to another discipline.
 - Wanted patient care but doesn't want like bed side
 - Prothestics
- · Ask about their first few weeks here on campus (so we can gather info about the "Freshman" experience).

0

- Tell them about your research/design project/extracurricular activities.
 - · Works, Letters of Love interest,
- · Ask them if they have attended any BMES events, perhaps invite them to attend with you.

0

• Find out about other activities they would like to be involved in within the mentorship program, BME, and UW in general.

0

• Bring these thoughts and your experience back to BSAC and BME.

0

Conclusions/action items:

Lauren Klein - Oct 03, 2025, 11:14 AM CDT

Title: BSAC Executive Meeting

Date: 10/03/25

Content by: Lauren

Present: Individual

Goals: To discuss next week's whole group BSAC Meeting

Content:

- -Recap of last meeting: Dr. P liked the idea of multiple ideas, BME Mentors came out, Suggestion Form, Semester changes/improvements
- -Went over Suggestion Form!
- -Made a couple of alterations in order to better suit each question's needs on the form
- -Main topics for the semester: trainings, course advising, BME flowchart revamp?
- -Prelim Report and Eval form due Wednesday

Conclusions/action items: The suggestion form will be implemented for trainings throughout the semester/curriculum. We cut the meeting short due to Preliminary Presentations. We have a whole group BSAC meeting next week.

Lauren Klein - Oct 10, 2025, 11:44 AM CDT

Title: BSAC General Meeting

Date: 10/10/25

Content by: Lauren

Present: BSAC

Goals: To update the whole group on executive's topics and upcoming deadlines

Content:

- -Brought up moving 300 lecture to online, LOVE this idea cause it conflicts with ECE classes
- -Presetting meetings with clients for projects could be a logistical nightmare
- -Project selection website is too complex to fix the project selection issues
- -Advisors do pick their 200/300 project, new faculty pick first then the rest of faculty do selection similar to students
- -Presented the executive board's training throughout the curriculum
- -Thoughts on form: none --> getting sent to Dr. P and will be put on the website or google doc with training info
- -Talked about mentor/mentee meetings --> brought up mine doesn't know how to get into research labs

Discussion:

How were prelim presentations? --> Good! Generally positive outcomes

How was prelim report? --> A little less great, busy week and hard to get everything done with midterms. Some difficulty with concise writing

At what stage are you in your project? Prototypes? --> At a standstill because we need our contact to order them, have spent so much time writing deliverables but now need to kick it into gear to get a prototype for Show & Tell

Are expectations clear for Show and Tell? --> As long as it functions to some capacity, as long as some parts are complete

Whole Group:

- -Some presentations went on for 15-20 mins which took time away from other groups at the end.
- -Some groups had lots of questions and some had none, maybe advisors should call out each group so each question gets asked at least 2 questions
- -Maybe push prelim report due date off to Friday
- -Prelim feedback fruits also could get pushed off
- -Preliminary report discussion & testing section is really hard to write
- -More clarity needed^
- -Advisors still have inconsistency with grading LabArchives
- -A lot of groups didn't get prelim presentation feedback which then can't be implemented in prelim report
- -Advisor feedback fruits!
- -Unsure if we have 50\$ in makerspace for each group?
- -Encouragement of deviation from the normal path like if there isn't a strict shelf life

Conclusions/action items: Need to start prototyping and ordering. 3 weeks from today until Show & Tell. Everyone was on the same page about feeling overwhelmed the past few weeks with deliverables.

10/24/25 - BSAC General Meeting w Faculty

Lauren Klein - Oct 24, 2025, 11:46 AM CDT

Title: BSAC Meeting w Faculty

Date: 10/24/25

Content by: Lauren

Present: Individual

Goals: To talk about current problems in the BME program and address them

Content:

- -Touched on BME mentor/mentee program situation
- -I followed up with my 3rd one again today
- -Will be meeting with 2nd Sunday
- -Went through intros
- -Dr. David Dean
- -Prototype situations:
- -Explained we are having issues with connectivity and might have a hard time coming up with questions
- -Some groups have prototyped with plastic and are waiting for materials
- -Otherwise there are issues with finding difficulties with fabricating that lead to redesigning
- -Testing plans --> some are very straightforward and have 1-2 tests, we have 3 tests and are also relatively straightforward, continuation groups are redoing past tests, someone should be able to replicate or continue what you're doing based on written plan/protocol
- -Training throughout the curriculum: went well! some haven't done it yet, is due next Friday
- -Course Enrollment Questions from 200s?
- -Talked a lot of ISO/Standards and the tricky aspects of that with projects

Whole Group:

- -Material ordering usually raises problems (between getting the ordered product and just ordering it)
- -Maybe need to add a clause in the project proposal for specifications for that
- -BPAGs have been told to have the client buy things
- -Maybe suggest the client ship it to a different address
- -Some people use Venmo/Zelle if the client is personally fund it
- -If its UW funded it can be way more tricky
- -Physicians then have trouble due to being so busy
- -Some groups are having issue showing flow for software or AI
- -Some are having trouble deciding on testing methods
- -rabbit.wisc.edu --> search
- -wcnt
- -Make sure you're thinking about statistics and how we can utilize that (p or t tests)
- -Could go deeper into tracks during 201

Conclusions/action items: I've completed the Training Throughout the Curriculum. We talked a lot about prototyping and testing in preparation for Show & Tell. We will not meet next week for a BSAC Executive meeting before Show & Tell.



10/24/25 - CITI "Training throughout the Curriculum"

Lauren Klein - Oct 24, 2025, 11:45 AM CDT

Title: CITI Training

Date: 10/24/25

Content by: Lauren

Present: Individual

Goals: To complete the CITI training for future human trials

Content:

-See attached PDF

-Training took roughly 2.5 hrs

-Completed on Oct 13th

Conclusions/action items: I completed the CITI Training and received a certificate. In the future, if we ever do clinical/human trials, or if I work in a lab this will be very helpful. It definitely felt more applicable to research labs but was still good knowledge.

Lauren Klein - Oct 24, 2025, 11:43 AM CDT



Download

Lauren_Klein_CITI_Cert_HSR.pdf (77.4 kB)

Lauren Klein - Nov 07, 2025, 11:30 AM CST

Title: BSAC General Meeting

Date: 11/07/25

Content by: Lauren

Present: BSAC

Goals: To get updated on current problems and concerns in BME

Content:

- -Client Budgets are set prior but we just can't see them
- -Report and feedback fruits deadlines will remain the same
- -A leadership talk on Wednesday before project selection was supposed to happen but got cancelled last minute
- -201 and 200 can't stop
- -CITI training expires in 3 years and was very much focused on research labs
- -Reviewed Training throughout the Curriculum request form again and approved it
- -Will update on a spreadsheet once approved by Dr. P
- -Are gonna have a regular one and a track specific one
- -Went through individual intros
- -Show & Tell: One cohort had issues with timing wise (400s), feedback was pretty decent could be more helpful, some groups had neither advisor there
- -Starting to move into fabrication and testing in the next few weeks before Thanksgiving
- -Some 200 questions on enrollment
- -Feeling stressed cause of exams and thanksgiving right before posters
- -Sometimes S&T is beneficial to just develop your elevator pitch of the project
- -NEED TO HAVE POSTER PRINTED ON WEDNESDAY

Conclusions/action items: We will have a BSAC Executive Meeting next Friday. We need to kick it into fear in terms of fabrication and testing. We can use some of the knowledge we got from Show & Tell in changes for fabrication.

Lauren Klein - Nov 21, 2025, 11:35 AM CST

Title: BSAC General w Faculty

Date: 11/21/25

Content by: Lauren

Present: Individual

Goals: To get updated on current problems in BME

Content:

- -Dr. P resent invites to mentees for the BME Advising Canvas page
- -CITI Training can be very useful if you get through a design project successfully
- -Did intros

Design Project Progress:

Team's plan for remainder of semester --> Varying stages in fabrication, lots of groups who are continuing less stressed.

Testing and data collection --> Some teams are finishing testing!

Ready for Poster Prez? --> Almost everyone has poster/report formatted and ready for data input

Expectations for project/prototype --> Pretty clear, some are at different stages than others but always trying to put our best foot forward

Client Questions:

How is client comms going? --> Varies, some have trouble with getting responses, ours have been really good

Is project continuing? --> Yes for most groups!

Enrollment went well! The tech electives sometimes have issues with enrolling in because of limited spots

- -Varying levels of mentorship from 300s
- -Go back to PDS and review criteria to test against
- -Try to get testing done before Thanksgiving so you can analyze over break
- -Some trouble figuring out amount used at Makerspace

Conclusions/action items: We have a lot of progress to make in the next 2 weeks in terms of our project. There have been some big hurdles to get over but it'll work out! Otherwise everything in BME is going pretty well.

Lauren Klein - Sep 10, 2025, 1:55 PM CDT

Title: BME Career Prep & Getting ready for the career fair AND job searching

Date: 09/10/25

Content by: Lauren

Present: BME 300's

Goals: To prepare for the career fair

Content:

- -Track what you do (ECS tracking sheet)
- -Quality of Source Matters (Handshake, LinkedIn, etc)
- -Connect before you are a candidate
- -Apply and then follow up (2-3 weeks later)
- -Focus on skills, industry, and exposure

Resumes:

- -Tailor the resume to the position (quick changes, watch out for AI scans)
- -Design projects without years/semesters
- -Technical skills and coursework
- -Jobs (organization, location, position title, and dates)
- -Make sure to integrate in key words
- -NO Dates unless actual job experience

Cover Letters:

- -Always based on the job posting
- -Customize to each job
- -Amplify your greatest selling points
- -Clear and Concise
- -Recommended vs required

Outline:

- 1) Intro: who are you, applying for, where you found it, and "thesis"
- ex: "Based on my experience in A and B, I believe I would be able to make a difference in the X role at Y company"
- 2) Paragraph all about A
- 3) Paragraph all about B
- 4) Why this employer/role + closing/next steps

Career Fair Advice for BME:

- -Identify your purpose (more than just an internship)
- -Look beyond obvious
- -Research employer, if its an alumni utilize that to your advantage

- -Develop your value added statement
- -Highlight why as a BME you are more diverse and well rounded than a typical Electrical Engineer

Conclusions/action items: Your resume is always changing and getting better. It will never be perfect. Always edit your documents to fit the job!

Lauren Klein - Sep 17, 2025, 2:01 PM CDT

Title: Lecture #2 - All about Leadership

Date: 09/17/25

Content by: Lauren

Present: 300's

Goals: To learn how to be a good leader in group settings and mentor the 200s

Content:

-Speaker: Dr. Angela Kita, PhD

-Focus on leadership and effective team dynamics

-INTEREGR 303

- -What is leadership, Leadership Styles, Connect, Goal Setting
- -Important Qualities of a leader! (Slido)
- -Self Awareness (understanding strengths and weaknesses)
- -Vision (provide direction and set purpose/goals)
- -Transparent (clear processes and open to feedback)
- -Communication (articulate goals)
- -Decision Making
- -Organizational, Team, Interpersonal, and Personal types of leaders
- -Self Assessment tools can help you grow
- 3 Example styles
- 1) Power Model 2) Servant/Service Leadership (mutual) 3) Authentic
- -Discussed working with someone of each of the leadership styles
- -Talked about Authentic leadership in SWE being super transparent and genuine in interactions
- -Servant is definitely super common, the leadership style I try to use
- -Power isn't ideal as it makes other members feel littled
- -People Oriented (Glue)
- -Process Oriented (sets pace)
- -Thought Oriented (see big picture)
- -Impact Oriented (set a high bar and push for excellent performance)
- -Self asses, Observe & Reflect, and Seek out Feedback when exploring and defining how you lead

GOAL SETTING:

How can we put our skills into practice?

- -Start small, slow down
- -Focus on one element to practice
- -Look for mentors

- -Ask questions, partner with others
- -Consider tracking your progress
- -Set a Personal Leadership goal or Interpersonal/Team leadership goal

MY GOAL:

A personal leadership goal I would like to set this semester is to foster my self-awareness and collaboration skills by trust others to take on bigger roles instead of trying to consistently control the situation. In my team currently, this might look like giving a 200 a lengthier task than I would typically entrust them to. Success would look like the 200 taking this task and exceeding the expectation that is needed to accomplish it.

Conclusions/action items: Overall, I believe I am a solid leader as I typically gravitate towards leading a group than sitting back silently. I need to work on being a more open leader in order to serve my groups better and grow as a team. I also can get flustered/frustrated with conflicts so working to resolve those more peacefully would also benefit my skillset.

Lauren Klein - Sep 24, 2025, 2:06 PM CDT

Title: Near Peer Mentoring

Date: 09/24/25

Content by: Lauren

Present: 300's

Goals: To learn about how to peer mentor

Content:

-Reached out to peer mentees

Why are you mentoring BME 200 students? --> I feel like having someone 1 year older is super helpful for growth but it also sucks if you have bad 300's. It helps be there for them when they have questions and don't know how to go about design

- -See more/one, do more/one, teach more/one!
- -We know what they're going through and can relate and help guide them or give advice you wish you had back then
- -Additional instructional and emotional support for students
- -Peer mentors are more approachable, mentees are more willing to ask questions (faculty can be scary)
- -Share experiences (courses, internships, research, coops, projects, etc)
- -Increases belonging
- -Mutual benefits (transferrable skills = leadership, communication, active listening, study practices, self awareness)
- -General Benefits: Increased confidence and self-esteem, increased patience, build positive habits, foster personal growth, help identify gaps in your own knowledge, sense of accomplishment

What does it mean to be a "good mentor" --> Being friendly + open/welcoming, giving good advice and gentle parenting, patience, fostering communication (trying not to shut down ideas even if they're bad) and being able to express thoughts and feelings without fear of rejection, etc)

- -organized, providing knowledge/info, open to help even if its not BME
- -Building Trust
- -Psychological Safety (share w/o fear)
- -Reliability
- -Support/Enthusiasm
- -Transparent (open/honest)
- -Be the coach, humanize/adknowledge their challenges

Listening effectively = get rid of distractions, stop talking, act like you're interested, look at the other person, get the main idea, ask questions, react to ideas & not the person, avoid hasty judgements

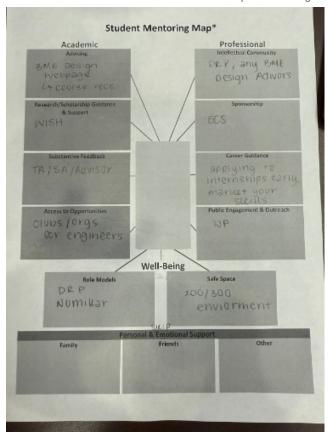
What do you wish you knew in BME 200?

Topics: 3D Printing, machining/fabrication, prototyping, writing documents

Resources: BME design tracking sheet & course recommendations

Advice: how to sell your skills, applying for internships, LabArchives isn't bad (lol), make a 4 year plan!

-Mentor Map = action plan, think about what you can actually do:



-Shared the results of collective Mentor Map

Conclusions/action items: We need to implement the Mentor Map/Action Plan with our 200s. Every team went down and filled the board with a pierce of info for each box as well. Instead of redoing/fixing everything they did, at least give them feedback.

10/01/25 - Lec #4 "Sustainability in design"

Lauren Klein - Oct 01, 2025, 1:58 PM CDT

Title: "Sustainability in design"

Date: 10/01/25

Content by: Lauren

Present: BME 300s

Goals: To learn about being sustainable in design

Content:

Speaker: Andrea Hicks (Associate Professor in Department of Civil & Environmental Engineering, Assistant Dean of Sustainability Education & Research)

- -What is sustainability? --> Everything we need for our survival and well-being depends, either directly or indirectly, on our natural environment.
- -Thinking about when is it worth it and when is it not worth it to recycle in the circular economy assessment
- -Life cycle assessment
- -Kurig and coffee pot have the same amount of weight
- -Research area: environmental impact of emerging objects
- -Found out that the paper that was used in patient rooms at the doctors doesn't prevent against infection and we save money by just disinfecting in between patients instead
- -A break even point is when 2 options are equal
- -Have to think about if the supply were to dissipate
- -Different types of Anesthesia have way different environmental affects based on the way they are produced
- -A little N2O has a big CO2 impact
- -Class I (low risk), Class II (medium risk), and Class III (high risk) safety categories in the FDA
- -How do we use these tools to engineer a more sustainable world?
- -Makes more sense to use reusable gowns due to the break even, supply restriction, and microbial benefits

Team time:

I think we need to focus on longevity of our battery for our device

Conclusions/action items: Overall, there are a lot more things to consider when trying to be sustainable in the medical industry than meet the eye. In project design, while it isn't always our top priority, when something is gonna go to the market it should be a genuine concern! We can start thinking about this in our design projects to benefit the future.



10/08/25 - Lec #5 "Patents & licensing with WARF"

Lauren Klein - Oct 08, 2025, 1:54 PM CDT

Title: "Patents & licensing with WARF"

Date: 10/08/25

Content by: Lauren Klein

Present: BME 300's

Goals: To learn about patenting and such regarding current projects from Jeanine Burmania (Senior Director, IP and Licensing) & Justin Anderson, JD

(Senior IP Manager)

Content:

- -Jeanine = BME alum
- -Often a Prototype judge in the spring semester for Tong
- -Technology transfer: moving research results from campus out into the market. WARF works at this interface to facilitate securing IP rights and commercial licenses (examples: intellectual property licenses, industry sponsored research, etc)
- -Intellectual Property overview:
- 4 common types = 1) Patents 2) Copyrights 3) Trademarks 4) Trade Secrets

Other WARP IP: Biomaterials, Technique and know how, and Data

Non-Patent IP:

- 1) Copyrights(protection for creative works that are expressed in a tangible medium, a wide range of subject matter including software code)
- 2) Trademarks(protection for names, marks, logos, etc and requires use in commerce, source-identifying function)
- 3) Trade Secrets(can be used to protect anything of value, protection is good so long the concept is not generally known)

Patents Generally:

- -A patent is property right, granted by a governmental agency (USPTO, no global patent)
- -Patent holder has right to exclude others from making, using, selling, or importing the claimed invention

There are three different types of U.S. patents:

- 1) Design (15 year term, limited to ornamental features)
- 2) Plant (new variety, 20-year term, asexually reproducing, non-tuber)
- 3) Utility (provisional(effectively a 1 year placeholder) or nonprovisional(20 year term, can claim priority to a provisional))

Utility patents = issued for the invention of a new and useful process, machine, manufacture, or composition of matter

A quid pro quo with the USPTO and public (applicant gets a time limited monopoly of your invention = 20 years from filing but applicant must teach others how to make and use claimed invention)

Often takes 2-5 years to issue after filing

Costs on avg 30K from mostly attorneys' fees

90% of patents issued by USPTO are non-provisional utility patents

Requirements for Patenting:

- 101 Eligible (cannot be a product of nature, abstract idea, or natural phenomenon)
- 102 Novel (new)
- 103 Non-Obvious (cannot be simple modification or combination of existing concepts)

112 - Enabled and Described *hardest to hit (must provide enough detail to teach others how to make or use the invention)

Patent examiners are scientists hired and trained by the USPTO to review patent applications for these requirements

WARF gets 400 new innovation disclosures each year

Disclosing: 1) Describe innovation 2) Identify advantages & potential applications 3) Name Contributors (Inventors & Authors) 4) Provide funding and public disclosure details

Meeting with WARF: 1) Discuss the innovation in more detail 2) Ask questions about WARF and patenting processes 3) Discuss next steps

WARF.org = where the form is

International Rights need to be patent submitted BEFORE POSTER PRESENTATION

Assessing University Inventions:

WARF bases its decision on accepting an innovation into our portfolio on:

IP Considerations: Types of IP protection, potential breadth and strength of IP protection, Public disclosure (past and planned), Stage of development

Licensing Considerations: Applications, Likelihood of identifying a commercial partner, likely return from licensing

Marketing and Licensing

-Market Analysis, License Negotiation, and Ongoing

Conclusions/action items: International Rights need to be patent submitted BEFORE POSTER PRESENTATION. Our team should begin thinking about this as our project has traction to change lives! Especially since we are working with the pharmacy school, we aren't sure how that will work.

10/15/25 - Lec #6 "Valuation of Intellectual Property"

Lauren Klein - Oct 15, 2025, 2:10 PM CDT

Title: "Valuation of Intellectual Property"

Date: 10/15/25

Content by: Lauren

Present: BME 300s

Goals: To learn more about Intellectual Property

Content:

Speaker: Andrea Arndt (Partner at Dickinson Wright PLLC) - BME Alum

- -Went through part of the patent process when on a design team
- -Intellectual Property Attorney

Importance of IP for BME:

- -BMEs create life changing solutions
- -IP protection allows research to safely transfer into products, processes, and/or systems (medical device --> patent filing --> marketplace)
- -IP enables investment, partnerships, and ethical competition
- -Engineers still have ethical responsibilities like lawyers
- -There are varying legal career paths for Engineers in IP
- -Technical Advisor (STEM Degree), Patent Examiner (STEM Degree), Patent Litigator & IP License Attorney (needs law degree), Tech Transfer Manager, and Engineer don't need to take Bar
- -Patent Agent, Patent Examiner, Patent Attorney (need law degree too) need to take Bar
- -The way we write as engineers is very efficient and tries to address the problem

Skills from Engineering to IP: Research, Analytical reasoning, Technical writing, etc

IP and Ownership Responsibilities in Biomedical Industry:

University, Company, or Startup all technically own ideas

- -SUPER important to know what you're signing when going into industry but still knowing the scope of the project
- -Timing and Publication: disclose internally first, publishing before filing and offers = losing patent rights abroad and possible US loss, Posters or abstracts can count as public disclosures, first to file system(not first to invent)
- -Respect each others' IP, keep invention notebooks, understand inventorship vs authorship, maintain confidentiality agreements

Biomedical Start-Up IP checklist: invent, conduct patent search, file patent, use NDA, file trademarks, form business, insurance, funding, licensing, franchise

-Common types of IP: Patent, Trademark, Copyright, and Trade Secret

What makes an invention patentable? --> Novelty(new), non-obviousness (more than a routine change), Utility(must work), enablement(describes how to make and use)

What is a patent? --> makes a monopoly/stops others from using/selling invention, two types: Utility(20yrs) or Design(15yrs), patents are critical in BME since innovation drives competitive advantage

- -Trademarks can be for words, devices, symbols, or composites, or smells, sounds, colors, buildings, package shapes, and a bunch of stuff
- -Distinguishes your goods or services from others

Copyright Protection

- -Trade Secret Protection is when things are kept secret (design projects)
- -Huge counterfeit in Biomedical Products (between 200 and 432 billion every year) like fake Ozempic and Viagra
- -Key takeaways: Innovation without protection is philanthropy, every engineer = potential inventor, etc

Conclusions/action items: Our team needs to speak to Dr. P about potentially filing. While we don't need to have a fully functioning prototype, we should have a solid footing before filing incase we come across any huge changes needed. IP Law could be a potential career path for me in the future!

10/22/25 - Lec #7 "Advising Day Pt 2, Post-Grad Plans"

Lauren Klein - Oct 22, 2025, 1:58 PM CDT

Title: Advising Day Pt 2, Post-Grad Plans

Date: 10/22/25

Content by: Lauren

Present: 300s

Goals: To learn about our options post-grad!

Content:

- -Use your undergrad degree to "build a story" --> Gain experience, tie them together to create a big picture of who you are/want to go/want to be, research is important in all post-grad paths
- -Do homework --> what does ideal career look like? What programs have the opportunities you are looking for? Location, career development, people, disease, research, courses, etc --> Use LinkedIn to connect and talk to people in positions you want to be in
- -Think about letter writers/references early (3 strong ones) --> For post grad education typically
- -School: prepare for the MCAT or GRE summer before senior year (not applicable to me)

Writing your story:

- -Look of typical (and wrong) personal statement or cover letter: legos --> engineer --> aunt dies of cancer --> BME PhD or MD
- -Research/Field Interest: Will do anything!
- -I did this and that then the other thing (basically writing about your resume)

What you wanna do:

General: Start with what you want to do/Thesis statement --> narrow experiences, how they apply, specific to each position/place, similar to cover letter

Personal Statement: show a resonable idea of what --> you will achieve at University, do afterwards, name of faculty interested

Post Graduate School Options:

- -Masters, MS --> Stepping stone/change directions/gain depth/expand credentials for future or Medical School or PhD or Industry (70%), usually 1 year long
- -Doctoral, PhD --> Desire to be an independent researcher, write research grants, work in academia, lead projects in industry, startups, and consulting

MS as a stepping stone:

- -Reasons: rewrite their story, MD: need time for MCAT, PhD: can't find funding
- -Makes you more desirable --> fills gaps in resume, higher level of skills, more experience, older
- -Really powerful is you add in industry experience
- -Opens doors
- -Higher starting salary
- -Another opportunity for summer internships
- -3 masters programs within BME at UW
- 1) Research (1.5 to 2 years) --> for those continuing onto PhD, can be fully funded as RA/TA/PA, Thesis required (Must have a lab PI identified & willing to support before applying)
- 2) Accelerated Programs (1 year) --> Funding (TA only) stipend only(no tuition remission \$1200/credit), no co-op allowed

Accelerated: coursework only, independent research/study allowed

Biomedical Innovation, Design, and Entrepreneurship (BIDE): Project based, project required (BME design project continuity), partnership with business school

Applying for BME MS Progrmas:

- -Applying online, pay fee and submit (Fall and Spring starts available)
- -Statement of purpose: why
- -Research MS: need PI who will support you
- -For Special UW BME BS Students: You need to input email addresses for Janna Pollock 3 different times
- -Easy to meet deadline of 12/15 for following fall (some flexibility), spring entry allowed, application is reviewed separately and we give special consideration to BME undergraduate students (need a 3.0 overall / 4.0 in last 60 credits)
- -Less than a 3.0 talk to them, otherwise auto-admitted
- -Could do a Masters somewhere else
- -MS in Engineering, Global Health, Other Engineering Dept, MBA generally industry pays for credits or evening options
- -Similar to advice earlier and for PhD programs later
- -Find faculty/labs performing research/work in: your passion area or an area that aligns with industry interests
- -Less competitive than PhD programs, generally not funded, some admit to MS or PhD programs
- -See premed/pre-health advising for medical school stuff
- -Research SHOWS you can apply your skills outside of classroom

Conclusions/action items: There are a variety of routes to go on post-grad if a full-time industry position doesn't happen. I'd like to do a masters in Electrical or Mechanical or BIDE if I chose to pursue that. I have no interest in a PhD.

10/29/25 - Lec #8 "Regulatory pathways"

Lauren Klein - Oct 29, 2025, 2:05 PM CDT

Title: "FDA Regulatory pathways"

Date: 10/29/25

Content by: Lauren

Present: BME 300s

Goals: To learn about FDA Regulatory Pathways

Content:

Guest Speaker: Prof. Kip Ludwig (Dept. of Neurological Surgery and Biomedical Engineering)

- -CDRA
- -FDA weighs if a device is beneficial not necessarily if its safe
- -3 classes of devices

Class I = low risk

Class II = Moderate/Controlled Risk --> 510(k) pathway or De Novo 510(k)

Class III = High Risk --? Either PMA (pre market approval) or HDE

- -More clearance needed for Class II and III
- -Materials aren't FDA approved, they're approved in different device uses
- -FDA started regulating medical devices in 1976
- -Pre and Post 1997 (1996 vs 1997) FDA regulations for medical devices were vastly different
- -FDA Device Oversight 1906 to Present: Dalkon Shield was an implantable contraceptive that just went to the market and later on research found it had a huge complication rate
- -There are strengths and weaknesses to the FDA regulations right now
- -The information pathway isn't very quick (failures can sit silent for years)
- -Product Recalls in the Medical Device Industry can be detrimental
- -See the 5 Hypotheses
- -CPAP killed 500 people in 2024
- -Abbott recall of 200k neurostim systems given FDA Class I rating due to turning off everything at once and not being able to turn back on
- -SEC charged ex-CEO of medical device company with fraud as some devices were just pieces of plastic --> Laura Tyler Perryman, the former CEO of medical device company Stimwave, was charged by the SEC and ultimately sentenced to prison for a scheme to defraud investors and insurers. She directed the creation and sale of a fraudulent, non-functional plastic component for a pain-relief device.
- ^ --> Was a device that couldn't even turn on being implanted in patients
- -Employees knew!!!
- -50k SCS devices implanted annually, 107k medical device reports related to spinal cord stimulation for pain in a 4 year period
- 1) 500 died
- 2) 78k patient injuries
- 3) 29k device malfunction
- -Kids in London got Alzheimer's due to growth hormones from cadavers with Alzheimers

Conclusions/action items: The FDA, just like other government aspects, is not perfect and has strengths and weaknesses. Over the years, the regulation of medical devices has arose and changed. The development of Classes helps distinguish devices but even if something is approved, it is not necessarily "safe."



11/05/25 - Lec #9 "Bringing biologics to market"

Lauren Klein - Nov 05, 2025, 2:08 PM CST

Title: "Bringing biologics to market"

Date: 11/05/25

Content by: Lauren

Present: BME 300s

Goals: To learn from Dr. Murphy about bringing biologics to market

Content:

Speaker: Prof. William Murphy, PhD (Dept. of Biomedical Engineering & Director, Forward BIO Institute)

-Objectives: Understand structure of FDA and its framework, how the regulations guide product development, learn what a "quality" mindset is and how that helps navigate regulatory framework, and learn about how science/engineering career opportunities connect

-See slides for a list of Regulatory Resources to grow your beginner toolkit

FDA STRUCTURE:

- -PMA, 510(k), and IDE in Device (CDRH)
- -CDER/Drug includes NDA and IND
- -Biologic(CBER) included BLA and IND
- -All have overlap
- -More Framework:

Federal Food Drug & Cosmetic Act (FD&C)

Public Health Service Act (PHS)

-CURES of 2026

CARES of 2020

US Laws --> Regulations (CFR Title 21) --> FDA Guidance

- -Dramatic Implications: 351 vs 361
- -See slides for complex chart of Human cells, tissues, and cellular and tissue-based product (HCT/Ps)
- 351 products are regulated as drugs and or biologics
- 361 products comparatively are largely unregulated
- -Product Development Life Cycle --> Extremely important to be able to distinguish between studies that are "on the critical path" vs "good research projects"
- -Target Product Profile (TPP) is your Product Vision --> Where, Why, How, Like a PDS for the product
- -See slide of TPP for info on what it includes at its Core, in Clinical Development Planning, and CMC (qTPP: Quality TPP)
- -Considerations when Developing a 351-Regulated CGT --> Nonclinical, Quality, Clinical, and Regulatory (OVERALL Time = \$\$)
- -Quality Management and technical training = MONEY (being able to separate yourself from other candidates
- -Quality Management System Implementation --> A system that documents policies, processes, internal rules, procedures, and other records to ensure consistent quality
- -Quality Exercise Slide shows how every aspect leads to unexpected outcomes, emerging differences, pre-, in-, & post run

Conclusions/action items: There is a lot more money for jobs that require knowledge of FDA/Regulatory pathways. If in the future, I want to work in patent law or something like WARF/Regulations it would be worthwhile to start learning more outside of just surface level research!

Lauren Klein - Nov 07, 2025, 12:47 PM CST

Title: Tong Lecture Fall 2025

Date: 11/7/25

Content by: Lauren

Present: BME's

Goals: To learn from the guest speaker on her innovations & etc.

Content:

Kristin Myers, BME Class of 2002 / MBA Harvard 2007 - COO of Blue Cross Blue Shield

Why Healthcare Needs More Engineers:

- -Worked at Medtronic, CVS Health, ETC
- -Serves 115+ million people
- -2025 Distinguished Awardee
- -2013 Early Career Awardee
- -30 students in a BME class when Myers and Dr P were in school
- -"Run towards the hard problems...they are the ones that change the world"
- -Chapter 1: The Foundation (Solve tangible problems, work hard, and add value)
- -UW Madison Biomedical Engineering --> Medtronic (5 yrs) --> Harvard MBA --> Skyline Ventures --> Arboretum Ventures
- -Chapter 2: Climb to Growth Curve (Combine EQ with IQ to multiply impact & reach)
- -Aetna (Chief of Staff to CEO, President) a CVS Health Company --> Unified Women's Healthcare (President & Chief Operating Officer)
- -Chapter 3: Build & Transform (Drive system-level impact through innovation & scale)

Hopscotch Health (Founder and CEO) --> Blue Cross Blue Shield Association (Chief Operating Officer, Enable Access, and Affordability for 1 in 3 Americans)

- -"You don't need to know your final destination just follow hard problems and build skills that allow you to make an impact"
- -What does great look like? --> Quadruple Aim of Improved Provider Experience, Improved Patient Outcomes, Lower Cost of Care, and Improved Patient Experience
- -How much do we spend on healthcare in the US (\$\$ and % of GDP) = 5.3 Trillion and 18% of GDP
- -1) Work Hard & Build Range --> Take on the hardest projects, classes, and experiences you can find. Effort and range are your foundation
- -2) Seek Diverse Exposure --> Explore different sectors, teams, and geographics. Gain perspective and learn how systems connect, not just how parts work.
- -3) Choose Your People Wisely --> Surround yourself with curious, driven, high-integrity people. They will shape who you become.
- -4) Know your Values & Protect Them --> Define what matters most -- family/friends, health, career/impact, values -- and make decisions that align.
- -5) Embrace Challenge & Keep Growing --> Run towards hard problems. Growth lives on the edge of discomfort -- where big impact starts.

Conclusions/action items: Kristin Myers has lived many lives and made many impacts. Overall, as engineers in healthcare you need to seek out the hard problems to improve lives of others. Growing your skills and range will take you very far if you work hard!

Lauren Klein - Nov 12, 2025, 2:00 PM CST

Title: "Do I need an Institutional Review Board (IRB)?"

Date: 11/12/25

Content by: Lauren

Present: 300s

Goals: To learn about IRB and when we need it.

Content:

Speaker: Stephanie Metzger, PhD (IRB Analyst) - Health Sciences Team

Historical problematic research!

- -Untreated Syphilis Study at Tuskegee
- -WWII Nazi Prisoner Experiments
- -US Public Health Service Guatemala Syphilis Experiments
- -Willowbrook State School Hepatitis Experiments

Ethical Research Frameworks:

- -Nuremberg Code --> emphasis on voluntary consent
- -Declaration of Helsinki --> focus on medical research
- -National Research Act --> US response to Tuskegee Syphilis Study

Belmont Report:

- 1) Respect for Persons/Autonomy --> respect for persons and acknowledgement of autonomy and protecting that
- 2) Beneficence --> maximizing possible benefits and minimizing possible harms
- 3) Justice --> who should receive the benefits of the research and who should take on the burdens

Applying the Belmont Principles:

- 1) 1991 DHHS 45 CFR 46 --> Common rule for approving research, protecting vulnerable groups, and requirements for IRB operations
- 2) 2018 Revised Common Rule --> Modifications to reduce administrative burden
- -IRB Composition: diversity of membership requires 1) race, gender, cultural backgrounds, scientific expertise (MD, PhD, MPH), faculty and clinicians
- 2) Non-scientists such as community members or IRB staff

IRB Purpose:

- 1) Protect rights and welfare of people in research (the subjects)
- 2) IRBs review human research according to ethical principles and federal regulations, state laws, and institutional policies

IRB Review Requirements:

- 1) UW Madison requires IRB review of all research involving human subjects
- 2) Research CANNOT begin until IRB approved

See Common Rule Criteria (45 CFR 46)

De-identifying Data:

-Directly identifiable -- identifiers included with data

- -Coded/Indirectly Identifiable -- identifiers removed from data but linked via study ID code
- -Anonymized/Deidentified -- all identifiers removed

Went through an example of how to make an image anonymized

Multiple Categories of Research

-Olive oil is used for those with asthma and considered a medical device

How to submit a study:

- 1) Create a study in ARROW
- -IRB Review Process: Administrative Review --> IRB Pre-Review --> Committee or Non-Committee Review

Once study is approved:

- -Can start research/study
- -Changes of Protocol if you want to change anything
- -Reportable Events: when something unexpected happens (noncompliance, unanticipated problem/SAE, New information)
- -Continuing Reviews: annual progress report for some non-exempt studies

UW Madison IRB Resources: IRB website & ARROW

See Slides for more Info

Conclusions/action items: IRB is an aspect we started learning about in our CITI Training. It is incredibly important when running human research/trials. We should be prepared to follow these guidelines if we take our device to human testing.

Lauren Klein - Nov 19, 2025, 1:57 PM CST

Title: Lecture 11 - "How medical product R&D works in industry"

Date: 11/19/25

Content by: Lauren

Present: 300s

Goals: To learn about medical products in the industry

Content:

Speaker: Dr. Russ Johnson, PhD - Director of corporate relations for the College of Engineering

Education:

BS in Biomedical Engineering at University of Iowa

MS in Bioengineering at Clemson

PhD in Materials Science & Engineering at Clemson

Experience:

Director of Corporate Relations at UW Madison for last 4 years

25 years of Industry experience prior to that, lots of leadership roles

- -Should be able to explain NPD (New Product Development) by the end of lecture
- -NPD in the medical device industry is: 1) Highly Regulated 2) Expensive 3) Resource Intensive 4) Competitive
- -Selecting and prioritizing projects is important (Corporate Business Strategy to Product Portfolio Review to Project Review to Budgeting and Resource Allocation)
- -Types of NPD Projects:
- 1) Line Extensions: Addition of additional sizes and configurations
- 2) Product Improvements: Existing product change due to market feedback or new customer needs
- 3) New-to-company: Product line that is not new to market but new for the company
- 4) New-to-world: Innovative products that create completely new markets
- -1 to 4 correlates to increasing risk and costs
- -There are a lot of different roles in NPD Team Members

Managing NPD (Stage-Gate Process):

Stage 0 = Ideation (Big Idea)

Stage 1 = Exploration (Cut down & nail one idea)

Stage 2 = Concept Development

Go/no-go decision

Stage 3 = Design Development

Stage 4 = Design Confirmation (Clinical or V&V testing = longest stage)

Design Freeze

Stage 5 = Design Transfer & Commercialization

Then Launch and Post-Market Surveillance

- "The Cloud" to "The Funnel" to "The Tunnel"
- -Case Study from Speaker's time at Cardinal Health: Fluid management solutions for high volume cases existing in 2007
- -Manual Suction Canisters versus Automated Stryker Neptune (had an onboard vacuum system)
- -Manual Suction Canisters were expensive to dispose of liquid
- -Cardinal Health in order to compete created the ORwell Fluid Management System

Goal: Provide clinicians with an innovative solution for fluid volume

- Stage 0 Ideation: Typical Activities = Choose Area of Opportunity, Review Market Trends or Competition, Conduct Primary and Secondary Market Research, Identify Customer Unmet Needs, and Create High-Level "back of the napkin" ideas
- Stage 1 Exploration: Typical Activities = Define Problem to be solved and customer requirements, etc
- Stage 2 Concept Definition: Typical Activities = Finalize on 1 leading concept, Develop business care and look into market opportunity, Conduct comprehensive IP Examination, Next Gate Review is a "go/no-go" business decision
- Stage 3 Design Development: Typical Activities = Move to functional prototype, Continue iterative design process, including initial testing and reviews with customers, Confirm regulatory pathway, and Begin formal Design Control documentation
- Stage 4 Design Confirmation: Typical Activities = Conduct V&V, Finalize product and component drawings/models, Accelerate manufacturing process (make vs buy), "Freeze" design at the end of this stage, Submit Regulatory documentation like FDA 510(k)
- Stage 5 Design Transfer & Commercialization: Typical Activities = Complete any remaining testing, Make final design changes, Build molds, assembly/test equipment, Create Instructions for Use (IFU) and user manuals, Develop service plan/resources, and Finalize go-to-market strategy and start limited release

Post Market Surveillance: Typical Activities = Regulatory agencies expect monitoring and documentation of customer complaints, Company continuously track customer and sales feedback/surveys, On a 4-6 month cadence project teams report out to stakeholders

-Stryker launched a revamped competing product that reduced their price by 50% and some physical components right after Cardinal Health launched ORwell

Summary: Medical device development is an expensive, complex, and highly-collaborative effort, Having limited resources, most businesses have instituted processes like Stage-Gate to reduce risk and increase probability of success, Good product design and development is necessary for commercial success but not sufficient!

Conclusions/action items: Overall, market can be very hard especially for medical devices due to all the implications. Even big companies like Cardinal Health have failed in the past. NPD seems very similar to BME Design and has a lot of the same general ideas of stages and typical activities. I'm very excited at the opportunity to make a difference in the medical device industry in the future.

Ella Prose - Sep 26, 2025, 12:12 PM CDT

Title: Pancreas of Type 1 Diabetics

Date: 09/11/2025

Content by: Ella Prose

Present: Individual

Goals: I want to learn more about what happens in the pancreas of diabetics. I wanted to know the physiological and anatomical side. I wanted to deepen my understanding of diabetes.

Search Engine: Google Scholar

Search Term: Pancreas of Type 1 Diabetics

Citation:

[1] M. Campbell-Thompson, T. Rodriguez-Calvo, and M. Battaglia, "Abnormalities of the Exocrine Pancreas in Type 1 Diabetes," *Current Diabetes Reports*, vol. 15, no. 10, Aug. 2015, doi: https://doi.org/10.1007/s11892-015-0653-y.

Content:

- Type 1 Diabetes is a chronic autoimmune disease in which pancreatic insulin-producing beta cells are destroyed, leading to chronic hyperglycemia (very high blood glucose)
- unclear whether exocrine changes in Type 1 are related to the same genetic, immunological, and environmental events resulting in beta cell destruction
- Normal Pancreatic Anatomy and Function
 - exocrine pancreas unit is composed of acinar, centroacinar, and ductal cells forming the acinus
 - exocrine region is divided by connective tissue into lobules containing hundreds of acinar units secreting 20 different enzymes
 - exocrine secretion tightly regulated by autonomic nervous system in response to meal and mediated by numerous hormonal secretagogues and neurotransmitters
 - 1-2% of entire pancreas comprised of neuroendocrine cells located in highly vascularized innervated islets of Langerhans
 - Islet neuroendocrine cells critical for multiple metabolic and physiological functions of body - several hormones, neurotransmitters, and peptides derived from islets -> play role in homeostasis of exocrine pancreas
 - insulin-producing beta cells are most abundant islet cells followed by alpha (produce glucagon),
 delta, gamma (produce pancreatic polypeptide), and epsilon
 - patients with T1D have abnormalities in exocrine pancreas secondary to lack of insulin and dysregulation of endocrine function
- Abnormal Pancreatic Anatomy and Function
 - Acute vs Chronic Pancreatitis
 - acute is sudden and life-threatening causes -> gallstones and heavy alcohol use
 - chronic results from progression of acute and severe pain with loss of exocrine function - causes -> malnutrition and weight loss
- Abnormal Pancreatic Exocrine Function in T1D

- prevalence of exocrine pancreatic insufficiency reported to be in 51% of patients with T1D and 35% in Type 2
- smaller pancreas in T1D weights reduced by 20-50%
 - possibly due to atrophy, impaired organ growth rate, or combo

Conclusions/action items: Type 1 diabetes (T1D) is considered a pancreatic beta cell-specific disease that results in absolute insulin deficiency. Clinical studies show that patients with T1D have an abnormal exocrine pancreas due to the presence of exocrine insufficiency and acinar atrophy. Exocrine abnormalities are an important and mostly neglected characteristic associated with T1D. This article mentions how T1D is a combined endocrine-exocrine disease in which the loss of functional beta cell mass is most clinically apparent.

Ella Prose - Sep 11, 2025, 11:00 AM CDT



Download

s11892-015-0653-y.pdf (512 kB)

Ella Prose - Oct 08, 2025, 5:24 PM CDT

Title: Stress for Caregivers

Date: 10/08/2025

Content by: Ella Prose

Present: Individual

Goals: I want to learn more about the effects a diagnosis has on parents and caregivers. I want to find out some

specific statistics.

Search Engine: Google Scholar

Search Term: Stress for parents of Type 1 Diabetics

Citation:

[1] R. Whittemore, S. Jaser, A. Chao, M. Jang, and M. Grey, "Psychological Experience of Parents of Children With Type 1 Diabetes," *The Diabetes Educator*, vol. 38, no. 4, pp. 562–579, May 2012, doi: https://doi.org/10.1177/0145721712445216.

Content:

- "The prevalence of parental psychological distress across all studies ranged from 10% to 74%, with an average of 33.5% of parents reporting distress at diagnosis and 19% of parents reporting distress 1 to 4 years after diagnosis."
- "Parental psychological distress in parents of children with T1D, regardless of how it was defined, was associated with higher child self-report of stress and depressive symptoms, more problematic child behavior, and lower child self-report of quality of life. Parental psychological distress also had negative effects on diabetes management."
- "Themes of the qualitative synthesis indicated that parents perceived T1DM as a difficult diagnosis that contributed to significant family disruption. Adjustment occurred over time; however, ongoing stress was experienced."
- "At different developmental phases, new issues arise that require a complete reevaluation of previously established and effective management strategies. The ongoing stress and worry manifest in elevated rates of parents' perception of stress and increased risk for depression and anxiety."

Conclusions/action items: Caring for a child with T1D has been described as an overwhelming experience, requiring constant vigilance. Parents must come to terms with having a child with a life-threatening illness and carrying out a labor-intensive and complicated daily regimen. Parents live with constant worry about hypoglycemia or hyperglycemia, heightened feelings of responsibility for their child's health, and the desire to promote optimal growth and development.



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Psychological Experience of Parents of Children With Type 1 Diabetes: A Systematic Mixed-Shades Review

Robin Whittemore, PhD, APRIN, FAAN, Sarah Jaser, PhD, Ariena Cheo, IRSN, Myseurgock Jang, IRSN, and Margaret Grey, Drifft, INIA PAAM Yale School of Narsing, New Harver, Connectical

Caring for a child with T1DM has been described as an overwhelming experience, requiring constant vigilance. 2 Parents must come to terms with having a child with a Life-threatening

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stress_of_t1d.pdf (77.3 kB)

Ella Prose - Oct 08, 2025, 5:30 PM CDT

Title: Type 1 Diabetes overview

Date: 10/08/2025

Content by: Ella Prose

Present: Individual

Goals: I want to learn more about the specifics of this disease. I wanted to find more about treatments and symptoms for the report. I wanted to gain more knowledge on the overview of Type 1.

Search Engine: Google Scholar

Search Term: Type 1 Diabetes management

Citation:

[1] Centers for Disease Control and Prevention, "Type 1 Diabetes," *CDC*, May 15, 2024. https://www.cdc.gov/diabetes/about/about-type-1-diabetes.html

Content:

- "If you have type 1 diabetes, your pancreas doesn't make insulin or makes very little insulin. Insulin helps blood sugar enter the cells in your body for use as energy."
- "Without insulin, blood sugar can't get into cells and builds up in the bloodstream. High blood sugar is damaging to the body and causes many of the symptoms and complications of diabetes."
- -"Type 1 diabetes was once called insulin-dependent or juvenile diabetes. It often develops in children, teens, and young adults, but it can happen at any age."
- "However, many of them won't go on to have type 1 diabetes even if they have the genes. A trigger in the environment, such as a virus, may also play a part in developing type 1 diabetes. Diet and lifestyle habits don't cause type 1 diabetes."
- "You'll need to take insulin shots (or wear an insulin pump) every day. Insulin is needed to manage your blood sugar levels and give your body energy."
- "You'll also need to <u>do regular blood sugar checks</u>. Ask your doctor how often you should check it and what your target blood sugar levels should be. Keeping your blood sugar levels as close to target as possible will help you prevent or delay <u>diabetes-related complications</u>."

Conclusions/action items: Although there is currently no way to prevent type 1 diabetes, it can be effectively managed through daily insulin therapy, regular blood sugar monitoring, and a healthy lifestyle. Working closely with a healthcare team, including doctors, dietitians, and diabetes educators, is essential for maintaining stable blood sugar levels and preventing complications. Education, self-management, and support from family

and healthcare professionals empower individuals with type 1 diabetes to lead healthy, active lives despite the challenges of the condition.

Ella Prose - Dec 10, 2025, 6:55 PM CST

Title: Blood Glucose Ranges

Date: 12/10/25

Content by: Ella Prose

Present: Individual

Goals: I want to learn more about the specifics of blood glucose ranges. I want to know why they vary based on each diabetic. I am interested to know how endocrinologists choose the range of values associated with "low" and "high" blood sugar.

Search Term: T1D blood glucose ranges

Citation:

[1] "Time-In-Range and Diabetes," www.endocrine.org, Jan. 24, 2022. https://www.endocrine.org/patient-engagement/endocrine-library/time-in-range-and-diabetes

Content:

- "Time in Range, or TIR, is the amount of time those with diabetes spend with their blood glucose levels in a recommended target range and is represented as a percentage. Finding this "happy medium" can be difficult."
- CGMs are used to achieve more TIR
- Time in range and out of range can vary per person and for different reasons but the main things that are generalized include:
 - "Glucose goals can vary for each person, but a typical target glucose range is from 70 to 180 mg/dL.
 - For most people with type 1 or type 2 diabetes, a TIR above 70% is recommended. That's about 17 hours of a 24-hour day.
 - You should aim to spend less than 4% (58 minutes) below 70 mg/dL, less than 1% (14 minutes) below 54 mg/dL, less than 25% (6 hours) above 180 mg/dL, and less than
 - 5% (1 hour, 12 minutes) above 250 mg/dL.
 - TIR targets can be lower for older or high-risk individuals and for those younger than age 25."
- "Measuring A1C levels has been a common way to track success managing diabetes"

Conclusions/action items: Diabetics constantly have to monitor their blood sugar and ensuring they stay in range can help prevent future complications. Many diabetics aim to have their TIR above 70%. The typical target range for a generalized diabetic is from 70 to 180 mg/dL.

Ella Prose - Dec 09, 2025, 11:15 PM CST

Title: Dexcom Continuous Glucose Monitor (CGM) Background

Date: 09/11/25

Content by: Ella Prose

Present: Individual

Goals: I wanted to know more about the basics of CGMs, specifically Dexcom. I wanted to know how CGMs work within the body. I wanted to deepen my understanding of CGMs.

Search Engine: Google Scholar

Search Term: Dexcom CGM Background

Citation:

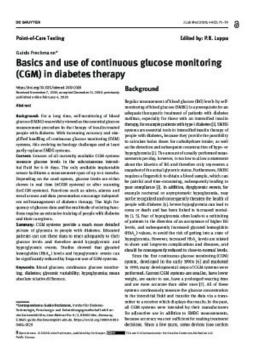
[1] G. Freckmann, "Basics and use of continuous glucose monitoring (CGM) in diabetes therapy," *Journal of Laboratory Medicine*, vol. 0, no. 0, Feb. 2020, doi: https://doi.org/10.1515/labmed-2019-0189.

Content:

- transition from self-monitoring of blood glucose (finger pricks) to CGM because of increased accuracy and simplified handling
- "sensors of all CGM systems measure glucose levels in the subcutaneous interstitial fluid for 6-14 days"
- "high frequency of glucose data and multitude of existing functions require extensive training of people with diabetes and their caregivers"
- CGMS developed in 1990s but current systems are smaller, weigh less, easier to use, and have prolonged wearing time with better accuracy
- "CGM systems consist of glucose oxidase (GOD)- glucose sensor which is inserted into the subcutaneous fatty tissue and continuously measures glucose concentration in interstitial fluid, a transmitter attached to sensor and trasnfers data to reciever/phone displays result"
- "glucose concentration is estimated based on production of hydrogen peroxide by GOD and associated release of electrical current which is directly proportional to the concentration of glucose in interstitial fluid
- GOD and its cofactor works as the initial electron acceptor catalyze the oxidation of glucose to hydrogen peroxide and gluconic acid, cofactor regenerated in a reaction with oxygen which leads to formation of hydrogen peroxide -> oxidized at catalytic electrode where amount of transferred electrons is detected"
- "this electron flow is proportional to the glucose concentration in interstitial fluid"

Conclusions/action items: CGM systems provide a much more detailed picture of glycemia in people with diabetes. Patients have to be educated to use these devices so they know how to use the data and react adequately to their glucose levels to avoid hypo/hyperglycemic events. CGM systems make diabetics lives easier.

Ella Prose - Sep 12, 2025, 9:23 AM CDT



Download

10.1515_labmed-2019-0189.pdf (392 kB)

Ella Prose - Dec 09, 2025, 11:15 PM CST

Title: Glowcose - CGM Light

Date: 09/18/25

Content by: Ella Prose

Present: Individual

Goals: I wanted to find ways that Diabetics make their lives easier. I wanted to figure out other things on the market that were similar to our glow bracelet idea. I wanted to see how customizable we could make our design.

Citation:

[1] "Glowcose," Glowcose, 2024. https://glowcose.com/

Content:

- "a visual link to glucose levels for both you and those who care about you. It's a simple signal for shared awareness, delivered without stress or noise."
- how it works:
 - "designed the system to connect easily with your CGM to get your data without a fuss."
- "Glowcose web app takes those glucose readings and turns them into colors based on how you've have them set up in your account."
- "Then, your glowcose uses your home Wi-Fi to simply get that color from your account, updating instantly to show you the latest status."
- the colors go from red to purple where red to light green is low, green is in range, and blue to purple is high
- very personalized for each user "We made sure you have control over the color levels. Each glucose reading turns into one of hundreds of possible colors, shifting smoothly. You can easily set your own high, low, and target numbers in the settings. This lets you personalize exactly how your glucose levels *shine*. It's all about making glowcose work best for you."

Conclusions/action items: Glowcose is a visual aid that can be used in homes (with WIFI access) that syncs users' CGM data to this glowing light. It is color-coded and customizable. The creators made it to simplify the lives of Diabetics by ensuring that it is used as a simple signal for shared awareness without noise or too bright of a light.



Download

glowcosecgmlight-800-1.webp (87.6 kB)

Ella Prose - Dec 09, 2025, 11:15 PM CST

Title: Apple Watch aid in T1D

Date: 09/18/25

Content by: Ella Prose

Present: Individual

Goals: I wanted to know more about how diabetics can aid themselves in making their lives easier by using technology. I wanted to know how the CGM app and apple watch communicate to one another. I wanted to know if technology makes that much of a positive impact on T1D management.

Search Engine: Google Scholar

Search Term: Apple watches and T1D

Citation:

[1] S. G. James, M. Elaine, Z. S. Abdallah, H. Emerson, and Aisling Ann O'Kane, "Integrating Technology into Self-Management Ecosystems: Young Adults with Type 1 Diabetes in the UK using Smartwatches," pp. 1–20, Apr. 2025, doi: https://doi.org/10.1145/3706598.3713247.

Content:

- "To examine this process, we used the case study of young adults with type 1 diabetes (T1D) in the UK who were given a smartwatch. Over six months, interviews and focus groups were performed to explore their smartwatch use alongside T1D management."
- "emphasised the need for customisation, flexibility and adaptability, and automation in the design of technology to promote integration into existing self-management ecosystems for both T1D and other chronic conditions."
- "The study addresses this gap with the following research questions:
- How can smartwatches be utilised in T1D management?
- How can smartwatches be designed to facilitate integration into T1D self-management ecosystems?"
 - "The concept of a self-management ecosystem allows for further consideration of the connections between devices and communication that may take place outside of an actor, for example, an algorithm updating the insulin pump automatically as performed by a closed-loop system in T1D."
 - "In T1D, the connection between devices is key as technological advancements have increased the number of devices used in self-management and their automatic capabilities."
 - "People who live with T1D are unable to regulate their blood glucose levels due to the loss of insulin-producing cells, and so must inject insulin themselves to manage it. Numerous activities impact blood glucose levels, including eating, drinking, sleeping, and physical activity, as well as several external factors, which all need to be factored into management decisions"

- -"the assertion that smartwatches are well suited to chronic condition self-management, with research highlighting user acceptance"
- -Inclusion criteria specified the use of both a CGM and insulin pump to ensure the findings applied to the integration of technology into self-management ecosystems with multiple devices and that utilise artificial intelligence.
- issues includes, cost, uncomfortable to wear, need wifi or bluetooth range (keep these factors in mind for our project)
- -"All the smartwatches used in the study had touchscreens and a range of features. Participants had different preferences for which of these features they used and how they interacted with the device, but throughout the study they discussed linking the smartwatch to T1D technology and extending the interactions that could be performed through it"

Conclusions/action items: Smartwatches can be utilized in T1D self-management. It can discreetly display CGM data and alerts that can allow users to easily self-manage their blood glucose. The aid of technology can be very useful for positive management that allows users to make their lives easier.

Ella Prose - Sep 18, 2025, 10:45 AM CDT



Download

applewatch_and_t1d.pdf (877 kB)

Ella Prose - Oct 01, 2025, 3:32 PM CDT

Title: Sugar Pixel

Date: 10/01/2025

Content by: Ella Prose

Present: Individual

Goals: I want to find more designs that are similar to ours. I want to find out the pros and cons of this design. I want to have a better understanding of what customers like.

Citation:

[1] "SugarPixel blood glucose pixel clock Review - Integrated Diabetes Services," *Integrateddiabetes.com*, 2022. https://integrateddiabetes.com/sugarpixel-blood-glucose-pixel-clock-review/?print=print (accessed Oct. 01, 2025).

Content:

How it Works

- **CGM Data Connection:** Sugar Pixel receives data from a compatible CGM (such as Dexcom or Freestyle Libre) and displays it to the user.
- **Bluetooth and App:** It uses Bluetooth to connect to a companion app, allowing users to customize display modes, alert settings, and the device itself.
- **Display Options:** The device can show various information, including:
 - Large numbers for the blood glucose level.
 - A trend arrow and a "delta" to indicate the rate of change.
 - Customizable emoji screens.
 - Color-coded displays that change based on glucose ranges.
 - A "night mode" for dim, colored pixels during the night.
- Customizable Alerts: Users can set up alerts with randomized sounds and vibrations, which are designed to keep the user's attention and prevent alarm fatigue.
- Multi-User Following: It can display readings for up to two users simultaneously.

Who It's For

- **Heavy Sleepers:** The randomized sounds and vibration puck can help users, like heavy sleepers or people with disabilities, wake up to critical alerts.
- Users Experiencing Alarm Fatigue: The unique alert system helps break the cycle of ignoring repetitive alarms.
- Those Needing a Dedicated Display: It provides a dedicated, easy-to-read display that doesn't require a smartphone or CGM reader to check blood sugar levels.

Key Features

- Retro Design: The device resembles a clock, adding a nostalgic touch for users familiar with older digital displays.
- Randomized Alerts: The sounds and vibration patterns are randomized to ensure they are heard.

- Vibration Puck: A separate puck can be placed under a pillow or mattress for a physical alert.
- Native Multi-User Support: The device supports up to two users' glucose data without requiring a third-party app.

Conclusions/action items: A Sugar Pixel is a secondary blood glucose display and alert system designed for individuals who use continuous glucose monitors (CGMs). It features a retro clock-like display that shows real-time glucose readings, trends, and can provide customizable audio and vibration alerts to address alarm fatigue and help users, especially heavy sleepers or those with hearing impairments, not miss critical glucose alerts. The device connects to major CGM systems and apps like Dexcom or Nightscout, offering various display options and adjustable settings through a companion app.

Ella Prose - Oct 01, 2025, 3:32 PM CDT



Download

SugarPixel_blood_glucose_pixel_clock_Review_-_Integrated_Diabetes_Services.pdf (324 kB)

Ella Prose - Dec 10, 2025, 6:37 PM CST

Title: Apple Watch Patent USD738749 S1

Date: 10/23/25

Content by: Ella Prose

Present: Individual

Goals: I wanted to know more about the basics of the Apple Watch design. I wanted to see if we could replicate any of their designs. I wanted to know more about the patents behind the Apple Watch.

Search Engine: Google Patents

Search Term: Apple Watch Patents

Citation:

[1] "USD738749S1 - Watch - Google Patents," *Google.com*, Dec. 17, 2013. https://patents.google.com/patent/USD738749S1/en

Content:

USD738749 S1 - "Watch" - one of Apple's early design patents covering the overall ornamental look of the watch

What it is

- Title: "Watch".
- Publication Number: USD 738,749 S1.
- Filing / priority date: December 17, 2013.
- Assigned to: (via assignment) though originally associated with and others.
- · Status: Active.
- Type: Design patent meaning it protects the ornamental appearance of the watch (its "look" or "ornamental design"), rather than the functional mechanism.

What the drawings / claims show

- The claim is very short (typical for a design patent): "We claim the ornamental design for a watch, as shown and described."
- The drawings (front view, side view, top view, bottom view, etc.) depict the external shape, contours, and general appearance of the watch.

- Note: The description mentions that "surface shading is included to show the character and contour of the three-dimensional aspects of the design."
- Also: "The structural features depicted by broken lines have been shown for the purpose of illustrating
 portions of the watch that form no part of the claimed design." i.e., features drawn in dashed lines are not
 claimed; they are just context.

What exactly is protected

- Since it's a design patent, the protection is limited to the ornamental design (appearance) of the watch as
 depicted in the drawings. That means the shape, contours, surfaces, proportions, and overall configuration
 matter.
- Functional or mechanical elements are *not* protected under this patent. If a feature is essential for function (rather than appearance), a design patent may not cover it.
- Because the claim refers to "as shown and described," the exact drawings become critical: any competitor design that is "substantially the same" in overall visual impression may risk infringing.
- The broken-lines indicate parts that are not claimed. That means those elements may be freely modified (functionally speaking) without necessarily infringing this design patent, as long as the claimed design is sufficiently different (depending on entire look).

Why it matters

- This appears to be one of the early design patents by Apple covering the external appearance of what later became the (or at least a watch device) the date (2013) aligns with early development.
- Having a design patent gives Apple the right to exclude others from making, using, selling or importing devices that copy the look of the claimed design (for the term of the patent).
- For anyone designing watches or watch-type wearables, this patent is relevant because it establishes a protected visual appearance baseline for Apple's product which can impact competition or design-inspired devices.
- For designers or accessory makers, it helps to be aware of what's claimed so as to avoid inadvertent copying of the "look" even when the mechanical functionality differs.

Conclusions/action items: If you're comparing product design or evaluating whether a design is "too similar" to Apple's, refer closely to the drawings of USD 738,749 S1. We should pay attention to the overall shape and contour of the watch: case shape, bezel, perhaps the way the band integrates, etc (as per drawings). We need to remember that design patents expire after their statutory term (typically 15 years for design patents filed in/after May 13, 2015 in the U.S.; older ones might differ). This one has a publication date of Sept 15, 2015. If you're designing a watch or wearable, you may want to do a "freedom-to-operate" check in the design patent space - design patents like this one can matter as much as utility patents in terms of aesthetic protection.







USD738749_-_Watch_patent.pdf (166 kB)

Ella Prose - Dec 10, 2025, 6:38 PM CST

Title: Apple Watch Patent

Date: 10/23/25

Content by: Ella Prose

Present: Individual

Goals: I wanted to know more about the basics of the Apple Watch design. I wanted to see if we could replicate any of their designs. I wanted to know more about the patents behind the Apple Watch.

Search Engine: Google Patents

Search Term: Apple Watch Patents

Citation:

[1] "USD745421S1 - Wearable device - Google Patents," *Google.com*, Sep. 08, 2014. https://patents.google.com/patent/USD745421S1/en (accessed Oct. 23, 2025).

Content:

USD745421 S1 "Wearable device" - drawings and views of the wearable's external appearance (front, side, back). Good for the overall case shape and layouts

What it is

- Title: "Wearable device".
- Publication Number: USD 745,421 S1.
- Filing/priority date: Filed September 8, 2014 (and also claiming priority to an earlier US29/501,746).
- Publication date: December 15, 2015.
- Type: US Design Patent protects the ornamental design (how it looks) of the wearable device.

What the drawings/claim cover

- The single claim states: "The ornamental design for a wearable device, as shown and described."
- The drawings include various views: front-right perspective, rear-right perspective, front view, left side view, right side view, bottom view, and alternate embodiment views.
- The drawings show a wearable device presumably a watch/fitness/wrist wearable form factor with case, display, band attachment (or strap connections), and other external surfaces.

• The description mentions the file contains at least one color drawing.

What is protected (in simpler terms)

- Because this is a design patent, what's protected is the **ornamental design**, meaning the shape, configuration, surface ornamentation (look and feel) of the wearable device as shown in the drawings.
- Features shown in dashed or broken lines are not part of the claimed design (they are illustrating
 environment or context). Only the solid-line elements define the claimed design. (That is a general principle
 of design patents.
- So any device that looks substantially the same in overall appearance (from the typical vantage points) might risk infringing, even if the internal functionality is different.
- The patent doesn't cover how the device works (that would be a utility patent), only how it appears.

Why it matters

- This patent appears to correspond to the early design of Apple's wearable product (likely the first generation of the Apple Watch or at least a device of that form). The date (2014) aligns with development prior to the product launch.
- For competitors/designers it sets a protected visual baseline: if you make a wearable device with a very similar overall look, you may have to consider whether you are infringing Apple's design rights.
- For designers & accessory makers, knowing this helps you navigate what design space is "claimed" and what you could vary (shape contours, band attachment, bezel design, etc.).
- For understanding Apple's IP strategy: this is part of their broader portfolio of design patents around their wearables showing how they protect not just function, but form. (See commentary about how Apple applied many design patents for the wearable market.)

Conclusions/action items: If you're comparing other wearable devices (or designing one), this is one of the foundational design patents for Apple's wearable look. We should check the drawings carefully: from different angles (front, side, back) to see shape of case, band attachment, display area, etc. If you design something with a notably different look (e.g., different case shape, strap mounting, proportions), you may reduce risk of design-patent issues.

Ella Prose - Oct 23, 2025, 6:10 PM CDT







Download

USD745421_-_Watch_patent_2.pdf (1.64 MB)

Ella Prose - Dec 10, 2025, 6:39 PM CST

Title: Design One focused on band material

Date: 09/21/25

Content by: Ella Prose

Present: Individual

Goals: I want to research different materials for the bracelet band. I want to make sure they are cost effective. I need to take into account child factors like comfortability and customization.

Search Term: best wristbands

Citation:

[1] "The Different Materials Used to Make Wristbands | Wristband Creation," *Silicone Wristbands & Rubber Bracelets* | Wristband Creation, Nov. 22, 2016. https://wristbandcreation.com/different-materials-used-make-wristbands/

Content:

Design idea and characteristics are shown below

Criteria and things to keep in mind

- slim and lightweight design
- durable
- -temperature sensitive
- -comfortable
- -not going to irritate skin
- -customizable or fun for kids

from article - different materials include:

silicone

- "different varieties, including debossed, embossed, deboss-filled, emboss-printed, imprinted, and several others"
- very durable and last long time

vinyl

- "very strong and hard-wearing, making them ideal "
- durable plastic material

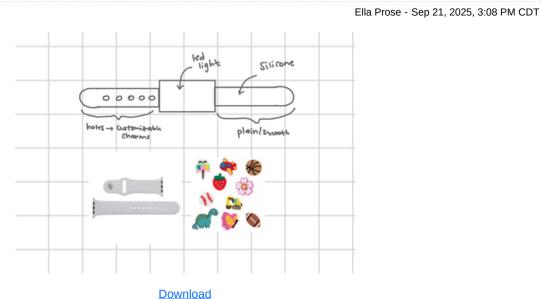
fabric

- "similar to those used in lanyards or identification card straps"
- "tend to be gentler on the skin compared to vinyl wristbands"
- "not all of them are resistant to water or moisture, unless they have been coated with a waterresistant layer."

tyvek

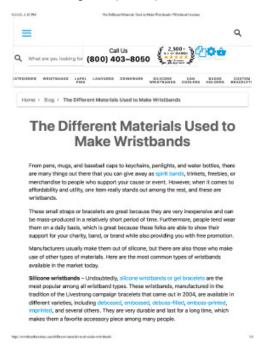
- " paper-like material made from polyethylene plastic fibers"
- "very strong, tear-resistant, and lightweight. It will also not dissolve in water."

Conclusions/action items: There are many different materials to make wristbands out of. Some of the main ones include silicone, vinyl, plastic, fabric, and Tyvek. I think for this project, silicone would be the best.



IMG_F8500592AD78-1.jpeg (229 kB)

Ella Prose - Sep 21, 2025, 3:30 PM CDT



Download

The_Different_Materials_Used_to_Make_Wristbands___Wristband_Creation.pdf (527 kB)

Ella Prose - Dec 10, 2025, 6:39 PM CST

Title: Design Two focused on band material

Date: 09/21/25

Content by: Ella Prose

Present: Individual

Goals: I want to research different materials for the bracelet band. I want to make sure they are cost-effective. I need to take into account child factors like comfort and customization.

Search Term: best wristbands

Citation:

- [1] "Fantasia Accessories Recalls Slap Bracelets Due to Laceration Hazard; Sold Exclusively at Target," *U.S. Consumer Product Safety Commission*, 2018. https://www.cpsc.gov/Recalls/2019/Fantasia-Accessories-Recalls-Slap-Bracelets-Due-to-Laceration-Hazard-Sold-Exclusively-at-Target (accessed Sep. 21, 2025).
- [2] "Custom Slap Bands | Wristband Creation," *Silicone Wristbands & Rubber Bracelets* | Wristband Creation, May 16, 2025. https://wristbandcreation.com/product/slap-bands/ (accessed Sep. 21, 2025).

Content:

Design idea and characteristics are shown below

PROS

- easy to use
- give a sense of nostalgia and fit the kid vibe
- inexpensive and customizable
- can be a sensory item "Some modern versions, like "sensory slap" bracelets, are designed with different textures to provide tactile input for individuals with sensory needs, such as those with ADHD or autism." (could be an issue in the classroom though)
- very versatile

CONS

- laceration hazard "A significant safety concern, particularly with older or cheaply made versions, is that the protective outer fabric or plastic can tear. This exposes the sharp, thin metal band inside, which can cause cuts or other injuries. Some versions were banned from schools because of this risk."
- distraction the slap sound could draw unnecessary attention in the classroom
- poor durability "The outer covering can wear out over time, especially with frequent slapping and manipulation, increasing the risk of the internal metal becoming exposed." This also could lead to the safety hazard

- unsecure fit
- varying quality "With a huge variety of manufacturers, the quality of slap bracelets can vary drastically. Inexpensive versions may use lower-quality materials that break down faster and increase the safety risk."

Conclusions/action items: The slap bracelet would be a fun, cost-effective design. It is not very durable and can be seen as unsafe as it wears over time. After doing research I would not say that this is a good option.

Production

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CONSUMER PRODUCT SAFETY COMMISSION

Fantasia Accessories Recalls Slap Bracelets

Due to Laceration Hazard; Sold Exclusively at Target

Download

Fantasia_Accessories_Recalls_Slap_Bracelets_Due_to_Laceration_Hazard_Sold_Exclusively_at_Target___CPSC.gov.pdf (408 kB)

Ella Prose - Sep 21, 2025, 6:55 PM CDT

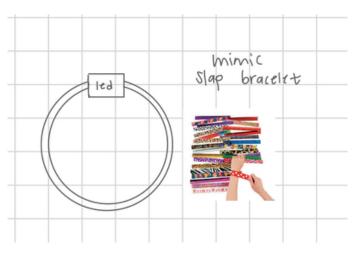
Ella Prose - Sep 21, 2025, 6:54 PM CDT



Download

Custom_Slap_Bands___Wristband_Creation.pdf (2.92 MB)

Ella Prose - Sep 21, 2025, 6:55 PM CDT



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IMG_DB456BAA6C50-1.jpeg (479 kB)

Ella Prose - Sep 21, 2025, 7:22 PM CDT

Title: Design Three focused on light aspect

Date: 09/21/2025

Content by: Ella Prose

Present: Individual

Goals: I want to research different lights for the bracelet band. I want to make sure they are cost-effective. I need to take into account child factors like accuracy and ensuring it is not too distracting.

Search Engine: Google Scholar

Search Term: Pancreas of Type 1 Diabetics

Citation:

[1] J. Fortmann, W. Heuten, H. Müller, and S. Boll, "Illumee: Aesthetic Light Bracelet as a Wearable Information Display for Everyday Life," 2013, doi: https://doi.org/10.1145/2494091.2495970.

Content:

Design idea and characteristics are shown below

Criteria and things to keep in mind:

- ease of use
- effectiveness
- not too distracting
- bright enough light
- accurate

From article:

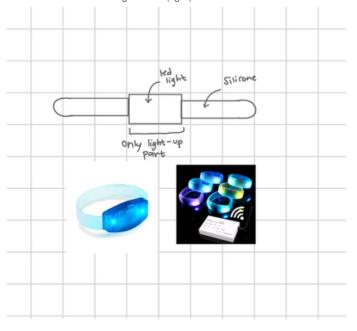
- "We present our vision of a wearable light display integrated into a piece of jewellery an aesthetic bracelet. As a piece of jewellery, the display is discreetly integrated into some accessoire that is worn anyway and therefore integrates excellently into everyday life. The bracelet can be used for various daily reminder tasks like intake of medication. It can also be used to present feedback on a persons health behaviour."
- "Therefore, aesthetics, comfort, but also behaviour and functionality of a worn device are crucial for its acceptance"
- "We believe that the wrist is a good location in terms of perception as well as for displaying information in an unobtrusive way" This correlates well with out wrist idea
- "Our idea is to discreetly integrate a wearable information display into a piece of jewellery."

- a charm bracelet in which LEDs are integrated into single charms and indicate information by their shape and colour
- "E.g. a charm shaped like a shoe or a water bottle can represent the users physical activity resp. water intake in an intuitive way. The shoe-shaped charms illuminate e.g. in green if the user has done an appropriate amount of steps recently and will slightly switch via orange to red when the physical activity of the user decreases. To keep the information private in public, more abstract or ambiguous shapes like stars, or balls can be used."
- "LEDs integrated into beads. Information can be encoded by colour, the number of illuminated beads, or spatial patterns."
- "LEDs can replace or be hidden underneath particular gemstones, like the gem in the centre of a ower. We assume the enchanting characteristic of digital jewellery will support its (long-term) usage. Regarding this, we think especially wearable technologies which are meant to motivate people for a healthier lifestyle could benefit from our idea."

Conclusions/action items: The main type of light used in wearable, light-up bracelets is LED lights. They shine very bright and can be seen from long distances. Their ease of use makes them easy to incorporate into a bracelet design while also making it customizable.



Ella Prose - Sep 21, 2025, 7:06 PM CDT



Download

IMG_E7F04203217B-1.jpeg (253 kB)

Ella Prose - Sep 21, 2025, 7:18 PM CDT

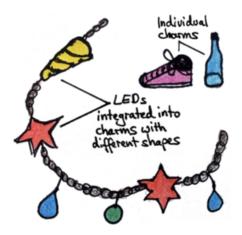


Figure 1: Sketch of a charm bracelet with LEDs placed inside the charms

Download

Screenshot_2025-09-21_at_7.18.24_PM.png (207 kB)

Ella Prose - Sep 21, 2025, 7:18 PM CDT

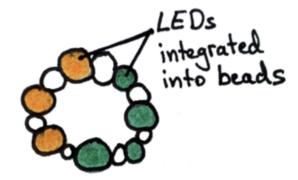


Figure 2: Sketch of a bracelet with LEDs placed inside beads

Download

Screenshot_2025-09-21_at_7.18.35_PM.png (96.9 kB)

Ella Prose - Sep 21, 2025, 7:18 PM CDT

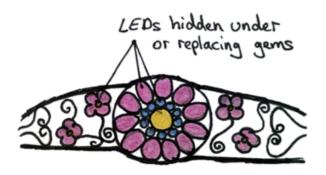


Figure 3: Sketch of an elegant bangle with LEDs replacing gems

Download

Screenshot_2025-09-21_at_7.18.45_PM.png (150 kB)

Ella Prose - Nov 19, 2025, 3:22 PM CST

Title: PLA material

Date: 11/19/2025

Content by: Ella Prose

Present: Individual

Goals: I want to learn more about the different materials the box could be made out of. I want to know the differences between the materials in the DI lab. I want to figure out which material would be the strongest and most durable.

Search Engine: Google Scholar

Search Term: PLA material

Citation:

[1] N. Tripathi, M. Misra, and A. K. Mohanty, "Durable Polylactic Acid (PLA)-Based Sustainable Engineered Blends and Biocomposites: Recent Developments, Challenges, and Opportunities," *ACS Engineering Au*, vol. 1, no. 1, pp. 7–38, Oct. 2021, doi: https://doi.org/10.1021/acsengineeringau.1c00011.

Content:

- Key themes:
 - Conventional durable plastics (petroleum-derived) carry high fossil-carbon and carbon-footprint burdens; shifting toward renewable-carbon content (e.g., biobased polymers like PLA) can reduce environmental impact.
 - PLA has much promise (biobased, good processability, etc) but in its native form it has limitations (brittleness, low heat resistance, limited durability for engineering service life). The review focuses on how to overcome those.
 - Strategies to enhance durability include: blending PLA with synthetic plastics or fibers, adding natural fibers or biocarbon fillers, use of additives (chain-extenders, compatibilisers, nucleating agents), improving crystallinity, optimizing processability, thermal stability, and flame or heat resistance.
 - The review also explores applications (automotive, electronics, medical, textiles, housing) where durable PLA-based materials might be used, and life-cycle / sustainability assessments of such materials.
 - The authors highlight challenges that remain: achieving good balance of stiffness vs toughness, improving interfacial adhesion in composites, increasing heat deflection temperature, flame resistance, cost-competitiveness, recyclability, and aligning durability with circular economy objectives.

 The paper finishes with an outlook on opportunities: more research into compatibilization, scalable processing, sustainable additive/filler systems, circular life-cycles (mechanical/chemical recycling), and techno-economic and environmental viability.

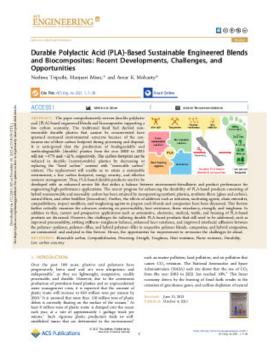
• Challenges:

- Toughness vs stiffness trade-off: Adding toughening fillers often sacrifices modulus or strength.
- Heat resistance / HDT: For engineering use, PLA must withstand higher temperatures; native PLA is limited.
- Interfacial adhesion: Especially in composites/blends, polymer-polymer or polymer-filler interfaces must be optimized.
- Recycling and end-of-life: More work needed to ensure PLA-based durable products can enter circular economy streams (mechanical/chemical recycling, reuse).
- Cost, scalability, industrial viability: Lab results exist, but scalable manufacturing and cost competitiveness with petroleum plastics remain

0

Conclusions/action items: The paper is a review of the state of the art of using polylactic acid (PLA) for durable engineering-type applications (rather than just biodegradable/short-life uses). It examines how PLA can be blended, modified and reinforced (as engineered blends and biocomposites) to produce materials suitable for long-term or structural use, and how this ties into a lower-carbon/more sustainable plastics economy. There are some main challenges with using PLA, including: cost, heat resistance, recycling inability, and more.

Ella Prose - Nov 19, 2025, 3:06 PM CST



 $durable-polylactic-acid-_pla_-based-sustainable-engineered-blends-and-biocomposites-recent-developments-challenges-and.pdf (3.26 \, MB)$

Ella Prose - Nov 19, 2025, 3:34 PM CST

Title: Resin Research

Date: 11/19/2025

Content by: Ella Prose

Present: Individual

Goals: I want to learn more about the different materials the box could be made out of. I want to know the differences between the materials in the DI lab. I want to figure out which material would be the strongest and most durable.

Search Engine: Google Scholar

Search Term: 3D printing materials

Citation:

[1] Amirhosein Ghaznavi Youvalari, Javad Alizadeh Kaklar, and M. Mohamadi, "Investigation of mechanical properties in PLA, ABS and epoxy resin parts fabricated by 3D printing technology," *Scientific Reports*, vol. 15, no. 1, Jul. 2025, doi: https://doi.org/10.1038/s41598-025-13866-8.

Content:

Material	Pros	Cons
PLA (Polylactic Acid)	- High stiffness / good modulus - Easy to print (lower warping) - Biodegradable / more sustainable	Brittle, low elongationLow heat resistance (softens)Possible degradation / warping underload or over time
Resin (Photopolymer / Epoxy)	- Variety of resin types (rigid, tough,	 Can be brittle depending on formulation Needs post-curing Toxic uncured resin; safety handling Potential long-term strength issues or creep
ABS (Acrylonitrile Butadiene Styrene)	 Good impact resistance (ABS is tough) Better ductility compared to PLA Higher heat resistance (than PLA) Well-understood, widely used 	Harder to print (warping, needs heated bed)Fumes during printingNot biodegradable

For box specifically:

- PLA is probably best bet for ease, good dimensional accuracy, and if the box doesn't need to withstand high stress or high heat.
- Use **resin** only if want very smooth surfaces, high detail (especially small features), and your box will not be load-bearing.

• Consider **ABS** if you need durability (e.g., box will be handled a lot or exposed to slightly higher temps) - but be prepared for more print difficulty.

This paper:

- · Compares PLA, ABS, and an epoxy resin.
- Finds PLA has a higher elastic modulus and tensile strength, but is brittle (low elongation).
- ABS shows better impact resistance.
- Resin (epoxy) had lower modulus but higher elongation, meaning it's more flexible / deformable under stress.

Relevance for 3D-Printed Functional Parts

- If you need high stiffness and static strength, PLA stands out; but remember its brittle nature.
- If impact resistance is important, ABS is strong there.
- For cyclic loading or fatigue scenarios, PLA interestingly performed best among these in this study.
- Sharp features or notches (especially in resin-based parts) degrade fatigue performance significantly-important for design of load-bearing printed parts.

Conclusions/action items: The study experimentally examines the mechanical behavior of three common 3D-printed polymers: Polylactic Acid (PLA), Acrylonitrile Butadiene Styrene (ABS), and a commercial epoxy-based resin, when fabricated by additive manufacturing. PLA had the highest elastic modulus and tensile strength among the three, followed by ABS and then the epoxy resin. In tensile tests, PLA exhibited brittle behavior, ABS showed a "tough" behavior, and the epoxy resin showed more ductile behavior. ABS had the highest impact strength, followed by the epoxy and then PLA. Under rotating bending fatigue (simple specimen), PLA exhibited the longest fatigue life, while the epoxy resin had the shortest.

Ella Prose - Nov 19, 2025, 3:35 PM CST

scientific reports

Drawn for upone

wave, nature, core (so is n'il ficre ports)

OPEN Investigation of mechanical properties in PLA, ABS and epoxy resin parts fabricated by 3D printing technology

Are informing Grazzovi Youwahali, Joseph Albadeh Kaklar²²³ b. Mahboube Hickoroodi²

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part? Consequently, recent years have seen a grifficant research into the mechanical properties of polymeric

¹Separation of Nechanizal Engineering, Faculty of Engineering, Sorrie University, Univid 5751-5188, Inc. Paparation of Polymer Engineering Faculty of Engineering, Univid University, Univid 5761-5818, Inc. "Series, placed higher in cr. 2

Scientific Reports 1 - DE SCHOLDER

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Ella Prose - Nov 21, 2025, 7:53 PM CST

Title: Microcontroller basics

Date: 11/21/2025

Content by: Ella Prose

Present: Individual

Goals: I want to learn more about what microcontrollers are. I want to know the basics of microcontrollers to build my background knowledge. I want to know how microcontrollers fit into my project.

Search Engine: Google Scholar

Search Term: Microcontrollers

Citation:

[1] "The Microcontroller Idea Book," *Google Books*, 2025. https://books.google.com/books? hl=en&lr=&id=VZfPBgAAQBAJ&oi=fnd&pg=PA1&dq=microcontroller+basics&ots=G65W3-m_DT&sig=RieImx9yhd4FMIpLxyOzUtMyyF8#v=onepage&q=microcontroller%20basics&f=false (accessed Nov. 22, 2025).

Content:

Microcontroller Basics

- A microcontroller = CPU + RAM + ROM + I/O + timers + serial port on one chip.
- Microcontrollers replace hardware logic with software-based control.
- Digital I/O pins read logic levels (0/1) and drive loads through buffers or drivers.

Why the 8052-BASIC MCU

- Based on Intel 8051 architecture.
- Contains a built-in BASIC interpreter, so no compiler or programmer is needed.
- Program can be typed in via serial terminal and runs immediately from RAM or EEPROM.
- Has built-in I/O ports, timers, serial UART, and support for external memory.

Digital Interfacing

- Inputs: switches require pull-up/pull-down resistors; mechanical switches need debounce.
- Outputs: LEDs require current-limiting resistors; high-current devices need transistor or MOSFET drivers.
- Ports are bit-addressable—individual bits can be set or cleared without affecting others.

Analog Interfacing

- The 8052 has no ADC, so analog inputs use external ADC chips (e.g., ADC0804/0809).
- Sensor signals often require op-amp conditioning before reaching the ADC.
- DACs or PWM can generate analog-like output signals.

Timers & Counters

- Internal timers operate as event counters or time-base generators.
- Used for delays, periodic interrupts, frequency measurement, and pulse counting.
- BASIC firmware provides commands for timing without needing register-level setup.

Serial Communication

- Built-in UART supports standard async serial (RS-232 via level shifter).
- Baud rate determined by timer settings.
- Used for program entry, debugging, and device-to-device communication.

Memory & Program Storage

- · Program can run from internal RAM or external EEPROM.
- Variables stored in small internal RAM; careful use required.
- BASIC interpreter includes commands for reading/writing EEPROM locations.

Peripheral Interfacing Examples (Actual Book Content)

- Keypads scanned using row/column matrix with port manipulation.
- Character LCDs driven via 4-bit or 8-bit parallel interface.
- Stepper motors driven using transistor arrays (e.g., ULN2003) with timed sequences.
- Temperature sensing via thermistors + ADC.
- Security devices using latches, sensors, and timed routines.

Design Principles Emphasized

- Keep the external circuitry minimal; offload complexity to software.
- Protect I/O lines from excess voltage/current.
- Use modular code and repeatable routines for timing, serial I/O, and port control.
- Separate power supply regulation and noise filtering from logic circuitry.

Conclusions/action items: *The Microcontroller Idea Book* teaches microcontroller fundamentals through hands-on circuits and programs built around the 8052-BASIC microcontroller. It explains how digital I/O, timers, serial communication, and external peripherals like ADCs, keypads, and displays interface directly with the MCU. The book focuses on practical, minimal-hardware designs where software handles most of the system's logic and control.

Ella Prose - Dec 10, 2025, 6:40 PM CST

Title: Dexcom Developer

Date: 11/21/2025

Content by: Ella Prose

Present: Individual

Goals: I want to learn more about what dexcom developer is. I want to find out how it works. I want to know how it works with our project.

Citation:

[1] "Dexcom API," Dexcom Developer. https://developer.dexcom.com/docs/

Content:

What Is the Dexcom Developer API?

- The Dexcom Developer Program allows third-party developers to access continuous glucose monitoring (CGM) data (e.g., glucose readings, events) via a RESTful API.
- Access is gated: developers must register, create an app, and apply for either Limited Access (for testing) or Full Access to become a Dexcom "Digital Health Partner."
- The API uses OAuth 2.0 for authentication, so users explicitly authorize an app to read their Dexcom data.

What Data You Can Access

Using the Dexcom API (V3), authorized apps can query endpoints such as:

- **legvs**: Estimated Glucose Values (glucose readings)
- /calibrations: Calibration data
- /alerts: Alert events (e.g., high/low glucose)
- levents: Records of user-entered events (like carbs, insulin, exercise)
- /devices: Information about user devices/transmitters
- /dataRange: Metadata around available data windows

Testing & Sandbox

- There's a sandbox environment for developers to test without using real user data.
- Sandbox uses simulated CGM data that mimics real Dexcom data, including glucose readings, events, and calibrations.

• The sandbox environment URL is https://sandbox-api.dexcom.com.

Real-Time vs Retrospective Data

- The "standard" Developer API (V3) is retrospective: not necessarily real-time streaming. Some developers note there may be a delay (e.g., ~3 hours) for data via this API.
- However, Dexcom also has a Real-Time API (FDA-cleared), which is meant for applications like secondary-display apps, monitoring, or analysis.
- The real-time API has limitations: it's not for automated insulin delivery systems, and usage is restricted by Dexcom's regulatory and technical policies.

Key Constraints & Considerations

- Because of HIPAA and privacy, users must consent and can revoke access.
- Not all developers get full access-Dexcom reviews applications to grant Limited or Full Access.
- Tokens must be refreshed: Dexcom's OAuth flow supports issuing of refresh_token to maintain long-term access.
- Errors (e.g., token expiration, revocation) must be handled in your app: e.g., if 401 is returned, refresh the token; if that fails, fire the re-auth flow.

Use Cases / Who's Using It

- Apps that analyze glucose trends or provide insights.
- Digital health tools that combine glucose + lifestyle data (insulin, carbs, exercise).
- Secondary-display apps (smartwatches, dashboards) using real-time API.
- Research / diabetes management platforms.

Conclusions/action items: The Dexcom Developer API is a REST-based system that lets approved third-party apps access Dexcom CGM data, including glucose values, alerts, events, and device information. Developers authenticate users through OAuth 2.0, and testing is done in a sandbox environment before Dexcom grants full production access. While the standard API provides retrospective data, Dexcom also offers a restricted real-time API for partners who meet stricter requirements.

Title: Circuit Schematics

Date: 12/10/25

Content by: Ella Prose

Present: Individual

Goals: I want to learn more about the specifics of circuits. I am interested in seeing how circuit schematics work and help engineers.

Search Engine: Google scholar

Search Term: Circuit Schematics

Citation:

[1] "Electronics for Beginners," Google Books, 2020. https://books.google.com/books?
hl=en&lr=&id=VLmbEQAAQBAJ&oi=fnd&pg=PR1&dq=what+are+circuit+schematic+diagram&ots=3jWV_TuBJ9&sig=vkvSGmYef3NRNiNnD8fJ1RwU4FM#v=onepage&q=w
(accessed Dec. 11, 2025)

[2] R. Mecomber, "What Is a Circuit Diagram?," All The Science, Jul. 15, 2011. https://www.allthescience.org/what-is-a-circuit-diagram.htm? (accessed Dec. 11, 202

Content:

What is a circuit schematic diagram?

- A schematic diagram (often just "schematic") is a symbolic drawing of an electrical or electronic circuit it shows components (like resistors, capacitors interconnect
- The schematic does not reflect the physical layout or precise placement of components; instead, it shows logical/functional connections (which pin conthan how the circuit physically looks.
- Components are represented by standardized symbols (zig-zag line for a resistor, parallel lines for a battery, etc.), which act like a kind of universal sh

Why schematic diagrams are useful

- Schematics make circuit design, analysis, troubleshooting, and documentation much easier you can see logically how current or signals should flow, components relate.
- For building hardware like a printed circuit board (PCB), you often start with a schematic once your schematic is correct, you generate a netlist (a for physical traces on the PCB based on that netlist.
- For documenting or sharing designs (for teaching, repair manuals, collaborative design), schematics provide a language that's independent of specific which makes them universal across projects, regions, and even decades

How to interpret a schematic - basics

Common conventions and what to watch for when reading a schematic:

- Wires/connections are shown via lines. When lines meet and are meant to connect electrically, often a dot or "node" is used at the intersection. If two no connection (just a "jump" or crossing).
- Each component is drawn using its symbol, and often annotated with a reference designator (like R1 for first resistor, C2 for second capacitor, etc.). T bill of materials (BOM).
- The schematic often arranges flow logically inputs on the left, outputs on the right; power supply rails sometimes top/bottom (or a similar conventional easy.
- Schematics may omit physical size, placement, or wiring "messiness" what matters is electrical connectivity. So even if your final circuit is a messy will present the clean, abstract version.

- it serves as a primer for people new to electronics, giving them the conceptual "language" of circuit diagrams. That matches what many public "beginners"

Conclusions/action items: The book provides a clear, beginner-friendly introduction to how circuits work, focusing on the meaning and purpose to interpret symbols, understand connections, and translate abstract diagrams into real, functioning hardware. Overall, it builds a solid foundation complex ideas into practical, usable skills.

Ella Prose - Dec 10, 2025, 7:21 PM CST

Title: Printed Circuit Boards

Date: 12/10/25

Content by: Ella Prose

Present: Individual

Goals: I want to learn more about the specifics of circuits. I am interested in seeing how PCBs work.

Search Engine: Google Scholar

Search Term: PCB

Citation:

[1] H. Shamkhalichenar, C. J. Bueche, and J.-W. Choi, "Printed Circuit Board (PCB) Technology for Electrochemical Sensors and Sensing Platforms," *Biosensors*, vol. 10, no. 11, p. 159, Oct. 2020, doi: https://doi.org/10.3390/bios10110159.

Content:

- The article reviews how established printed circuit board (PCB) manufacturing technology widely used for electronics - can be adapted to build electrochemical sensors and biosensing platforms. PCBs can serve as substrates for electrodes and other electrical parts of chemical/biological sensors, offering high reproducibility, low cost, and broad availability.
- The authors describe the history and typical materials used in PCB fabrication (e.g. FR-4 substrate, or alternatives like polyimide or Teflon for specialized applications), and explain the standard multi-layer manufacturing process (CAD → film transfer → etching → lamination → drilling/stacking) that yields precise, manufacturable circuit boards.
- The review also surveys recent advances in PCB-based electrochemical sensors, noting that this approach facilitates integration of electronics with microfluidics and supports miniaturization enabling point-of-care or field-deployable sensor platforms with potentially low cost and high sensitivity.
- Challenges and Limitations:

1. Material constraints:

The most common PCB substrate, FR-4, is inexpensive and widely available but not ideal for all electrochemical or biological applications because it can absorb moisture and has limited chemical resistance. More specialized substrates (like Teflon or polyimide) improve performance but increase cost and manufacturing complexity.

2. Surface quality and electrode precision:

Standard PCB copper layers are optimized for electronics, not sensing, so electrode surfaces may lack the smoothness or micro-scale precision needed for high-performance electrochemical detection. This can affect sensitivity, reproducibility, and long-term stability.

3. Biocompatibility considerations:

Some PCB materials, coatings, and solder masks are not inherently biocompatible, which can limit their safe use with biological samples unless additional layers or specialized fabrication steps are added.

4. Integration challenges:

Although PCBs enable easy integration of electronics, adding features such as microfluidics, specialized coatings, or multilayer sensing structures can be technically demanding and may require non-standard fabrication steps.

5. Environmental durability:

PCB-based sensors can be sensitive to environmental conditions like humidity and chemical exposure, potentially affecting long-term sensing performance unless protective strategies are used.

Conclusions/action items: PCB-based electrochemical sensors offer a promising platform because they combine low cost, broad availability, and seamless integration with electronic components. However, their performance is still limited by factors such as substrate properties, electrode surface quality, and biocompatibility challenges. Overall, the article concludes that PCB technology has strong potential for future sensing applications, but continued material and fabrication improvements are essential to fully optimize these systems.

Ella Prose - Dec 10, 2025, 7:23 PM CST



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biosensors-10-00159.pdf (2.49 MB)

Ella Prose - Dec 10, 2025, 7:36 PM CST

Title: Nightscout

Date: 12/10/25

Content by: Ella Prose

Present: Individual

Goals: I want to learn more about the specifics of Nightscout. I want to know its aid in helping diabetics.

Search Engine: Google Scholar

Search Term: Nightscout

Citation:

[1] *Proquest.com*, 2025. https://www.proquest.com/docview/3098791625?pq-origsite=gscholar&fromopenview=true&sourcetype=Scholarly%20Journals (accessed Dec. 11, 2025).

Content:

- Better glucose regulation through enabling group-based motivational mechanisms in cloud-based solutions like

Nightscout

- Introduction: The Nightscout project "(represented under the name "CGM in the Cloud" at Facebook and other sources)" is an open source, DIY (initiative that permits real time access to CGM (Continuous Glucose Monitor) data through personal website and smartwatch and smartphones apps.
- Nightscout was started by parents of children with Type 1 Diabetes and has continued to be developed, maintained, and supported by volunteers. The goal of the Nightscout project is to allow flexible, remote monitoring of a person with type 1 Diabetes' glucose level using existing monitoring devices.
- Few solutions offer multi-user functionality to share blood glucose data and work together to achieve healthy glucose control.
- The typical user interfaces present the current BG value and the historical development of the user's BG values for one single user only.

Conclusions/action items: Nightscout is a project initiated and performed by computer-skilled parents with children with type 1 diabetes, parents who are not willing to wait to get access to technologies that can enhance their children's health. The software has been developed by several people with the same goal – get better solutions, and get them fast. As a consequence, the source code repository and code quality does not have industrial qualities. Therefore, even though the code is freely accessible, it is challenging for programmers outside the core development team to extend this kind of source code.

Ella Prose - Oct 19, 2025, 10:37 AM CDT

Title: 3D box sketch

Date: 10/19/2025

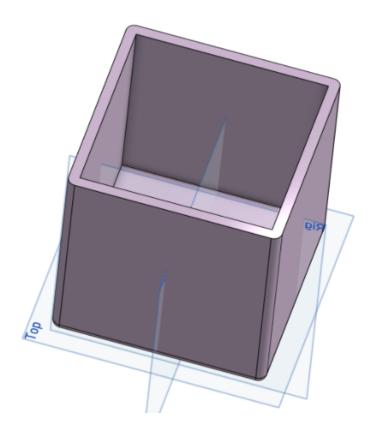
Content by: Ella Prose

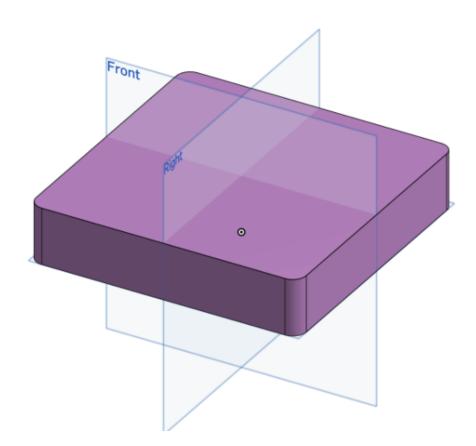
Present: Individual

Goals: I want to create a box that can be used as a prototype for the team's LED face design. I want the box to be 30x30x15 mm. The edges of the box should be chamfered and smooth.

Content:







Conclusions/action items: The box is the correct dimension of 30x30x15 mm. This is a rough draft, and I will work on making the lid flush with the box. This is a good start to a prototype.



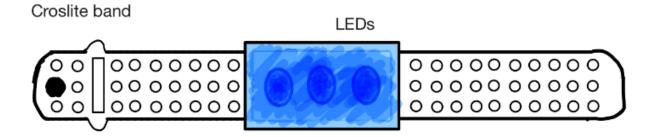
Ella Prose - Oct 31, 2025, 4:56 PM CDT

Title: Pictures

Date: 10/31/2025
Content by: Ella

Goals: I want to draw and get the designs down. I want to have a space to reference all the designs. I want to add dimensions.

Content:



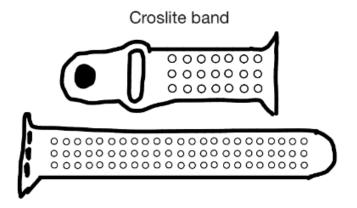
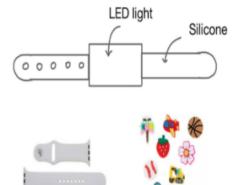




Figure 1: Sketch of a charm bracelet with LEDs placed inside the charms



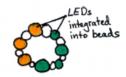
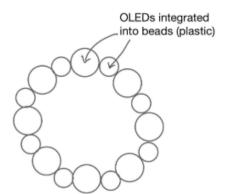


Figure 2: Sketch of a bracelet with LEDs placed inside beads



Figure 3: Sketch of an elegant bangle with LEDs replacing gems



Conclusions/action items:

Ella Prose - Sep 26, 2025, 12:27 PM CDT

Title: BPAG Meeting

Date: 9/26/2024

Content by: Ella Prose

Present: Individual

Goals: I want to learn more about my role as BPAG. I need to figure out my semester tasks and who to be in contact with. I need to be organized with the funds and material.

Content: https://docs.google.com/presentation/d/1afzZducXt7gQVMzRxzyJ6cwwz9kEzfxt0djJqp8hhZc/edit?slide=id.gcfbd29954d 0 154#slide=id.gcfbd29954d 0 154

- Get client to purchase for you or I pay and then get reimbursed
- have all expenses approved by client prior to purchase
- keep track of all purchases
 - all original detailed receipts in notebook
 - table of expenses notebook, progress report, and report
- Client UW affiliation but not BME
 - figure out if UW funds or not !!!!!
 - o no
 - anything fair game
 - yes
 - o follow uw purchasing rules
 - I am only one to deal with purchasing and refunding
- ShopUW+ has complete list of vendors
 - client pays for materials with funding string I cannot order directly

if client using UW funding, must show that these vendors do not have the product available from vendors first

- DI Lab at Wednt has mini-mart for electronics, components, plastics
 - \$50 budget per team here BMEDesign
 - · if client purchasing, need to set up account with funding string
- DI Lab at ECB has FREE stockroom supplies screws, nuts, bolts, glue, tape, pipe fitting, etc and tool crib
- reimbursement
 - only BPAG reimbursed
 - e-reimbusement from UW-Client before poster session (LAST RESORT)
 - o original invoice receipts

- o takes 3+ weeks
- requires valid project number obtained from UW-client
- non-reimbursable
 - lab archives notebook \$25
 - makerspace fee free
 - poster printing \$50 per team
- accounting: use table with ALL vital information needed to purchase again
 - put table in progress report, notebook
 - include even free/gift things

Conclusions/action items: Have the client make purchases. All expenses should be approved by the client prior to purchase. I should keep track of all expenses and try to find materials from UW vendors first.



Ella Prose - Oct 31, 2025, 4:52 PM CDT



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Screenshot_2025-10-31_at_4.49.47_PM.png (145 kB)

Ella Prose - Oct 31, 2025, 4:52 PM CDT



Download

Screenshot_2025-10-31_at_4.48.58_PM.png (324 kB)

Ella Prose - Nov 07, 2025, 12:58 PM CST

Title: Tong Lecture - Why healthcare needs more engineers

Date: 11/07/25

Content by: Ella Prose

Present: All BME Lecture

Goals: I want to learn more about the Blue Cross. I want to know why healthcare needs more engineers. I want to know how to build a career of

impact.

Content:

Kristin Myers, Blue Cross Blue Shield Insurance

- "Run towards the hard problems... they are the ones that change the world"
 - o pick big problems and run towards them make biggest impact
- · Chapter 1: The foundation
 - o solve tangible problems, work hard, add value
 - she had 4 internships and co-ops --> guidant, baird, abiomed, medtronic
 - · engineering marketing/product launch technical sales\
 - harvard MBA --> skyline ventures and then arboretum ventures
 - o all about individual and getting experience
- · Chapter 2: The growth
 - o combine EQ with IQ to multiply impact and reach
 - · Aetna chief of staff to CEO President, Student health president, CVS
 - willingness to take on the challenge --> building opportunities
 - o Unified Women's Healthcare President and Chief Operating Officer
 - OBGYN doctors, pandemic hits, practice had to layoff 50% of workers, shortage of protection equipment --> lot of challenges
 - · all about team and collaboration
- · Chapter 3: Build and transform
 - o drive system-level impact through innovation and scale
 - · Hopscotch Health founder and CEO, advanced primary care for rural communities
 - Blue Cross Blue Shield Association, chief operating officer enable access, affordability, outcomes and experience for 1 in 3
 americans
 - making healthcare better for our country
- "You don't need to know final destination just follow hard problems and perceive through them"
- · What does great look like?
 - · improved provider experience, improved patient outcomes, lower cost of care, improved patient experience
 - · tough to be a doctor in this country
 - · a smaller percentage of time is about patients and more of it is about administrative burdens and charts
- We spend 18% of GDP on healthcare in the US
- · We spend 2x as much in compared to other companies
- · US ranked last on equity, access and outcomes, lower life expectancy
- · so complicated --> 900 insurers, misaligned incentives, inequities, fragmented financing and regulation
- healthcare is a broken system because it was never designed to be one system
- goal: build an integrated system to enable health and wellness for all
- · healthcare needs better systems and systems are what engineers build best
 - interconnected nature of data
 - o aligned incentives and measurements clinicians being rewarded for their service
- 1. work hard and build range take on the hardest projects, classes, and experiences you can find. effort and range are your foundation

look for companies with places that have an office with other people - can collaborate better and reach out for other perspectives range of manufacturing facilities to pace making business

2. Seek diverse exposure

explore different sectors, teams, and geographies - gain perspective and learn how systems connect, not just how parts work

- 3. Choose your people wisely surround yourself with curious, driven, high-integrity people --> they will shape who you become
- 4. Know your values and protect them define what matters most: family/friends, health, career/impact, values and make decisions that align
- 5. Embrace challenge and keep growing run towards hard problems, growth lives on the edge of discomfort where big impact starts
 - · how to avoid burnout
 - · energy flows
 - o take a break during lunch
 - · late afternoon finish own priorities and then focus on the other people or tasks
 - · system thinking its okay to say no to social stuff
 - · we can only do so much
 - · being willing to let things go
 - work towards making a system where all data is put in, and it can be accessed by all caregivers and specialists, no matter where the
 consultation is located
 - · connected data and empowering consumers
 - · drug prices are an issue in the US
 - · career oriented going to business school 5 years post grad was something she regretted the least

Conclusions/action items: Healthcare needs better systems, and systems are what engineers do best. The healthcare system is broken because it wasn't built on a good single system. We need to work towards making caregivers and patients feel more connected and seen. In the next steps of being an engineer, I should focus on working hard and building a broad range of skills, seeking diverse exposure, choosing my colleagues wisely, understanding my values and protecting them, and embracing challenges to continue growing as a person and engineer.

Ella Prose - Nov 20, 2025, 2:27 PM CST

Title: Box Testing

Date: 11/18

Content by: Ella Prose

Present: Kiera and Audrey

Goals: I want to figure out which box is the strongest. I want to know which material we should make our final product

in. I want to make a testing plan.

Content:

1. Impact Tests (Drop + Point Impact)

A. Standard Drop Test aimed at the corners

Purpose: See how the box handles everyday falls. Corners and watch slots are the most failure-prone areas. **Setup:**

- Use a tape measure.
- Drop your box from the following heights onto a hard surface (concrete, tile, or hardwood):
 - o 2 ft 0.609 m
 - o 3 ft 0.914
 - 8.2 ft 2.5 m (height of average playground equipment)
- Perform **3 drops per height**, rotating the box to hit a different face each time.

Record: Cracks, seam splits, corner damage, lid failure, etc.

PLA	PLA	PETG	PETG
Carpet -	Wood -	Carpet -	Wood -

Ella Prose/11/18/25 - Testing 429 of 531

		2 ft - minimal damage on the corners
	3 ft - little to no damage near watch slot	3 ft - minimal damage on the corners
9	9	9 ft - minimal damage near watch slot

2. Compression Test (Crush Resistance)

A. Sidewall Compression

Purpose: Test how the walls resist squeezing.

Setup:

• Use a clamp and turn the handle slowly

• Note the number of turns until deformation

	PLA	PETG
Number of turns	¼ turn	½ turn
	Entire bottom falling off, clean break of bottom, more damage	Part of bottom falling off, crack down side of bottom

3. Wear & Fatigue Tests

A. Abrasion Test

Purpose: See how PETG and PLA handles repeated scraping.

Setup:

• Rub a file over the base and edges of each box

Ella Prose/11/18/25 - Testing 430 of 531

· Keep track of each pass of the file

Record: Number of files, visible wear, changes in texture, structural damage.

	PLA	PETG
Starting Length	32.04mm	32.02mm
Ending Length	31.87mm	31.97mm
Difference	0.17mm	0.05mm
Number of Files	20	20
_	_	Edges were rougher, better resistance to file

Overall: PETG had a better resistance to the file.

Conclusions and Action items: We determined that the PETG box was the strongest. The PLA box was not as durable in any aspect. We want to test the box made out of Resin, however, Resin is expensive, so we need to determine if we want to do a full-size box test or a smaller version for testing to save money.

Audrey Zeller - Sep 15, 2025, 11:13 PM CDT

Title: Insulin injection practice and health related quality of life among individuals with diabetes

Date: 9/12/2025

Content by: Audrey Zeller

Goals: To learn about the quality of life and insulin practices/injections for those with type one diabetes. Also learn more about insulin practices and how they can be improved. To get more background information about what diabetes is.

Content:

- "insulin therapy can be inconvenient, painful, burdensome, and restrict patients' daily activities and health related quality of life (HRQOL) due to improper injection techniques or the nature of administration.
- The burden of diabetes mellitus (DM) has become a major public health problem and is steadily increasing in developing as well as developed nations
- Faulty injection technique is associated with injection-site complications, including lipohypertrophy (LH). Moreover, improper handling of needles and other sharps used in insulin injection may increase the risk of accidental injury and transmission of blood-borne infections in patients and their close contacts
- Until recently, many of the recommendations on insulin administration worldwide had little or no scientific underpinning and were based as much on habit and tradition as on evidence"

Good to know for kids -

- "The recommended site of insulin injection subcutaneously are upper arm; and the anterior and lateral aspects of the thigh, buttocks, and abdomen at a 90° angle. However, for thin individuals or children, it is advised to use short needles and inject at 90° subcutaneously on the above mentioned sites or may need to pinch the skin and inject at a 45° to avoid intramuscular injection, especially in the thigh area.
- A study in Bangladesh showed that dependence on others (family members and paramedics) for injections was also a barrier to multiple daily insulin
 injections
- There's a lot of misuse and more education needed in some parts of the world for administering insulin (particularly when administering insulin to
 yourself or others), Regarding other components of the correct technical insulin injection practice, 96.9% and 53.9% of patients correctly reported
 inserting the needle perpendicularly (90 degree) and raising the skin at the site of injection, respectively. "

Study aims/results

- "the study participants had fair practices in insulin handling, storage, and administration techniques, and it was seen that male and type one diabetes patients have a better quality of life compared to their counterparts.
- Therefore, improving patients' perceptions and acceptance of insulin should be a primary goal of diabetes care"

Conclusions/action items:

Overall, insulin therapy is so important but can feel like a burden when people don't get the right education on how to use it. Simple things like where to inject, what angle to use, and how to handle needles safely make a huge difference in avoiding problems. Kids especially need extra care since they often rely on parents or caregivers, and thin/smaller kids might need different techniques to stay safe. Making insulin easier to understand and less intimidating can really improve daily life for patients and their families.

Cite: References

Negash, Z., Tadiwos, A., Urgessa, E. M., Gebretekle, G. B., Abebe, E., & Fentie, A. M. (2023). Insulin injection practice and health related quality of life among individuals with diabetes at Tikur Anbessa Specialized Hospital, Ethiopia: a cross-sectional study. *Health & Quality of Life Outcomes*, 21(1), 1–11. https://doiorg.ezproxy.library.wisc.edu/10.1186/s12955-023-02123-z

Audrey Zeller - Sep 12, 2025, 3:27 PM CDT



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EBSCO-FullText-09_12_2025.pdf (1.05 MB)

11/12/25 Type One Diabetes Research

Audrey Zeller - Dec 10, 2025, 1:20 PM CST

Title: Background on Type one diabetes

Date: 11/12/25

Content by: Audrey

Goals:

Type 1 diabetes requires constant daily management, and because symptoms can mimic other conditions, people unfamiliar with diabetes often struggle to recognize early warning signs. Increasing awareness can help identify Type 1 diabetes sooner and support better long-term health.

Content:

What Type 1 Diabetes Is

- · The pancreas makes no insulin or very little insulin.
- · Insulin helps sugar enter cells so the body can use it for energy.
- · Without insulin, blood sugar builds up, causing serious complications.
- · Previously called insulin-dependent or juvenile diabetes, but it can happen at any age.
- Only 5-10% of people with diabetes have Type 1.

Symptoms

- · Symptoms can develop quickly once they appear.
- They can be severe and often look similar to other health issues.
- Untreated Type 1 diabetes can become life-threatening.
- · Important: Many people who don't know about diabetes don't recognize the symptoms, which makes early detection difficult.

Risk Factors

- Family history (parent, brother, sister with Type 1).
- · Most common in children, teens, and young adults, but can occur at any age.
- In the U.S., White individuals are statistically more likely to develop Type 1 diabetes.

Causes

- · Caused by an autoimmune reaction that destroys insulin-producing beta cells.
- · May involve:
 - Genetic risk
 - Environmental triggers (possibly viruses)
- Not caused by diet or lifestyle.

Testing & Diagnosis

- · Diagnosed with a blood test for blood sugar.
- · Doctors may test for:
 - Autoantibodies (common in Type 1)

Ketones in urine (suggest Type 1 if present)

If a Young Child Has Type 1 Diabetes

- · Parents often manage:
 - · Daily insulin injections or pump use
 - · Watching for and treating low blood sugar
 - Staying in contact with the child's medical team

Treatment & Daily Management

- Type 1 diabetes is mostly managed by the individual with support from a medical team.
- · You may work with:
 - Primary care doctor
 - Endocrinologist
 - Dietitian
 - Diabetes educator
 - · Eye doctor
 - · Foot doctor
 - Dentist
 - Pharmacist
 - · Support people (family, teachers, friends)

Daily Management Includes:

- · Taking insulin every day (shots or pump)
- · Doing regular blood glucose checks
- · Knowing how to treat:
 - Low blood sugar (hypoglycemia)
 - Diabetic ketoacidosis (DKA)
- · Healthy lifestyle habits:
 - Eating healthy foods
 - Staying active
 - Managing blood pressure and cholesterol
 - · Getting enough sleep
 - Managing stress

Conclusions/action items:

Type 1 diabetes requires constant daily management, and because symptoms can mimic other conditions, people unfamiliar with diabetes often struggle to recognize early warning signs. Increasing awareness can help identify Type 1 diabetes sooner and support better long-term health.

https://www.cdc.gov/diabetes/about/about-type-1-diabetes.html



11/19/25 Type One Diabetes Research

Audrey Zeller - Dec 10, 2025, 1:25 PM CST

Title: Type one diabetes background information

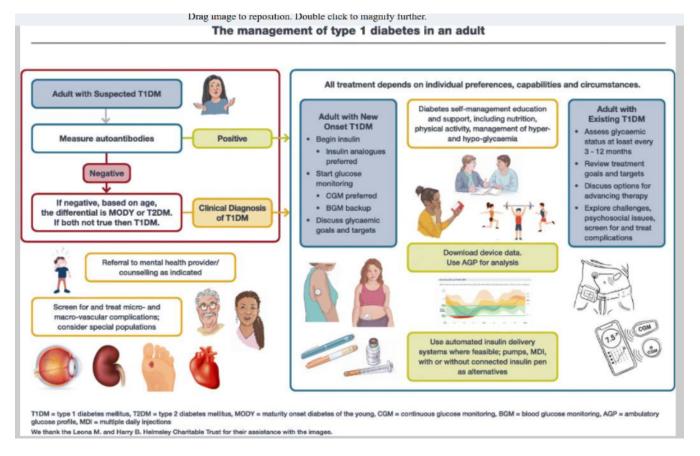
Date: 11/19/25

Content by: Audrey

Present: Audrey

Goals: The goal of this research is to gain a clearer understanding of Type 1 diabetes, including its autoimmune cause, prevalence, and how it is diagnosed. This research also aims to explore how Type 1 diabetes is managed in adults and why accurate diagnosis is essential for long-term care.

Content:



- "Type 1 diabetes is a condition caused by autoimmune damage of the insulin-producing beta cells of the pancreatic islets, usually leading to severe
 endogenous insulin deficiency."
- "Type 1 diabetes accounts for approximately 5–10% of all cases of diabetes."
- "The global prevalence of type 1 diabetes is 5.9 per 10,000 people, while the incidence has risen rapidly over the last 50 years and is currently estimated to be 15 per 100,000 people per year."
- "Prior to the discovery of insulin a century ago, type 1 diabetes was associated with a life expectancy as short as a few months."
- "Over the ensuing decades, insulin concentrations were standardised, insulin solutions became more pure... and additives, such as zinc and protamine, were incorporated into insulin solutions to increase the duration of action."
- "Despite these advances, many people with type 1 diabetes do not reach the glycaemic targets necessary to prevent or slow the progression of diabetes complications."
- "Unlike many other chronic conditions, type 1 diabetes places a unique burden of management on the individual with the condition."

- "Adults with new-onset type 1 diabetes can present with a short duration of illness of 1–4 weeks or a more slowly evolving process that can be mistaken for type 2 diabetes."
- "Misclassification of type 1 diabetes in adults is common and over 40% of those developing type 1 diabetes after age 30 years are initially treated as having type 2 diabetes."

Conclusions/action items:

Overall, the article explains that Type 1 diabetes is caused by "autoimmune damage of the insulin-producing beta cells," leading to severe insulin deficiency and the need for lifelong management. It also highlights the challenges in diagnosing adults, noting that misclassification is common and that "over 40% of those developing type 1 diabetes after age 30 years are initially treated as having type 2 diabetes," emphasizing the importance of correct identification and treatment.

The management of type 1 diabetes in adults. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD) - PMC

Audrey Zeller - Dec 10, 2025, 1:31 PM CST

Title: Background info on type one diabetes/ Diagnosing type 1 diabetes

Date: 11/26/25

Content by: Audrey

Present: Audrey

Goals: learn more about how health care professionals diagnose type 1 diabetes and what testing methods are most commonly used. Another goal is to understand how autoantibody testing and family history contribute to determining risk and identifying the disease early

Content:

"Your health care professional can diagnose diabetes by reviewing your symptoms, asking about your medical history, and using diabetes tests."

"Health care professionals often test for type 1 diabetes in people who have common diabetes symptoms" and may also test those "who have no symptoms but have a parent or sibling with type 1 diabetes."

"Health care professionals can diagnose diabetes using blood tests that measure your blood glucose level to see if it's higher than normal," including "the random plasma glucose test," "the fasting plasma glucose test," and "the A1C test."

"These blood glucose tests can help your health care professional tell if you have diabetes, [but] the tests don't show the type of diabetes you have."

"To find out if your diabetes is type 1, your health care professional may test your blood for certain autoantibodies."

"Autoantibodies are proteins made by your immune system that attack healthy tissues and cells by mistake."

Some adults develop symptoms more slowly, and this type "is sometimes called latent autoimmune diabetes in adults (LADA)."

People with a family history may be tested even without symptoms because the test "may show if you have a higher risk of developing symptoms of type 1 diabetes and if you should be treated to delay the disease."

If the diagnosis isn't clear, providers may order "a C-peptide test to see how much insulin your pancreas makes" or "genetic testing to rule out less common types of diabetes."

Conclusions/action items:

Diagnosing type 1 diabetes relies on evaluating symptoms, family history, blood glucose measurements, and specialized tests that identify autoimmune markers. Because "blood glucose tests...don't show the type of diabetes you have," health care professionals depend on autoantibody testing and additional tests like C-peptide or genetic testing to determine the correct diagnosis.

Type 1 Diabetes - NIDDK

Audrey Zeller - Sep 15, 2025, 11:18 PM CDT

Title: Designing a Closed-Loop Automated Insulin Delivery System: Simplifying Life for People, Including Children, Living With Type 1 Diabetes.

(competing design from another source)

Date: 9/12/2025

Content by: Audrey Zeller

Present: NA

Goals: Explore and study a competing design. Learn what insulin pumps are prevalent and what components make them useful. Also be on the lookout for things that can be improved.

Content:

(Background info)

- "Type 1 diabetes is an autoimmune disorder in which the body attacks and destroys its own insulin-producing beta cells of the pancreas
- · Without insulin, blood glucose levels rise, and if left untreated, may lead to dangerous complications
- Treatment involves having external insulin administered via injections or pump to support normal metabolic function including glucose levels. If too much insulin is administered, blood glucose drops, which can lead to severe immediate consequences, including death.
- people with diabetes are to aim to spend at least 70% of the time with glucose levels in the target range of 70–180 mg/dL (known as "time in range (TIR)"), and to aim for an HbA1c level <7%
- insulin pumps, a medical device typically attached to a person's belt/waistline that delivers insulin through a tube into an infusion set applied to the abdominal area, were commonly used"

About Omnipod

- "Omnipod was to be "life-proof," including for kids. Omnipod was envisaged to be worn 24/7, 365 days per year: whether swimming2, mixing it up on a playground, or wrestling with a sibling. Eliminating injections and associated fears was another key design goal, so Omnipod required a way to insert a small, flexible tube (known as a cannula) that was hidden from view
- Omnipod was revolutionary Users can see their glucose readings and control the system all from their fingertips with the Omnipod 5
 App on the Insulet-provided controller or their own compatible smartphone.3 Also, the Omnipod 5 includes a SmartBolus calculator that
 can automatically incorporate a user's CGM value and trend, making it quick and easy to calculate and deliver additional insulin
- Thanks to the unique Omnipod form factor and the simplicity of Omnipod 5, the user experience is easier than multiple daily injections or tubed pump therapy.
- The ability to analyze real world data from Omnipod 5 users contributes to a better user experience that helps Insulet simplify life for people with diabetes and their caregivers
- The more burdensome the therapy (irrespective of disease), the less likely a person is going to stay on therapy. So, the connection between ease-of-use and efficacy is powerful and unusually clear in diabetes."

Conclusions/action items:

Type 1 diabetes is an autoimmune condition where the body destroys insulin-producing cells, requiring lifelong insulin therapy to manage blood glucose levels and prevent dangerous complications. People with diabetes aim to keep glucose within 70–180 mg/dL (time in range) and an HbA1c below 7%. The Omnipod system simplifies insulin delivery by eliminating injections, using a discreet wearable pod with an automatic administration and smartphone control. Its ease of use, data integration, and "life-proof" design improve adherence and quality of life compared to traditional pump or injection therapy.

Cite:

Benjamin, Eric. "Designing a Closed-Loop Automated Insulin Delivery System: Simplifying Life for People, Including Children, Living With Type 1 Diabetes." *IEEE Pulse*, vol. 15, no. 3, 2024, pp. 5-10. IEEE

Designing a Closed-Loop Automated Insulin Delivery System: Simplifying Life for People, Including Children, Living With Type 1 Diabetes

Eric Benjamin

Extrace were treet (dathetes a difficult. This is experiently two for young children and adelegement, who are developing—dispecially, memby, emotion. 42000 proofs with dathen, being them has developing—dispecially, memby, emotion. 42000 proofs with dathen, being them has dispersed to the less. 42000 proofs with dathen, being them has dispersed to the less. 42000 proofs with dathen, being them has districted being the continued of the less. 42000 proofs with dathen, being them has districted being the dathen defined contribute of the section of the less. 42000 type I of districts as a statistic member dathen defined contribute of the contribution of the district of the less. 42000 type I of districts has a statistic member description of the length of the less of the district of the less of the district of the length of the length

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Designing_a_Closed- $Loop_Automated_Insulin_Delivery_System_Simplifying_Life_for_People_Including_Children_Living_With_Type_1_Diabetes.$ pdf (180 kB)

Audrey Zeller - Dec 10, 2025, 1:37 PM CST

Title: Glowcose

Date: 9/12/2025

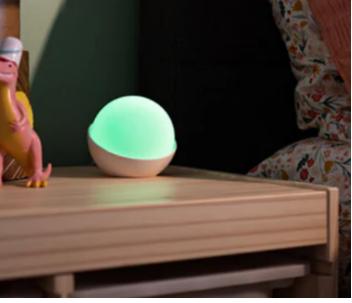
Content by: Audrey

Present: Audrey

Goals: Learn more about the competing design Glowcose

Content:





Working with a CGM--

Glowcose supports Dexcom G6 and G7, as well as Libre 2 and 3. We also offer support for other CGMs via Nightscout, if you're using it. In general, if your CGM provides cloud data, there's a very good chance Glowcose will work with it.

Colors

Hundreds of colors! Glowcose uses the full hue spectrum—from red for lows to a pinkish-purple for highs. It becomes surprisingly intuitive in no time.

Portable- can only use with a portable battery

Yes! While we can't promise every power bank will work, we do use them quite often. It's lovely when outside relaxing on the patio.

Updating time

Glowcose updates every few minutes to follow along with your current CGM reading.

Conclusions/action items:

Glowcose is great for a bedside/table setting. Is neither portable or wearable. It also needs a constant energy source.

Glowcose - Glucose Light - CGM Light - Glucose Monitor Light

Audrey Zeller - Dec 10, 2025, 1:39 PM CST

Title: Sugar pixel

Date: 9/17/25

Content by: Audrey

Present: Audrey

Goals: Learn more about the competing design Sugar Pixel

Content:



110 \$

Use SugarPixel for...

- Hard to wake teens and college students transitioning to independent care.
- Vibration alerts for hearing impaired and and dual audio-vibration alerts for heavy sleepers.
- Displaying BG values from multiple T1D at the same time on a single device.
- A quick glance from across the room or across the yard with the large display.

SugarPixel requires:

- The Dexcom app or Libre app with at least 1 Dexcom Follower or Libre Linkup Connection, a Nightscout site, or a Gluroo account to read CGM data from.
- · 2.4ghz wifi network.

Conclusions/action items:

- Nice that is shows a visual number- doesn't communicate via color signals, neither portable nor wearable.

 $\underline{SugarPixel-CustomTypeOne.com}$

Audrey Zeller - Dec 10, 2025, 1:46 PM CST

Title: Diabetic Alert Dogs

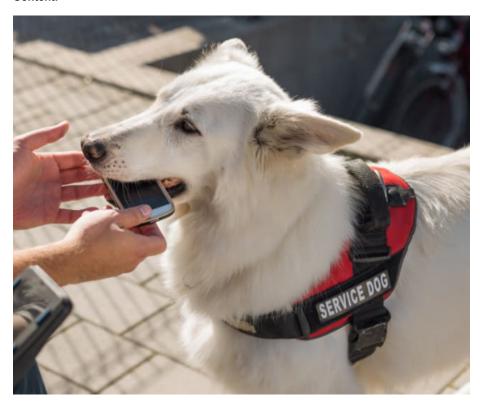
Date: 9/25/25

Content by: Audrey

Present: Audrey

Goals: Learn more about diabetic Alert dogs and there effectiveness

Content:



"Diabetic alert dogs are trained using the same methods as the Federal Bureau of Investigation (FBI) and the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) to train scent detection in dogs."

"These pups are here to sniff out their owner's blood glucose (sugar) levels."

"Diabetic alert dogs are trained to detect a change in smell from their owner, indicating lower or higher blood sugar levels than normal."

"They are believed to be able to smell a change in their owner's blood sugar levels by recognizing changes in the scent of sweat or saliva."

"Researchers found that hypoglycemia significantly raises the presence of isoprene (found in breath)."

"A diabetic alert dog can be trained to perform a variety of responsibilities... They can even carry sugary foods or insulin in their harnesses."

"Some dogs can also be instructed alongside specific technology that can help to assist their owners during an emergency."

"People who have diabetic alert dogs cite a level of support from the dog that CGMs just don't match."

"Dogs can also increase psychological and emotional functioning... acting as a companion."

Conclusions/action items:

Dogs are a really cool way of keeping track of changes in blood glucose level but obviously take a lot of work to handle. They are portable-but its not feasable for children in a school setting to always have. They can be expensive and hard to maintain.

Audrey Zeller - Sep 15, 2025, 11:40 PM CDT

Title: Average weather Data for the US

Date: 9/15/2026

Content by: Audrey

Goals: Learn about the high and low temperatures in the US. Use that information to put in PDS for "operating environment". Establish high and low temp. values the device should operate at.

Content:

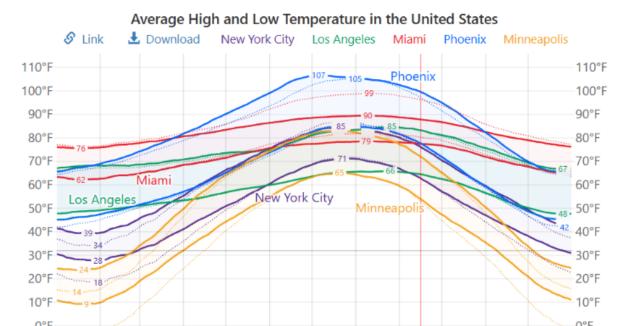
-10°F

Feb

Jan

Mar

Apr



The daily average high and low air temperature at **2 meters** above the ground. The thin dotted lines are the corresponding perceived temperatures.

Jul

Jun

May

High	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
New York City	40°F	42°F	51°F	61°F	71°F	79°F	84°F	82°F	75°F	65°F	54°F	45°F
Los Angeles	68°F	68°F	70°F	72°F	74°F	78°F	83°F	84°F	83°F	78°F	72°F	67°F
Miami	76°F	77°F	79°F	82°F	85°F	88°F	89°F	89°F	88°F	85°F	80°F	77°F
Phoenix	67°F	71°F	78°F	86°F	95°F	104°F	<u>106°F</u>	104°F	99°F	88°F	75°F	66°F
Minneapolis	24°F	29°F	42°F	58°F	70°F	79°F	83°F	80°F	71°F	58°F	42°F	28°F

Now

Oct

Nov

Dec

Sep

Aug

-10°F

Low	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
New York City	29°F	30°F	37°F	46°F	56°F	65°F	71°F	69°F	62°F	52°F	42°F	34°F
Los Angeles	49°F	50°F	52°F	55°F	59°F	62°F	65°F	66°F	64°F	60°F	53°F	48°F
Miami	63°F	64°F	67°F	70°F	74°F	77°F	78°F	78°F	77°F	74°F	70°F	65°F
Phoenix	46°F	49°F	54°F	61°F	70°F	79°F	85°F	84°F	77°F	65°F	53°F	<u>46°F</u>
Minneapolis	<u>10°F</u>	14°F	26°F	39°F	50°F	60°F	65°F	6 Pho	enix	41°F	28°F	15°F

Cite: United States Climate, Weather By Month, Average Temperature - Weather Spark. https://weatherspark.com/countries/US#google_vignette. Accessed 15 Sep. 2025

Conclusions/action items: temps range from -5 to 120 degrees F. Will use this information in PDS and make the device operational in all these temps.

Audrey Zeller - Sep 15, 2025, 11:53 PM CDT

Title: Apple Watch Lifespan: How Many Years Will Your Device Last?

Date: 9/15/2025

Content by: Audrey

Goals: Determine lifespan of a apple watch lithium battery. Use this value as a goal/standard to compare our device to. Include this value in our PDS.

Content:

"For most users, you can expect your Apple Watch to last 3-5 years. With good care, however, you can expect to add an additional 1+ or more years to its life.

water damage remains one of the most common issues people have with their watches.

Lithium-ion batteries degrade over time, losing capacity and requiring more frequent charging.

- Optimize Battery Usage: Reduce screen brightness, limit notifications, and disable unused features.
- Charge Properly: Avoid overcharging and follow Apple's charging guidelines.
- Update Software: Install the latest watchOS updates for optimal performance and security.
- Protect from Damage: Use a case and screen protector to prevent physical damage."

Cite: Apple Watch Lifespan: How Many Years Will Your Device Last? - SimplyMac. 10 Jul. 2024, https://www.simplymac.com/apple-watch/apple-watch-lifespan.

Conclusions/action items:

An Apple Watch typically lasts 3–5 years, with careful use potentially extending its life, though water damage and battery degradation are common issues. To maximize longevity, optimize battery usage, charge properly, keep software updated, and protect it from physical damage.



9/20/25 More background information

Audrey Zeller - Dec 10, 2025, 4:41 PM CST

Title: OLEDS INFO

Date: 9/20/25

Content by: Audrey

Goals: More information about OLEDS

Content:

materials

- "An OLED device is typically formed in a sheet with emissive organic layer(s) located between a cathode and anode and deposited
 on a substrate."
- o "The substrate can be rigid such as glass or metal or flexible using a polymer plastic."

· Applications & potential

 "OLED technology has great potential for new uses such [as] flexible paper-thin OLED panels, transparent OLED panels and white OLED."

White OLED performance

- "White OLED was developed as device with extremely high power efficiency and long lifetime."
- "The performance achieved was 64 lm/W, and 10,000 hours of lifetime at initial luminance of 1000 cd/m² with light out-coupling technique."

· Durability & stability

• "The device also exhibited good durability such as storage stability, which is important performance in practical use."

• Environmental benefits

- "From a recent environmental problem and energy supply circumstances, light sources of low energy consumption and eco-friendly are demanded."
- "OLED is regarded as a powerful candidate because it is an area light source, can be driven at low voltage, and does not include a
 material which is harmful to the human body and environment like mercury."

· White light realization

- "As a light source for illumination or backlight, a white light is usually required."
- "To realize a white OLED device, plural light emissive materials such as blue, green, red are used generally."

Allergic contact dermatitis to Crocs™

bad reactions to cros material has been documented

Conclusions/action items:

Not as bright as LEDS. Great use for gaming/TVs. Good for technology that you want high definistion colors.

S. Kunić and Z. Šego, "OLED technology and displays," *Proceedings ELMAR-2012*, Zadar, Croatia, 2012, pp. 31-35. keywords: {Image color analysis;Active matrix organic light emitting diodes;Lighting;Time factors;Anodes;Cathodes;Organic Light Emitting Diode (OLED);flexible paper-thin OLED;transparent OLED;white OLED},

Audrey Zeller - Dec 10, 2025, 2:14 PM CST

Title: About PLA

Date: 9/24/25

Content by: Audrey

Present: Audrey

Goals: Learn more about PLA as a potential box design

Content:

- PLA is a very popular 3D printing material because it is strong, stiff, and easy to print. As the study notes, "PLA has a tensile strength of around 48 MPa and a bending stress of cca. 57 MPa, offering high strength, a high elastic modulus, and excellent stiffness."
- 3D printing with PLA is reliable and accessible: "Eco-friendly PLA filaments were 3D-printed using FDM," which is one of the most common and
 cost-efficient 3D printing methods.
- The study tested different infill shapes and rotations to see which made PLA parts strongest. Triangles performed best in elasticity: "Specimens with an
 order of rotational symmetry of 3 (triangle) showed the highest modulus of elasticity."
- · Rotating the pattern slightly (like 15°) often improved the material's storage modulus, meaning it could handle more stress over time.
- PLA parts hold up well under normal wear and tear for many applications, though it can deform under high heat. Customizing the infill pattern helps spread stress and increases durability.
- The research concludes that "for specific stress conditions, customizing the geometry and infill orientation can improve load distribution and durability," which is useful for things like drone frames, medical implants, and structural parts.

Conclusions/action items:

- · PLA is strong, stiff, and performs well in 3D printing, making it suitable for both everyday and technical applications.
- · Adjusting infill shapes and angles can optimize strength, helping PLA parts stand up to wear and tear.

Mechanical Properties of 3D-Printed PLA Structures Observed in Framework of Different Rotational Symmetry Orders in Infill Patterns



Audrey Zeller - Dec 10, 2025, 2:17 PM CST

Title: PLA Research

Date: 9/24/25

Content by: Audrey

Present: Audrey

Goals: See how printing PLA goes/ how the material is

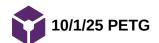
Content:



The first prototype prints show that PLA is really strong, but the tiny details kind of get lost. The printers aren't great at handling small infill patterns, which is probably why you can see the broken part at the top. it's just the printer struggling. I'm going to try printing slower to get more accuracy because the watch band needs those little details, and right now the printers just can't quite handle it. PLA works great for bigger parts, but for small, precise stuff, you really have to tweak the settings to get it right.

Conclusions/action items:

Think about other research/other materials



Audrey Zeller - Dec 10, 2025, 4:21 PM CST

Title: Pros and Cons of PETG material

Date: 10/1/25

Content by: Audrey

Goals: Establish clear goals for all text entries (meetings, individual work, etc.).

Content:

Pro's and Con's

Pro

- **High Durability:** PETG is known for its exceptional durability, making it suitable for a wide range of applications.
- Heat Resistance: PETG retains its strength and integrity at elevated temperatures, expanding its usability.
- Weather Resistance: It withstands moisture and environmental factors, making it a good choice for outdoor use.
- Food-Safe: PETG meets food contact standards, ensuring safety for food-related applications.
- Translucent: PETG offers partial transparency, adding aesthetic appeal for specific designs.
- Biocompatible: Suitable for certain medical and industrial applications.
- UV Stability: PETG exhibits reasonable UV resistance, suitable for outdoor applications.
- High Tensile Strength: PETG offers high tensile strength for load-bearing components.

Con

- UV Instability: PETG is not highly resistant to UV light and may experience color changes over time.
- Lower Resolution in FDM Process: PETG may offer lower resolution in fine details when using the Fused Deposition Modeling (FDM) process.
- Not Ideal for Very Large Prints: PETG may not be the best choice for very large components requiring high stability.
- Challenging to Post-Process: PETG can be more challenging to work with during post-processing and modifications.

Technical specifications

General Properties

Property	Test Method	Value			
Density	ISO 1183, GB/T 1033	1.24 g/cm3 at 23°C			
Melting Point	210°C, 2.16kg	17.1 g/10min			
Light Transmission	N/A	N/A			
Flame Resistance	N/A	N/A			
Moisture Absorption	70% RH - 23°C	0.542%			

Applications in Research and Medical Technology:

- · Laboratory Equipment: PETG can be used to create custom laboratory equipment, such as sample holders, test tube racks, and vial holders.
- Medical Prototypes: PETG is suitable for prototyping medical devices and components, such as prosthetic parts, dental models, and orthopedic aids.
- · Surgical Guides: It can be employed to produce surgical guides for precision procedures in the medical field.
- · Research Models: PETG can be used to fabricate models and prototypes for research purposes in various scientific disciplines.
- Medical Instrument Housings: PETG is ideal for producing housings and enclosures for medical instruments and devices due to its durability and biocompatibility.

PETG Material Details | Department of Biomedical Engineering | University of Basel

Conclusions/action items:

PETG is a stronger material compared to PLA. Its very similar in price so is a good alternative. Still a very safe material and compatible for the device

Audrey Zeller - Dec 10, 2025, 4:45 PM CST

Title: About resin material

Date: 10/1/25

Content by: Audrey

Present:

Goals: Learn more about resin material as a potential box material

Content:

Tensile & Flexural Strength:

Standard resin: 20-50 MPa tensile; suitable for light prototypes but brittle.

Tough or engineering resin: "raise tensile into the 55–90 MPa range, giving you more reliable results for fixtures, housings, and snap-fit parts."

Composite/rigid resins: flexural strength "can reach 150–170 MPa after proper UV and thermal cure," compressive strength around 158 MPa.

Comparison to filaments: PLA ~28-50 MPa, ABS ~32 MPa, PETG ~40-60 MPa.

"Resin prints, with the right material and cure, can match or even surpass these plastics in tensile and flexural strength."

Impact Resistance:

Standard resins: 17–20 J/m, rigid and can chip under shock.

Tough or ABS-like: "absorb more energy, often 41-48 J/m, and trade a little stiffness for elongation and crack resistance."

FDM filaments still generally perform better under repeated shocks.

Isotropy Advantage:

Resin parts cured by SLA, DLP, or LCD are more isotropic because "light crosslinks the entire layer, giving you consistent properties across axes," unlike filament prints, which rely on layer adhesion.

Design Influences Strength:

Wall thickness: keep most parts at least 1-2 mm; unsupported walls no less than 1 mm.

Fillets and chamfers "diffuse loads and reduce crack initiation."

Ribbing and gussets add strength without extra material.

Hollow designs save resin but require proper drain holes to prevent cracking or failed curing.

Printer Settings Matter:

Layer height, exposure, orientation, and peel speed affect bonding and mechanical performance.

"Under-exposed layers weaken interlayer crosslinking, but over-exposure can embrittle surfaces and reduce accuracy."

Proper support placement and curing are critical to prevent weak spots or stress risers.

Resin Type Matters:

Tough/ABS-like resins: balance stiffness and impact resistance; ideal for snap-fits and functional parts.

Engineering/rigid resins: "shift the balance toward stiffness, with tensile values between 55–90 MPa and flexural properties above 130 MPa."

Composite-reinforced resins: best for structural parts or jigs; high compression strength ~158 MPa.

Flexible resins: low tensile (~4–9 MPa) but elongation >100%; good for seals or cushioning.

Specialty types (high-temp, ESD, chemical-resistant) suit specific environmental needs.

Practical Use:

Standard resin: best for decorative or miniature models.

Tough/engineering/composite resins: "Snap-fits, hinges, and small jigs built from engineering resins can hold up to functional loads."

High-temp or UV-resistant resins perform well outdoors or in heated environments.

How Strong is Resin 3D Printing: Factors that Influence Resin Strength - Raise3D: Reliable, Industrial Grade 3D Printer

Conclusions/action items:

- · Resin excels in high-detail, precise, small functional parts, while filament is better for impact-heavy or flexible components.
- Success relies on material choice, geometry, printer settings, curing, and minimizing stress concentrations.

Resin is great for a small part that we need- it also is stronger than both PETG and PLA. Will probably go with this material. Bit expensive but overall not bad.

Audrey Zeller - Dec 10, 2025, 2:23 PM CST

Title: Onshape Box

Date: 10/17/25

Content by: Audrey

Present: Audrey

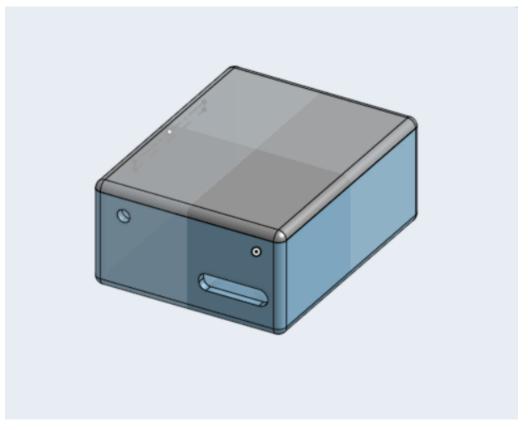
Goals: Make a prototype in CAD

Content:

Youtube video used to make the snap fix box for protype one

Bing Videos





Conclusions/action items:

Made the prototype in Onshape- going to need to add slits for the band

Audrey Zeller - Dec 10, 2025, 4:26 PM CST

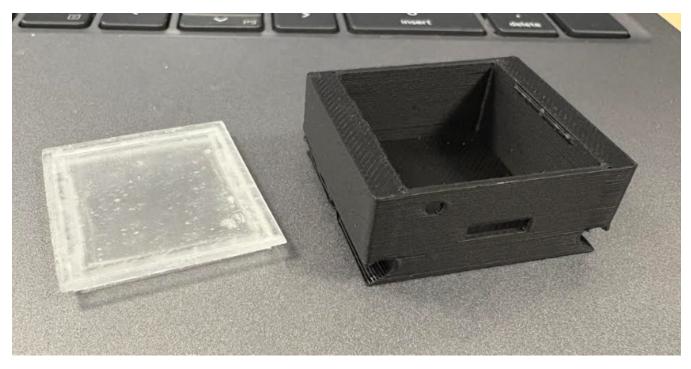
Title: PETG printed box

Date: 10/20/25

Content by: Audrey

Goals: Evaluate PETG print

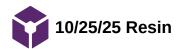
Content:



PETG Box on the right side- not a super exact print you can clearly see the lines of filament. Bit flaky and the band isn't tight inside. Lid is good- had to print out of resin becuase thats the only clear material- and thats needed for the led.

Conclusions/action items:

Reprint to fit the band tighter-- need to revaluate the PETG material- its still not exact enough.



Audrey Zeller - Dec 10, 2025, 4:32 PM CST

Title: Evaluate the print of resin

Date: 10/25/25

Content by: Audrey

Present:

Goals: See how well resin 3D prints

Content:

Resin printing gives way more detail than PLA or PETG, which is awesome for small, precise parts. You can make the bond tighter because the print can handle thinner walls and smaller gaps, giving the piece more structural control. You do have to be careful about where you put the supports, though extra supports can leave a rough surface. That roughness can actually be helpful in areas like the slits for the watch band because it adds grip, but on the outside surfaces it makes the finish look less clean. So with resin, it's all about balancing support placement to get both strength and a smooth final look.



Conclusions/action items: Print resin again with supports in the slits to provide a tighter fit

Audrey Zeller - Oct 05, 2025, 12:47 PM CDT

Title: Audrey Z Date: 10/5/2023

Goals: Learn about Night Scout API and how to implement it into our designs

Content:

Nightscout is an open-source cloud platform that allows people with diabetes (or caregivers) to view, store, and share Continuous Glucose Monitoring (CGM) data in real time from anywhere.

- Nightscout Site the cloud application used to display and store the glucose data.
- Uploader a device or app that sends CGM data to the Nightscout site.
- Followers optional viewers using phones, smartwatches, browsers, or other connected devices.

Purpose

Originally designed for Dexcom G4 monitoring, Nightscout now supports most commercial CGM sensors and gives users remote access to glucose levels, insulin dosing info, and treatments.

You can:

- 1. DIY (build and host your own instance), or
- 2. Use a managed hosting service (paid providers).

Setting up DIY requires basic tech skills, patience, and careful step-by-step following of instructions.

Costs

- DIY: Can be free depending on cloud hosting choice.
- Managed services: Paid subscriptions that handle setup and maintenance for you.

Safety Notes

Users are responsible for reliability, backups, and alternative ways to monitor glucose in case of outages. It is not a medical-grade or regulated therapy tool.

Support

Support is **community-driven** via Facebook groups—especially "CGM in the Cloud." Developers encourage respectful collaboration, not private requests.

"Nightscout (also known as CGM in the Cloud) is an open-source cloud application... to visualize, store and share the data from their Continuous Glucose Monitoring sensors in real-time."

Once setup, Nightscout acts as a central repository of blood glucose and insulin dosing/treatment data for a single person..."

What you need

"A CGM sensor... a way to upload your data... internet access... and... the ability to carefully follow the installation guides shown on this site."

"'Carefully' means that you will thoroughly read, follow and complete each step without skipping any and without giving up thinking that it is too difficult..."

DIY

"If you will be using DIY: You must understand that you take full responsibility for building and running this system and you agree to do so at your own risk."

"Do not rely only on Nightscout as the only way you have of knowing your blood glucose values and trends."

Cost

"Your monthly hosting cost can be free - \$0 with this [DIY] option."

Community of individuals. #WeAreNotWaiting

"Unless you're paying for a hosted Nightscout including support, this project is 'Do It Yourself' (DIY) and supported by volunteers."

"Ask nicely, and nice people will always do nice things and help you."

Conclusions/action items:

Could be an amazing option to implement. See problems with set up and ease of use for the user.

Cite- Welcome to Nightscout — Nightscout Documentation documentation

summarized with chatgpt

Audrey Zeller - Oct 09, 2025, 9:07 PM CDT

Title: NightScout - description of system

Date: 10/9/2025

Content by: Audrey

Goals: To learn the basics of NightScout and find ways into the "Nightscout community"

Content:

Systems for continuous glucose monitoring (CGM) in inter stitial fluid are becoming increasingly popular in the manage ment of diabetes mellitus.

The Nightscout system is not an officially registered solution, and patients use it at their own respon sibility.

Nightscout is a non-commercial Do-It-Yourself (DIY) system, developed in 2014 by the parents of children with type 1 diabetes.

It should be borne in mind that the installation of the Night scout system, its use, adaptation after modifications, or mal function requires strong involvement and certain IT skills from the user.

It is impressive that members of this social network group support each other, and the vast majority of questions related to technical problems are answered by the administrator, which makes the use of the Nightscout system easier, and additionally may improve the therapeutic process.

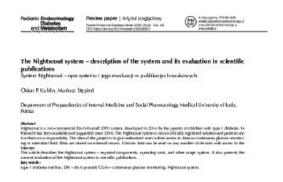
It is worth noting that, despite the free access to the Night scout system, it is necessary to have a device for downloading data – an uploader (different for individual solutions), the cost of which is usually not relatively high.

he Nightscout system can be regarded as an improve ment of the standard continuous glucose monitoring in inter stitial fluid. For some users this system can be used as sup port for activating a closed-loop function in a personal insulin pump. Based on the cited articles, the use of the Nightscout system may improve the efficacy of treatment among patients with type 1 diabetes, and it may have a positive effect on the safety of insulin therapy and quality of life.

Conclusions/action items:

Look for reddit sites and channels to find the community and IT help of those who already use nightscout.

Audrey Zeller - Oct 09, 2025, 9:08 PM CDT



Download

PEDM_Art_40742-10.pdf (393 kB)



Audrey Zeller - Dec 10, 2025, 4:42 PM CST

Title: Design 1

Date: 9/20/2025

Content by: Audrey

Goals: Comparing and find materials for the device's wristband.

Content:

Best Buy Examples of popular wristbands:

Links: Insignia™ Stainless Steel Mesh Band for Apple Watch 38mm, 40mm, 41mm, SE (1 3), and 42mm Black NS-AWB41BMB2 - Best Buy

Material: Stainless steal

Link: Apple 45mm Sport Band M/L Midnight MT3F3AM/A - Best Buy

Material: Fluoroelastomer

Link: Best Buy essentials™ Silicone Bands for Apple Watch 42mm, 44mm, 45mm, SE (1.3), 46mm, Ultra 49mm and Ultra 2.49mm (3 Pack) Starlight, Blue/Gray and Gray BE-AWB45SIL3GY - Best Buy

Material: Silicone

Quick google search tells me that silicone is a popular wristband material.

Pros and cons of silicone:

GO TO TABLE PDF

Examples of what the product could look like-



Apple Watch Band|soft Silicone Replacement|sport Bands|apple Watch With Holes|apple Watch Bands With Charms|bands - Etsy



Slap on wristbands- look more at it for the designs rather than material/ functionality, link: 12pcs one set super hero spiderman hulk Captain America Iron Man Slap Bracelet Birthday Party Decoration papa circle gift

Cite: Mojsiewicz-Pieńkowska K, Jamrógiewicz M, Szymkowska K, Krenczkowska D. Direct Human Contact with Siloxanes (Silicones) - Safety or Risk Part 1. Characteristics of Siloxanes (Silicones). Front Pharmacol. 2016 May 30;7:132. doi: 10.3389/fphar.2016.00132. PMID: 27303296; PMCID: PMC4884743.

Mentioned Crocs

Material: Croslite

What Crocs are made of — and how they're changing - Summary made from Chatgpt.com

Croslight - polymer/plastic

Pros of Croslite (PEVA foam)

- Lightweight & Cushioned: Soft, springy foam that provides comfort against the skin. This "bounce back" quality is excellent for shoes and would prevent a bracelet from feeling rigid or brittle.
- Durable & Long-lasting: Highly resistant to wear and tear; won't easily rip, stretch, or degrade.
- Water-resistant & Easy to Clean: Repels water, sweat, and dirt practical for daily wear.
- Breathable Feel: The foamed structure allows airflow, reducing sweat build-up.
- Color & Design Versatility: Can be injection-molded into various shapes and dyed in many colors.

Cons of Croslite (PEVA foam)

 Not made for Bracelets: The springy, cushioning qualities are ideal for shoes, but may be unnecessary or even bulky for a small bracelet/wristband.

- Fossil Fuel-Derived Plastic: Traditional Croslite comes from nonrenewable sources, contributing to CO2 emissions.
- Not Biodegradable: Even newer "bio-based" Croslite is still a plastic that will persist in landfills.
- Hard to Recycle: Requires a specialized take-back program; can't go into normal recycling streams.
- Environmental Burden: Durability becomes a problem when discarded waste can accumulate in landfills or oceans.

Criteria to think about-

Toxicity

Resistance to temperature

Water resistance

durability

longevity

Texture

Conclusions/action items: Silicone wristbands are durable, chemically stable, and resistant to heat, UV, and moisture, making them well-suited for long-term wear in exposure studies and consumer products like Apple Watches. Their inertness and low toxicity mean they are generally safe for skin contact, with minimal risk of irritation or harmful leaching under normal conditions.

However, their performance depends on material quality, as low-molecular-weight siloxanes or impurities can leach, and extreme heat or poor curing can reduce safety and durability. Overall, silicone wristbands provide a practical, safe, and effective tool for both everyday wear and scientific exposure assessment.

Audrey Zeller - Sep 20, 2025, 6:10 PM CDT



Table_-_PMC.html (33.3 kB)

Audrey Zeller - Sep 20, 2025, 6:37 PM CDT

Title: Design two

Date: 9/20/2025

Content by: Audrey

Goals: Lights LEDS

Content:

Pro and con list

"A light accounts for approximately 20 percent of the world's total energy consumption."

"The invention of a light emitting diode (LED) is expected to significantly alleviate the energy consumption of a light, because the LED lighting device consumes 50 percent of the energy consumption compared to the fluorescent lighting device."

"Since the existing lighting control systems can support only simple on/off or dimming control according to user movement or brightness of surroundings, it is hard to be applied to complex environments such as house or office."

"The proposed system utilizes multi sensors and wireless communication technology in order to control an LED light according to the user's state and the surroundings."

"The proposed minimum light intensity control algorithm automatically adjusts Lmin based on the signal of inconvenience of users."

"The proposed lighting system reduces total power consumption of the test bed up to 21.9%."

Pros

- High energy efficiency consume about 50% less energy than fluorescent lighting.
- Durability longer lifespan compared to traditional bulbs.
- Compatibility with smart systems can integrate well with intelligent control systems for better optimization.
- Customizable brightness allows for flexible dimming and control.
- Supports sustainability goals helps reduce global energy usage and greenhouse gas emissions.

Cons

- Initial cost higher upfront compared to fluorescent or incandescent bulbs.
- User comfort trade-offs aggressive energy saving can cause frequent on/off cycles or low brightness, leading to user dissatisfaction.
- System complexity smart LED control requires sensors, communication modules, and algorithms, which increases design and maintenance complexity.
- · Dependence on electronics if not designed with adaptive middleware, limited microcontrollers may restrict system flexibility.
- J. Byun, I. Hong, B. Lee and S. Park, "Intelligent household LED lighting system considering energy efficiency and user satisfaction," in *IEEE Transactions on Consumer Electronics*, vol. 59, no. 1, pp. 70-76, February 2013, doi: 10.1109/TCE.2013.6490243. keywords: {Lighting;Light emitting diodes;Artificial intelligence;Lighting control;Sensor systems;household LED lighting system;situation awareness;minimum light intensity control;adaptive middleware},

Conclusions/action items: This article talks about an intelligent LED lighting system that uses sensors and wireless control to change brightness depending on movement and the environment. It has a feature that adjusts the minimum light level so it saves energy but still keeps people comfortable, cutting power use.

Audrey Zeller - Sep 22, 2025, 1:58 PM CDT

Title: OLEDS

Date: 9/20/2025

Content by: Audrey

Goals: Find another Idea for a light source.

Content:

The passage is about OLEDs (Organic Light-Emitting Diodes) and why they are becoming very popular compared to LEDs, LCDs, and other solid-state lighting devices. The main points are:

- 1. Why OLEDs are promising:
 - They are low-cost and easy to make.
 - They are bright, fast, energy-efficient, and have a wide viewing angle.
 - They provide high contrast, which makes colors look more vivid.
- 2. Importance of the emissive layer:
 - The emissive layer is the key part of an OLED.
 - o It determines the color of light, brightness, efficiency, and contrast of the device.
- 3. Focus of the review:
 - The review looks at how OLEDs are made, how they emit light, their achievements, and challenges.
 - Specifically, it examines PMMA (polymethyl methacrylate) and its nanocomposites as materials for the emissive layer.
- 4. Why PMMA-based nanocomposites are good for OLEDs:
 - · They are transparent, meaning light passes through easily.
 - They are thermally stable, so they can handle heat.
 - They have high electrical conductivity, which helps them efficiently emit light.
- 5. Fabrication techniques:
 - The review also discusses the most common methods used to make OLEDs

Pictures I like:



I know its not adjustable and everything, but I think it could be good to extend the light to make it more visible to caregivers. I also think it looks ready cool

• OLED

- Self-lit pixels → perfect blacks, infinite contrast
- Thinner, flexible, wider viewing angles
- · Risk of burn-in, lower peak brightness
- More expensive

• LED

- Needs backlight → less contrast, weaker blacks
- Brighter, no burn-in, longer lifespan
- Thicker panels, narrower viewing angles
- o Cheaper

Conclusions/action items:

OLEDs are a newer type of light source that can outperform LEDs in certain ways, and researchers are focusing on special polymer materials like PMMA for the layer that actually emits light because they combine transparency, stability, and conductivity.

Cite: Bauri, J., Choudhary, R.B. & Mandal, G. Recent advances in efficient emissive materials-based OLED applications: a review. *J Mater Sci* 56, 18837–18866 (2021). https://doi.org/10.1007/s10853-021-06503-y

OpenAI. ChatGPT. 22 Sept. 2025, https://chat.openai.com/



Audrey Zeller - Dec 10, 2025, 4:43 PM CST

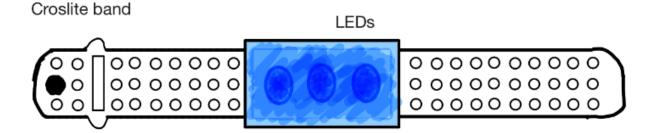
Title: Pictures

Date: 9/24/2025

Content by: Audrey

Goals: Draw/get more designs! Type info about designs out.

Content:



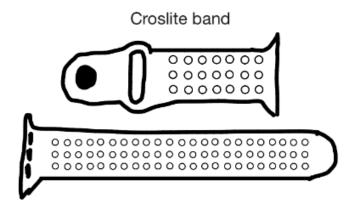
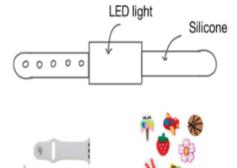




Figure 1: Sketch of a charm bracelet with LEDs placed inside the charms



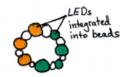
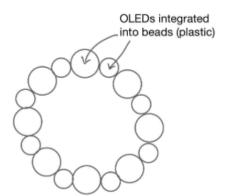


Figure 2: Sketch of a bracelet with LEDs placed inside beads



Figure 3: Sketch of an elegant bangle with LEDs replacing gems



Conclusions/action items:

Audrey Zeller - Dec 10, 2025, 2:22 PM CST

Title: Box design

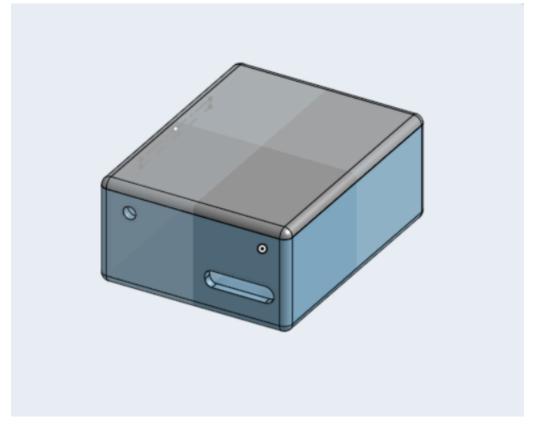
Date: 10/17/202

Content by: Audrey Z

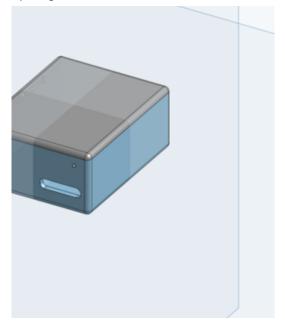
Goals:

Content:





Conclusions/action items:



Download

Part_Studio_1.png (599 kB)



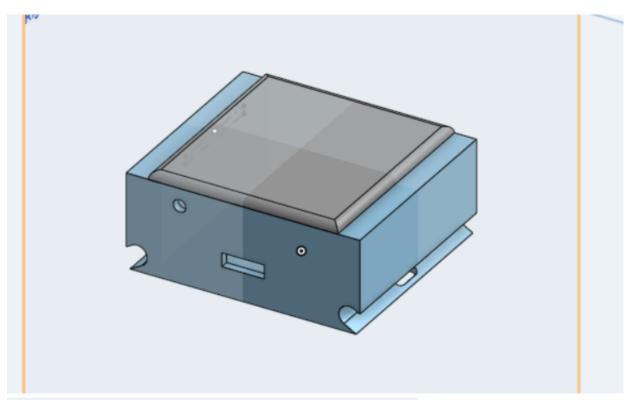
Audrey Zeller - Oct 24, 2025, 2:15 PM CDT

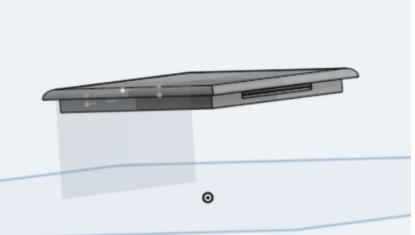
Title: Updated box designs

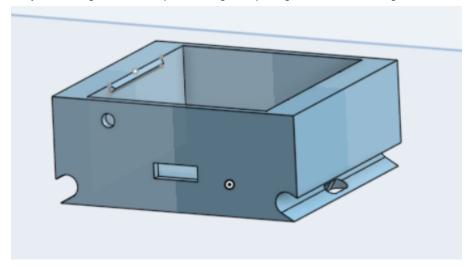
Date:10/24/2025

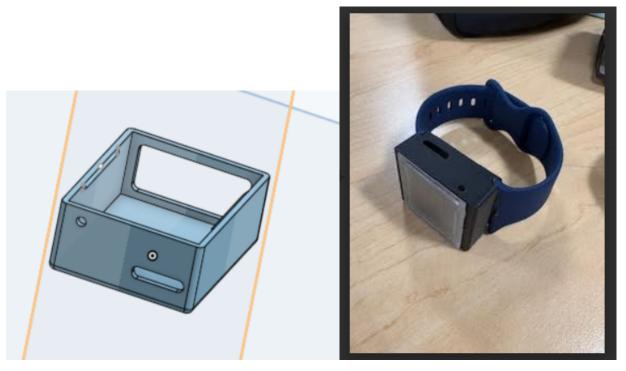
Content by: Audrey (Kira updated box via solid works)

Content:









Conclusions/action items:

Change final design a bit to make the band more secure

Audrey Zeller - Oct 31, 2025, 2:32 PM CDT

Title: Box Design 3

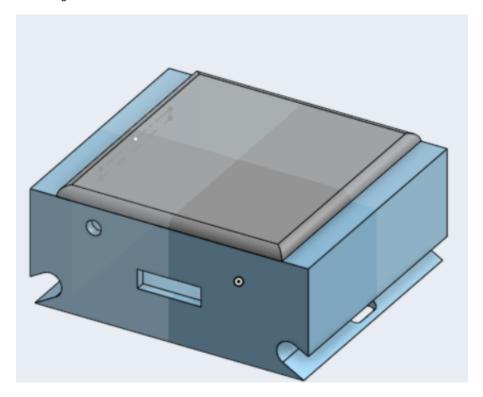
Date: 10/31/2025

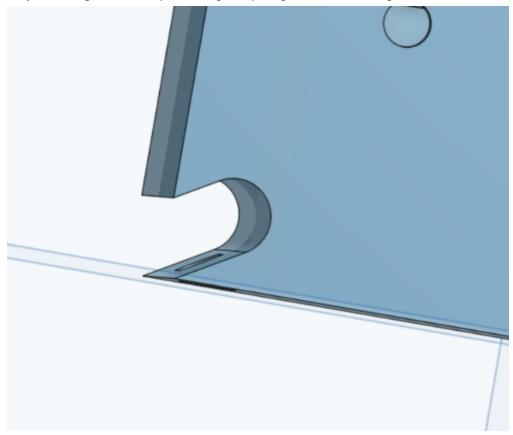
Content by: Audrey, Kira

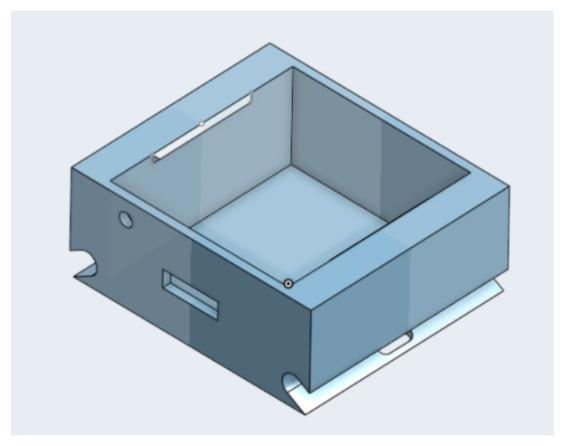
Content:

The band needed a tighter fit plus need to be further pushed back into the box area of the design. Changes made to allow for the secureness of the band. Going forward still want it to be more secure, maybe make the band go all the way through the box, but worried about space within the box for electronics.

CAD Images







Audrey Zeller - Nov 21, 2025, 1:16 PM CST

Title: Resin Print

Date: 11/16/2025

Content by: Audrey

Content:

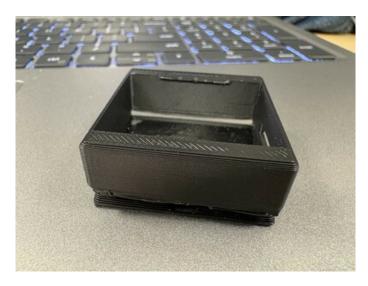
The most recent prototype is currently being tested on Kira's wrist. The lid did not fit as cleanly as expected, likely due to switching printers. (For some reason active bobcat is better than flyingRavin?) which now requires the box to be resized. Achieving the most secure, snug fit for the wristband while keeping costs low has been challenging, as PLA and resin behave very differently. Resin prints are far more precise, which meant the side holes/slits had to be tightened, while PLA/PETG worked fine with the original dimensions due to their slightly rougher tolerance.

Unfortunately, resin is significantly more expensive, making repeated reprints difficult without using a large portion of our budget. At this point, I have printed more than seven box variations, adjusting both dimensions and materials to find the optimal combination. Resin will be used for the final design because it is more durable and offers a superior finish.

Conclusions/action items:

Wait for the final dimensions to be given to us to not waste money on unused prototypes.

Audrey Zeller - Nov 21, 2025, 1:09 PM CST



Download

IMG_8960.jpeg (2.56 MB)

Audrey Zeller - Nov 21, 2025, 1:09 PM CST

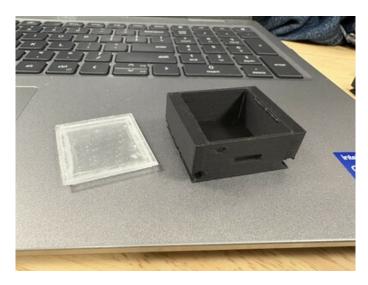




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IMG_8961.jpeg (1.62 MB)

Audrey Zeller - Nov 21, 2025, 1:09 PM CST



Download

IMG_8959.jpeg (2.27 MB)

11/18/2025 Testing of materials for box

Audrey Zeller - Nov 21, 2025, 1:19 PM CST

Title: Testing

Date: 11/18/2025

Content by: Audre, Kira, Ella

Content:

See PDF Results below

Conclusions/action items:

Write testing into the poster and make sure tests are clear

Audrey Zeller - Nov 21, 2025, 1:17 PM CST

PETG and PLA Small Box Durability Test

1. Impact Tests (Drop + Point Impact)

- Biop your box from the following heights onto a hard surface [concrete, tile, or hardwood]:

 - 2 ft -0.69 m
 3 ft -0.914
 8.2 ft -2.5 m (holight of average playground equipment)
- Perform 3 drops per height, rotating the box to hit a different face each time.

Record: Cracks, seam spits, comer demage, lid failure, etc.

PLA	PLA	PETG	PETG
Corpet -	Wood -	Carpet-	Wood-
2 ft - minimal derrage neerwatch sibt	2 ff - some damage to the corners	2 ft - little to no da mage	2 ft - minimal damage on the corners
3 ft - minimal demage nee rwatch sibt	3 ft - some damage to the corners	3 ft - little to no da mage neer welch sibt	3 ft - minimal damage on the corners
9 ft - minimal darrage nearcorne s	9 ff - some damage rear corres	9 ft - minimal damage near comers	9 ft - minimal damage near welch slot

Download

Testing.pdf (89.4 kB)

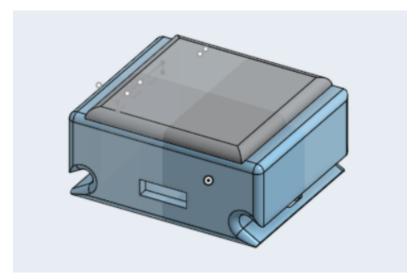
Audrey Zeller - Dec 10, 2025, 4:49 PM CST

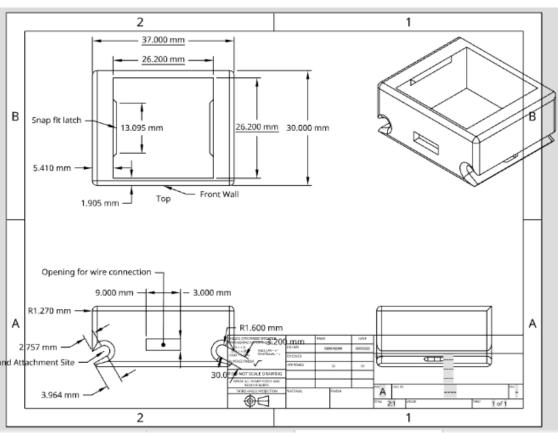
Title: Final Design

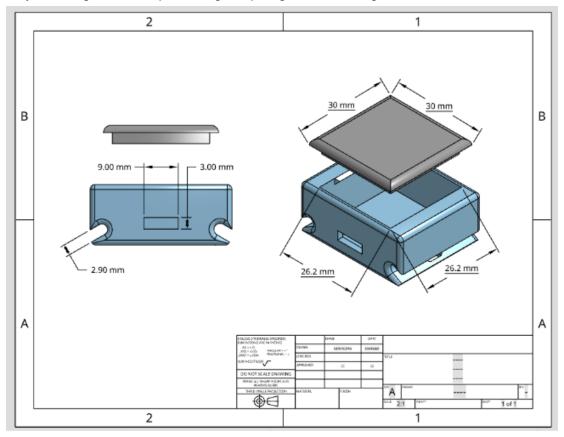
Date: 12/5/25

Content by: Audrey

Content:

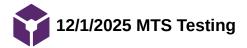






Conclusions/action items:

FINAL Box BME 200 | Part Studio 1



Audrey Zeller - Dec 10, 2025, 4:50 PM CST

Title: MTS Testing

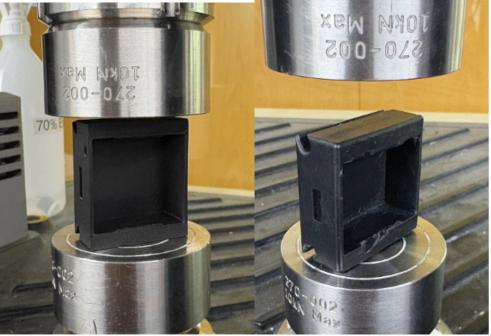
Date: 12/1/2025

Content by: Audrey

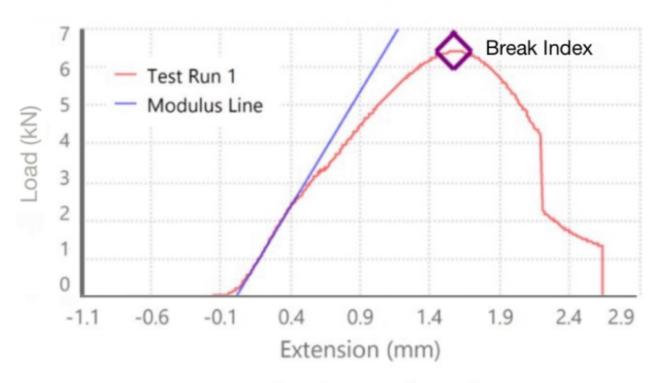
Present: Audrey and Lauren

Pictures of the Resin and PETG materials tested. Final graphs posted at the bottom of the page

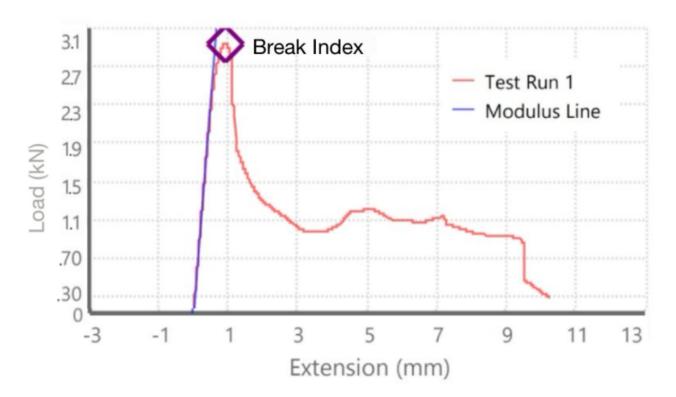




Load versus Extension



Load versus Extension





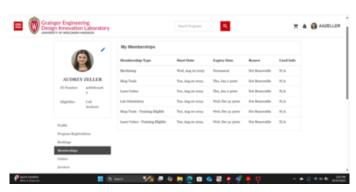
resin--



petg---

Machine training Certificate 10/24/2025

Audrey Zeller - Oct 24, 2025, 2:03 PM CDT



Download

training_certificate_machiene.png (222 kB)



Biosafety and OSHA training documents 10/24/2025

Audrey Zeller - Oct 24, 2025, 2:09 PM CDT



Download

OSHA_and_Biosafety_training.png (143 kB)

Audrey Zeller - Nov 07, 2025, 1:16 PM CST

Title: Tong Lecture

Date: 11/7/2025

Content by: Audrey Z

Goals: Analyze the tong lecture

Content:

Foundation, growth, build, and transform.

- Background education was undergraduate degree in biomedical engineering and MDA from Harvard

Had a huge number of jobs in her history

- Some of the cool jobs were small business owner of a cycling studio, lead a network of OBGYNs, CVS, lead over 350 staff team, chief of staff

Looking into systematic changes to make healthcare more assessable for all people, gave example how it's hard for even her to get the care with all her connections.

You don't need to know your final destination, just do the best you can in the moment.

Healthcare

- Spend a lot of money, but still low stats in a ton of fields (lots of people skip doctors appointments cause of cost)
- Future of healthcare to incentivize healthcare workers and doctors to provide continuous care and not just see as many of people as possible for a short time.
- She says work hard and build range, take hard classes and get out there- move around and make a strong foundation (live in a lot of places)

She loved her job where she tested devices that were then put into patients

Embrace challenges and keep going

- You become like the people you surround yourself with, and its very important
 - Think about how far you've already made it, give yourself some grace

Conclusions/action items:

Get experience

Take the time to do the things you need to do for your mental health

- create a healthy lifestyle
- -Saying no to some things

Run towards the hard problems... they are the ones that change the world

KIERA KLEMM - Sep 11, 2025, 9:54 PM CDT

Title: Type 1 Diabetes in Children Research

Date: 9/11/25

Content by: Kiera Klemm

Present: Kiera Klemm

Goals: To better understand Type 1 Diabetes and how it affects those who have it.

Citation: Johns Hopkins Medicine, "Type 1 diabetes in children," *www.hopkinsmedicine.org*, Jun. 29, 2022. https://www.hopkinsmedicine.org/health/conditions-and-diseases/diabetes/type-1-diabetes-in-children

Content:

- -Type 1 diabetes is an auto immune disorder that happens when the bodies immune system damages the pancrease resulting in a lack of insulin or an inability to use it.
- Insulin is a hormone that allows the body to process glucose into fuel, without it glucose builds up in the blood (high blood sugar)
- -The cause of Type 1 diabetes remains unknown
- -It cannot be cured and blood sugar must be manages with supplemental insulin to prevent damage to the body
- -Treatment includes insulin injections and timing meals/counting carbohydrates
- -Regular blood testing is also necessary to monitor blood glucose levels (This is what a CGM does)
- -High blood sugar can cause ketoacidosis which can lead to brain swelling and even death
- -High blood sugar levels damage blood vessels leading to possible eye, kidney,nerve,tooth, and heart problems
- -Children can feel stressed, guilty, or angry as a result of having diabetes, it is recommended that they are treated as a normal child

Conclusions/action items: In the upcoming days we will begin to brainstorm ideas for our project design. I begin to implement what I learn from this article when coming up with ideas, especially the information about it being valuable for children with type 1 diabetes to be treated like a normal child. It is importaant to recognize that this condition require constant monitoring which we will have to take into account in our design.

KIERA KLEMM - Sep 11, 2025, 10:03 PM CDT



What causes type 1 diabetes in a child?

The cause of type 1 diabetes is unknown. Researchers think some people inherit a gene than can cause type 1 diabetes if a trigger such as a stal infection occurs.

Which children are at risk for type 1 diabetes?

A child is more at thick for type 1 diabetes if they have any of these risk factors:

Has a family member with the condition

http://www.hapdonsudicine.cop/had thicodifican-and-discount datases/type-1-distance-in-thibited-nature/Tribbus with type 1 distance out to redsity into the r...

Download

Type_1_Diabetes_in_Children___Johns_Hopkins_Medicine.pdf (270 kB)

KIERA KLEMM - Dec 10, 2025, 11:23 AM CST

Title: Sizing/Wrist Circumference Research

Date: 9/13/2025

Content by: Kiera Klemm

Present: Kiera Klemm

Goals: To understand the range in wrist circumference sizes in children to aid in deciding what size the bracelet should be.

Citation:

[8] A. Öztürk, B. Çiçek, M. M. Mazıcıoğlu, G. Zararsız, and S. Kurtoğlu, "Wrist Circumference and Frame Size Percentiles in 6-17-Year-Old Turkish Children and Adolescents in Kayseri," *Journal of Clinical Research in Pediatric Endocrinology*, pp. 329–336, Dec. 2017, doi: https://doi.org/10.4274/jcrpe.4265

Content:

- -For males ages 6-17 the range in wrist circumference was 11.47- 19.17 cm in circumference
- -For females the range was 10.7-17.15 cm
- -The data set only ranges from the 3rd-97th percentile of weight
- The age range is consistent with that of school age children
- -For 6 year olds the range is 11.47-14.75 cm, wide range per age group

Boys n 6 127 11.47 11.60 11.82 11.99 12.27 12.92 13.65 14.01 17 7 174 11.70 11.84 12.06 12.23 12.52 13.18 13.91 14.27 12.88 8 11.99 12.12 12.36 12.53 12.83 13.50 14.23 14.59	Age (years	5)	Percentiles										
6 127 11,47 11,60 11.82 11.99 12.27 12,92 13,65 14,01 14 7 174 11,70 11.84 12.06 12.23 12.52 13,18 13,91 14,27 14 8 11,99 12.12 12.36 12.53 12.83 13.50 14.23 14.59 14 185 11 156 12.31 12.46 12.70 12.88 13.19 13.86 14.59 14.95 15 10 179 12.67 12.83 13.08 13.27 13.58 14.27 15.00 15.36 15 11 168 13.05 13.21 13.48 13.68 14.00 14.69 15.42 15.78 16 12 126 13.42 13.59 13.88 14.08 14.40 15.11 15.83 16.19 16 13 139 13.79 13.98 14.28 14.50 14.84 15.54 <td< th=""><th></th><th></th><th>3rd</th><th>5th</th><th>10th</th><th>15th</th><th>25th</th><th>50th</th><th>75th</th><th>85th</th><th>90th</th><th>95th</th><th>97th</th></td<>			3 rd	5 th	10 th	15 th	25 th	50 th	75 th	85 th	90 th	95 th	97 th
7 174 11.70 11.84 12.06 12.23 12.52 13.18 13.91 14.27 14.88 8 11.99 12.12 12.36 12.53 12.83 13.50 14.23 14.59 14.95 15.60 15.36 14.59 14.95 15.60 15.36 14.95 14.95 14.95 14.95 14.95 14.95 14.41 15.11 15.83 16.19 16 12.11 15.83 16.19 16.62	Boys	n											
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185 9	7	174	11.70	11.84	12.06	12.23	12.52	13.18	13.91	14.27	14.50	14.82	15.02
9	8		11.99	12.12	12.36	12.53	12.83	13.50	14.23	14.59	14.82	15.14	15.34
10	185												
11 168 13.05 13.21 13.48 13.68 14.00 14.69 15.42 15.78 16 12 126 13.42 13.59 13.88 14.08 14.41 15.11 15.83 16.19 16 13 139 13.79 13.98 14.28 14.50 14.84 15.54 16.26 16.62 16 14 153 14.19 14.39 14.71 14.94 15.29 15.99 16.70 17.08 17 15 223 14.55 14.76 15.10 15.34 15.69 16.39 17.11 17.50 17 16 217 14.80 15.03 15.38 15.63 15.99 16.69 17.41 17.82 18 17 84 14.92 15.16 15.54 15.79 16.16 16.85 17.58 18.02 18 17 87 175 11.09 11.26 11.55 11.76 12.09 12.80 13.48 13.78 12.11 18 191 11.51 1	9	156	12.31	12.46	12.70	12.88	13.19	13.86	14.59	14.95	15.18	15.51	15.71
12 126 13.42 13.59 13.88 14.08 14.41 15.11 15.83 16.19 16 13 139 13.79 13.98 14.28 14.50 14.84 15.54 16.26 16.62 16 14 153 14.19 14.39 14.71 14.94 15.29 15.99 16.70 17.08 1° 15 223 14.55 14.76 15.10 15.34 15.69 16.39 17.11 17.50 1° 16 217 14.80 15.03 15.38 15.63 15.99 16.69 17.41 17.82 18 17 84 14.92 15.16 15.54 15.79 16.16 16.85 17.58 18.02 18 16 135 10.70 10.87 11.16 11.37 11.70 12.41 13.08 13.37 12 6 135 10.70 10.87 11.16 11.37 11.70 12.41 13.08 13.37 12 8 191 11.51 11.68 11.	10	179	12.67	12.83	13.08	13.27	13.58	14.27	15.00	15.36	15.59	15.92	16.12
13	11	168	13.05	13.21	13.48	13.68	14.00	14.69	15.42	15.78	16.01	16.34	16.55
14 153 14.19 14.39 14.71 14.94 15.29 15.99 16.70 17.08 17.08 17.11 15 223 14.55 14.76 15.10 15.34 15.69 16.39 17.11 17.50 17.11 16 217 14.80 15.03 15.38 15.63 15.99 16.69 17.41 17.82 18.02 17 84 14.92 15.16 15.54 15.79 16.16 16.85 17.58 18.02 18.02 Girls n 6 135 10.70 10.87 11.16 11.37 11.70 12.41 13.08 13.37 12.77 7 175 11.09 11.26 11.55 11.76 12.09 12.80 13.48 13.78 13.89 14.21 14.99 9 162 11.92 12.09 12.38 12.58 12.91 13.60 14.29 14.62 14.10 10 193 12.35 12.52 12.80 13.01 13.33 14.02 14.72	12	126	13.42	13.59	13.88	14.08	14.41	15.11	15.83	16.19	16.43	16.76	16.97
15 223 14.55 14.76 15.10 15.34 15.69 16.39 17.11 17.50 17.50 16 217 14.80 15.03 15.38 15.63 15.99 16.69 17.41 17.82 18.02 17 84 14.92 15.16 15.54 15.79 16.16 16.85 17.58 18.02 18.02 Girls n 6 135 10.70 10.87 11.16 11.37 11.70 12.41 13.08 13.37 11.77 7 175 11.09 11.26 11.55 11.76 12.09 12.80 13.48 13.78 11.88 8 191 11.51 11.68 11.97 12.17 12.51 13.21 13.89 14.21 14.62 9 162 11.92 12.09 12.38 12.58 12.91 13.60 14.29 14.62 14.62 10 193 12.35 12.52 12.80 13.01 13.33 14.02 14.72 15.05 13.12 12<	13	139	13.79	13.98	14.28	14.50	14.84	15.54	16.26	16.62	16.86	17.20	17.42
16 217 14.80 15.03 15.38 15.63 15.99 16.69 17.41 17.82 13.17 84 14.92 15.16 15.54 15.79 16.16 16.85 17.58 18.02 13.18 15.18 18.02 13.18 15.19 16.16 16.85 17.58 18.02 13.19 17.19 17.10 12.41 13.08 13.37 13.19 17.10 17	14	153	14.19	14.39	14.71	14.94	15.29	15.99	16.70	17.08	17.32	17.68	17.91
17 84 14.92 15.16 15.54 15.79 16.16 16.85 17.58 18.02 18.03 in 6 135 10.70 10.87 11.16 11.37 11.70 12.41 13.08 13.37 13.7 13.7 17.5 11.09 11.26 11.55 11.76 12.09 12.80 13.48 13.78 13.8 191 11.51 11.68 11.97 12.17 12.51 13.21 13.89 14.21 14.99 162 11.92 12.09 12.38 12.58 12.91 13.60 14.29 14.62 14.00 193 12.35 12.52 12.80 13.01 13.33 14.02 14.72 15.05 13.11 13.6 12.81 12.98 13.26 13.46 13.78 14.46 15.15 15.50 13.12 13.38 13.65 13.84 14.16 14.82 15.51 15.86 14.13 14.14 150 13.80 13.95 14.21 14.39 14.69 15.32 15.99 16.33 16.15 15.50 13.15 15.50 13.15 15.50 13.15 15.50 13.16 15.50 13.80 13.95 14.21 14.39 14.69 15.32 15.99 16.33 16.15 15.50 13.50 13.97 14.12 14.36 14.54 14.83 15.44 16.09 16.43 16.15 15 15.50 16.43 16.50 15.50	15	223	14.55	14.76	15.10	15.34	15.69	16.39	17.11	17.50	17.76	18.15	18.40
Girls n 6 135 10.70 10.87 11.16 11.37 11.70 12.41 13.08 13.37 13.78 13.78 13.78 13.78 13.78 13.78 13.78 13.78 13.78 13.78 13.78 13.78 13.78 13.78 13.78 13.78 13.78 13.78 14.21 14.21 14.21 14.21 14.21 14.21 14.22 14.21 14.22 14.21 14.22 14.21 14.22 14.22 14.22 14.22 14.22 14.22 14.22 14.22 14.22 14.22 14.22 14.22 14.22 14.22 14.22 14.22 14.22 14.22 14.23 14.46 15.15 15.50 14.23 14.23 14.46 15.15 15.50 14.23 14.24 14.24 14.45 15.10 15.78 16.13 16.13 16.13 16.13 16.13 16.13 16.13 16.13 16.13 16.13 16.13 16.13 16.13	16	217	14.80	15.03	15.38	15.63	15.99	16.69	17.41	17.82	18.11	18.54	18.83
6 135 10.70 10.87 11.16 11.37 11.70 12.41 13.08 13.37 13.77 7 175 11.09 11.26 11.55 11.76 12.09 12.80 13.48 13.78 13.88 8 191 11.51 11.68 11.97 12.17 12.51 13.21 13.89 14.21 14.99 9 162 11.92 12.09 12.38 12.58 12.91 13.60 14.29 14.62 14.10 10 193 12.35 12.52 12.80 13.01 13.33 14.02 14.72 15.05 13.11 11 136 12.81 12.98 13.26 13.46 13.78 14.46 15.15 15.50 13.12 12 165 13.21 13.38 13.65 13.84 14.16 14.82 15.51 15.86 16.13 13 167 13.53 13.69 13.96 14.15 14.45 15.10 15.78 16.13 16.13 14 150 13.80 1	17	84	14.92	15.16	15.54	15.79	16.16	16.85	17.58	18.02	18.33	18.83	19.17
7 175 11.09 11.26 11.55 11.76 12.09 12.80 13.48 13.78 13.88 8 191 11.51 11.68 11.97 12.17 12.51 13.21 13.89 14.21 14.99 9 162 11.92 12.09 12.38 12.58 12.91 13.60 14.29 14.62 14.10 10 193 12.35 12.52 12.80 13.01 13.33 14.02 14.72 15.05 13.11 11 136 12.81 12.98 13.26 13.46 13.78 14.46 15.15 15.50 13.12 12 165 13.21 13.38 13.65 13.84 14.16 14.82 15.51 15.86 16.13 13 167 13.53 13.69 13.96 14.15 14.45 15.10 15.78 16.13 16.13 14 150 13.80 13.95 14.21 14.39 14.69 15.32 15.99 16.33 16 15 379 13.97 14.	Girls	n											
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9 162 11.92 12.09 12.38 12.58 12.91 13.60 14.29 14.62 14.10 193 12.35 12.52 12.80 13.01 13.33 14.02 14.72 15.05 15.11 13.6 12.81 12.98 13.26 13.46 13.78 14.46 15.15 15.50 15.12 165 13.21 13.38 13.65 13.84 14.16 14.82 15.51 15.86 16.13 167 13.53 13.69 13.96 14.15 14.45 15.10 15.78 16.13 164 150 13.80 13.95 14.21 14.39 14.69 15.32 15.99 16.33 165 13.97 14.12 14.36 14.54 14.83 15.44 16.09 16.43 16.15	7	175	11.09	11.26	11.55	11.76	12.09	12.80	13.48	13.78	13.96	14.21	14.35
10 193 12.35 12.52 12.80 13.01 13.33 14.02 14.72 15.05 13.11 11 136 12.81 12.98 13.26 13.46 13.78 14.46 15.15 15.50 13.12 12 165 13.21 13.38 13.65 13.84 14.16 14.82 15.51 15.86 16.13 13 167 13.53 13.69 13.96 14.15 14.45 15.10 15.78 16.13 16 14 150 13.80 13.95 14.21 14.39 14.69 15.32 15.99 16.33 16 15 379 13.97 14.12 14.36 14.54 14.83 15.44 16.09 16.43 16	8	191	11.51	11.68	11.97	12.17	12.51	13.21	13.89	14.21	14.40	14.66	14.81
11 136 12.81 12.98 13.26 13.46 13.78 14.46 15.15 15.50 13.11 12 165 13.21 13.38 13.65 13.84 14.16 14.82 15.51 15.86 16 13 167 13.53 13.69 13.96 14.15 14.45 15.10 15.78 16.13 16 14 150 13.80 13.95 14.21 14.39 14.69 15.32 15.99 16.33 16 15 379 13.97 14.12 14.36 14.54 14.83 15.44 16.09 16.43 16	9	162	11.92	12.09	12.38	12.58	12.91	13.60	14.29	14.62	14.82	15.10	15.27
12 165 13.21 13.38 13.65 13.84 14.16 14.82 15.51 15.86 16 13 167 13.53 13.69 13.96 14.15 14.45 15.10 15.78 16.13 16 14 150 13.80 13.95 14.21 14.39 14.69 15.32 15.99 16.33 16 15 379 13.97 14.12 14.36 14.54 14.83 15.44 16.09 16.43 16	10	193	12.35	12.52	12.80	13.01	13.33	14.02	14.72	15.05	15.26	15.56	15.74
13 167 13.53 13.69 13.96 14.15 14.45 15.10 15.78 16.13 16.13 14 150 13.80 13.95 14.21 14.39 14.69 15.32 15.99 16.33 16.33 15 379 13.97 14.12 14.36 14.54 14.83 15.44 16.09 16.43 16.09	11	136	12.81	12.98	13.26	13.46	13.78	14.46	15.15	15.50	15.72	16.04	16.23
14 150 13.80 13.95 14.21 14.39 14.69 15.32 15.99 16.33 16 15 379 13.97 14.12 14.36 14.54 14.83 15.44 16.09 16.43 16	12	165	13.21	13.38	13.65	13.84	14.16	14.82	15.51	15.86	16.09	16.42	16.62
15 379 13.97 14.12 14.36 14.54 14.83 15.44 16.09 16.43 16	13	167	13.53	13.69	13.96	14.15	14.45	15.10	15.78	16.13	16.36	16.69	16.90
	14	150	13.80	13.95	14.21	14.39	14.69	15.32	15.99	16.33	16.56	16.88	17.09
16 413 14.04 14.18 14.43 14.60 14.89 15.49 16.12 16.43 16	15	379	13.97	14.12	14.36	14.54	14.83	15.44	16.09	16.43	16.64	16.96	17.15
	16	413	14.04	14.18	14.43	14.60	14.89	15.49	16.12	16.43	16.64	16.96	17.15
17 133 14.09 14.24 14.49 14.67 14.95 15.54 16.15 16.46 10	17	133	14.09	14.24	14.49	14.67	14.95	15.54	16.15	16.46	16.65	16.96	17.15

Conclusions/action items:

The age range of this study is similar to our target audience of kids in school. Wrist circumference in highly variable within this age range and therefore the bracelet should be adjustable to both fit a wider population but also to grow with children as they grow. We can use the data from this table to shape our PDS requirements for size of the band and watch face.

KIERA KLEMM - Sep 19, 2025, 10:13 AM CDT

Title: Comfort of smart watches

Date: 9/15/25

Content by: Kiera Klemm

Present: Kiera Klemm

Goals: To better understand how smart watches fit and how to develop a similar comfortable device

Citation:

H. Zhu, M. Zhou, and B. Wu, "Comfort of smartwatch wearing: A comparative study of

different hand types," Wearable Technology, vol. 5, no. 1, p. 2963, Dec. 2024, doi:

https://doi.org/10.54517/wt2963.

Content:

- The shape and size of one's hand is what primarily affects the fit of the watch
- -the weight of a watch also highly effects the comfort of a watch

Most smart watches range from 30-60g

- -Apple Watch and others come in multiple sizes that allow consumers to fit the watch To themselves
- -smaller Apple Watches targeted towards women and children have weights around 40g
- -aluminum watches tend to be the lightest

Conclusions/action items:

We cannot control the hand and wrist shape of those using out device. We should make the watch adjustable to fit differing hand shapes. The weight of the watch should be minimized to improve comfort. As a ceiling the watch should stay below 58g but the lighter the better.

9/18/25 - Managing T1D at School - Parent Perspectives

KIERA KLEMM - Dec 10, 2025, 6:58 PM CST

Title: Managing T1D at School Parent Perspectives

Date: 12/10/25

Content by: Kiera Klemm

Present:

Goals: To understand current experiences of having a child in school with type 1 diabetes and identify ways our device could aleviate some stress.

Content:

A. Stern *et al.*, "Parent Perspectives of School/Daycare Experiences in Young Children Newly Diagnosed With Diabetes," *Journal of Pediatric Psychology*, Mar. 2023, doi: https://doi.org/10.1093/jpepsy/jsad011.

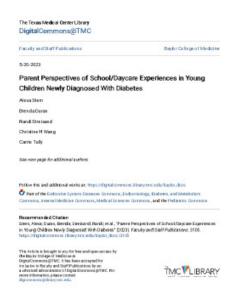
- "This study aimed to describevparent experiences with school/daycare during the first 1.5 years following a young child's T1Ddiagnosis. Methods As part of a randomized controlled trial of a behavioral intervention, 157parents of young children with new-onset (<2 months) T1D reported on their child's school/daycare experience at baseline and at 9- and 15-month post-randomization"
- "While most children were enrolled in school/daycare at all timepoints, over 50% of parents endorsed that T1D affected their child's enrollment, rejection, or removal from school/daycare at 9 or 15 months. We generated five themes related to parents' school/daycare experiences: Child factors, Parent factors, School/Daycare factors, Cooperation between Parents and Staff, and Socio-historical factors. Parents of younger children and those with lower subjective socioeconomic status were significantly more likely to endorse challenges with school/daycare enrollment. Conclusions School/daycare settings present challenges for parents of young children with T1D. Changes may need to occur across contexts to support early childhood education, including advocacy resources for parents to navigate school policies, increased training for school staff, and healthcare team outreach initiatives to parents and schools"
- "At each time point, 15% endorsed their child having been turned down or asked to leave school/daycare because of T1D, and 13% endorsed having removed their child from school/daycare due to difficulties withT1D management. The majority of parents (87% at 9months and 89% at 15 months) rated their child's teacher or staff as "pretty or very receptive" to parental instruction on T1D care in the school."
- ""It was less stressful for me to homeschool. Lots of paperwork and advocating if in public school."

	Baseline	9 Months	15 Months
Attends school/daycare	67 (105)	73 (114)	70 (110)
Full day program ^a	83 (87)	81 (92)	85 (94)
Half day program ^a	16 (17)	14 (16)	14 (15)
Decline/Did not answer	1 (1)	5 (6)	1 (1)
School/daycare type ^{a,b}			
Public school	50 (53)	60 (68)	71 (78)
Private school	30 (32)	25 (29)	22 (24)
Center Daycare	16 (17)	14 (16)	6 (7)
In-home school/daycare	7 (7)	5 (5)	5 (6)
Days per week child attends school/daycare	4.67 ± 0.93	4.82 ± 0.79	4.76 ± 0.98
How often caregiver goes to school/daycare to assist with child's T1D ^a			
0 days/week		54 (62)	55 (61)
1–2 days/week		27 (31)	28 (31)
3–7 days/week		18 (20)	17 (18)
Did not answer		1 (1)	0 (0)
Parent rating of teacher/staff receptivity to parent instruction on T1D care ^a			
Not at all or a little bit receptive		3 (3)	5 (6)
Somewhat receptive		7 (8)	2(2)
Pretty or very receptive		87 (99)	89 (98)
Decline/did not answer		3 (4)	4 (4)
Has 504 Plan ^{a,c}		49 (56)	54 (59)
Parent endorsement of T1D-related school/daycare enrollment challenges ^d			
Child's T1D affected parent's decision about enrolling them in school/daycare		34 (52)	41 (63)
Child has been turned down for enrollment or asked to leave school/daycare because of T1D		15 (23)	15 (22)
Parent removed child from school/daycare because of difficulty with T1D management		13 (20)	13 (20)

Conclusions/action items:

Currently children and parents face difficulties with school options due to lack of staff competent in caring for their child. The extent of this is to the point that some parents pull their kids out of public school and some are even denied admission from private institutions. Our device could make it easier for these untrained caregivers to understand and respond to high/low blood sugars. It would make it easier for them which would additionally relieve stress from parents knowing there is a clear way for their child to be monitored.

KIERA KLEMM - Dec 10, 2025, 7:11 PM CST



Download

KIERA KLEMM - Dec 10, 2025, 8:28 PM CST

Title: Sugar Mate App research

Date: 9/11/25

Content by: Kiera Klemm

Present:

Goals: To understand how the sugarmate app acts as a glucose alerting system and allows type 1 diabetics to better understand their blood glucose levels.

"Features," Sugarmate. https://www.sugarmate.io/features

Content:

- The sugarmate app uses data directly from a cgm
- -It allows users to graph and analyze their data to identify trends and patterns
- -It has features that track nutrition and consumption and how it effects blood glucose levels
- -In nightstand mode it easily shows blood glucose levels s on a dark screen, like an alarm clock
- -"helps reduce the guesswork that often accompanies diabetes management by giving you the tools you need to get the most out of your CGM data."
- -"As an authorized Dexcom Connected Partner, the Sugarmate app uses Dexcom CGM data to create a wide range of visualization tools. " has direct access to Dexcom data, also compatible with tandem mobi

Conclusions/action items:

This competitor also pulls data from a CGM device into an app where it uses the data to help reduce stress of type 1 diabetics and their caregivers. However, instead of being focused on alerting the user it is more aimed at analyzing data and finding patterns in a users habits and blood sugar levels. It is emphasizing the ability to predict the effects of diabetes not making it easier to respond to them.

KIERA KLEMM - Dec 10, 2025, 8:28 PM CST

Title: Dexcom Alarms and Alerts

Date: 9/15/25

Content by: Kiera Klemm

Present:

Goals: To understand how the current dexcom alerts and alarms work and how we can diffenciate from them to improve our design for kids.

Content:

"What are the Dexcom G6 alert capabilities? | Dexcom," *Dexcom*, 2024. https://www.dexcom.com/en-sc/faqs/what-are-dexcom-g6-alert-capabilities (accessed Dec. 11, 2025).

- -"The Dexcom G6 mobile app not only displays glucose information on your compatible smart device but can also deliver glucose alerts to notify you of pending highs and lows."
- "Customizable alerts enable greater control over glucose management, empower better diabetes treatment decisions, and help reduce hypoglycemic incidents. By setting your own optimal range, you will be notified when you are heading high or low, based on your specific needs and preferences."
- -Has Urgent low, urgent low soon, and urgent high alerts
- -Customizable levels allow different patients to adjust based on their needs and blood glucose tends
- -Requires a phone to be nearby at all times to recieve alerts

Conclusions/action items:

This system of alerting a patients of blood glucose levels is helpful because it notify's them of dangerous levels. It is also customizable which we should include in our final design. This is more targeted to adults who always have a phone on them while a child may want to play without their device with them. Additionally, loud alerts could be disruptive to teaching in a class room.

KIERA KLEMM - Dec 10, 2025, 8:27 PM CST

Title: Dexcom for Apple Watch

Date: 10/2/25

Content by: Kiera Klemm

Present:

Goals: To understand a current form of wearable glucose alerting system that allows T1 Diabetics to see their glucose levels on their wrist

Content:

"NEW! Dexcom G7 Direct to Apple Watch: Manage Diabetes Hands-Free | Dexcom," *Dexcom*, 2024. https://www.dexcom.com/all-access/dexcom-cgm-explained/direct-to-apple-watch

- "a smartwatch can be such a powerful tool for people living with diabetes to monitor glucose levels discreetly, conveniently track the direction their glucose is headed and act when receiving an alert."
- "Living with diabetes, it can be frustrating to feel as if you always need to have your phone close by so you can keep an eye on your glucose. Now, the new Direct to Apple Watch feature allows your Dexcom G7 sensor to connect to your Apple Watch through its own dedicated Bluetooth connection, independent of a user's iPhone.[†]"
- "This means when Direct to Apple Watch is connected you no longer need to keep your iPhone within Bluetooth range of the Dexcom G7 sensor to get your glucose readings.†"
- "Enhanced discretion with glucose numbers at a glance Whether you're in a meeting, enjoying a movie or out to dinner with a loved one, sometimes it's hard or inconvenient to pull out your phone to check your numbers. With Dexcom G7 Direct to Apple Watch, it's easy to see where your glucose is and where it's headed with just a quick glance at your wrist."
- "Actionable and acknowledgeable alerts from your watch CGM alerts can help you increase the time you spend in range. When Direct to Apple Watch is connected, alerts are generated on your watch and are acknowledgeable, so you won't have to pull out your iPhone* and acknowledge the alert once you get one. "

We could use the same bluetooth connection the dexcom uses to connect to the apple watch to connect our device directly to the dexcom. While the apple watch is a competitor as it allows glucose levels to be easily seen on the wrist we can differenciate our product by not showing the number and having a simpler light that is easier for children to interpret. Additionally, the apple watch may not be a good option for children as it is expensive and they can lose them easily.



KIERA KLEMM - Dec 10, 2025, 8:20 PM CST

KIERA KLEMM - Dec 10, 2025, 8:27 PM CST

Title: Glowcose

Date: 10/6/25

Content by: Kiera Klemm

Present:

Goals: To understand the competing design we are going to feature on our preliminary report in order to better acknowledge currently existing glucose alerting systems.

Content:

"Glowcose," Glowcose, 2024. https://glowcose.com/

"I needed a simple way to know everything was okay without constantly asking or worrying that I hadn't checked recently. So, we made a light that changed color with her CGM readings. It sat on the nightstand for years."

"Glowcose – a visual link to glucose levels for both you and those who care about you. It's a simple signal for shared awareness, delivered without stress or noise" -uses color as a simple way to represent glucose levels

"We designed the system to connect easily with your CGM to get your data without a fuss. Your Glowcose web app takes those glucose readings and turns them into colors based on how you've have them set up in your account. Then, your glowcose uses your home Wi-Fi to simply get that color from your account, updating instantly to show you the latest status." - requires wifi and a plug not portable

"We made sure you have control over the color levels. Each glucose reading turns into one of hundreds of possible colors, shifting smoothly. You can easily set your own high, low, and target numbers in the settings. This lets you personalize exactly how your glucose levels *shine*. It's all about making glowcose work best for you." - We should also let people customize their levels based on their personal data

"Glowcose supports Dexcom G6 and G7, as well as Libre 2 and 3. We also offer support for other CGMs via Nightscout, if you're using it. In general, if your CGM provides cloud data, there's a very good chance Glowcose will work with it." -They also offer nightscout connection but have a direct connection to dexcom

Conclusions/action items:

This device uses a simialr color scale for representing glucose levels hwoever it needs to be plugged in and connected to wifi which makes it not portable. Our device will also be wearable which this is not. Overall we are developing a similar concept but not the same device. Their use of nightscout affirms this as a reputable option for connectivity and their dexcom connection is promising for future direct connection later in the project.

KIERA KLEMM - Oct 06, 2025, 3:19 PM CDT

Title: Battery Options Research

Date: 9/25/25

Content by: Kiera Klemm

Present: Kiera Klemm

Goals: To understand what our options are for battery systems and which would be best

Content:

Citation: D. Parsons, "The environmental impact of disposable versus re-chargeable batteries for consumer use," *The International Journal of Life Cycle Assessment*, vol. 12, no. 3, pp. 197–203, Aug. 2006, doi: https://doi.org/10.1065/lca2006.08.270.

- · Most people opt to use disposable alkaline batteries in small electronics
- · Other options include rechargeable lithium ion batteries and small charger
- Disposable results in a higher price over time and greater environmental impact
- · Rechargeable batteries have a higher upfront cost but lesser environmental impact over time
- The majority of the environmental impact actually comes from the transport and production of the batteries as opposed to their disposal.
- · Rechargeable batteries were highly favored in results of the study

Conclusions/action items: In the long term rechargeable batteries are both cheaper and better for the environment. If the bracelet will not last for a long period of time disposable batteries would be the a better option.



9/25/25 - Dangers of Button Battery Consumption

KIERA KLEMM - Oct 06, 2025, 3:21 PM CDT

John Puccinelli - Nov 03, 2014, 3:20 PM CST

Title: Dangers of Button Battery Consumption

Date: 9/9/25

Content by: Kiera Klemm

Present: Kiera Klemm

Goals: To understand the risks of the batteries we are using fro a device marketed towards children. To know the importance of properly securing

Content:

Citation: "What to Do If Your Child Swallows or Ingests a Button Battery," *Connecticut Children's*, Dec. 15, 2023. https://www.connecticutchildrens.org/growing-healthy/what-to-do-if-your-child-swallows-or-ingests-a-button-battery

- Battery can get stuck in the air way (chocking risk)
- · Battery can also get caught in the throat of stomach
- Within 15 minutes of consumption a chemical reaction begins that starts causing burns
- · Within 2 hours life threatening tissue damage can occur
- · Products wtih accessible batteries should not be used around children
- · Batteries should only be accessible with a screwdriver of special tool
- Larger batteries pose a bigger risk, especially 3 volt lithium batteries as theyre more liekly to get stuck but still small enough to swallow

Conclusions/action items:

Battery consumption can be a fatal situation for kids. They often swallow small things they find so its important that the battery is secure within the device. The battery should be secured by a screw or other closure requiring a tool to access it. A warning may need to be included within the packaging to warn parents against the risk of battery consumption.

10/2/25 - Customizable Wearable Device batteries

KIERA KLEMM - Oct 03, 2025, 10:09 AM CDT

KIERA KLEMM - Oct 06, 2025, 3:32 PM CDT

Title: Customizable Wearable Device Batteries

Date: 10/2/25

Content by: Kiera Klemm

Present: Kiera Klemm

Goals: Understand what type of battery is best for wearable devices. Explore a possible procurement option for our battery. BEtter understand the size and weight specs of a lithium ion battery.

Citation: "Elevate Your Wearables With Advanced Wearable Device Battery," *Ufine Battery [Official]*, 2025. https://www.ufinebattery.com/applications/wearable-device-battery/ (accessed Oct. 06, 2025).

Content:

- -Lithium ion batteries opperate at a higher volatage than most other batteries types and therefore require less cells. This then reduces size and wight of these batteries.
- lithium ion batteries have the fastest charging time
- Nickle batteries have a less comlicated chagring process reducing overheating risks
- -For lithium ion batteries "For optimal charging, careful trade-offs must be made in the selection of current and voltage levels. Charging at a higher voltage can increase battery capacity, but voltages that are too high can cause the battery to become stressed or overcharged, causing permanent damage, instability and danger."
- -"Because of this complexity, charging solutions must be able to closely monitor charging current and voltage. And provide a stable control loop to keep the charging current and voltage at appropriate values at the appropriate point in the charging cycle "
- -Lithium ion batteries are the best ooption for wearable devices
- -some batteruies have built in safety features
- -The litium ion battery in this article is 6.6mm X 4mm

Conclusions/action items:

We should use a lithium ion battery in our device. This require a more complex charging system that is able to monitor the voltage imput during chargin to maintain the safety and battery life of the device.

KIERA KLEMM - Oct 10, 2025, 10:36 AM CDT

Title: Nightscout research

Date: 10/6/25

Content by: Kiera Klemm

Present: Kiera Klemm

Goals: To understand the nigthscout system and how it will be set up in the fabrication process.

Citation:

"Nightscout Configuration — Nightscout Documentation documentation," *Github.io*, 2024. https://nightscout.github.io/nightscout/setup_variables/ (accessed Oct. 10, 2025).

"New Nightscout Users — Nightscout Documentation documentation," *Github.io*, 2024. https://nightscout.github.io/nightscout/new_user/ (accessed Oct. 10, 2025).

Content:

- Nightscout uploads data into a spread sheet and would be read from there
- Nightsout depends on an external piece of hardware (a device sensor or phone application) that allows it to connect to the CGM and upload the data to the internet allowing others to access the data
- We will need both an engine and database to process and then store our data
- The API has built in alarm systems for hyper and hypo glycemia that could be altered and used to manipulate the LEDs
- · We will need to create a new access token within nightscout with the role readable
- Users will be able to do the same as above and then use their nightscout URL to give the system access to their data
- From there we would need to input the data into our microcontroller to produce a signal to turn the LEDs on

Conclusions/action items: As we had already decided the nightscout system will allow us to customize our engine as necessary. In order to connect a device to the API we will need to create a new access token with the role readable to give the microcontrolled access to the data. From there the programmed microcontroller will output signals to the LED. We have the option to analyze the readings as high, low, or within range either within the API or microcontroller programming.

KIERA KLEMM - Oct 10, 2025, 10:12 AM CDT

Title: Micro Controller Basics

Date: 10/9/25

Content by: Kiera Klemm

Present: Kiera Klemm

Goals: To better understand the micro controller system in order to be competent in these systems when fabrication begins

Citation: H. M. | D. Electronics | 0, "Introduction to Microcontrollers," *Circuit Basics*, Oct. 21, 2021. https://www.circuitbasics.com/introduction-to-microcontrolleres/

Content:

- -the most simple model of a micro controller is an input that makes something happen then produces an output
- They depend on the ability to interact (both input and output) with external devices
- -"A typical microcontroller includes a processor, program memory, RAM, input/output pins, and more on a single chip."
- -They are good for performing repetitive and high speed operations
- -Development boards such as an Arduino or raspberry pi use micro controllers with development boards to make development and prototyping easy.
- -using a more popular microcontroller allows for easier access to resources and assistance when needed
- https://www.amazon.com/gp/product/B01EA3UJJ4/ref=as_li_qf_asin_il_tl?ie=UTF8&tag=circbasi-20&creative=9325&linkCode=as2&creativeASIN=B01EA3UJJ4&linkId=6377bc4d00abfe86b6088dd50384e948 could be an option for our project
- -Intel 8051 is also commonly used in medical devices

Conclusions/action items:

Microcontrollers are less confusing than they come off to be. We should consider ease of programming, cost, and size when looking into micro controller options. We will need our device to receive an input of a glucose reading and produce an output of an LED turning on or off. This repetative input -> output task is a good fit for a microcontroller.

KIERA KLEMM - Dec 10, 2025, 1:30 PM CST

Title: Battery Security

Date: 10/9/25

Content by: Kiera Klemm

Present:

Goals: To understand the clear legal guidelines set in place in by Reese's law to consider in the process of designing the case of our device. These regulations pertain to batteries in devices for children.

Content:

[3] "Button Cell and Coin Battery Business Guidance," *U.S. Consumer Product Safety Commission*. https://www.cpsc.gov/Business--Manufacturing/Business-Education/Business-Guidance/Button-Cell-and-Coin-Battery

"On Tuesday, August 16, 2022, Reese's Law (Public Law 117-171), was passed to protect children and other consumers against the dangers associated with the accidental ingestion of button cell or coin batteries. The law requires the Consumer Product Safety Commission to require child-resistant closures on products that use these batteries and more stringent warning labels on all packaging."

- Per ANSI/UL 4200A-2023, the requirements for consumer products containing or designed to use button cell or coin batteries are as follows:
 - Battery compartments containing replaceable button cell or coin batteries must be secured such that they require the use of a tool or at least two independent and simultaneous hand movements to open.
 - Button cell or coin battery compartments must not allow such batteries to be accessed or liberated as a result of use and abuse testing.
 - The packaging for the overall product must bear a warning.
 - The product itself must bear a warning, if practicable.
 - Accompanying instructions and manuals must include all of the applicable warnings.
- Section 14(a) of the Consumer Product Safety Act (CPSA) requires manufacturers of consumer products subject to a regulation, standard, or ban enforced by the CPSC to certify that those products meet the requirements of the standard by issuing a Children's Product Certificate (CPC) for children's products or a General Certificate of Compliance (GCC) for general-use products.

Conclusions/action items:

This law is specific to button and coin batteries however we can apply some of it's regulations to our design with a rechargeable battery in order to protect children from accessing this component. The most clear guideline applicable to our design in that the device must require a tool or two simultaneous hand motions to access the battery. We. can insure this by including a screw or double latch in our final design.



Button Cell and Coin Battery Business

Enacted in 2022, Reese's Law (P.L. 117-171) mandates federal safety requirements for button cell or can balletine. Below see the various regularments for bullon need or can balletines as well as consumer products that contain or can use such batteries. The requirements range from performance to labeling and certification.

Products Containing or Designed to Use Button Cell or Coin Batteries - Reese's Law Section 2

Section 2 of Resear's Law requires CPSC to promulgate a rule for button cell or coin batteries and consumer products that contain such batteries. CPSC has published a direct final rule (88 FR 65274 Intal incorporates by reference Attibute. According to the contraction of the contraction enforcement discretion such that these requirements will apply to products manufactured or imported after March 19, 2024.

A "button cell or coin battery" first is subject to the requirements of 16 CFR part 1283 means a single cell battery with a clariseter greater than the height of the battery. The rule excludes zinc-air button cell or coin batteries from the scope of 16 CFR part 1263.

Per ANSAUL 4200A-2023, the requirements for consumer products containing or designed to use button cell or coin batteries are as follows:

Download

Button_Cell_and_Coin_Battery_Business_Guidance___CPSC.gov.pdf (173 kB)

10/15/25 - Optimizing 3D sketches for 3D printing

KIERA KLEMM - Oct 17, 2025, 10:26 AM CDT

Title: Optimizing 3D sketches for 3D pritning

Date: 10/15/25

Content by: Kiera Klemm

Present: Kiera Klemm

Goals: To better understand what a 3D model need in order to be 3D orinted and identify what components will be the most important when

designing and printing our box.

Content:

Citation:

[10]R. Forgach, "How to design for 3D printing - optimize your 3D models for print," www.shapr3d.com, Oct. 17, 2022. https://www.shapr3d.com/blog/design-for-3d-printing

- Walls of the box must have a thinkness, ideally of .8mm or more
- -This is becaumse 3d printers arent able to create smaller walls due to the width of their filament
- -Small details may not be printed exactly how they were sketches so its important to consider how exact a certain material can be when printing when making your design
- -Support structures should be avoided to not waste material, for example we may want to print he lid upside down if it has an overhang
- -before printing you should make sure the design is water tight to avoid discontinuities in the print
- -Adding a raft creates a buffer between the plate and the print and can help improve the visuals of the design
- -Only overhangs with angles greater tha 45 degrees require supports
- -supports can be created in the slicer software or designing software
- -Threads often come out imperfect from the printing process

Conclusions/action items:

The most important considerations for our 3d model will be the wall thickness and non-manifold geometries. we should make sure our walls are more than .8mm think and that our box has correctly made corners and edges.



10/22/25 - Apple watch band design guidelines

KIERA KLEMM - Oct 22, 2025, 11:00 PM CDT

Title: Apple Watch Band Design Guidelines

Date: 10/22/25

Content by: Kiera Klemm

Present:

Goals: To analyze the dimensions of an apple watch and the band to be able to create a female component of the watch band interface on our

device.

Content: See attached annotated document

"Well-designed cases, covers, screen overlays, watch bands, camera attachments, and Bluetooth accessories complement Apple devices without interfering with their operation. As you create accessories for Apple products, follow the design guidelines and test your prototypes to make sure they meet the necessary requirements."

Conclusions/action items: These dimensions were vital in the design of the band attachment on our box. We need to ensure thier use is both legal and ethical with apples terms when distributed but is convenient for the prototype process.

KIERA KLEMM - Oct 22, 2025, 10:25 PM CDT

Band Design Guidelines for Apple Watch

desseR2

Developer

Download

band-design-guidelines-for-apple-watch.pdf (3.65 MB)

11/6/2025 - 3D Printing Material Options

KIERA KLEMM - Dec 10, 2025, 11:11 AM CST

Title: 3D Printing Material options research

Date: 11/6/2025

Content by: Kiera Klemm

Present:

Goals: To better understand what material options we have to print in and the benefits of each. Ultimately, we want to find a better material that is more durable and able to create the level of detail we need.

Content:

PLA: Currently we are using PLA this is a cheap material. PLA is a plastic It is the easiest to print and is considered very rigid but IT IS BRITTLE, this explains the issues weve been having will thin small pieces breaking. It is the easiest to print as it is odorless and doesn't require ventilation. It is known for its use in modeling and concepts not functional prorotypes

- -ABS: This material is known for being tough and durable which is something we look for. It is also heat and impact resistant. It is more difficult to print as it requires a heated bed and ventilation. It is known for its use in functional prototypes
- -PETG: PETG is known for being stronger and more detailed in fast prints. It is humidity and chemical resistant. It is good for waterproof and snap fit components which we need.
- -Resin: The biggest benefit of resin is that it can create clear prints which we need for our lid. However for the box it is known for creating concept models and not necessarily for its durability. However Polyurethane Resin is known for being very durable in UV, temp, and humidity. It good fr tough long lasting prototypes

Overall the plastic and resin options listed above would be our best bet for creating our box prototype

Conclusions/action items:

Overall the plastic and resin options listed above would be our best bet for creating our box prototype. Because resin is a ,much more expensive material we should continue the testing process with the plastics (PLA, ABS, PETG) and once we've arrived at a final design print in resin for final testing. All of these materials will provide more durability and detail than our original PLA prints.

11/18/2025 - On Shape Simulation Software

KIERA KLEMM - Dec 10, 2025, 8:01 PM CST

Title: On Shape Simulation Software

Date: 11/18/25

Content by: Kiera Klemm

Present:

Goals: To understand how we can sue the onshape simulation software as a possible tool in our testing process

Content:

P. Business, "3D CAD Simulation Software for Engineering," *Onshape.com*, 2025. https://www.onshape.com/en/features/simulation#features (accessed Dec. 11, 2025).

"Onshape Simulation is the easiest and fastest way to examine meaningful structural analysis results such as stress, displacement and natural frequencies, as you create and iterate in the Onshape design environment."

"Onshape delivers simulation in the assembly environment, so you can easily simulate full assemblies, not just parts. Assembly mates – such as fastened, revolute, slider and more " - simulation will allow us to test how our parts fit togetehr before printing to ensure a good strong fit

- You create a simulation the same way you would create a new sketch or other layer
- -We can stress test our box to determine weak points and how altering different components changes the strength

Conclusions/action items: I want to start experimenting with the software on different project to get a better understadning of how it works. From there we can use it to test different materials and configurations of our box to determine the strongest option without spending money to print multiple versions. We should confirm this testing option with real life testing to ensure it matched our actual prototype.

KIERA KLEMM - Dec 10, 2025, 11:31 AM CST

Title: Tong Lecture VIdeo Notes

Date: 11/14/2025

Content by: Kiera Klemm

Present:

Goals: To watch the tong lecture video and identify key points and takeaways that I can apply to my studies and life. Also, to better understand modern healthcare in the US and how it needs to be improved.

Content:

- -She graduated with a degree in biomedical engineering then got an MDA
- -In her past she's held leadership ship positions with both entrepreneurial opportunities and in organized positions like chief of staff
- -health care is too expensive at the moment
- -in the future continuous care can help doctors create patient relationships by seeing them over time instead of trying to see them guickly. This improves patient and provider experience
- -administrative tasks like charting take up time away from patients
- -Healthcare insurance is disorganized and way to big in the US
- -Work hard and put yourself in uncomfortable opportunities
- -Take on the hard projects those are the ones that make a difference
- -Surrounds yourself with other curious hard working people
- -Define your values and follow and protect them

Conclusions/action items:

The healthcare system in th eunited states needs to be improved and it is a big challege to do this. By improving it costs can be lowered as well as improving both provider and patient experience. There were also personal takeaways fomr the lecture, wokring hard and taking on big challenges is what bring opportunity and success. Surrounding yourself with others who value hard work and curiosity can also lead you to new opportunities and growth.

KIERA KLEMM - Oct 10, 2025, 10:42 AM CDT

Title: Battery and Charging designs

Date: 9/23/25

Content by: Kiera Klemm

Present: Kiera Klemm

Goals: To develop multiple design options for the battery and charging components of our device. To understand the pros and cons of each.

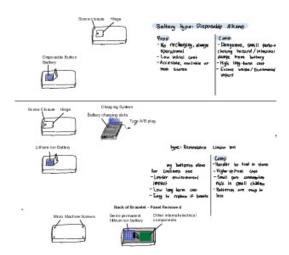
Content:

See attached

Conclusions/action items:

We should continue to develop these ideas and research each of them to better understand them. Each of them would be usable in our device and we should analyze them through a design matrix and client meeting to decide which would be best fro our device.

KIERA KLEMM - Oct 10, 2025, 10:42 AM CDT



Download

BME_designs_.pdf (643 kB)

KIERA KLEMM - Oct 17, 2025, 10:06 AM CDT

Title: 3D sketch of box for device face

Date: 10/17/25

Content by: Kiera Klemm

Present: Kiera Klemm

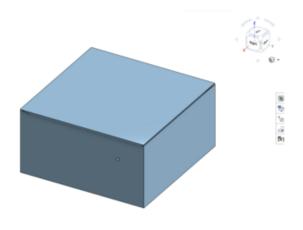
Goals: To create an design idea that will be compared altered and printed to be the original prototype of the box.

Content:

-30x30x15mm box with a lid that fits in by diagonal chamfered edges

Conclusions/action items: This box is a rough design idea in the future it should be improved by flaying the edges and better insuring the fit on the lid in the box. We met on Wednesday to improve the design of the box.

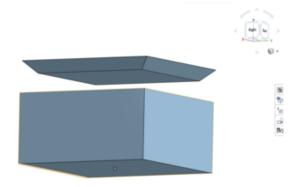
KIERA KLEMM - Oct 17, 2025, 10:07 AM CDT



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Screenshot_2025-10-17_at_10.02.32_AM.png (198 kB)

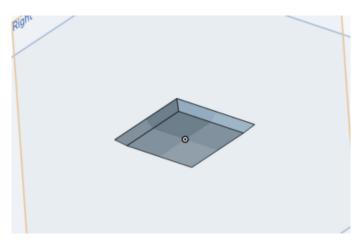
KIERA KLEMM - Oct 17, 2025, 10:07 AM CDT



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Screenshot_2025-10-17_at_10.02.42_AM.png (174 kB)

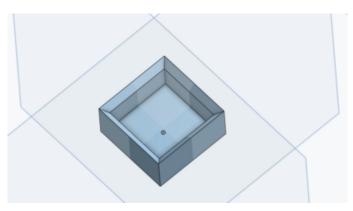
KIERA KLEMM - Oct 17, 2025, 10:07 AM CDT



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Screenshot_2025-10-17_at_10.03.23_AM.png (76.2 kB)

KIERA KLEMM - Oct 17, 2025, 10:07 AM CDT



Download

Screenshot_2025-10-17_at_10.03.04_AM.png (268 kB)



10/31/25 Show and Tell Box Design Improvement Notes

KIERA KLEMM - Dec 10, 2025, 11:09 AM CST

Title: Show and Tell Box Design Improvement Notes

Date: 10/31/25

Content by: Kiera Klemm

Present: All team

Goals: At the show and tell even I asked some of the people we presenting to about how we could more accurately print/create the detailed sections of the box. They're advice will help us improve our design in the future.

Content:

- Sharp corners should be filleted, Missed corned below lug attachment.
- -Thin portion of latch is very weak, easy to break
- -Could create boxout of metal and using milling or laser jet to create lug attachment, Would be very expensive and difficult. could be too heavy.
- -Print out of different filament materials, look into PETG or Resin

Conclusions/action items:

Printing in a different material will most likely be the best way to create a more durable and detailed box however these materials are more expensive. While metal would be more durable it is going to be expensive and most liekly beyond our timeline of this semester.



10/22/25 - 3D sketch of Box with apple watch band attachment

KIERA KLEMM - Oct 22, 2025, 9:52 PM CDT

Title: 3D Sketch of Box with Apple Watch Band Attachment

Date: 10/22/25

Content by: Kiera Klemm (Original Box by Audrey Zeller)

Present: Kiera Klemm

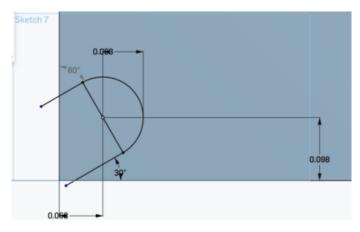
Goals: To alter our origiunal box to have different dimentions and be able to connect to an apple watch band

Content:

See attached

Conclusions/action items: In the future we should print the box and continue editing the dimensions of the file so that the band fits snugly while still being easily replaceable.

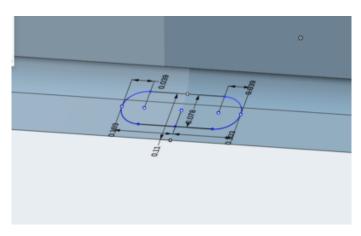
KIERA KLEMM - Oct 22, 2025, 9:53 PM CDT



Download

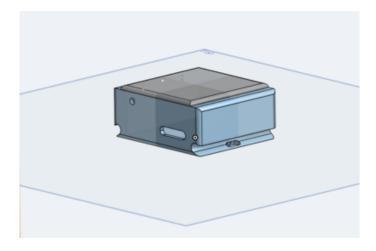
Screenshot_2025-10-22_at_8.33.47_PM.png (125 kB)

KIERA KLEMM - Oct 22, 2025, 9:53 PM CDT



Download

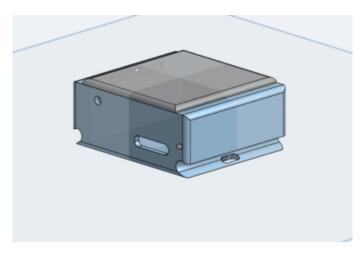
Screenshot_2025-10-22_at_9.14.40_PM.png (219 kB)



Download

Screenshot_2025-10-22_at_9.42.59_PM.png (155 kB)

KIERA KLEMM - Oct 22, 2025, 9:53 PM CDT



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Screenshot_2025-10-22_at_9.43.25_PM.png (163 kB)

KIERA KLEMM - Dec 10, 2025, 11:09 AM CST

John Puccinelli - Nov 03, 2014, 3:20 PM CST

Title: Improved 3D Sketch of box

Date: 10/29/25

Content by: Kiera Klemm and Audrey Zeller

Present:

Goals: To create a box for the device that fits the apple watch band lug securely and tightly.

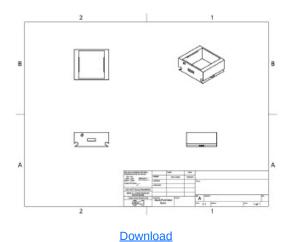
Content:

After printing the last box it was clear the lug needed to fit further into the box and the changing port needed to be adjusted. This new design includes these changes by mocing the lub hole deeper into the side of the box and moving the latch hole along with it.

Conclusions/action items:

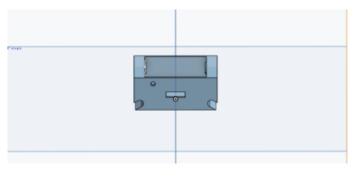
We will print the box tomorrow and test the fit of the band. We will continue to test and reprint until we are happy with the outcome. Additionally, Since the inner dimensions of the box have not changes we do not need to reprint the lid. This is good because the box is very cheap to print (around 50 cents) while the clear lid is upwards of \$2.

KIERA KLEMM - Oct 29, 2025, 10:11 PM CDT



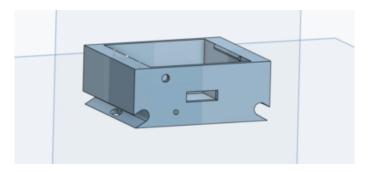
BME_CGM_Container_Drawing.pdf (81.7 kB)

KIERA KLEMM - Oct 29, 2025, 10:12 PM CDT



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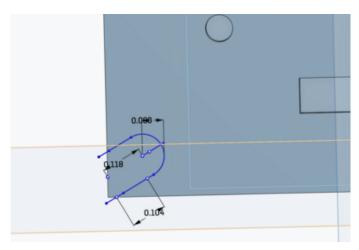
Screenshot_2025-10-29_at_9.59.19_PM.png (55.6 kB)



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Screenshot_2025-10-29_at_10.01.02_PM.png (153 kB)

KIERA KLEMM - Oct 29, 2025, 10:12 PM CDT



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Screenshot_2025-10-29_at_10.03.55_PM.png (204 kB)

KIERA KLEMM - Dec 10, 2025, 11:10 AM CST

Title: Larger Box Cad Model

Date: 11/9/25

Content by: Kiera Klemm

Present:

Goals: To increase the internal area of the box to fit the battery, capacitor, micro controller and other components.

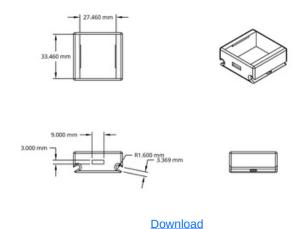
Content:

The last print resulted in a hole in the side of the box as the lug was moved too deep into the wall. The walls have been thickened to prevent this and make it bigger. The box was also made bigger in order to have more internal space for the hardware components. This box will be printed in PETG to be stronger.

Conclusions/action items:

We will print the box in the upcoming days and evaluate if the components fit inside at the next team meeting.

KIERA KLEMM - Dec 07, 2025, 9:04 PM CST



Blgger_box_sketch.JPG (71.3 kB)

KIERA KLEMM - Nov 18, 2025, 12:54 PM CST

Title: Final Poster Format

Date: 11/18/25

Content by: Kiera Klemm

Present:

Goals: To create a clear and concise format to showcase our work from this semester.

Content:

See attached

Conclusions/action items: In the upcoming weeks we will continue to fill in the sections of this format. Making this format now will allow us to same time when we are crunched with many tasks at once.

KIERA KLEMM - Nov 18, 2025, 12:54 PM CST



Download

Screenshot_2025-11-18_at_12.51.14_PM.png (228 kB)

KIERA KLEMM - Dec 10, 2025, 11:11 AM CST

Title: Final Box Desgin

Date: 12/3/25

Content by: Kiera Klemm

Present: Kiera Klemm and Audrey Zeller

Goals: To make a final design for the box that will be presented as our prototype at the poster session.

Content:

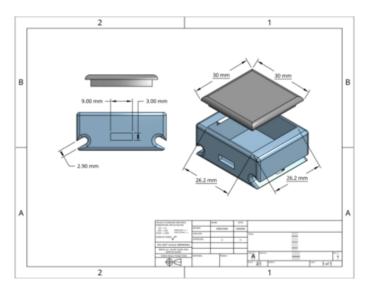
For this iteration of the box I made the lug attachments smaller because the resin prints more accurately which results in the band fitting looser. This should make a tight connection that is strong enough for our PDS.

Because we are no longer using the battery in our device we can make the box smaller again to our original PDS specifications for box size.

Conclusions/action items:

We will print this box now in order to have it ready in time for the final presentation. It will be our final box as the band should fit tight due to the smaller openings. We will print 2 iterations of the box incase one of them breaks before the poster session/

KIERA KLEMM - Dec 07, 2025, 9:09 PM CST



Download

Screenshot_2025-12-07_at_9.05.04_PM.png (218 kB)

KIERA KLEMM - Oct 29, 2025, 1:39 PM CDT

Title: 9-26-24 Interegr 170 training

Date: 9-26-24

Content by: Kiera Klemm

Present: Whole group

Goals: Develop skills in the desgin innocvation lab and better understand the design process. Also to develop some basic design ideas for our

device.

Content:

For the first part of this meeting we focused on the 3-D printing section of the wendt design innovation lab. We registered ourselves on the computer system and were shown some of the printers and past prints. From there we bagan to aclimate ourselves with onshape, the softare we will be suing for cad this semester. We followed a tutorial to create a donut on the software and the basic tools on shape uses. Overall, this helped us gain confidence and literacy with cad softwares for the future.

References:

Picture of Onshape donut, taken by Kiera Klemm:

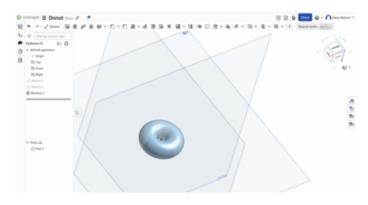
Conclusions:

We learned many important skills in lab today that will help us in this course and in future design courses. IT is important that we Connie to expand on our design abilities in the lab and 3-d printing cad to allow us to design the best possible product. We also were able to brainstorm some solid basic ideas and noticed that a lot of their flaws come from how easy it will be for a patient to put the device on.

Action items:

- -preliminary design ideas
- -identiry pros and cons of design ideas

KIERA KLEMM - Sep 30, 2024, 12:02 AM CDT



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Screen Shot 2024-09-26 at 3.04.24 PM.png (1.51 MB)

KIERA KLEMM - Oct 29, 2025, 1:40 PM CDT





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Screenshot_2025-10-29_at_1.40.08_PM.png (345 kB)

KIERA KLEMM - Oct 29, 2025, 1:34 PM CDT

Title: UW Safety Trainings documentation

Date: 10/29/2025

Content by: Kiera Klemm

Present:

Goals: Provide documentation that I completed the required UW safety trainings.

Content:

Conclusions/action items: Submit documentation to canvas.

KIERA KLEMM - Oct 29, 2025, 1:34 PM CDT



This certifies that Kiera Klemm has completed training for the following course(s)

Course	Assignment	Completion	Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024-2025	10/25/2025	10/25/2028
Chemical Safety: The OSHA Lab Standard	Final Quiz	10/23/2025	

Data Last Imported: 10/29/2025 01:24 PM

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Screenshot_2025-10-29_at_1.30.29_PM.png (143 kB)

KIERA KLEMM - Oct 29, 2025, 1:36 PM CDT

Title: Machining training documentation

Date: 10/29/25

Content by: Kiera Klemm

Present:

Goals: To provide documentation that I completed the Lathe and Mill training

Content:

Conclusions/action items: Upload documentation to canvas.

KIERA KLEMM - Oct 29, 2025, 1:42 PM CDT



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Screenshot_2025-10-29_at_1.40.08_PM.png (345 kB)

2014/11/03-Entry guidelines 530 of 531



John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity, subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

Title: Descriptive title (i.e. Client Meeting)

Date: 9/5/2016

Content by: The one person who wrote the content

Present: Names of those present if more than just you (not necessary for individual work)

Goals: Establish clear goals for all text entries (meetings, individual work, etc.).

Content:

Contains clear and organized notes (also includes any references used)

Conclusions/action items:

Recap only the most significant findings and/or action items resulting from the entry.

2014/11/03-Template 531 of 531

John Puccinelli - Nov 03, 2014, 3:20 PM CST

Title:	
Date:	
Content by:	
Present:	
Goals:	
Content:	
Conclusions/action items:	