BME Design-Spring 2026 - Biopsy Press
Complete Notebook

PDF Version generated by

Simon Nam

on

May 04, 2026 @01:10 PM JST

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Team contact Information

Simon Nam - Jan 24, 2026, 5:22 AM GMT+9

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Gibson	Angela	Client	gibson@surgery.wisc.edu		SMPH
Nagarkatte	Ruhi	Leader	nagarkatte@wisc.edu	630-329-3070	
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Project description

Simon Nam - Jan 26, 2026, 5:13 AM GMT+9

Course Number: BME 402

Project Name: Improving the precision of small human tissue biopsy processing

Short Name: Biopsy Press

Project description/problem statement:

Project Objective

Design a tool that allows for consistent and accurate cutting of tissue biopsies

Project Description

Pig skin is very dense and difficult to work with. As a result, it is more difficult to de-fat than human skin and much less manipulative. Even small layers of residual fat prohibits tissue preservation for more than 3 days in culture. We usually obtain a piece of tissue, about 6in x 9in, and separate the fat from the dermis using sharp surgical scissors and occasionally the assistance of a scalpel. Then, 4-mm contact burn wounds are created on the epidermis of the de-fatted sheet of tissue, spaced at least 12mm apart. Once this is finished, a full-thickness 12-mm biopsy punch is taken, locating the burn wound as the center of the biopsy. At this point, tissue biopsies are usually between 4-5mm thick. When cultured in this form, the samples have little-to-no success culturing for 7 days. We have tried using a scalpel to remove the bottom ~2 mm of the biopsy, but the round shape, difficulty securing the biopsy, and lack of standardization makes this difficult. We also usually have experiments with up to 40 samples that would need to be cut. Cutting away the bottom half of the biopsy, leaving about 2mm from the biopsy epidermis to the bottom, has shown much higher success when cultured for 7 days. We are looking for a reliable, consistent, and quick way of cutting the excess fat off the bottom of our tissue biopsies

Materials and Supplies Available

3D printer with filament, high profile blades (3 inches wide), self-healing cutting mats, styrofoam blocks/boxes, cardboard sheets and boxes, most common laboratory consumables.

Relevant Journal Articles and Websites

Related Literature:
Gou, S. et al. (2023) 'Development of an ex vivo porcine skin model for the preclinical evaluation of subcutaneously injected biomacromolecules', International Journal of Pharmaceutics, 648, p. 123562. doi:10.1016/j.ijpharm.2023.123562.
Gou et al. (2023) explained the development of an ex vivo porcine skin model that retains viability in extended periods of tissue culture. The paper initially discussed existing explant models of approximately 1mm thickness, containing only the epidermis and dermis, lacking the hypodermis which is responsible for subcutaneous investigation. Looking to solidify a "full thickness" tissue model with extended viability was the goal of this investigation.
Dame, M. K., Spahlinger, D. M., DaSilva, M., Perone, P., Dunstan, R., & Varani, J. (2008). Establishment and characteristics of Gottingen minipig skin in organ culture and monolayer cell culture: relevance to drug safety testing. In vitro cellular & developmental biology. Animal, 44(7), 245–252. https://doi.org/10.1007/s11626-008-9091-3
Dame et al. (2008) describes an optimized culture process for ex vivo minipig tissue culture with potential to be used as a surrogate for human skin in similar studies. The authors describe many similarities found in the physiological and pathophysiological responses of pigs and humans, allowing translatability between the two models.
Ching-Yan C. Yeung, PhD1 ; David F. Holmes, PhD 2; Helen A. Thomason, PhD 1;Christian Stephenson, BSc Hons 3; Brian Derby, PhD 4; Matthew J. Hardman, PhD, (2016). An ex vivo porcine skin model to evaluate pressure-reducing devices of different mechanical properties used for pressure ulcer prevention. Wound repair and regeneration, DOI:10.1111/wrr.12481.

Chen, P.; Sebastian, E.A.; Karna, S.L.R.; Leung, K.P. Development of a Stringent Ex Vivo-Burned Porcine Skin Wound Model to Screen Topical Antimicrobial Agents. Antibiotics 2024, 13, 1159.

Qingping Yang, MS; Priscilla L. Phillips, PhD; Edith M. Sampson, MS; Ann Progulske-Fox, PhD; Shouguang Jin, PhD; Patrick Antonelli, MD; Gregory S. Schultz, PhD, (2013). Development of a novel ex vivo porcine skin explant model for the assessment of mature bacterial biofilms. Wound repair and regeneration, DOI:10.1111/wrr.12074

About the client:

Dr. Angela Gibson
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UW School of Medicine and Public Health
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(608) 265-9574

Alternate Contact

Ms. Bailey Donahue
Surgery
UW School of Medicine and Public Health
badonahue@wisc.edu

2026/02/02 - Check in meeting

SARAH RAUBENSTINE - Feb 03, 2026, 4:31 AM GMT+9

Title: Check in meeting with client

Date: 2/2/26

Content by: Sarah Raubenstine and Ella Lang

Present: BME Badgers

Goals: Initial check in with client to set up goals for this semester

Content:

- right before the end of semester used the device
    - took a long time to get histology back
    - got it today
    - looks like it went well
    - scientist did it, not bailey
    - with the two biopsy punch, she found it difficult to distribute the pressure, variable cutting
    - one biopsy was a better option with this way of securing
    - variance with height
    - much more even with one, not too time consuming with one
    - easy to clean
    - came apart well
    - stabilized well with the rubber mat
- Presentation Thursday!
- Histology cultures, pretty consistent cut wise
    - will touch base to see if any variances were because of certain things
- Rubber mat was nice, the pressure to hold it in place while doing something secured it well enough, don't need it to be more adherent necessarily
- Found that it cut better with the 11 blades - straight edge blade
    - originally had said 10s, but the curve of blade made the slicing more difficult
- Upcoming collections for tissue this month, she can come back with exact dates, will be able to mess around with it more and give more feedback
    - Feb 19th and Feb 26th
    - usually around 11:30 ish when the samples are ready to test with
    - we might be interested in doing something with the actual pig skin if we want to feel it
    - They will have it that day and can hold onto it for an additional day
    - Try to email this week but she seems totally fine with shorter notice
- Can measure the histology
    - can give us photos
    - birds eye view of multiple days in culture
    - LDH stains
- Will touch base with Dr. Gibson about what we are able to use in our journal article and what she can give us
- Ideas for keeping pressure even
    - screws
    - newton reader from their last device
    - fears with a latch - breaking off
    - Sarah - what about like a leveling rod? like the little bubble thing
- Not only is the pressure different on each biopsy, it sometimes moves within the well, uneven cut towards the last end of cutting
- Last things for this design to make it better
    - they have another design that we may want to hear about and add onto, they'd like our input on it
        - we would be interested in hearing about what to do
            - with human skin biopsies, smaller 4 - 6 mm biopsy

            - cut away the fat like with the pig skin
            - Make partial thickness wounds, make an incision on the skin at a mm marker level within the biopsy column
            - creates a curved indent in the skin
            - method of creating a more consistent partial thickness wound
            - the issue here is the blade, they use the blade right now to mark it, wondering if there is a good way to address it
            - we will think about it and get back!
    - She will send us LDH images in a powerpoint she put together
        - images are a little less clear than last time
- Two wells vs. one well
    - just make it one! will be easier
    - the size is fine, we can change if we want, whatever works for the design
- Blade handle
    - should we keep it?
        - she will test putting the blade in and make sure it fits well, will get back to us to see if we move forward
- Single use vs longevity
    - long term use would be good, would definitely repeat usage
    - max use is once a month in a year, not a ton of wear and tear
    - nylon would be nice, would be a little more expensive, max $48 a unit, don't worry about the pricing
        - so low she doesn't even have to ask Dr. Gibson
- Vertical cutting
    - she ended up not using it
    - burn is not garunteed to be in the center, they're pretty easy to chop
    - the way they use the device, doesn't stand out as need to use
    - not essential
    - Do we want to keep it?
        - yes for right now, it has it's application and use
        - she will talk with scientist too and get more input
        - nice to have and works but so quick to do it the other way...
- Are the slits good?
    - will ask scientist about it
- ADD SOME OF THESE QUESTIONS TO A FOLLOW UP EMAIL!
- Weekly lab meeting this semester Wednesday 10:30 to 12, can zoom us in or come in whenever, Dr. Gibson guaranteed to be there
    - really anytime in this window, just let her know :)

Conclusions/action items: Follow up email, plan when to come in with the pig skin, she will answer some more questions, work on goals presentation!

2026/02/20 - Initial Lab Testing

Simon Nam - May 03, 2026, 1:07 AM GMT+9

Title: Lab Testing

Date: 2026/2/20

Content by: Gianna

Present: Simon, Sarah, Ruhi, Gianna

Goals: Test the device in Dr. Gibson's lab and take measurements of the samples

Content:

Notes

- while cutting, the beginning side of the cut was larger in thickness than the end
- liked the transparentness of the top layers

Old Design Cuts:

- 2.1 mm

New Design Cuts:

- 4.5 mm
- 4.6 and 2.3 mm (slanted)
- 3.3 and 1 mm
- 3.7 mm
- 4.5 mm

See attached file below

Conclusions/action items: The PLA layers weren't laying properly, thus, there was extra space which resulted in a longer than optimal sample cut. We will combine the bottom two layers to help reduce this space, bolts will also be considered to secure them.

Simon Nam - May 03, 2026, 1:07 AM GMT+9

Download

2_20_26_Sample_Testing.xlsx (6.67 kB)

2026/03/06 - Survey Testing

Simon Nam - May 03, 2026, 1:13 AM GMT+9

Title: Lab Testing #2

Date: 2026/03/06

Content by: Simon Nam

Present: Whole team

Goals: Test the updated device in Dr. Gibson's lab and take measurements of the samples

Content:

We were able to obtain more consistency in sample thickness

More users/researchers of the client's lab participated in usability testing

Microtome blade was also tested for additional input

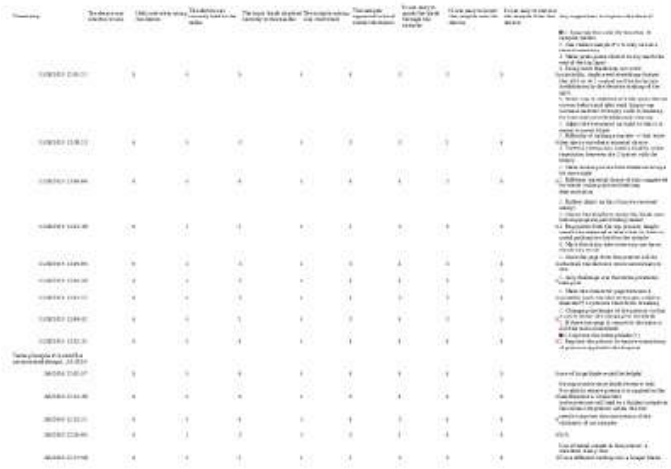
Slight variations occured between the old, experienced users vs. the new users who have never previously interacted with the device

See attached files below

Conclusion/Action Items:

Continue updating the design based on received feedback. Need to especially focus on sample well depth at the bottom below blade trajectory for better stability of the samples inside the well.

Simon Nam - Mar 07, 2026, 1:30 PM GMT+9



Download

Survey_Testing_Protocols_Responses_.xlsx (11.6 kB)

Simon Nam - May 03, 2026, 1:08 AM GMT+9

Download

3.6.26_Measurements_of_Sample_thickness.xlsx (10.8 kB)

2026/03/12 Lab Testing with PLA Base

Simon Nam - May 03, 2026, 1:32 AM GMT+9

Title: Lab Testing (with PLA incorporated design, depth of bottom base adjusted)

Date: 3/12/2026

Content by: Ella Lang and Simon

Present: All group members

Goals:

- Collect user surveys from participants

- Go over any feedback participants have on ideas to improve the device

- Check in with the client- Bailey

Content:

- Tested tissue slicing with multiple participants: collected thickness consistency and accuracy as well as survey results

- Client likes the design, but the biopsy thickness varies among users

- Good feedback on cleanability, client is using a rinse and soak method to clean the device after use

- Contributions to thickness variation: Large blade insertion line, sample pressure applicator user variation, and pressing down on polycarbonate top pieces while cutting

- Participant idea: Adding a weighted pressure applicator piece that is not handled by the user; instead, it is just placed on top of the tissue sample within the well. The metal bullet is a comparison given by the participant. This would reduce user pressure application variation, ensuring consistent pressure; however, it would have to be a pretty heavy and compact piece of equipment

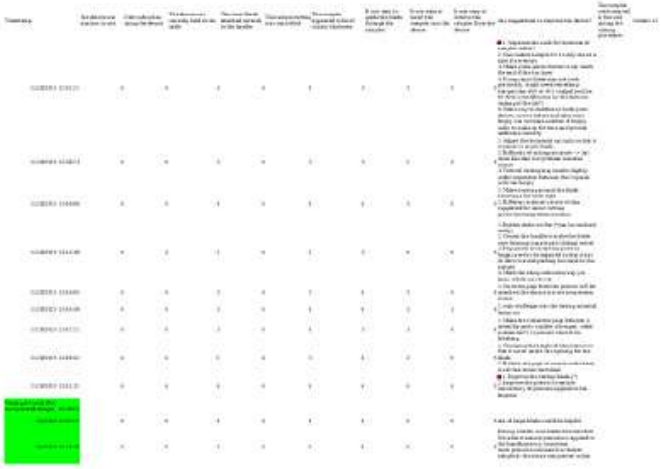
- The client expects more tissue to be available in early April after spring break

-See attached files below for results

Conclusions/action items:

-Plan future testing opportunities and continue to meet with the client. Update the design based on feedbacks received.

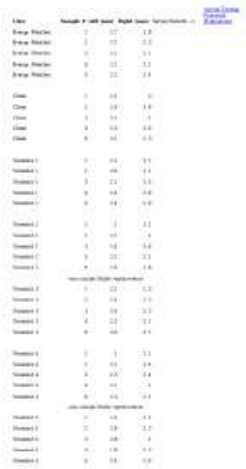
Simon Nam - May 03, 2026, 1:31 AM GMT+9



Download

Survey_Testing_Protocols_Responses_.xlsx (13.9 kB)

Simon Nam - May 03, 2026, 1:33 AM GMT+9



Download

3.12.26_Measurements_of_Sample_thickness.xlsx (7.71 kB)

2026/04/10 - Lab Testing with Nylon Base

RUHI NAGARKATTE - Apr 11, 2026, 6:45 AM GMT+9

Title: Lab Testing with Nylon Base

Date: 4/10/2026

Content by: Ruhi

Present: Ella, Gianna, Sarah

Goals: To perform usability testing with the clients with the nylon layer

Content:

- Bailey and another lab student completed testing with the device
- See testing results for thickness data
-

Conclusions/action items:

Analyze this testing data!

RUHI NAGARKATTE - Apr 16, 2026, 2:41 AM GMT+9

* there was more variability in the thicknesses this time. We are unsure if this was because of when the porcine skin was prepared.

Sample	mm	mm
1	2	1.3
2	1.6	2.2
3	2.2	1.4
4	1.1	1.9
5	1.8	1.4
1	1.5	1.2
2	1	1.9
3	1.6	1
4	2	1.7
5	2	1.1
1	1.7	0.9
2	2.2	3
3	2	2.5
4	2.1	1.2
5	0.7	0.9
1	1.4	2
2	2	2.1
3	2	2.3
4	2.9	2.5

5	2.2	3
1	2.3	2.1
2	2.1	2.2
3	3.1	2.4
4	2.5	0.9
5	2.2	1.7

2026/01/29 Team Meeting 1

RUHI NAGARKATTE - May 04, 2026, 12:28 PM GMT+9

Title: Team Meeting 1

Date: 1/29/26

Content by: Ruhi

Present: Whole team

Goals: To go over the agenda

Content:

Agenda:

- New semester!

- Progress from Fall

  - Changes need to be made to the design to deal with the surgical blades, NOT razor blade
  - Pivot to a new design: assembly, layered, machinable

- Schedule first meeting with client and adjust meeting time with Tracy

  - In the upcoming week
  - Move to thursday time - 3:30? Simon and Ella have 201 on Fridays
  - This opens up availability with the client on Fridays

- Begin researching, iterating once we get feedback from client

  - Research fabrication methods, materials, and appropriate testing
  - Fabrication: 3d printing, bandsawing, drilling, water jetting
  - Testing: refine usability survey, sanitization, and fea testing
    - Ask tracy what other testing we can complete

Conclusions/action items:

- All agenda items were discussed!

2026/02/05 Team Meeting 2

RUHI NAGARKATTE - May 04, 2026, 12:33 PM GMT+9

Title: Team Meeting 2

Date: 2/5/25

Content by: Ruhi

Present: Whole Team

Goals: Go over agenda items

Content:

- Delivered preliminary presentation to Tracy today - went well

- based on feedback from client, let's make adjustments: pivot to a new type of design that is machinable

- Begin thinking about preliminary presentation- let's divide it up!

- Follow similar format from last semester

- Tissue sampling dates - more data points for testing

- Coordinate with bailey to conduct more usability testing

- Perhaps schedule a follow up with client to see ldh staining/histology - this would be good for future presentations

Conclusions/action items:

- delivered preliminary presentation

- iterate on biopsy press design

2026/02/12 Team Meeting 3

RUHI NAGARKATTE - Feb 13, 2026, 6:08 AM GMT+9

Title: Team Meeting 3

Date: 2/12/26

Content by: Ruhi Nagarkatte

Present: Wole team

Goals: To follow agenda below

Content:

Agenda

- new design & machining plans

bottom layer: nylon, top 3 layers: polycarbonate

- new testing protocols

all testing protocols have been updated

- 2/20: tissue sampling date - confirm

Bailey will let us know a time closer to the date

- journal article - preliminary draft/report

let's start thinking about research and data to include, first draft (preliminary report) due in two weeks

- anything else?

- outreach - get checked by Tracy

Conclusions/action items:

Work on the first draft of the article, start moving into testing

2026/02/19 Team Meeting 4

ELLA LANG - May 04, 2026, 11:41 AM GMT+9

Title: Team Meeting 4

Date: 2/19/2026

Content by: Ella Lang

Present: All

Goals:

- Plan material ordering and client testing/meeting plans

Content:

Agenda:

1. Client Visit Plans - Tomorrow, bring a prototype

- Plan future lab visits and ensure materials like calipers and user survey are brought with

2. Materials - ordering, when to start machining

- Need to order polycarbonate sheets

3. Report outline - divide up!

- Begin soon and reach out to Tracy for suggested edits

4. Anything else?

Conclusions/action items:

- Continue to meet and get guidance from our client and advisor

2026/02/26 Team Meeting 5

RUHI NAGARKATTE - May 04, 2026, 12:19 PM GMT+9

Title: Team Meeting 5

Date: 2/26/26

Content by: Ruhi

Present: Whole team

Goals: To go over agenda

Content:

1. Machining Plans

- As of right now, plan is to bandsaw or maybe waterjet the PC
- fabrication protocol is made

2. Final Design Plans

- Move into final layered assembly, move away from hinged design

3. Next client meeting/ tissue sampling dates?

- Bailey will let us know upcoming dates, hopefully in the next week

4. Anything else

- keep fabricating and iterating

Conclusions/action items:

The team is in the middle of fabricating the new type of design with the polycarbonate. There is not much else to do (other than research) until the fabrication is complete.

2026/03/04 - Team Meeting 6

RUHI NAGARKATTE - May 04, 2026, 12:35 PM GMT+9

Title: Team Meeting 6

Date: 3/4/26

Content by: Ruhi

Present: Whole team

Goals: Go over agenda

Content:

Agenda:

1) Any updates from client?

- Not really, there might be upcoming tissue sample dates

2) Machining with the waterjet went well! Very precise and clean cuts

- Straightforward process in the makerspace
- Prep included downloading the cad files and converting them to a dmf dile

3) Assembly of the whole device looks good - no changes/iterations need to be made

- The fit is fine
- Tolerances made well, everything is snug and fits

4) Let's plan a time with a client to test the device with tissue

- New iteration = new usability feedback to get
- Let's see how this performs compared to other designs

5) Revise the prelim report - based on feedback from tracy

- we need to focus on finalizing our design and getting our results in the report

Conclusions/action items:

Everything on the agenda was discussed.

2026/03/19 - Team Meeting 7

ELLA LANG - Apr 15, 2026, 2:40 AM GMT+9

Title: Team Meeting 7

Date: 3/19/2026

Content by: Ruhi and Ella

Present: Whole Team

Goals: Go over agenda

Content:

Agenda:

1) Nearing the end! Base has been printed in nylon - hopefully that's done by next week, continue to check in with MakerSpace staff

2) Let's continue testing with polycarbonate: sterilizability with the Glo Germ testing

- Plan on using ImageJ to analyze the buildup

- Use MATLAB to analyze buildup results, likely t-tests

3) Move into other areas of testing: FEA analysis and analyze usability data from clients

- Start brainstorming how to present thickness consistency data

- Potentially have 4 testing results sections on poster, instead of the original 3

4) Start thinking about executive summary - design excellence

- Plan sections

- Reach out to Tracy about providing feedback/ideas

Conclusions/action items:

All agenda items were met. Continue to meet multiple times each week and communicate over text.

2026/03/26 - Team Meeting 8

ELLA LANG - Apr 15, 2026, 2:45 AM GMT+9

Title: Team Meeting 8

Date: 3/26/26

Content by: Ruhi and Ella

Present: Whole Team

Goals: Address all areas of the agenda below

Content:

1. New nylon print - received
    1. Fit with polycarbonate- adjust the tolerances?
    2. Some polycarbonate pieces fit snugly, while others are looser
2. Sterilizability testing
    1. ImageJ and MATLAB to analyze data, t testing and % buildup reduction
    2. Discuss with Dr. P ways to analyze the nylon base buildup, as the boundaries are unclear
    3. Plan to do autoclaving tests in coming weeks
3. Testing April 10th - Final day to conduct usability testing with the client with porcine samples
    1. Ensure we collect data from multiple participants using the newly printed nylon base
4. Executive summary
    1. Design excellence
    2. Split up outline
    3. Tech, split up outline
5. Begin planning out poster sections
    1. Revamp final design, results and testing sections
    2. Keep similar format, ensure we are keeping the poster colorful and using enough images!
6. Happy spring break!

Conclusions/action items:

- Catch up on work over break and continue communication

2026/04/09 - Team Meeting 9

ELLA LANG - Apr 15, 2026, 2:51 AM GMT+9

Title: Team Meeting 9

Date: 4/9/26

Content by: Ruhi and Ella

Present: Whole Team

Goals: Go over the action items below and make important group decisions

Content:

- Testing - what more to do?
  - finish ImageJ analysis
    - Confirm with Tracy MATLAB analysis plans
    - Share photos of GloGerm testing with Tracy
  - Autoclave the nylon and pc parts
    - Sarah and ruhi have finished training now
    - Plan to complete this by the end of next week
  - finalize fea results
- More testing with the client - Friday 4/10
  - Final usability testing
  - Communicate with client on any final suggestions or design wishes
- Device dropped off with client today, 4/9
  - Client plans to do some testing of her own, ensure we collect the device at the beginning of next week to finish testing on our end
- Poster session 2 weeks away!
  - Remind client of presentation date in next email
  - Continue working on the poster
    - Collect high-quality images of our final design to include (Sarah can bring her camera?)
- Anything else?
  - Remind Tracy about giving us feedback on the executive summary draft
  - Prepare for outreach!

Conclusions/action items:

The agenda was followed. Continue wrapping up final project to-dos

2026/04/16 - Team Meeting 10

RUHI NAGARKATTE - May 04, 2026, 12:37 PM GMT+9

Title: Team Meeting 10

Date: 4/16/26

Content by: Ruhi

Present: Whole Team

Goals: Follow agenda below

Content:

- Lots of things coming up
    - Final poster draft - share with tracy
    - Executive summary - due tomorrow!
        - We need to update based on feedback
    - Outreach - presentation
        - Focus on anatomical positions, gait cycle, biomechanics background
- Extension for final report and notebook - May 3rd (Sunday after due date)
    - Busy week for most of us, extension would be a good idea
    - Revise final report based on feedback - everyone can work on their assigned sections
    - Keep updating the notebook
- Client likes both nylon and PLA, but may prefer PLA?
    - PLA had less variability in thickness consistency
    - PLA would just have to be reproduced more frequently
        - We could potentially print a bunch and hand them off? Not as sustainable as using nylon
- In the home-stretch; think about coordinating a drop off with the client

Conclusions/action items:

The agenda was followed.

We need to prepare for our final poster presentation next week!

2026/04/23 - Team Meeting 11

RUHI NAGARKATTE - May 04, 2026, 12:20 PM GMT+9

Title: Team Meeting 11

Date: 4/23/26

Content by: Simon

Present: Ruhi, Sarah, Gianna, Simon

Goals: Follow agenda below

Content:

- Final team meeting before poster presentation
  - Rehearse the sections of the poster together
  - Order and print out the finalized poster
  - Print other labels for props
  - Discuss & decide the coverage for Design Excellence and TECH award judges
  - Prepare setup for tomorrow (poster day)
- Next steps:
  - Ensure that BME project webpage is update to date
  - Discuss with Tracy about final team meeting time during finals week
  - Reach out to Clients and Grace about poster day times & location
  - Begin final revising on journal/final report deliverable
  - Peer evaluation (feedback fruits)
  - Client evaluation
  - 402 Course evaluation
  - Clean up the 402 project - can't be in the green room!

Conclusions/action items:

The agenda was followed.

We need to give our final poster presentation tomorrow!

2025/01/23 - Spring Intro

Gianna Inga - Feb 03, 2026, 5:53 AM GMT+9

Title: Spring Intro

Date: 1/23/25

Content by: Gianna

Present: Gianna, Sarah, Ruhi

Goals: Reconnect with advisor and understand goals for the next semester.

Content:

- Advisor meetings: Thursdays 3:30
- Preliminary presentation
  - specific goals of every month
  - only with Tracy
  - include more testing plans
- Journal article
  - think about what kind of article you want to write (proof of theory, design, research) and then look at websites to post
  - final report will go into the appendix
- Outreach
  - needs to be done by the end of the semester
- Advisor meeting
  - will reach out to client about meetings throughout the semester
  - the newest model was printed and handed off to the client before break to incorporate into their lab
  - will receive feedback on how it worked at the first meeting

Conclusions/action items: We will start preparing for the preliminary presentation and deciding monthly goals for the semester after we initially meet with the client. We are prepared to do our outreach project as a team. We will look more into journal articles and websites to potentially submit to.

2025/01/29 - Meeting 1

SARAH RAUBENSTINE - Jan 30, 2026, 6:55 AM GMT+9

Title: Advisor Meeting 1

Date: 1/29/26

Content by: Sarah Raubenstine

Present: BME Badgers

Goals: Go over initial goals for the project

Content:

- The client has the most updated version, on the meeting on Monday they will tell us how it's been going
- Chatting about grad school
- Tuesdays and wednesday are best for meeting about stuff like outreach, working on getting materials
    - between 2:30 and 3:30?
- Journal article
    - look for a specific journal to submit it to...
    - we pick a journal to submit a manuscript to and hope it gets published
    - since we are sticking around, why not just follow through and publish something
    - looking at chat for an appropriate journal
    - **Journal of Medical Devices** - good place to start
        - click on submit, information for authors
        - look into the journal guidelines and submission instructions
        - accepted manuscripts to know what they are looking for
        - select your paper type, submission type (what kind of paper, not really a research paper, depends on how robust your data is)
        - Probably wait and see what the client gives, maybe will have enough data for research who knows?
        - Design innovation pretty typical for students
    - Maybe take a look at a couple of others that may be applicable, **Biomedical Engineering Advances**
    - Look at impact factor, anywhere between 3 and 6 to get published
    - **JMIR Biomedical Engineering**
    - Good place to start looking into journals to submit our article to, may others out there that we can look into as well
    - Use chat to narrow it down too...
    - Also look at the cost, do they have waivers for students, can contact an editor for more information
        - Department might provide support for funding
        - Tracy will be an author, if it ends up costing something it will be on her, but we need to check if there is a student discount
- MIGHT BE BETTER TO SUBMIT PROGRESS REPORT ON WEDNESDAY NIGHTS
    - just so she is ready for questions at Thursday meetings
    - Just skip it for this week, but we have one so maybe not and just email anyways...
- Look into thinking about the data we may receive, and how we might analyze it, good area to focus on for research
- Presentation next week, we should be fine to put stuff together

Conclusions/action items: Work on presentation and meet with client on Monday!!

RUHI NAGARKATTE - Jan 30, 2026, 7:04 AM GMT+9

https://asmedigitalcollection.asme.org/medicaldevices

https://www.sciencedirect.com/journal/biomedical-engineering-advances

https://biomedeng.jmir.org/

2025/02/5 - Meeting 2 - Prelim Presentation

SARAH RAUBENSTINE - Feb 06, 2026, 7:02 AM GMT+9

Title: Advisor Meeting 2 - Prelim Presentation

Date: 2/05/26

Content by: Sarah Raubenstine

Present: BME Badgers

Goals: Present and get feedback on preliminary presentation

Content:

- Presented preliminary presentation describing last semester's accomplishments and our goals for this upcoming semester
- Timeline notes
    - Testing for this semester
        - Actual testing with porcine skin tissue models
        - This time around, multiple dates that we can go in an do the porcine testing ourselves
        - LDH staining results, images from the client themselves
            - potentially more available from the client
        - FEA analysis with our new materials
        - Sterilizability with the new materials
        - Moving to an 11 scalpel blade, new testing with the actual blade that we will now transition to
    - Client wants space for one sample only
        - uneven pressure
        - ended up being preferable to only do one sample at a time
        - more about precision than timing in this scope
        - Brainstorming mechanisms to improve the two design with a new pressure application tool
    - Variation in pressure
        - no way to standardize with the current model
        - visualizing is one of the most critical aspects
            - this is good for resins
            - look at resin samples, different degrees of transparency
    - For next week
        - updated testing protocol
        - printing again next week
            - go down to one sample and try the resin
                - maybe print sample parts first
            - Have to have it ready by the end of the month to go see them in the lab - by the 20th for next prototype
    - Slides uploaded to canvas and website
    - on track to have a really great product
        - lots of iterations
        - lots of changes in client opinions
    - Keep med tech in the loop
    - Tentatively plan on an in person meeting next week
    - Measles...
- Finding a journal, pick on by next week

Conclusions/action items: Prototype to build, testing protocols to refine, and a journal to choose -- AGENDA FOR THIS WEEK.

SARAH RAUBENSTINE - Feb 06, 2026, 6:39 AM GMT+9

https://asmedigitalcollection.asme.org/medicaldevices

https://www.sciencedirect.com/journal/biomedical-engineering-advances

https://biomedeng.jmir.org/

2025/02/12 - Meeting 3

SARAH RAUBENSTINE - Feb 13, 2026, 6:30 AM GMT+9

Title: Advisor Meeting 3

Date: 2/12/26

Content by: Sarah Raubenstine

Present: BME Badgers

Goals: Show off our newest print and ask about the journal article

Content:

- Machining!
  - polycarbonate scratches easily
  - try out an etching solution
- Updated testing protocols
  - sterilizability testing, new sutoclave section
    - visually inspect for warping and damage to the device
  - Melting point of polycarbonate - 288 degrees, compatible with autoclaving
- Final journal - Journal of medical devices
- Preliminary report
  - First draft of the article
  - need appendices with last years report and any edits she suggested
  - Same format as the submission requirements
  - typically double spaces, etc, etc.
- Data in preliminary
  - should we pull the testing results from the first draft
  - really solid introduction, similar in length and style to the journal
    - line or two summarizing preliminary results
    - whittle the prelim results down to one or two sentences
    - indicate what needed to be changed
  - Journal article should reflect our absolute final design and results
  - This could still be preliminary testing
  - Solid materials and methods
  - Manufacturer parenthetically and location of manufacturer (look at author requirements)
    - figure out where all the materials came from
    - ask the maker space
    - first make sure they require that!!!
  - Update PDS and include in the appendix
- Way to apply even pressure with the applicator
  - thread the hole and the applicator
  - good idea, but more difficult to clean
  - in a "kit" include a brush for cleaning
  - ASK BAILEY - would it be okay to apply that twisting mechanism to the skin? we don't want to ruin viability
  - only one way to find out, gotta try it
- Testing next Friday in the lab
- BE SAFE with the blades!!!
  - Simon... be safe...
  - use a hemostat! (for blade removal, check the green room)
  - go online and get the keycard access to the autoclave room, 2048 - follow the online steps
- Outreach!!

Conclusions/action items: Start drafting the journal article, get a list of questions for next week! Prep materials for testing next Friday.

SARAH RAUBENSTINE - Feb 13, 2026, 6:04 AM GMT+9

https://asmedigitalcollection.asme.org/medicaldevices

https://www.sciencedirect.com/journal/biomedical-engineering-advances

https://biomedeng.jmir.org/

2026/02/19 - Meeting 4

SARAH RAUBENSTINE - Feb 20, 2026, 6:59 AM GMT+9

Title: Advisor Meeting 4

Date: 2/19/25

Content by: Sarah Raubenstine

Present: BME Badgers

Goals: Talk about the journal article drafting and preliminary testing

Content:

- Look at representative journal articles, similar to our project, for inspo
    - take note of the organization
        - we have an outline based on an example found online
    - Example in the drive
        - Methodology section
        - Design innovation paper
    - Cost of paper submission
        - Tracy will be the one to actually submit if we do this
        - FAQs they have a way to contact the editor and associate editor if we have want to waive the fee for student submission
    - Not enough data to do a research paper, need to do a innovation in design paper
    - Go to library system and search for design innovation, look at the different categories of paper
        - see if there is consistency or a lot of variation between papers
        - can reach out to her if we have a question before we put it all together
- Focus on having good intro and testing protocols
- Materials and methods - some fabrication details and materials should be included
    - still not sure what that section is going to be called
- Results and discussion, don't expect to see anything there
    - subtitles should match the testing protocol section
    - depends on how we're going to present it
- Figures, don't separate them out yet, wait until we're ready to submit to isolate the figures
    - also want as high resolution as possible for images
- Go check in with the library for examples of the ASME design innovation papers
- A little worried about the innovation part of it... as long as they're not super strict on the definition of the word, they may argue for patent purposes
- Patent application - pursue this after journal article, doesn't hurt, could have a shot
    - You have a year from your first disclosure
    - Should be fine
- Reach out with any questions before Wednesday!

Conclusions/action items: Work on the paper!!

2026/02/26 - Meeting 5

SARAH RAUBENSTINE - Mar 21, 2026, 10:09 AM GMT+9

Title: Advisor Meeting 5

Date: 2/26/25

Content by: Sarah Raubenstine

Present: BME Badgers

Goals: Lots of updates for this week!

Content:

- New design! - Tested it last Friday!
  - went well
  - biomed clear resin ended up a little cloudy
  - moving towards the polycarbonate and will be water jetting on tomorrow
- Wrote out journal article draft
  - will go over it next week
- Bottom layers into one piece to make slices 2 mm
  - preliminary testing went well last Friday!
- BME Outreach
  - Schools bailed on outreach...
  - Tracy has new opportunities about to email out in Sun Prairie -- look out for this email in fifteen!

Conclusions/action items: Look into outreach soon!

2025/03/5 - Meeting 6

SARAH RAUBENSTINE - Mar 06, 2026, 6:57 AM GMT+9

Title: Advisor Meeting 7

Date: 3/5/26

Content by: Sarah Raubenstine

Present: BME Badgers

Goals: Discuss the journal article and testing this week

Content:

- Able to waterjet the new sheest
    - look at them, they look pretty!
- Combined the bottom two layers into one print
- We ahve another water jet appointment tomorrow
- Fit together nicely!
- Getting samples tomorrow, meeting them at 2:30 to do testing
    - they have four people we could test with tomrrow
- Going in again March 12th and we could bring three people but they might have more in the lab to do testing
- Testing protocol
    - three samples per person
    - also pay attention to how the blades go, scalpal blades wear out so easily after the sample cutting
- Check for hemostats in 1002, should have some for removing the blades
- Sent over the journal stuff
    - hard to say because limited requirements from the website
    - vague requirements
    - went off of example pdf
- Journal article chat...
    - by tomorrow we should have the comments available to us
    - Add her as an author
    - Ask clients tomorrow if they'd like to be an author
    - Didn't really look at the abstract
    - A few areas where its a little conversational
    - More technical language
    - Methodology/design requirements paragraph, seems weird, just hanging out there a little
    - minor typos or missing some words
    - validation from LDH staining, should mention the group that did that, common to reference the particular research group
    - a couple awkward sentences, she will help us edit those
    - stay away from conversational language, be careful how you refer to the client etc.
    - come up with a formal name for the device, should refer to it as the name, biopsy press is pretty generic, might want to get more creative with it
    - WARF is worth a shot, might be too obvious of a solution, might not be patentable
    - missing some words, as, and the's, just needs some editing
        - at some point send her a google doc and she can go through and rewrite
    - Figures are not as helpful as they should / could be
        - tidy up the figures and labeling, design iteration image specifically
            - need to have the test closer to it here
        - more labeling on figures
    - Citations added in certain areas
    - Not consistent with the companies used for various products throughout the paper, check if the journal requires that
        - either delete of be consistent for all materials
    - Descriptive subtitles

- cleanability ? -- maybe find a new word
- Testing section stick to facts of the testing methods, bulk of the testing section should be earlier when describing the design
- precise and technical wording in testing
- look for prior work and research on materials where they are evaluating a particular material's ability to be autoclaved or sanitized, find methods that we can shout out similar to this group, verify we are using well documented methods
- SHARE THIS WITH HER AND LET HER DO SOME EDITING BEFORE THE FINAL
  - more rounds of her editing before attempting to submit, she is hoping we are around virtually to do this after graduation
  - she is pushing us to go for it!
-

Conclusions/action items:

2025/03/19 - Meeting 7

SARAH RAUBENSTINE - Mar 21, 2026, 10:10 AM GMT+9

Title: Advisor Meeting 7

Date: 3/19/26

Content by: Sarah Raubenstine and Ella Lang

Present: BME Badgers

Goals: Discuss the journal article and testing this week

Content:

- Printing the nylon copy, just submitted today
- Testing last week
- Small adjustments to the depth of the well based on results from last time
- Lots of people taking data!
- Much more accurate the second time around
- Record of blade replacement
- Sterlilizability testing tomorrow with new black light
- Share the article for some easier feedback
- Show and tell
    - Probably done early
    - look at the spreadsheet and find three different teams
    - take some notes on it and put it in the notebook
- Thursday zoom meeting last wekk
- Executive summary
    - Tong or design excellence
    - we have so mich iteration
    - we have data and changes based on the data
- Image J measure area and quantify for the sterilizablity testing
    - wash with soap before whatever sterilization technique
    - wash with soap and water before autoclave
- Iterative image for journal
    - descriptive caption
    - maybe try to scale bar
    - just need overall dimensions - even on the little guys
    - include any feature that you made a change to in the caption

Conclusions/action items: Show and tell tomorrow!! Design excellence executive summary!!

2025/03/26 - Meeting 8

SARAH RAUBENSTINE - Mar 27, 2026, 5:48 AM GMT+9

Title: Advisor Meeting 8

Date: 3/26/26

Content by: Sarah Raubenstine

Present: BME Badgers

Goals: Discuss final testing plans, executive summaries, and outreach plans.

Content:

- Makerspace did end up printing the Nylon print!
  - Final design is ready!
- Did sterilization testing with the nylon print
  - will autoclave the design is next step
- Coming in for testing the Friday after spring break with the nylon design
- Executive summaries
  - divided up parts to start drafting over break
  - Design excellence
  - BWIG select on the website -- Done!
- Add to spreadsheet -- need extra space and an outlet
- Get there early to help set up and claim the spot
- Likes the motion capture activity
- Have a good break!

Conclusions/action items: Executive summaries coming up fast! Outreach is coming up fast! Happy spring break!!

2025/04/09 - Meeting 9

SARAH RAUBENSTINE - Apr 10, 2026, 6:04 AM GMT+9

Title: Advisor Meeting 8

Date: 4/09/26

Content by: Ella Lang and Sarah Raubenstine

Present: BME Badgers

Goals: Back from break! Check in about everything, executive summary review

Content:

- Data analysis for sterilization using image J
  - A little tricky to be objective about assessing the coated areas
  - Nylon is difficult due to the porous surface, glo germ is trapped on the surface
  - There are sealants that we could spray on to make a smoother surface!!
    - could we still autoclave with a sealant, maybe? will look into it.. !!!!!!!!
  - circling the areas that appear to be built up
  - Using the hole diameter to scale each picture
  - Share the photos on a google drive so Tracy can check in
  - Better data on the wells than the pegs
- Will provide feedback on Monday to executive summary, final is due on Friday
- More sample testing tomorrow at WIMR
- Poster draft -- show during the meeting Thursday before EXPO
- Don't worry about turning in outreach late, just get it out of the way before poster presentations!
- Don't have files in the notebook, copy and paste protocols directly into the entry, client cannot see the files
- Comprehensive spreadsheet about what we have spent in the notebook
  - Me Sarah will work on this
- Updated notebook grade will be in the week 6 slot

Conclusions/action items: Update notebook areas, good luck on testing Friday, keep up with ImageJ analysis, look into sealant for nylon.

2025/04/16 - Meeting 10

SARAH RAUBENSTINE - Apr 17, 2026, 6:05 AM GMT+9

Title: Advisor Meeting 9

Date: 4/16/26

Content by: Sarah Raubenstine

Present: BME Badgers

Goals: Discuss outreach, executive summary, poster

Content:

- Dodged the tornado!
- Feedback from Bailey - she was fine with the Nylon!
- Executive summary draft feedback
- TECH award - can opt out? she will leave it up to us, don't have to write another thing for the tech
- Autoclave testing
    - shrinking and expanding?
    - Most likely the nylon expanding rather than the plastic shrinking
    - should repeat the test a couple more times
    - maybe a touch more research on the material
    - focus on other data
- Usability testing
    - show earliest and latest one
    - side by side comparison
    - make it clear what was changed and whats different
- Thickness accuracy
    - box plot over time, over iteration of design, design 1, design 2
    - show the different iterations
- Sanitization
    - take away the photos
    - make a plot for the buildup numbers from image J
    - maybe make a supplemental paper copy of the photos for further explanation, have some up on the laptop ready to look at
- Can send over the poster on Monday
- Extension -- Sunday afterwards
- Outreach - presentation up on laptops
    - Eval form - try to flag down a chaperone -- maybe print two copies
    - Photo release -- all good!!

Conclusions/action items: Expo tomorrow, send in poster Monday, turn in executive summary.

2026/02/10 - Updated Biopsy Press & Pressure Applicator

RUHI NAGARKATTE - Feb 11, 2026, 11:49 PM GMT+9

Title: Updated Biopsy Press & Pressure Applicator

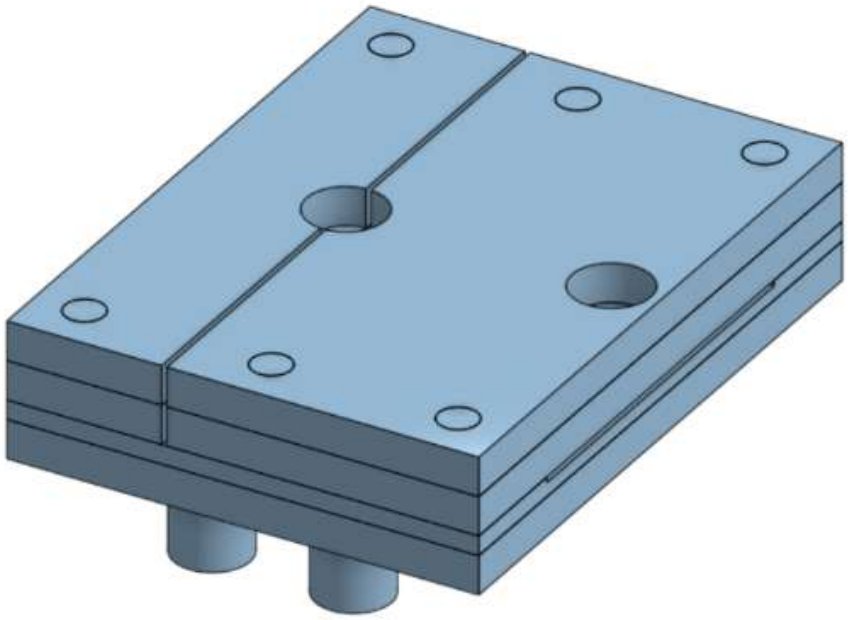
Date: 2/10/26

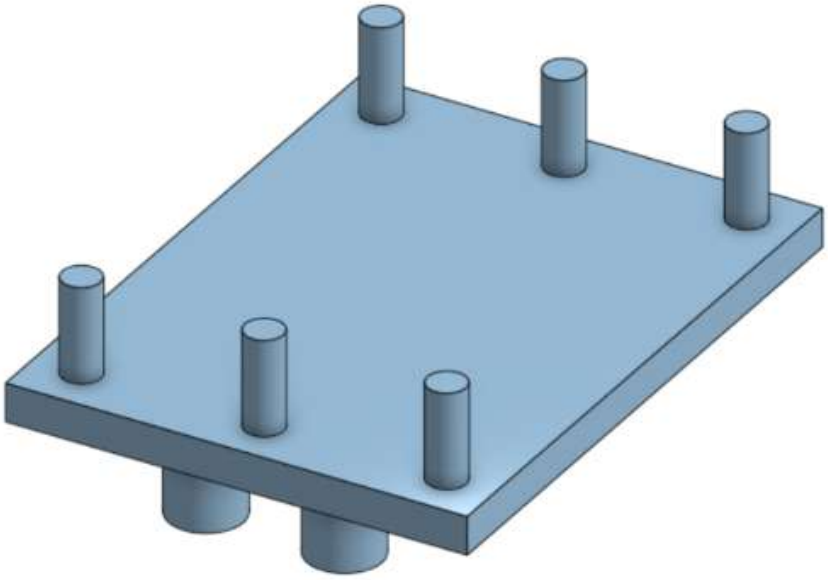
Content by: Ruhi Nagarkatte

Present: Biopsy Badgers

Goals: To update the design based on client feedback and manufacturability

Content:





Main changes/updates:

- The biopsy press is now machinable; the first three layers will be made of polycarbonate and the bottom layer will be made of nylon

- There are now 6 internal connectors to improve stability and connection

- The pressure applicator is more sleek and can maneuver around more easily

Conclusions/action items:

This new design accounts for the client feedback and overall manufacturability. Next steps include printing this design out in PC and nylon and machining it. Additionally, the team wants to have the client test it out to understand how the new design works for them.

2026/2/18 - PLA & Bioresin print

Gianna Inga - Apr 10, 2026, 6:03 AM GMT+9

Title: PLA & Bioresin Print

Date: 2026/02/18

Content by: Gianna

Present: Gianna

Goals: Document the print and the dimensions of this design iteration for 2/20 sample testing.

Content:

Dimensions -

- Cut track thickness: 1 mm
- layer 2 thickness: 3 mm
- layer 3 & 4 thickness: 6 mm
- well depth: 2.5 mm

Figure 1: Bio-resin of layer 4

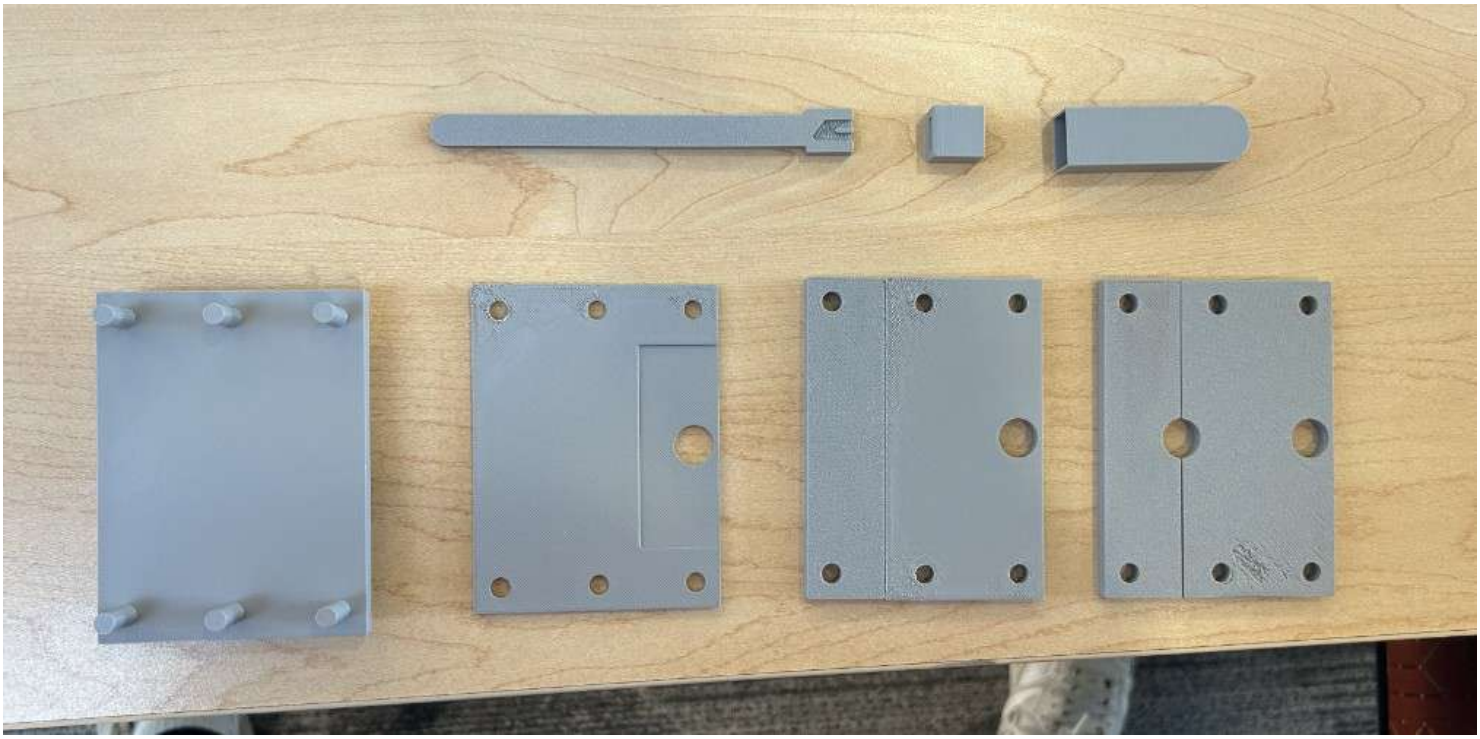


Figure 2: Right to left: Layer 1, layer 2, layer 3, layer 4

Figure 3: PLA layer warpping

Figure 4: New design

Conclusions/action items: The initial design iteration of BME 402 was printed in PLA, this is to show proof of concept of the design. This design will be used in porcine sample testing on 2/20 to see how it compares to last semesters iterations. Polycarbonate will be utilized in layers 3 & 4, sheets will be ordered and fabrication will begin.

2026/02/27 - Polycarbonate layers

Gianna Inga - Apr 10, 2026, 6:09 AM GMT+9

Title: Polycarbonate layers

Date: 2026/03/04

Content by: Gianna

Present: BME Team

Goals: Document the updates to the design after the 2/20 sample testing

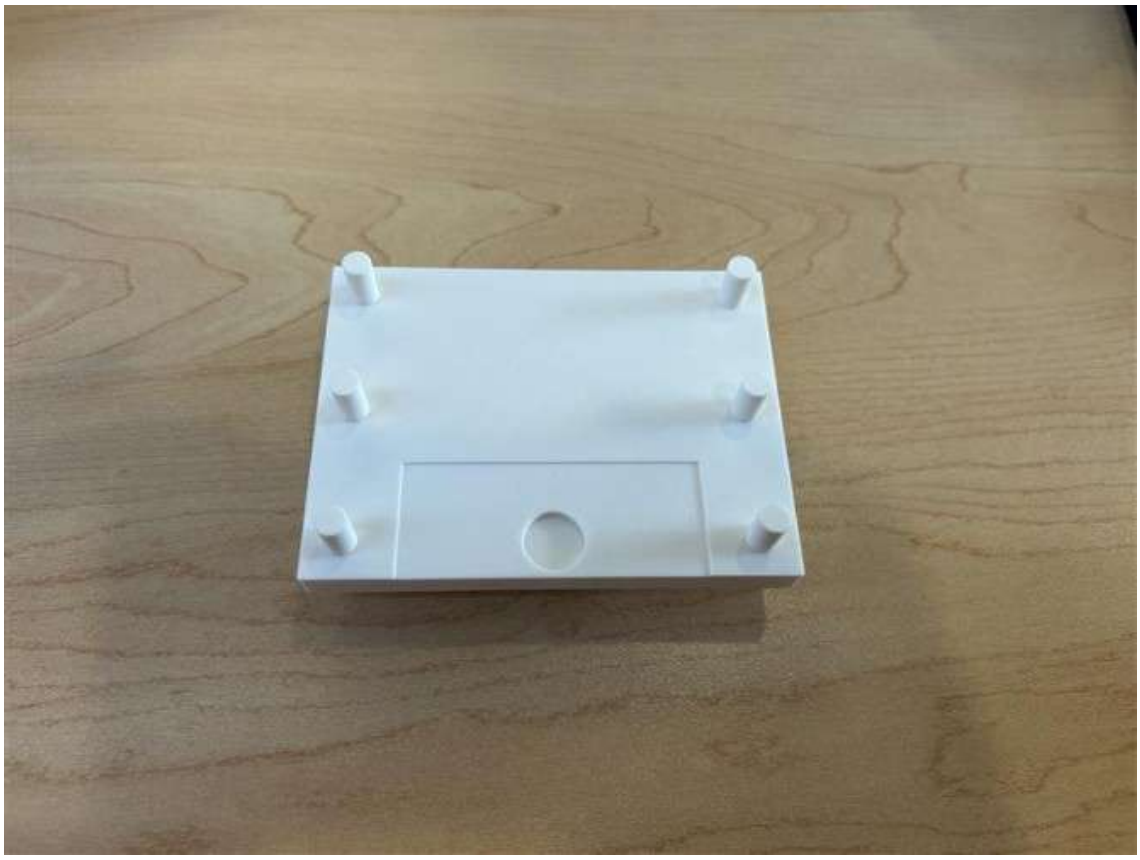
Content:

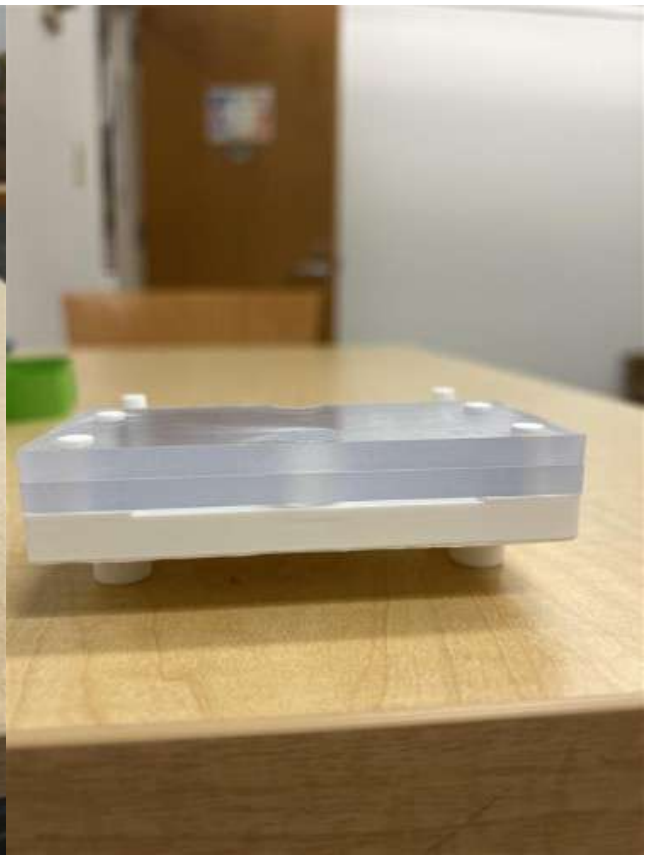
Dimensions -

- Cutting track thickness: .5 mm
- well depth 2.75 mm

Updates

- Layer 1 & 2 were combined to mitigate the spaces between the layers to get better cut accuracy from 2/20 testing
- cutting track thickness was also shrunk from 1 mm to .5 mm because of the high angle variance in 2/20 testing
- the polycarbonate layers 3 & 4 were waterjetted to get exact dimensioning





Conclusions/action items: The bottom layers were combined to be printed in nylon and PLA. The polycarbonate layers were cut by the water jet. The cut track thickness was decreased as the angle variance of the cut samples was large on 2/20 sample testing.

2026/03/10 - Layer 1 updates

Gianna Inga - Apr 10, 2026, 6:11 AM GMT+9

Title: Layer 1 design updates

Date: 2026/03/10

Content by: Gianna

Present: BME Team

Goals: Document design iteration 9 with dimensional changes to layer 1

Content:

Dimension -

- Cutting track thickness: .5 mm
- Well depth: 2 mm

Conclusions/action items: Well depth was decreased to 2 mm because sample testing on 3/6 still had a larger sample thickness than required. This design will be utilized on sample testing on 3/12. Hopefully results show that the sample thickness is closer to 2mm.

2026/03/25 - Nylon printing

Gianna Inga - Apr 10, 2026, 6:14 AM GMT+9

Title: Nylon printing

Date: 2026/03/25

Content by: Gianna

Present: BME Team

Goals: Document iteration 9 and the dimensional changes to layer 1

Content:

Dimensions -

- Cutting track thickness: .5 mm
- well depth: 1.8 mm

Conclusions/action items: The well depth was decreased based on the data collected on 3/13 to 1.8 mm. The cutting track thickness was good based on angle data and thus stayed the same. Layer 1 was printed in nylon 12, this new design will be utilized for hopefully final sample testing on 4/10.

2026/04/22 - Final Design Iteration images

Simon Nam - May 03, 2026, 2:11 AM GMT+9

Title: Nylon printing

Date: 2026/03/25

Content by: Sarah and Simon

Present: Sarah, Ruhi, Simon

Goals: Take good photos of final design iteration for final deliverables (poster & report/journal)

Content:

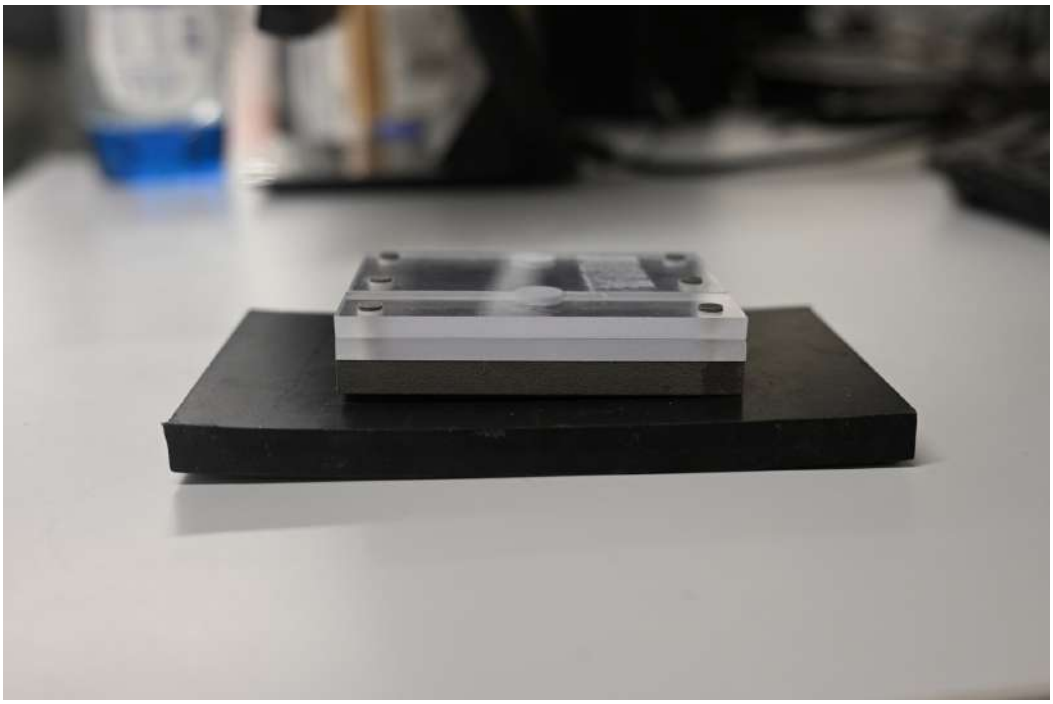


Fig 1: Sideview of the final iteration

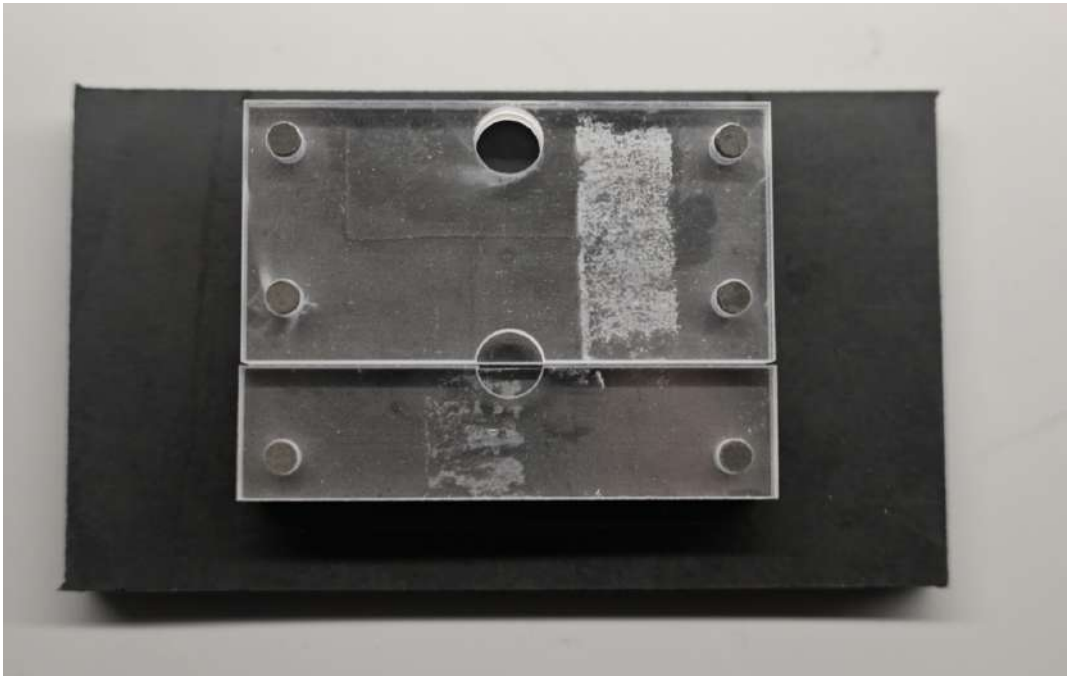


Fig 2: Topview of the final iteration

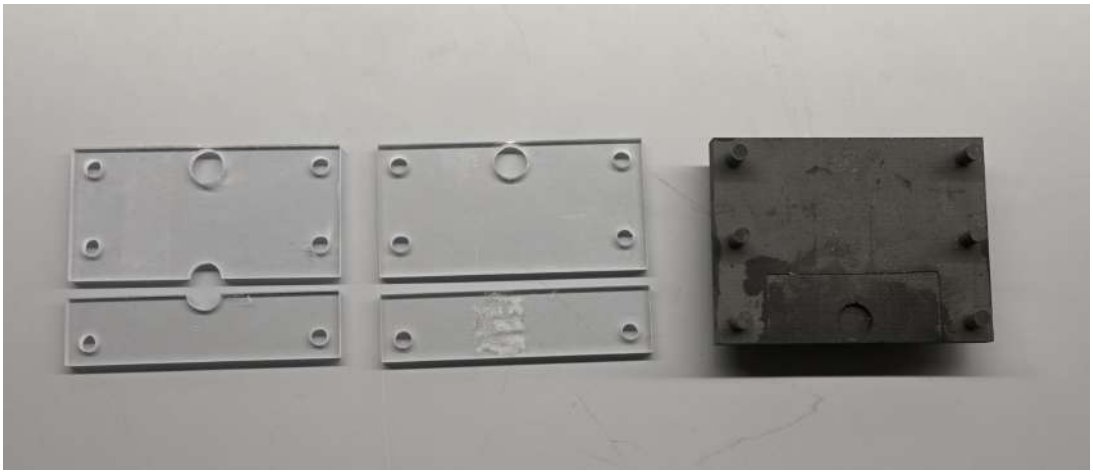


Fig 3: Disassembled view of the components of the final iteration

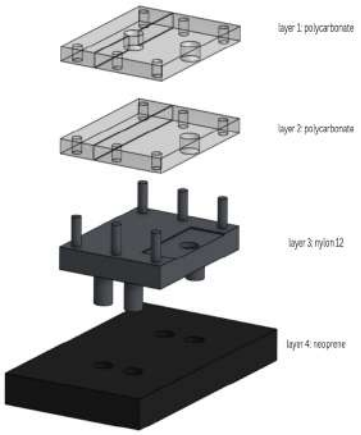


Fig 4: Exploded view of the components of the final iteration

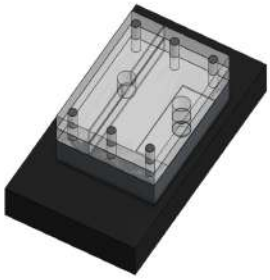


Fig 5: Isometric/3D view of the components of the final iteration

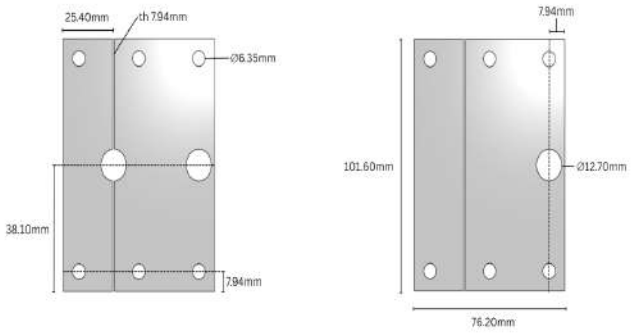


Fig 6: Dimensions of the layer 1 (left) and layer 2 (right), both made out of polycarbonate sheet, .236” thick

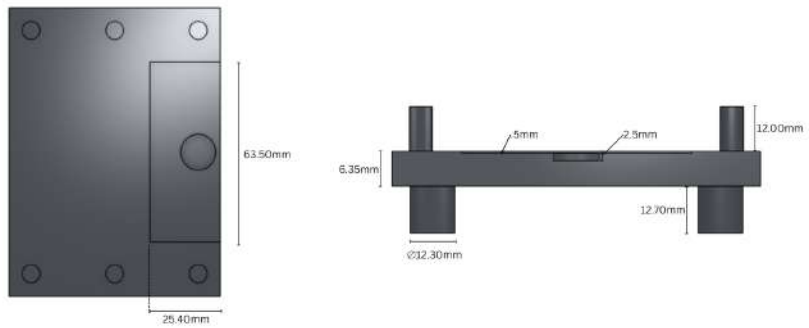


Fig 7: Dimensioned layer 3

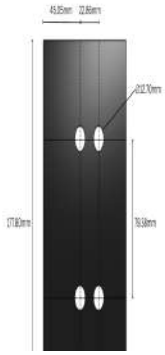


Fig 8: Dimensioned layer 4, neoprene, .5” thick

Conclusion/Action Items: Utilize these photos for final deliverables

2025/12/10 - 400 Final Expense Sheet

SARAH RAUBENSTINE - Dec 11, 2025, 4:35 AM GMT+9

Title: Final Expense Sheet

Date: 12/10/25

Content by: Sarah Raubenstine

Goals: Identify all material expenses from this semester of design

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	QTY	Cost Each	Total	Link
PLA	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	9/26/25	1	$5.00	$5.00	N/A
PLA	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	10/16/25	1	$1.20	$1.20	N/A
Rubber Slab	12 in x 12 in sheet of 50A black rubber	Grainger Vendor	6050-1/2A	Grainger	848EH8	10/31/25	1	$49.99	$49.99	https://www.grainger.com/product/Rubber-Sheet-Commercial-Grade-848EH8
Glo Germ Gel - White	Gel used to investigate thoroughness of surface cleaning.	Glo Germ	GEL	Avantor Science Central	470100-620	11/7/25	1	$25.75	$25.75	https://www.avantorsciences.com/us/en/product/8875880/glo-germ
PLA	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	11/18/25	1	$1.84	$1.84	N/A
PLA	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	11/25/25	1	$1.79	$1.79	N/A
Nylon	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	11/28/25	1	$21.00	$21.00	N/A
Nylon	3D printed polymer	Makerspace	N/A	UW-Madison	N/A	12/3/25	1	$19.50	$19.50	N/A

	through BME design Makerspace budget									
PLA	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison		12/10/25	1	$3.08	$3.08	N/A
								TOTAL:	$129.15	

Conclusions/action items: Keep sheet updated with any expenses from project next semester.

2026/02/20 - Polycarbonate

RUHI NAGARKATTE - Mar 21, 2026, 12:31 AM GMT+9

Title: Polycarbonate

Date: 2/20/26

Content by: Ruhi

Present: Team

Goals: To find vendor and specs for the PC

Content:

Two great slabs of PC from grainger:

https://www.grainger.com/product/Polycarbonate-Sheet-0-236-1ETY6

- 12x12 in, 0.236 in thick

https://www.grainger.com/product/Polycarbonate-Sheet-0-118-1ETY4

- 12 x 12 in, 0.118 in thick

Conclusions/action items:

Design update: PC will be used in the new machinable design. It has really good mechanical properties and can be cleaned/maintained well, making it a good fit for our design.

These materials were ordered and picked up.

Start figuring out a machining plan.

2026/5/3 - 402 Final Expense Sheet - Copy

SARAH RAUBENSTINE - May 04, 2026, 4:49 AM GMT+9

Title: FInal expense sheet

Date: 5/3/26

Content by: Sarah Raubenstine

Goals: Outline total expenses for this semester

Content:

	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	QTY	Cost Each	Total	Link
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	2/10/26	1	$2.81	$2.81	N/A
r n	3D printed polymer through Makerspace design budget	Makerspace	N/A	UW-Madison	N/A	2/18/26	1	$11.42	$11.42	N/A
6	Polycarbonate Sheet: 0.236 in Thick, 12 in x 12 in, Colorless, Clear, 9,500 psi Tensile Strength	N/A	PS-PC-SR-189	Grainger	1ETY6	2/20/26	1	$21.20	$21.20	https://www.grainger.com/product/Polycarbonate-Sheet-0-236-1ETY6
8	Polycarbonate Sheet: 0.118 in Thick, 12 in x 12 in, Colorless, Clear, 9,500 psi Tensile Strength	N/A	PS-PC-SR-181	Grainger	1ETY4	2/20/26	1	$14.36	$14.36	https://www.grainger.com/product/Polycarbonate-Sheet-0-118-1ETY4
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	3/4/26	1	$1.12	$1.12	N/A

	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	3/11/26	1	$2.06	$2.06	N/A
ɔn	3D printed polymer through the BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	3/19/26		$8.00	$8.00	N/A
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	4/15/26	1	1.12	1.12	N/A
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	4/20/26	1	$1.61	$1.61	N/A
								TOTAL:	$63.7	

Conclusions/action items: Final expense sheet for second semester of design.

2026/5/3 - 400/402 Total Expenses

SARAH RAUBENSTINE - May 04, 2026, 4:53 AM GMT+9

Title: FInal expense sheet

Date: 5/3/26

Content by: Sarah Raubenstine

Goals: Depict total expense from both this and last semester for the biopsy press

Content:

	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	QTY	Cost Each	Total	Link
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	9/26/25	1	$5.00	$5.00	N/A
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	10/16/25	1	$1.20	$1.20	N/A
ber	12 in x 12 in sheet of 50A black rubber	Grainger Vendor	6050-1/2A	Grainger	848EH8	10/31/25	1	$49.99	$49.99	https://www.grainger.com/product/Rubber-Sheet-Commercial-Grade-848EH8
n - te	Gel used to investigate thoroughness of surface cleaning.	Glo Germ	GEL	Avantor Science Central	470100-620	11/7/25	1	$25.75	$25.75	https://www.avantorsciences.com/us/en/product/8875880/glo-germ
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	11/18/25	1	$1.84	$1.84	N/A
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	11/25/25	1	$1.79	$1.79	N/A
on	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	11/28/25	1	$21.00	$21.00	N/A

ɔn	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	12/3/25	1	$19.50	$19.50	N/A
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison		12/10/25	1	$3.08	$3.08	N/A
								TOTAL:	$129.15	

Semester 2 (BME 402):

	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	QTY	Cost Each	Total	Link
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	2/10/26	1	$2.81	$2.81	N/A
r n	3D printed polymer through Makerspace design budget	Makerspace	N/A	UW-Madison	N/A	2/18/26	1	$11.42	$11.42	N/A
6 in	Polycarbonate Sheet: 0.236 in Thick, 12 in x 12 in, Colorless, Clear, 9,500 psi Tensile Strength	N/A	PS-PC-SR-189	Grainger	1ETY6	2/20/26	1	$21.20	$21.20	https://www.grainger.com/product/Polycarbonate-Sheet-0-236-1ETY6
8 in	Polycarbonate Sheet: 0.118 in Thick, 12 in x 12 in, Colorless, Clear, 9,500 psi Tensile Strength	N/A	PS-PC-SR-181	Grainger	1ETY4	2/20/26	1	$14.36	$14.36	https://www.grainger.com/product/Polycarbonate-Sheet-0-118-1ETY4
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	3/4/26	1	$1.12	$1.12	N/A
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	3/11/26	1	$2.06	$2.06	N/A
ɔn	3D printed polymer through the BME design	Makerspace	N/A	UW-Madison	N/A	3/19/26		$8.00	$8.00	N/A

	Makerspace budget									
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	4/15/26	1	1.12	1.12	N/A
	3D printed polymer through BME design Makerspace budget	Makerspace	N/A	UW-Madison	N/A	4/20/26	1	$1.61	$1.61	N/A
								TOTAL:	$63.7	

Conclusions/action items: TOTAL DESIGN EXPENDITURES: $192.85 --- primarily spent through UW Makerspace budget.

2026/02/20 - Neoprene waterjetting

Simon Nam - May 04, 2026, 2:49 AM GMT+9

Title: Neoprene Waterjetting

Date: 2026/02/20

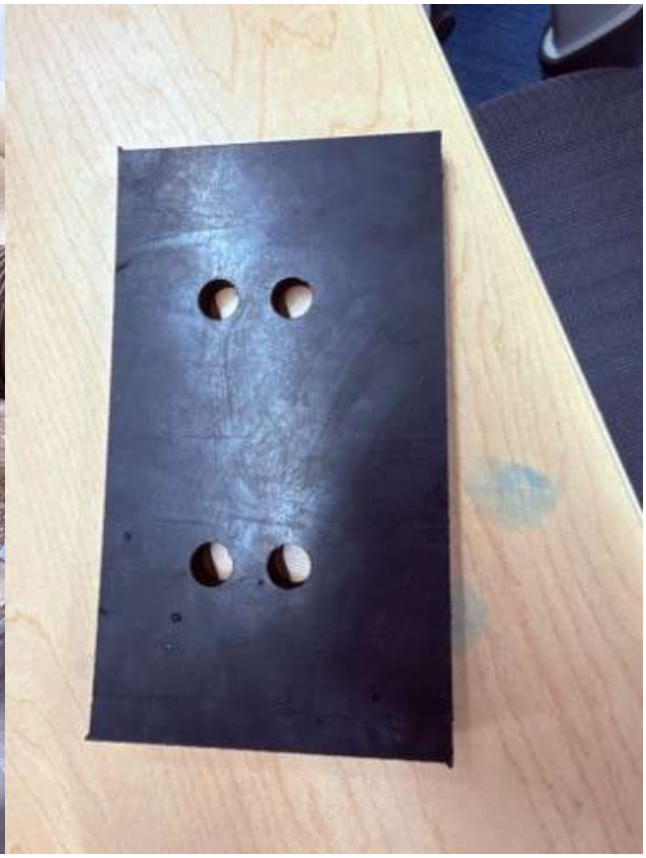
Content by: Simon Nam

Present: Whole team

Goals: To print the neoprene rubber base for the device attachment to the ground surface of the lab environment

Content:

- Selected a neoprene rubber sheet with appropriate thickness to provide both flexibility for surface contact and sufficient stiffness for supporting the device.
- Created a 2D CAD model of the base, including the rectangular outer profile and four mounting holes positioned according to the device attachment requirements.
- Imported the CAD file into the waterjet software and generated the cutting toolpath.
    - Adjusted parameters such as cutting speed, jet pressure, and abrasive flow rate to suit neoprene material properties and minimize deformation.
- Placed the neoprene sheet onto the waterjet cutting bed and secured it using clamps to prevent movement.
    - Added a sacrificial layer underneath the material to allow full cut-through without damaging the machine bed.
- Initiated the waterjet cutting operation.
    - The high-pressure water mixed with abrasive particles followed the programmed path to cut the outer profile and mounting holes with precision.
- Removed the cut neoprene base from the machine.
    - Rinsed off residual abrasive material and dried the part completely to prevent surface contamination.
- Checked the final part for dimensional accuracy, hole alignment, and edge quality.
    - Confirmed that the holes were cleanly cut and suitable for fastener integration.
- Prepared the neoprene base for assembly.
    - The completed part provides a compliant, vibration-damping interface for secure attachment of the device to the ground surface.



Conclusions/action items: Test this component with the client for part of device usability protocol/testing and receive feedback

2026/02/25 - Polycarbonate Bandsaw Protocol

Gianna Inga - Apr 22, 2026, 2:02 AM GMT+9

Title: Polycarbonate Bandsaw Protocol

Date: 2/25/26

Content by: Gianna

Present: Ruhi, Ella

Goals: Develop a bandsaw protocol for the polycarbonate

Content:

Polycarbonate fabrication

1. Starting with 12x12” polycarbonate sheet
2. Bandsaw two 4x3” pieces
3. Drill 2 .5” diameter holes .3125”and 2” centrally off the right 4” side
4. Drill 3 .25” diameter holes .3125” internally offset the 3” side at .3125”, 1.5”, and 2.6875” off the right 4” side
5. Repeat on other 3” side
6. Bandsaw through the entire length of the part 2” from the right 4” side
7. Repeat all steps but the .5” diameter hole 2” from the right 4” side in step 3

- Polycarbonate information (.236” thick)

- Thickness was selected based on available material on grainger catalog
- Good water absorption .13%
- Clear!
- Max temp 270 degree F
- Scratch resistant
- Good tensile strength 9,500 psi

Conclusions/action items: Fabrication of the polycarbonate using the bandsaw was initially used. However, observable in the photo above, it was not accurate enough to successfully create the device. We decided to move forward with waterjet fabrication instead of manual fabrication for increased accuracy. We will not use the laser cutter, because although it would be cheaper than the waterjet, it would melt/burn the polycarbonate.

RUHI NAGARKATTE - Mar 21, 2026, 12:26 AM GMT+9

- Polycarbonate fabrication
  - Starting with 12x12" polycarbonate sheet
  - Bandsaw two 4x3" pieces
  - Drill 2 .5" diameter holes .3125" and 2" centrally off the right 4" side
  - Drill 3 .25" diameter holes .3125" centrally offset the 3" side at .3125", 1.5", and 2.6875" off the right 4" side
  - Repeat on other 3" side
  - Bandsaw through the entire length of the part 2" from the right 4" side
  - Repeat all steps but the .5" diameter hole 2" from the right 4" side in step 3
- Polycarbonate (.236" thick)
  - Thickness was selected based on available material on grainger catalog
  - Good water absorption .13%
  - Clear!
  - Max temp 270 degrees F
  - Scratch resistant
  - Good tensile strength 9,500 psi

Download

Polycarbonate.docx (7.4 kB)

2026/02/27 - Polycarbonate Waterjet

Gianna Inga - May 03, 2026, 8:53 AM GMT+9

Title: Waterjet

Date: 2026/2/27

Content by: Gianna

Present: Simon, Gianna, Ruhi

Goals: Document fabrication of the polycarbonate

Content:

- initial plans to fabricate the polycarbonate layers included using the bandsaw and mill
    - however, due to the inaccuracy of of the bandsaw, the waterjet was decided to move forward with future fabrication

Protocol

1. the onshape CAD file top orientation was utilized to turn into needed DXF files for the waterjet
2. the DXF files were transported on a flash drive and uploaded to the waterjet computer
3. the polycarbonate sheet was fastened with clamps to the bed of the waterjet
4. water was added to the machine until it cover the surface of the polycarbonate
5. the nozzle was lowered to the polycarbonate surface
6. the splash shield was lowered
7. the waterjet cutting was started
8. after cutting, the polycarbonate pieces were removed and cleaned

Conclusions/action items: Waterjetting provided a clean and fast way to fabricate the polycarbonate layers. We decided to do this to not damage the polycarbonate and get the most accurate cuts. The only downside was that the initial piece of polycarbonate cut was lost to the tank of the waterjet as

it sank before we could grab the part. If this fabrication method is used again, creating a small attachment between the part and sheet is recommended to ensure we don't loose the part again.

2026/04/21 - Final base fabrication

Gianna Inga - May 04, 2026, 1:05 AM GMT+9

Title: Final Base Fabrication

Date: 2026/04/21

Content by: Gianna

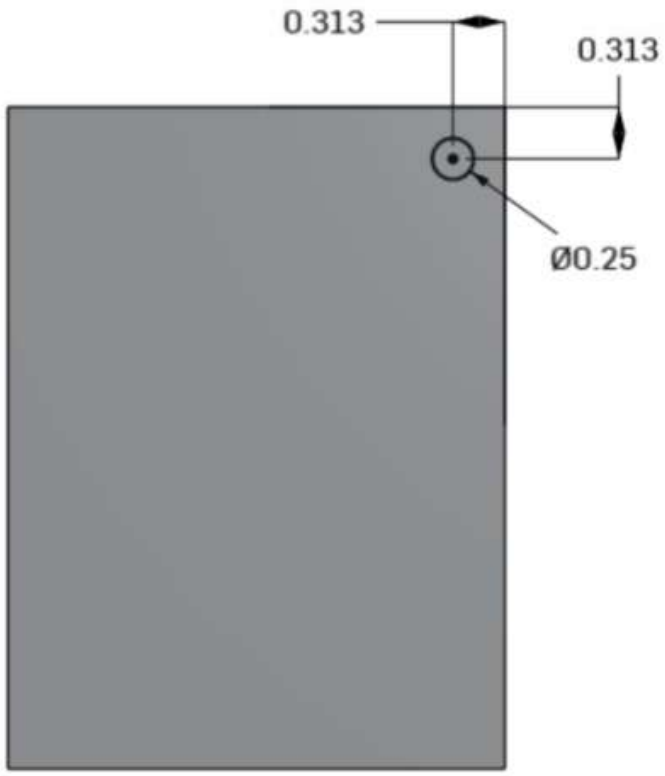
Present: Gianna

Goals: Document the protocol for making the final base on onshape

Content:

Protocol:

1. Extrude a 3x4" (76.2x101.6mm) sketch by .368" (9.3472mm)
2. Sketch a .25" (6.35mm) diameter circle .3125" (79.375mm) square to the top right corner (along the 3" (76.2mm) side)

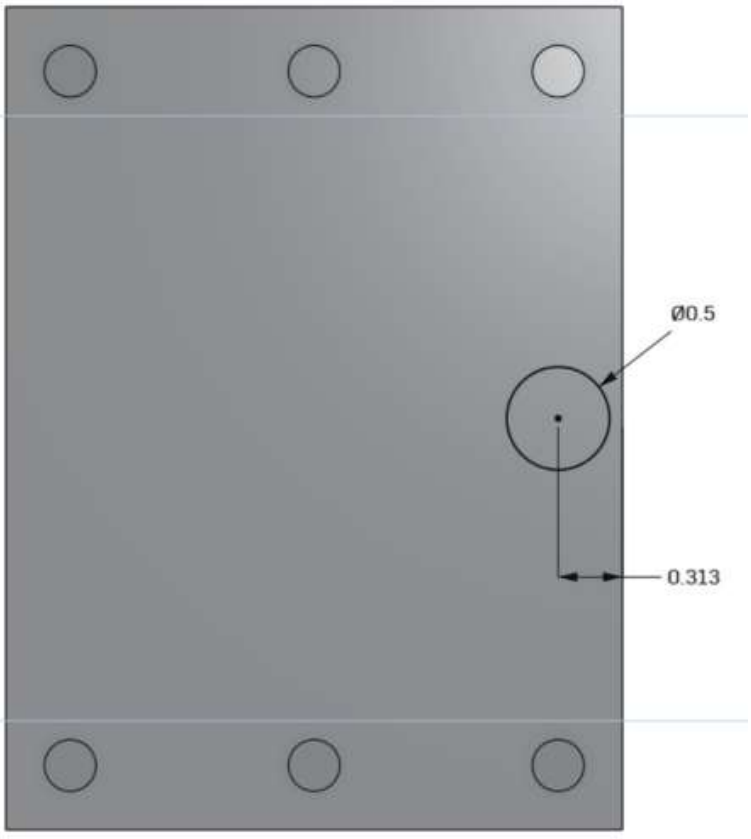


1.

3. Linear pattern the circle twice with 1.1875" (30.1625mm) between each circle
4. Mirror the circles to the bottom 3" (76.2) side
5. Extrude all the circles by .472" (11.99mm)

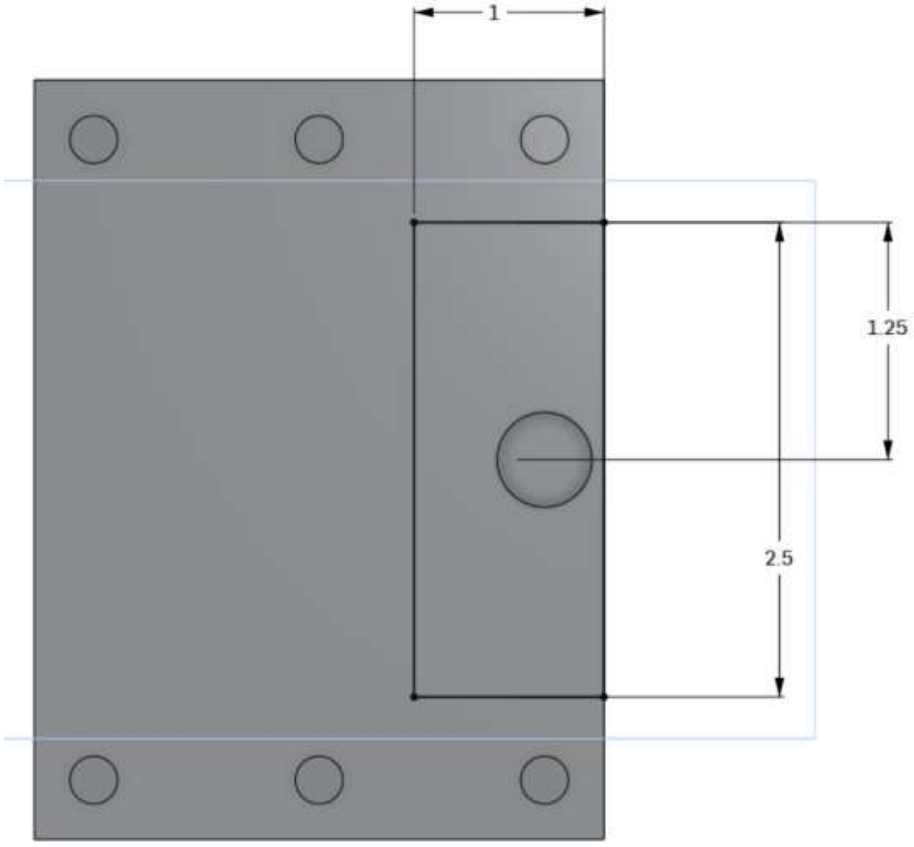
1.

6. Subtract extrude a .5" (12.7mm) diameter circle on the midline of the 4" side (101.6mm), .3125" (7.9375mm) from the edge by 2.3mm

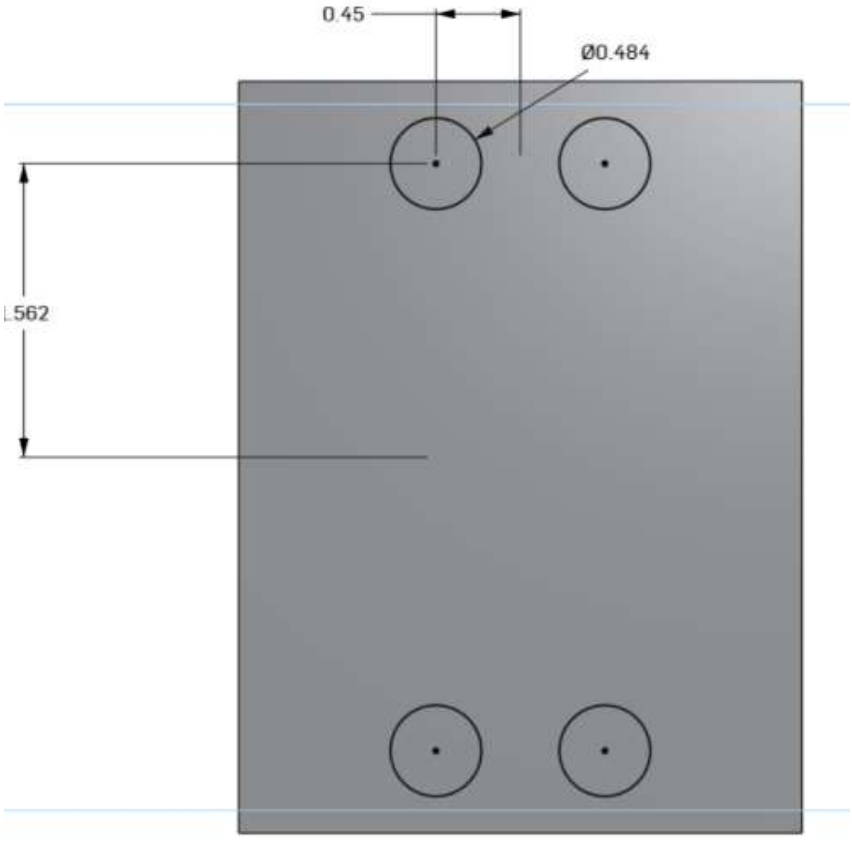


1.

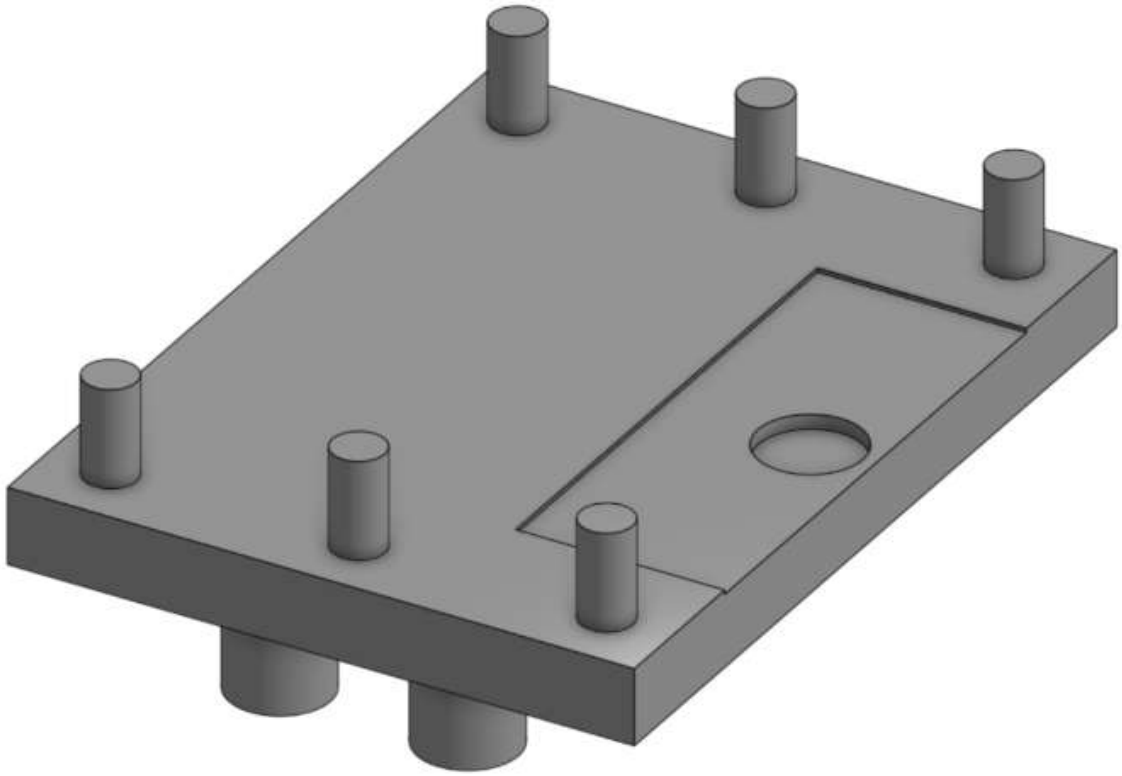
7. Subtract extrude 1x2.5" (25.4x63.5mm) centered on the midline of the 4" (101.6mm) side, flush to the edge with step 6, by .5mm

1. 

8. On the bottom surface, sketch a .4843" (12.3mm) diameter circle .45" (11.43mm) to the side and 1.5625" (39.69mm) to the top from the center

1. 

9. Mirror the circle across the midline of the 3" (76.2mm) side
10. mirror the 2 circles across the midline of the 4" (101.6mm) side
11. Extrude the circles by .5" (12.7mm)



Conclusions/action items: Utilize this procotol to fabricate the final base in onshape. The stl file is also attached of the design for future adjustments. Print this design in PLA to utilize in the final prototype.

Gianna Inga - May 04, 2026, 12:59 AM GMT+9

Download

final_base.stl (322 kB)

2026/04/21 - Final sample presser

Gianna Inga - May 04, 2026, 1:11 AM GMT+9

Title: Final sample presser

Date: 2026/04/21

Content by: Gianna

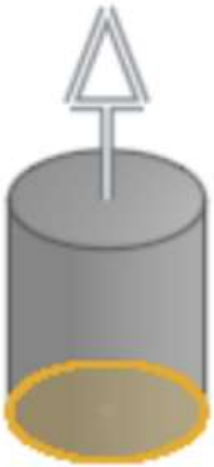
Present: Gianna

Goals: Document the protocol for making the final base on onshape

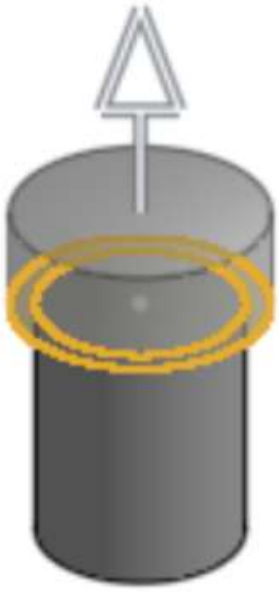
Content:

Protocol:

1. Extrude a .5" (12.7mm) diameter circle by .625" (15.875mm)



1.
2. Extrude a .625" (15.875mm) diameter circle centered on step 1 by .25" (6.35mm)



1.

3. Extrude a .375" (9.525mm) diameter circle centered on step 2 by 4" (101.6mm)

1.

Conclusions/action items: Utilize this procotol to fabricate the sample presser in onshape. The stl file is also attached of the design for future adjustments. Print this design in PLA to utilize in the final prototype.

Gianna Inga - May 04, 2026, 1:12 AM GMT+9

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sample_presser.stl (86.5 kB)

2025/11/30 - FEA Analysis Testing Protocol

RUHI NAGARKATTE - Mar 21, 2026, 12:44 AM GMT+9

* Update with materials (nylon, polycarbonate) and the different layers in the new design

Gianna Inga - May 04, 2026, 1:14 AM GMT+9

Title: FEA Analysis Testing Protocol

Date: 12/9/25

Content by: Ruhi Nagarkatte

Present: NA

Goals: Develop a thorough FEA testing protocol

Content:

FEA Protocol
1. Open OnShape, create a new assembly tab by clicking the + in the lower left corner
2. Import the selected parts into the page by clicking Insert.
3. Right click on the imported parts and select Nylon as the material from the OnShape library
4. Select the force simulation icon, in the top right corner, and input the considered forces for each component
5. Select the moment simulation icon, in the top right corner, and input the considered moment for each component
6. Finalize the direction of the applied forces and moments
7. Generate the simulation and wait for the results to load.

Conclusions/action items:

Use this protocol to perform analysis on the blade handle and body/pegs of the biopsy press. The results will help point out any potential weak points of the design.

RUHI NAGARKATTE - Dec 10, 2025, 6:10 AM GMT+9


FEA Protocol
1. Open OnShape, create a new assembly tab by clicking the + in the lower left corner
2. Import the selected parts into the page by clicking Insert.
3. Right click on the imported parts and select Nylon as the material from the OnShape library
4. Select the force simulation icon, in the top right corner, and input the considered forces for each component
5. Select the moment simulation icon, in the top right corner, and input the considered moment for each component
6. Finalize the direction of the applied forces and moments
7. Generate the simulation and wait for the results to load.

Download

FEA_Protocol.pdf (33.2 kB)

2026/02/20 - Usability Testing Protocol and Survey

Gianna Inga - May 04, 2026, 1:15 AM GMT+9

Title: Usability Testing Protocol and Survey

Date: 2/20/26

Content by: Whole team

Present: whole team

Goals: use this protocol and survey to conduct testing

Content:

Survey Testing Protocols

Survey participants selected from individuals outside the design group with previous experience using lab blades to mitigate safety risks associated with blade usage. Participants will sign forms of consent and be briefed on how to safely use the device and associated blades.

Participants asked to use the device to slice 12 mm diameter, 5 mm long biopsy samples.

Instructions for using device:

1. Insert 12 mm biopsy sample into each indentation on the base of the device (2 samples total)

2. Attach covered razor blade to blade handle

3. Unsheath razor blade

4. Use compression piece to lightly press down on the biopsy samples, aligning the extrusions with the indentations in the base

5. Insert razor blade into side slot in the base and slice through samples

6. Remove razor blade from device

7. Insert razor blade into top slot in the base and slice through sample cross sections

8. Remove razor blade from handle and dispose of blade in sharps bin

9. Take off top section

10. Remove biopsy samples

11. Visually compare the prepared biopsy samples

12. Reassemble device

Participants will be asked to repeat the sample slicing procedure twice. After completing this task, participants will be asked to fill out a printed survey assessing the performance and functionality of the device. Each question will be answered by assigning a number based on their satisfaction, a rating of 1 indicating strongly disagree and a rating of 5 indicating strongly agree, 3 indicating neutrality.

Survey Questionnaire given to participants shown on the following page.

Please evaluate each of the following statements on a scale of 1-5 based on your agreement, a score of 1 indicating strong disagreement, a score of 3 indicating neutrality, and a score of 5 indicating strong agreement. Your answers to this survey will remain anonymous and the data collected will be presented in aggregate form with no identifying information.

The device was intuitive to use:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

I felt safe when using the device:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

The device was securely held to the table:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

The razor blade attached securely to the handle:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

The sample cutting was controlled:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

The samples appeared to be of similar thickness:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

It was easy to guide the blade through the samples:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

It was easy to insert the samples into the device:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

It was easy to remove the samples from the device:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

Any suggestions to improve the device?

Conclusions/action items:

- This protocol and survey will be important when we test the effectiveness of our design with the client and other subjects.

RUHI NAGARKATTE - Mar 21, 2026, 12:47 AM GMT+9

Survey Testing Protocols

The team will go to the client's lab and test out the device using real pig skin biopsy samples. Biopsy samples will be prepared by the lab technicians and sliced using the updated device design. Each of the five team members will try out the device using the pig skin samples and answer the following series of questions based on their experience. Lab technicians will also try out the updated device and answer the following questions, noting any suggestions for improvement or concerns to be addressed.

Survey Questions:

Please evaluate each of the following statements on a scale of 1-5 based on your agreement, a score of 1 indicating strong disagreement, a score of 3 indicating neutrality, and a score of 5 indicating strong agreement. Your answers to this survey will remain anonymous and the data collected will be presented in aggregate form with no identifying information.

The device was intuitive to use:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

I felt safe when using the device:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

The device was securely held in the table:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

The scalpel blade was attached securely to the handle:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

The sample cutting was controlled:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

The samples appeared to be of similar thickness:

1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree

Download

402_-_Suvery_Testing_Protocols.docx (8.09 kB)

RUHI NAGARKATTE - Mar 21, 2026, 12:47 AM GMT+9

Survey Testing Protocols

Survey participants selected from individuals outside the design group with previous experience using lab blades to mitigate safety risks associated with blade usage. Participants will sign forms of consent and be briefed on how to safely use the device and associated blades.

Participants asked to use the device to slice 12 mm diameter, 5 mm long biopsy samples.

Instructions for using device:

1. Insert 12 mm biopsy sample into each indentation on the base of the device (2 samples total)
2. Attach covered razor blade to blade handle
3. Unsheath razor blade
4. Use compression piece to lightly press down on the biopsy samples, aligning the extrusions with the indentations in the base
5. Insert razor blade into side slot in the base and slice through samples
6. Remove razor blade from device
7. Insert razor blade into top slot in the base and slice through sample cross sections
8. Remove razor blade from handle and dispose of blade in sharps bin
9. Take off top section
10. Remove biopsy samples
11. Visually compare the prepared biopsy samples.
12. Reassemble device

Participants will be asked to repeat the sample slicing procedure twice. After completing this task, participants will be asked to fill out a printed survey assessing the performance and functionality of the device. Each question will be answered by assigning a number based on their satisfaction, a rating of 1 indicating strongly disagree and a rating of 5 indicating strongly agree, 3 indicating neutrality.

Survey Questionnaire given to participants shown on the following page.

Download

Survey_Testing_Protocols.docx (8.84 kB)

2026/03/06 Updated Sterilizability Testing Protocol

Gianna Inga - May 04, 2026, 1:16 AM GMT+9

Title: Sterilization Protocol

Date: 3/6/2026

Content by: Ella Lang

Content:

Sanitization Testing Protocols
Participants asked to use the device to evaluate sufficient sanitization after use. In place of porcine tissue residue, a biologics-free product, GloGerm, is used for the visualization of cleaning mode effectiveness. GloGerm is UV reactive. Autoclave compatibility will also be visually evaluated to ensure the device does not begin to degrade.
Material list:
● 1 UV flashlight
● 8 oz Lotion-based GloGerm solution
● 1 Small paintbrush
● Paper towel
● Spray bottle of ethanol
● Bottle of dish soap
● 1 sponge
● Autoclave tape
Material setup instructions for the GloGerm application:
1. Place a tablespoon of GloGerm solution in a dish
2. Wash and dry the paintbrush
3. Prepare multiple dry paper towels
GloGerm application instructions:
1. Completely disassemble the Biopsy Press device
2. Thoroughly coat the tip of the paintbrush with GloGerm solution. Repeat as often as necessary throughout the remaining steps
3. For each piece, thoroughly coat each face enclosed within the device when assembled with the GloGerm solution
a. Once coated, set each piece on a clean, dry paper towel
4. For each piece with extruding pegs, thoroughly coat the entire peg with the GloGerm solution
a. Once coated, set each piece on a clean, dry paper towel
5. For each piece with intruding connectors for peg insertion, coat the entire intrusion with the GloGerm solution
a. Once coated, set each piece on a clean, dry paper towel
Soap and water testing instructions:
1. Prepare device components according to the GloGerm application instructions section
2. For each of the four pieces:
a. Run thoroughly under warm sink water for 20 seconds
b. Apply Dawn dish soap to a sponge and scrub the device component under warm water for 20 seconds
c. Pat the component dry with a clean paper towel
d. Set the component out to air dry for a minimum of 15 minutes
e. Image all orientations of the component using the UV light, ensuring any intruding ports are visible
Ethanol spray testing instructions:
1. Prepare device components according to the GloGerm application instructions section
2. For each of the four pieces:
a. Spray all faces, connectors and ports with ethanol
b. Use a dry paper towel to wipe down all faces, connectors and ports for 45 seconds
c. Set the component out to air dry for 3 minutes
d. Image all orientations of the component using the UV light, ensuring any intruding ports are visible
Autoclave testing instructions:
1. Completely disassemble the Biopsy Press device

2. Wash each component with soap and water. Let dry for 5 minutes.
3. Apply autoclave tape to three separate components
a. The components selected can be at random
4. Image all components, with and without autoclave tape
5. Place all components in the autoclave, ensuring about an inch of space between components
6. Run the autoclave for 30 minutes
a. Ensure a minimum temperature of 121 degrees Celsius is reached
b. Ensure a minimum pressure of 15 psi is reached
7. Upon completion of the autoclave cycle, let the parts cool for 10 minutes
8. Put on heat-resistant gloves and lab goggles
9. Remove the components from the autoclave
10. Examine the tape on the three components and ensure the tape has turned black, indicating the autoclave reached adequate sterilization temperature
a. If the tape has not turned a dark color, return to step 1 and run the autoclave for a longer period
11. Visually inspect each component for melting, warping, deformation, or damage
12. Image all components, noting any damage found in step 8

Conclusions/action items:

- Continue to update the protocol based on advisor feedback

- Perform testing

ELLA LANG - Mar 21, 2026, 12:14 AM GMT+9

Sanitization Testing Protocol

Participants asked to use the device to evaluate sufficient sanitization after use. In place of proteins from residue, a biologics-free product, GloGerm, is used for the visualization of cleaning mode effectiveness. GloGerm is UV reactive. Autoclave compatibility will also be visually evaluated to ensure the device does not begin to degrade.

Material list
- 1 UV flashlight
- 8 oz Lotion-based GloGerm solution
- 1 Small paintbrush
- Paper towel
- Spray bottle of ethanol
- Bottle of dish soap
- 1 sponge
- Autoclave tape

Material setup instructions for the GloGerm application
1. Place a tablespoon of GloGerm solution in a dish
2. Wash and dry the paintbrush
3. Prepare multiple dry paper towels

GloGerm application instructions:
1. Completely disassemble the Biopsy Press device
2. Thoroughly coat the tip of the paintbrush with GloGerm solution. Repeat as often as necessary throughout the remaining steps
3. For each piece, thoroughly coat each face and bead within the device when assembled with the GloGerm solution
   a. Once coated, set each piece on a clean, dry paper towel
4. For each piece with extending pegs, thoroughly coat the entire peg with the GloGerm solution
   a. Once coated, set each piece on a clean, dry paper towel
5. For each piece with extending connectors for peg insertion, coat the entire intrusion with the GloGerm solution
   a. Once coated, set each piece on a clean, dry paper towel

Soap and water testing instructions:
1. Prepare device components according to the GloGerm application instructions section
2. For each of the four pieces:
   a. Run thoroughly under warm sink water for 20 seconds
   b. Apply Dawn dish soap to a sponge and scrub the device component under warm water for 20 seconds
   c. Pat the component dry with a clean paper towel
   d. Set the component out to air dry for a minimum of 15 minutes

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Sterilizability_Testing_Protocol-_402.pdf (68.2 kB)

2026/04/18 - Device Usability Testings Final Overview

Simon Nam - May 03, 2026, 2:01 AM GMT+9

Title: Sterilization Protocol

Date: 3/6/2026

Content by: Simon Nam

Goals: To visually depict the process of device usability testings from the client meetings in the lab

Content:

Device Usability Testings

Porcine sample/layer before biopsy processed

Biopsy samples placed into the sample

Device Usability Testings

Biopsy sample slicing using the device + pressure applicator

Biopsy sample after horizontal cut (≈2mm)

Device Usability Testings

Repetition of device usability testings (5 samples per participant)

Biopsy samples (left: 2mm sample, right: excess fat layer)

Conclusions/action items: Utilize these photos and figure captions for final deliverables (poster and final journal report)

2026/03/20 - Sterilizability Testing Results

ELLA LANG - Apr 10, 2026, 5:06 AM GMT+9

Title: Sterilizability Testing Results

Date: 3/20/2026

Content by: Ella Lang

Goals:

- Analyze build-up areas on the device with Image J

- Perform t-tests to show design sterilizability improvement

Content:

Attached below

Conclusions/action items:

- Create Matlab code for running t-tests

ELLA LANG - Apr 20, 2026, 9:02 AM GMT+9

Download

Sanitization_Build-up_Analysis.xlsx (23.3 MB)

ELLA LANG - Apr 15, 2026, 2:13 AM GMT+9

Title: Sterilizability Testing Results

Date: 4/14/2026

Content by: Ella Lang

Goals:

- Analyze build-up areas on the device with Image J

Content:

0.017 in^2 was added as the peg base area of interest control group. Since the coated peg bases showed no clear edges, 0.017 was found as the average area around the peg bases. This area will be used as the control comparison.

	Before cleaning			After cleaning			After cleaning		

				(ethanol)			(soap and water)		
	Build-up area in^2	Assosciated picture	Analysis	Build-up area in^2	Assosciated picture	Analysis	Build-up area in^2	Assosciated picture	Analysis
Polycarbonate, peg connection intrusions	0.026		Average build up area	0.008		Average build up area	0.007		Average build up area
Diameter of holes: 0.25 in	0.02		0.01416666667	0.005		0.008666666667	0		0.003416666667
	0.014		Standard deviation	0.007		Standard deviation	0		Standard deviation
	0.022		0.005921199715	0.005		0.004030189108	0		0.005247654599
	0.017			0.009			0.009		
	0.013			0.006			0		
	0.008			0.015			0		
	0.008			0.005			0		
	0.008			0.012			0		
	0.012			0.017			0.012		
	0.012			0.009			0		
	0.01			0.006			0.013		
Polycarbonate, sample wells	0.031			0			0		
Diameter of holes: 0.5 in	0.049			0.017			0		
Nylon, sample well	0.135			0.041			0		
Diameter of well: 0.5 in									
Nylon, around pegs	N/A unmeasurable - 0.017	N/A		0.004		Average build up area	0		
0.25 in diameter pegs	N/A unmeasurable - 0.017	N/A		0		0.002	0		
	N/A unmeasurable - 0.017	N/A		0		Standard deviation	0		
	N/A unmeasurable - 0.017	N/A		0.003		0.001673320053	0		
	N/A unmeasurable - 0.017	N/A		0.002			0		
	N/A unmeasurable - 0.017	N/A		0.003			0		

2026/04/14 Sterilization MATLAB Analysis

ELLA LANG - Apr 15, 2026, 2:16 AM GMT+9

Title: Sterilization MATLAB analysis

Date: 4/14/2026

Content by: Ella Lang

Goals:

- Determine if the reduction in buildup is statistically significant across sterilization treatments

- Find % buildup reduction

- Create code for goals above

Content:

```
Polycarbonate peg connections analysis
PC_coated = Polycarb1.Coated
PC_ethanol = Polycarb1.Ethanol
PC_soap = Polycarb1.Soap

% Compare Ethanol to Coated
[h1,p1] = ttest2(PC_coated, PC_ethanol)

% Compare Soap to Coated
[h2,p2] = ttest2(PC_coated, PC_soap)

% Means
meanCoated = mean(PC_coated)
meanEthanol = mean(PC_ethanol)
meanSoap = mean(PC_soap)

% Percent reduction
ethanolReduction = ((meanCoated - meanEthanol)/meanCoated)*100
soapReduction = ((meanCoated - meanSoap)/meanCoated)*100
PC_coated =

    0.0260
    0.0200
    0.0140
    0.0220
    0.0170
    0.0130
    0.0080
    0.0080
    0.0080
    0.0120
    0.0120
    0.0100


PC_ethanol =

    0.0080
    0.0050
    0.0070
    0.0050
    0.0090
    0.0060
    0.0150
    0.0050
```

```
    0.0120
    0.0170
    0.0090
    0.0060


PC_soap =

    0.0070
         0
         0
         0
    0.0090
         0
         0
         0
         0
    0.0120
         0
    0.0130


h1 =

     1


p1 =

    0.0143


h2 =

     1


p2 =

   1.0743e-04


meanCoated =

    0.0142


meanEthanol =

    0.0087


meanSoap =

    0.0034


ethanolReduction =

   38.8235


soapReduction =

   75.8824

Nylon peg analysis
N_coated = Nylon.Coated
N_ethanol = Nylon.Ethanol
```

```
% Compare Ethanol to Coated
[h3,p3] = ttest2(N_coated, N_ethanol)

% means
meanNCoated = mean(N_coated)
meanNEthanol = mean(N_ethanol)

% Percent reduction
N_ethanolReduction = ((meanNCoated - meanNEthanol)/meanNCoated)*100
N_coated =

    0.0170
    0.0170
    0.0170
    0.0170
    0.0170
    0.0170


N_ethanol =

    0.0040
         0
         0
    0.0030
    0.0020
    0.0030


h3 =

     1


p3 =

   8.5971e-10


meanNCoated =

    0.0170


meanNEthanol =

    0.0020


N_ethanolReduction =

   88.2353
```

Conclusions/action items:

- Utilize these results in final reports and deliverables

```
%% Sanitization Testing Analysis
%% Polycarbonate peg connections analysis

PC_coated = Polycarb1.Coated
PC_ethanol = Polycarb1.Ethanol
PC_soap = Polycarb1.Soap

% Compare Ethanol to Coated
[h1,p1] = ttest2(PC_coated, PC_ethanol)

% Compare Soap to Coated
[h2,p2] = ttest2(PC_coated, PC_soap)

% Means
meanCoated = mean(PC_coated)
meanEthanol = mean(PC_ethanol)
meanSoap = mean(PC_soap)

% Percent reduction
ethanolReduction = ((meanCoated - meanEthanol)/meanCoated)*100
soapReduction = ((meanCoated - meanSoap)/meanCoated)*100

%% Nylon peg analysis

N_coated = Nylon.Coated
N_ethanol = Nylon.Ethanol

% Compare Ethanol to Coated
[h3,p3] = ttest2(N_coated, N_ethanol)

% means
meanNCoated = mean(N_coated)
meanNEthanol = mean(N_ethanol)

% Percent reduction
N_ethanolReduction = ((meanNCoated - meanNEthanol)/meanNCoated)*100
```

Download

Sanitization.m (837 B)

ELLA LANG - May 04, 2026, 11:32 AM GMT+9

Sanitization Testing Analysis

Contents

- Polycarbonate peg connections analysis
- Nylon peg analysis

Polycarbonate peg connections analysis

```
PC_coated = Polycarb1.Coated
PC_ethanol = Polycarb1.Ethanol
PC_soap = Polycarb1.Soap

% Compare Ethanol to Coated
[h1,p1] = ttest2(PC_coated, PC_ethanol)

% Compare Soap to Coated
[h2,p2] = ttest2(PC_coated, PC_soap)

% Means
meanCoated = mean(PC_coated)
meanEthanol = mean(PC_ethanol)
meanSoap = mean(PC_soap)

% Percent reduction
ethanolReduction = ((meanCoated - meanEthanol)/meanCoated)*100
soapReduction = ((meanCoated - meanSoap)/meanCoated)*100

PC_coated =

    0.0160
    0.0200
    0.0310
    0.0220
    0.0170
    0.0330
    0.0000
    0.0000
    0.0000
    0.0130
    0.0120
    0.0180


PC_ethanol =

    0.0000
    0.0050
    0.0070
    0.0050
    0.0000
    0.0000
    0.0150
    0.0050
    0.0120
    0.0170
    0.0000
    0.0000
```

Download

Sanitization.html (7.36 kB)

2026/04/17 - Usability All Measurement Data

Simon Nam - May 03, 2026, 1:47 AM GMT+9

Title: Usability Statistics Overview

Date: 2026/04/17

Content by: Simon

Present: N/A

Goals: Evaluate overall measurement consistency across all users by analyzing central tendency, spread, and distribution characteristics to identify patterns in variability and reliability.

Content:

The dataset compiles all measurement values across users and derives key statistical metrics, including mean, standard deviation, minimum, maximum, and mean ± 1 standard deviation.

The aggregated data shows a stable overall mean, indicating that measurements are centered within a reasonable and expected range.

However, variability across the full dataset is more pronounced compared to individual user summaries, reflecting differences in measurement consistency between users.

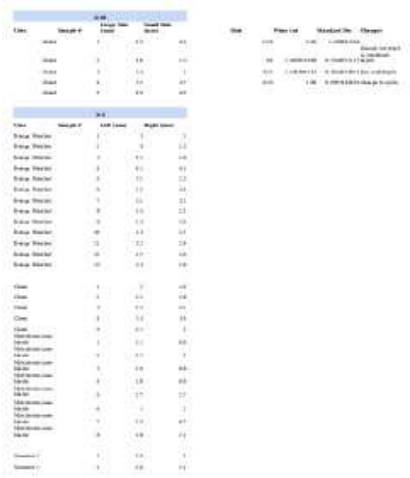
The range (min–max) highlights the full spread of values and suggests the presence of potential outliers or extreme cases.

The mean ± 1 SD bounds capture the majority of data points, illustrating the typical distribution while also emphasizing deviations in certain subsets of the data.

Conclusions/action items:

Additional analysis may be needed to identify and address outliers. Visual tools and statistical analysis should continue to be used to give a full overview for final deliverables.

Simon Nam - May 03, 2026, 1:47 AM GMT+9



Download

All_measurement_data_1_.xlsx (8.35 kB)

2026/04/17 - Autoclave testing

RUHI NAGARKATTE - May 04, 2026, 12:12 PM GMT+9

Title: Autoclave Testing

Date: 4/17/26

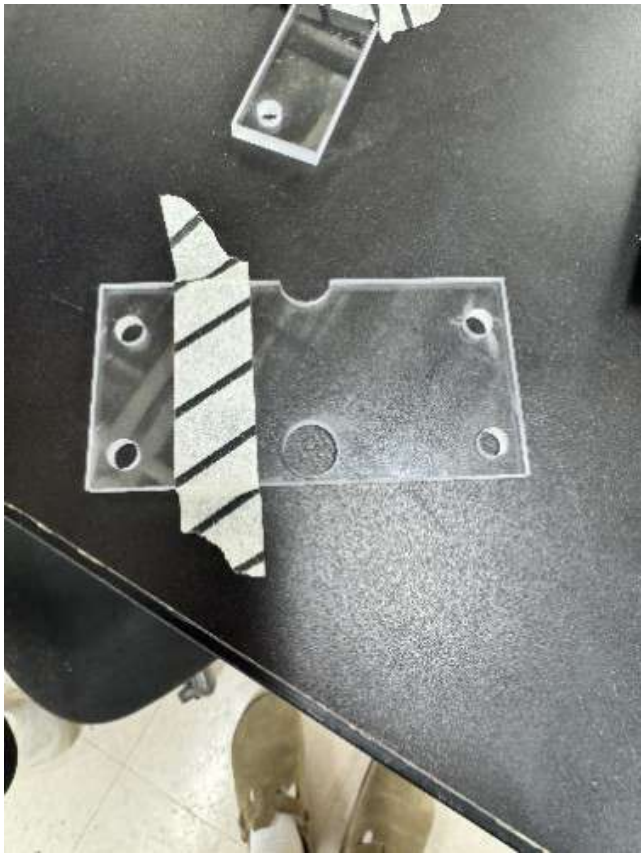
Content by: Ruhi and Sarah

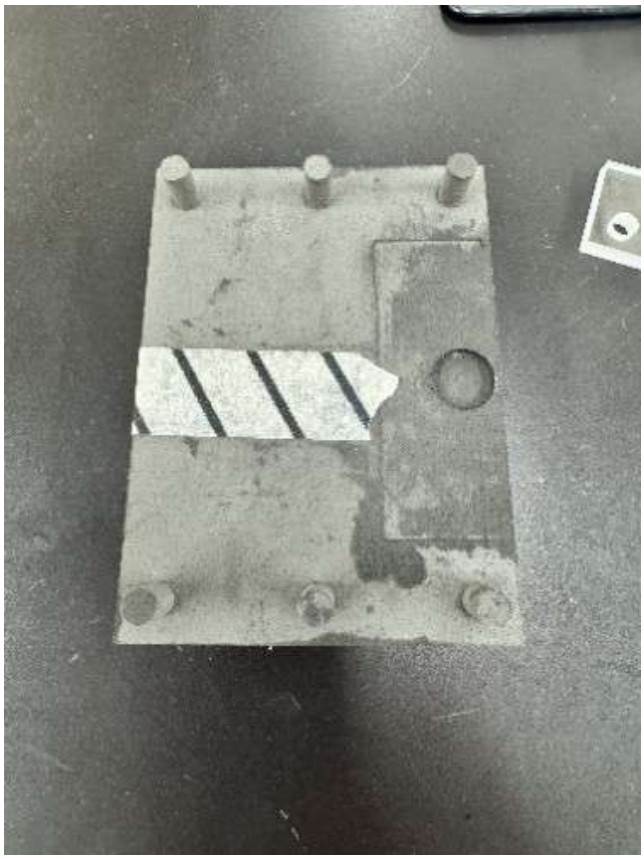
Present: NA

Goals: To test the integrity of nylon and polycarbonate after an autoclave cycle

Content:

- Nylon and PC tested
- The device was disassembled and marked with autoclave tape, which changed color to indicate that the necessary cycle temperature has been reached
- Three thirty-minute cycles at 121 degrees Celsius and a minimum of 15 psi were performed
- Once finished: the components were removed from the autoclave, and the applied tape was visually examined to ensure the temperature requirement was reached
- Each component was visually inspected and did not display melting, warping, deformation, or damage





Conclusions/action items:

The autoclave is a sterilization method that doesn't immediately affect the integrity of nylon or PC. However, the nylon was observed to have swelling, as expected with its absorption behavior. It returned to its original shape after drying. However, there are some concerns for repeated or heavy use of an autoclave with these components as it can lead to nylon degradation or PC brittleness.

2026/04/20 - Usability Statistics Overview

Simon Nam - May 03, 2026, 1:42 AM GMT+9

Title: Usability Statistics Overview

Date: 2026/04/20

Content by: Simon

Present: N/A

Goals: Summarize sample consistency across users by evaluating central tendency and variability metrics, including mean, standard deviation, and range (min–max), to assess reliability and dispersion of measurements.

Content:

The dataset presents measurements for multiple users, with key statistical indicators computed for each: mean, standard deviation, minimum, maximum, and bounds defined by mean ± 1 standard deviation.

Overall, the means appear relatively consistent across users, indicating similar central tendencies.

However, variability differs between users, as reflected in the spread of standard deviation values.

Some users show tighter clustering (lower standard deviation) --> more consistent measurements, while others exhibit wider ranges and higher dispersion.

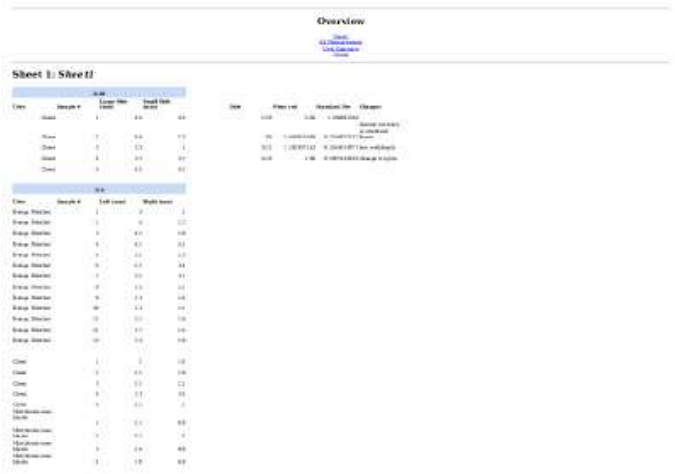
The inclusion of min–max values and mean ± 1 SD provides a clearer visualization of distribution spread and potential outliers within each user's dataset.

Conclusions/action items:

Focus should be placed on users with higher variability to identify potential sources of inconsistency, such as measurement technique or instrumentation differences.

Future work for testing should aim to standardize data collection procedures and reduce variability.

Simon Nam - May 03, 2026, 1:42 AM GMT+9



Download

sample_consistency_visualization_1_.xlsx (155 kB)

2026/04/20 - FEA Analysis Results

RUHI NAGARKATTE - May 04, 2026, 12:07 PM GMT+9

Title: FEA Analysis Results

Date: 4/20/26

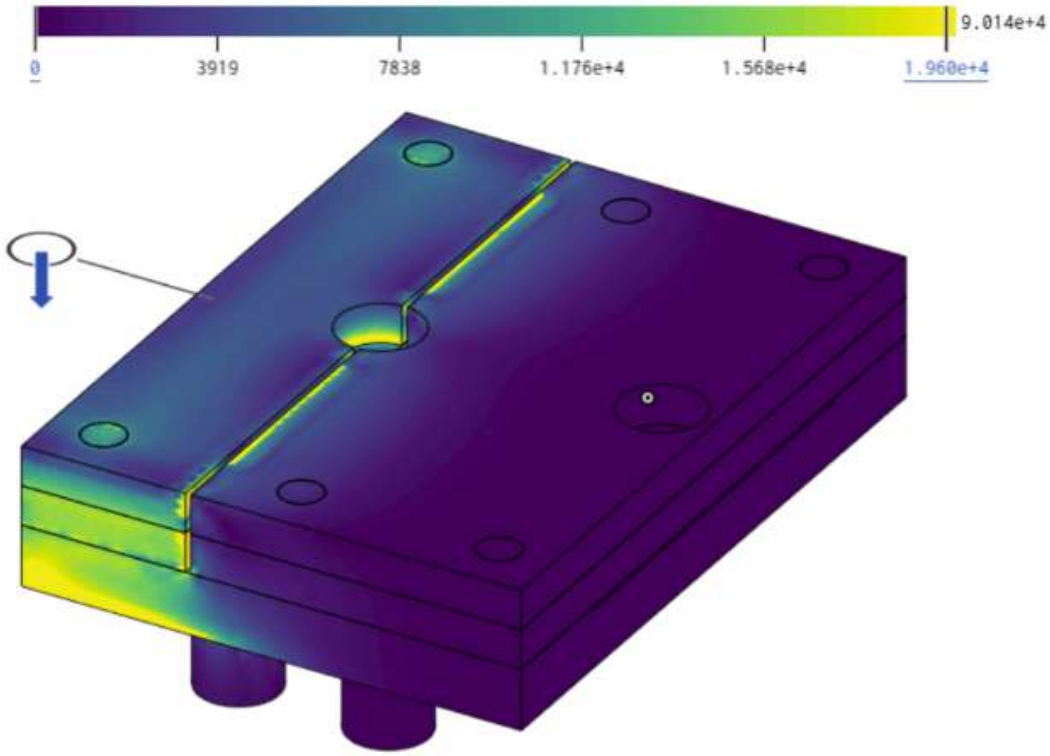
Content by: Ruhi Nagarkatte

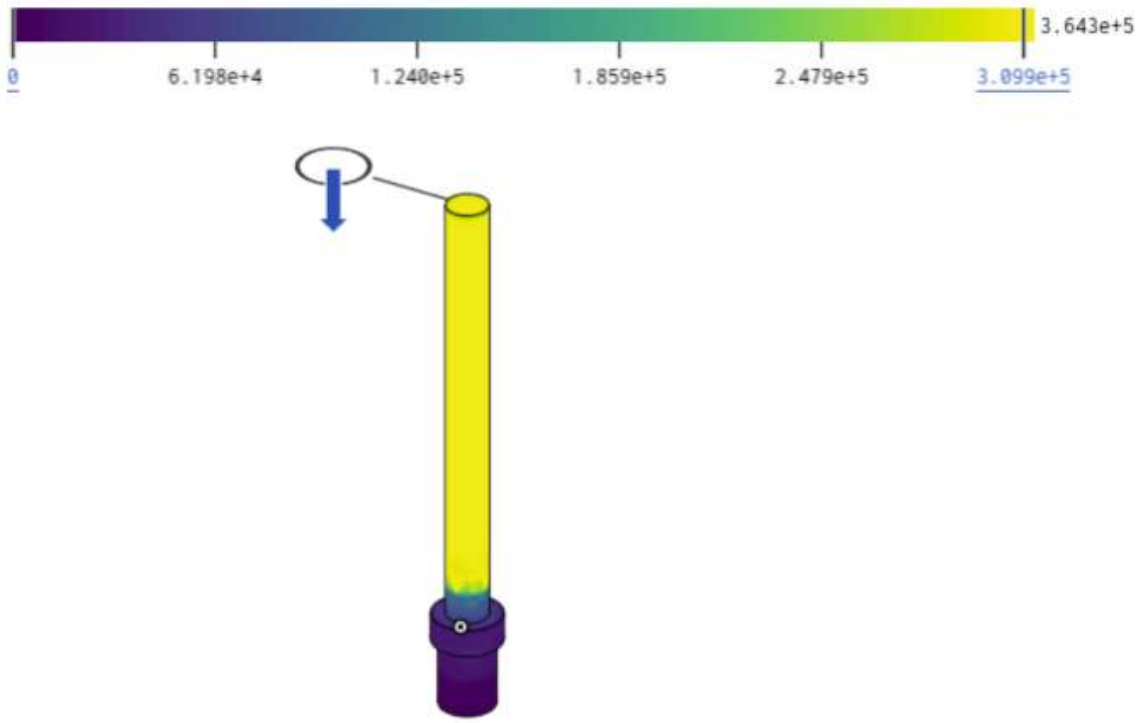
Present: Whole team

Goals: To generate a stress distribution of the device

Content:

- Biopsy press and pressure applicator were simulated in an FEA.
- These parts were selected to be simulated as they are the most susceptible to plastic deformation due to the frequency with which they are used.
- 50 N applied to assembly, 22 N applied to applicator (picked from a range of values)
- Due to the inherently ductile properties of the polycarbonate and PLA used in the final material selection, a von Mises stress analysis was performed to predict the failure criterion





Conclusions/action items:

- The results validated the mechanical strength of both the assembly and the pressure applicator.
- The assembly demonstrated a maximum tolerable load of 1.96×10^4 Pa
- The pressure applicator exhibited a higher load capacity, withstanding up to 3.099×10^5 Pa.
- The components maintained functional integrity

2026/02/05 - 402 Preliminary Presentation

Simon Nam - Mar 21, 2026, 1:16 AM GMT+9

Title: 402 Preliminary Presentation

Date: 2/25/26

Content by: Whole Team

Present: Whole Team

Goals: To complete a preliminary presentation of the design project for 402 initial deliverables

Content:

See attached file below.

Conclusions/action items:

Receive feedback from advisor about the design approach and future goals for this semester

Simon Nam - Mar 21, 2026, 1:16 AM GMT+9

Download

402_-_biopsy_badgers_prelim_presentation.pptx.pdf (3.73 MB)

2026/02/25 - 402 Preliminary Report

Simon Nam - May 03, 2026, 12:56 AM GMT+9

Title: 402 Preliminary Report - Article Draft #1

Date: 2/25/26

Content by: Whole Team

Present: Whole Team

Goals: To complete a preliminary draft of the article

Content:

See attached file below.

Conclusions/action items:

Revise based on advisor feedback and testing data.

RUHI NAGARKATTE - Mar 21, 2026, 12:15 AM GMT+9

Improving the Precision of Small Human Tissue Biopsy Processing

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biopsy_badgers_402_Article_draft1.pdf (8.66 MB)

2026/04/17 - 402 Executive Summary

Gianna Inga - May 04, 2026, 1:13 AM GMT+9

Title: 402 Preliminary Report - Executive Summary

Date: 2026/04/17

Content by: Whole Team

Present: Whole Team

Goals: To write an executive summary for the 402 project to showcase for Design Excellence award

Content:

Current laboratory research into novel burn treatments relies on porcine skin models to analyze wound healing behavior and cellular regeneration. To preserve tissue viability during sample culturing and imaging, subcutaneous fat must be removed to enable the uptake of culture media. Currently, cylindrical biopsy samples are manually secured with tweezers and sliced using a scalpel, which results in uneven cuts, safety risks, and ergonomic discomfort. Commercially available slicing matrices fail to secure samples and are costly. This design provides a shape-tailored, low-cost alternative for accurate and efficient tissue slicing. The Biopsy Press is a crucial tool for improving small tissue processing for researchers across dermatology, plastic surgery, and gastroenterology studies to generate quantifiable results.

The Biopsy Press design consists of a rubber base, tissue slicing matrix, and pressure applicator. The tissue slicing matrix snaps into the rubber base for stability and is constructed from layered polycarbonate components that are secured to a nylon part with pegs. This matrix is a two-well system with guided blade tracks for making horizontal and vertical cuts. Samples are placed in the wells and stabilized using a 3D-printed PLA pressure applicator during slicing.

User survey results led to several design iterations of the Biopsy Press, which improved cutting accuracy, ergonomics, and structural stability. The sample well was positioned to accommodate a #11 surgical blade, while the blade track width and well depth were optimized to reduce angle variability and improve cut precision. The pressure applicator was extended for improved grip, and overall device dimensions were increased to enhance user safety. A rubber base was incorporated to improve traction between the device and lab benchtop. Initial connector designs were replaced with a layered assembly to improve stability, cleanability, and visibility through the implementation of polycarbonate

components.

After design iterations were complete, the design was validated through functionality, sterilization ability, and strength analyses. Users with tissue handling experience completed surveys assessing slicing performance and evaluating sample uniformity. Sterilization was evaluated using a UV-tagged coating, intended to represent the buildup of fat within the device over time. Cleaning protocols involved using ethanol or soap and water, which exhibited the matrix's ability to be cleansed, and autoclaving revealed that the polycarbonate and nylon components maintained structural integrity. FEA confirmed the device withstood expected user-applied loads of 50 N to the main biopsy press and 22 N to the pressure applicator without deformation or component disassembly. Through rigorous testing, the device consistently surpassed previously established performance and quality benchmarks.

The Biopsy Press meets the defined requirements by enabling consistent and controlled fat removal while reducing user variability and tissue damage. Guided cutting tracks constrain the blade motion, improving repeatability. Enclosed blade pathways enhance safety and usability, while nylon and polycarbonate components provide mechanical strength and compatibility with standard sterilization methods. Testing demonstrated improved slice consistency and reduced deformation compared with manual techniques, with strong user survey agreement in terms of blade control, device safety, and ease of use.

The Biopsy Press improves user performance by reducing the skill required for precise biopsy preparation, increasing efficiency and reproducibility. Standardizing the slicing process minimizes the inter-user variability and supports consistent experimental outcomes. The ergonomic, guided design reduces physical strain, while integrated safety features lower injury risk. The device enables faster, more consistent sample preparation that directly supports improved tissue preservation and data reliability.

Conclusions/action items:

Publish on the BME design webpage.

402 - Excellence - 4 - tissue_processing - Executive Summary

[illegible]

Current laboratory research into novel burn treatments relies on porcine skin models to analyze wound healing behavior and cellular regeneration. To preserve tissue viability during sample culturing and imaging, subcutaneous fat must be removed to enable the uptake of culture media. Currently, cylindrical biopsy samples are manually secured with tweezers and sliced using a scalpel, which results in uneven cuts, safety risks, and ergonomic discomfort. Commercially available slicing matrices fail to secure samples and are costly. This design provides a shape-tailored, low-cost alternative for accurate and efficient tissue slicing. The Biopsy Press is a crucial tool for improving small tissue processing for researchers across dermatology, plastic surgery, and gastroenterology studies to generate quantifiable results.

The Biopsy Press design consists of a rubber base, tissue slicing matrix, and pressure applicator. The tissue slicing matrix snaps into the rubber base for stability and is constructed from layered polycarbonate components that are secured to a nylon part with pegs. This matrix is a two-well system with guided blade tracks for making horizontal and vertical cuts. Samples are placed in the wells and stabilized using a 3D-printed PLA pressure applicator during slicing.

User survey results led to several design iterations of the Biopsy Press, which improved cutting accuracy, ergonomics, and structural stability. The sample well was positioned to accommodate a #11 surgical blade, while the blade track width and well depth were optimized to reduce angle variability and improve cut precision. The pressure applicator was extended for improved grip, and overall device dimensions were increased to enhance user safety. A rubber base was incorporated to improve traction between the device and lab benchtop. Initial connector designs were replaced with a layered assembly to improve stability, cleanability, and visibility through the implementation of polycarbonate components.

After design iterations were complete, the design was validated through functionality, sterilization ability, and strength analyses. Users with tissue handling experience completed surveys assessing slicing performance and evaluating sample uniformity. Sterilization was evaluated using a UV-tagged coating, intended to represent the buildup of fat within the device over time. Cleaning protocols involved using ethanol or soap and water, which exhibited the matrix's ability to be cleansed, and autoclaving revealed that the polycarbonate and nylon components maintained structural integrity. FEA confirmed the device withstood expected user-applied loads of 50 N to the main biopsy press and 22 N to the pressure applicator without deformation or component disassembly. Through rigorous testing, the device consistently surpassed previously established performance and quality benchmarks.

The Biopsy Press meets the defined requirements by enabling consistent and controlled fat removal while reducing user variability and tissue damage. Guided cutting tracks constrain the blade motion, improving repeatability. Enclosed blade pathways enhance safety and usability, while nylon and polycarbonate components provide mechanical strength and compatibility with standard sterilization methods. Testing demonstrated improved slice consistency and reduced deformation compared with manual techniques, with strong user survey agreement in terms of blade control, device safety, and ease of use.

The Biopsy Press improves user performance by reducing the skill required for precise biopsy preparation, increasing efficiency and reproducibility. Standardizing the slicing process minimizes the inter-user variability and supports consistent experimental outcomes. The ergonomic, guided design reduces physical strain, while integrated safety features lower injury risk. The device enables faster, more consistent sample preparation that directly supports improved tissue preservation and data reliability.

Download

402_-_Excellence_-_4_-_tissue_processing_-_Executive_Summary_1_.pdf (80.6 kB)

2026/04/24 - 402 Final Poster Presentation

Gianna Inga - May 04, 2026, 1:13 AM GMT+9

Title: 402 Final Poster Presentation

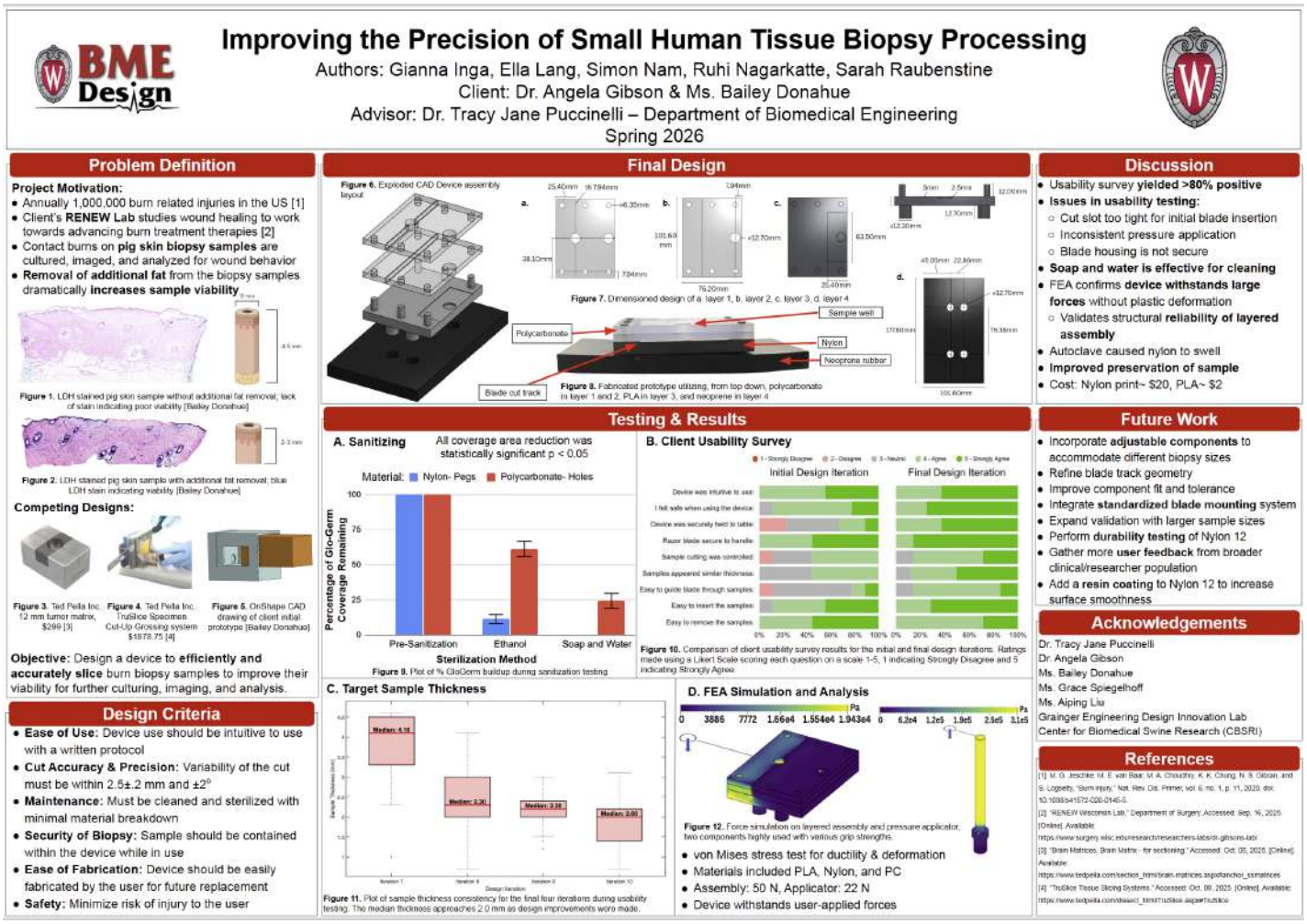
Date: 2026/04/24

Content by: Whole Team

Present: Whole Team

Goals: To give a final poster presentation on BME Poster Session Spring 2026

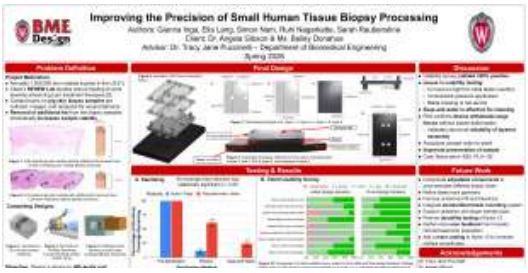
Content:



Conclusions/action items:

Await for judges final award result.

Simon Nam - May 03, 2026, 1:00 AM GMT+9



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402_-_final_poster_biopsy_badgers.pptx.pdf (2.46 MB)

2026/05/03 - 402 Final Report (Journal Article)

Simon Nam - May 04, 2026, 12:30 PM GMT+9

Title: 402 Final Report (Journal Article)

Date: 5/3/2025

Content by: Ruhi

Present: Whole team

Goals: Complete the final report based on advisor feedback

Content:

See attached file below.

Conclusions/action items:

This is the end of this project!

RUHI NAGARKATTE - May 04, 2026, 1:03 PM GMT+9

Improving the Precision of Small Human Tissue Biopsy Processing

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biopsy_badgers_402_Article_final_.pdf (10.1 MB)

2026/01/29 - Progress Report 1

Simon Nam - May 03, 2026, 12:49 AM GMT+9

Title: 402 Progress Report 1

Date: 2026/01/29

Content by: Simon

Present: Whole Team

Goals: To write progress report for the weekly contributions and progress made for the design

Content:

See attached file below.

Conclusions/action items:

Discuss with advisor and clients for guidance and planning for future work and progress

Simon Nam - Mar 21, 2026, 1:06 AM GMT+9

Improving the precision of small human tissue biopsy processing

Date: 1/22/26-1/29/26

Client: Dr. Angelo Gibson
Advisor: Dr. Tracy Jane Pacinelli
Team:
- Ruhi Nagarkatte (Team Leader)
- Ellie Lang (Communication)
- Gianna Inga (BSAC)
- Simon Nam (BWIG)
- Sarah Ibrahemtine (BPAG)

Problem Statement

In the treatment of extensive burns or wounds, patients rely on emerging treatment research in the field of tissue growth and healing. Currently, studies into the healing properties of porcine skin are conducted to visualize how viable epidermis cells migrate over the site of the wound to promote cell regrowth. However, once in a culture, the porcine tissue samples cannot remain viable unless all fat is removed and the cells are able to absorb the culture media. Additionally, this process of creating samples is not standardized, resulting in samples of varying sizes with jagged edges, which limits the efficiency of sample preparation. To solve this, fabricating a tool that incorporates multiple sample slots, with uniform sizing, and a fixed blade will help to streamline research efficiency and produce more viable samples that can be successfully imaged.

Brief Status Update

The team is renewing the project: Improving the precision of small human tissue biopsy processing for the 2026 Spring semester. The team plans to meet with the client on February 2nd, 2026, and has scheduled a weekly meeting with their advisor on Thursdays. Currently, the team is awaiting design feedback from the client regarding the testing they performed over winter break. This feedback will guide the team's semester goals and design plans. Additionally, the team is conducting research into some improvement areas discussed at the end of last semester, such as sterilization.

Summary of Weekly Team Member Design Accomplishments

- Team
  - Arrange and scheduled a time to meet with client (Feb 2nd)
  - Team meeting to discuss plans moving onwards for updating design
- Ruhi Nagarkatte
  - Setup new design notebook
  - Met with team to set and discuss semester goals
  - Conducted research on market forecast for biopsy devices

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402_-_Progress_Report_1.pdf (152 kB)

2026/02/04 - Progress Report 2

Simon Nam - May 03, 2026, 12:50 AM GMT+9

Title: 402 Progress Report 2

Date: 2026/02/04

Content by: Simon

Present: Whole Team

Goals: To write progress report for the weekly contributions and progress made for the design

Content:

See attached file below.

Conclusions/action items:

Discuss with advisor and clients for guidance and planning for future work and progress

Simon Nam - Mar 21, 2026, 1:07 AM GMT+9

Improving the precision of small human tissue biopsy processing

Date: 1/28/26 - 2/4/26

Client: Dr. Angelo Gibson
Advisor: Dr. Tracy Jane Puccinelli
Team:
- Rubi Nagarkatte (Team Leader)
- Ellie Lang (Communication)
- Gianna Inga (BSAC)
- Simon Nam (BWIG)
- Sarah Ibrahemkhan (BPAG)

Problem Statement

In the treatment of extensive burns or wounds, patients rely on emerging treatment research in the field of tissue growth and healing. Currently, studies into the healing properties of porcine skin are conducted to visualize how viable epidermis cells migrate over the site of the wound to promote cell regrowth. However, once in a culture, the porcine tissue samples cannot remain viable unless all fat is removed and the cells are able to absorb the culture media. Additionally, this process of creating samples is not standardized, resulting in samples of varying sizes with jagged edges, which limits the efficiency of sample preparation. To solve this, fabricating a tool that incorporates multiple sample slots, with uniform sizing, and a fixed blade will help to streamline research efficiency and produce more viable samples that can be successfully imaged.

Brief Status Update

The team met with the client on Monday, February 2nd to discuss the results of the testing they conducted with the newest iteration of the biopsy press that was provided to them over winter break. Some of the challenges the team needs to focus on are cutting down to one well to process one sample at a time, increasing the diameter of the well, using nylon for longevity, and adjusting the blade handle for a better fit. Additionally, the team established goals for the next future and summarized them in the preliminary presentation.

Summary of Weekly Team Member Design Accomplishments

- Team
  - Met with the client to discuss results and feedback from the latest iteration
  - Completed & practiced the preliminary presentation for Thursday, 2/5
  - Set up meeting with Grace to discuss future goals for the semester
  - Continued research on sanitization
- Rubi Nagarkatte
  - Attended client meeting to receive feedback on the design
  - Completed assigned portion of the preliminary presentation

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2026/02/11 - Progress Report 3

Simon Nam - May 03, 2026, 12:50 AM GMT+9

Title: 402 Progress Report 3

Date: 2026/02/11

Content by: Simon

Present: Whole Team

Goals: To write progress report for the weekly contributions and progress made for the design

Content:

See attached file below.

Conclusions/action items:

Discuss with advisor and clients for guidance and planning for future work and progress

Simon Nam - Mar 21, 2026, 1:08 AM GMT+9

Improving the precision of small human tissue biopsy processing

Date: 24/26–2/11/26

Client: Dr. Angelo Gibson
Advisor: Dr. Tracy Jane Puccinelli
Team:
- Ruhi Nagarkatte (Team Leader)
- Ellie Lang (Communication)
- Gianna Inga (BSAC)
- Simon Nam (BWIG)
- Sarah Ibrahemtine (BPAG)

Problem Statement

In the treatment of extensive burns or wounds, patients rely on emerging treatment research in the field of tissue growth and healing. Currently, studies into the healing properties of porcine skin are conducted to visualize how viable epidermis cells migrate over the site of the wound to promote cell regrowth. However, once in a culture, the porcine tissue samples cannot remain viable unless all fat is removed and the cells are able to absorb the culture media. Additionally, this process of creating samples is not standardized, resulting in samples of varying sizes with jagged edges, which limits the efficiency of sample preparation. To solve this, fabricating a tool that incorporates multiple sample slots, with uniform sizing, and a fixed blade will help to streamline research efficiency and produce more viable samples that can be successfully imaged.

Brief Status Update

Last week, the team presented past accomplishments and future goals to their advisor. The team also met with Grace, the MedTech, to update her on future plans for the semester and receive feedback on the presentation. Changes were made to the biopsy press to have one well and a new pressure applicator. To be easily machinable, the first three layers will be clear polycarbonate (PC) and the bottom layer will be nylon. Lastly, the team updated testing protocols and finalized a journal to publish an article to.

Summary of Weekly Team Member Design Accomplishments

- Team
  - Met with Grace and Dr. TJP to present the preliminary presentation and goals
  - Redesigned the biopsy press based on the client feedback
  - Updated sanitization, usability, and FEA testing protocols
  - Finalized a journal to publish an article to: ASME Journal of Medical Devices
- Ruhi Nagarkatte
  - Presented preliminary presentation to advisor
  - Updated FEA testing protocol
  - Researched and finalized different journals to publish to

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2026/02/17 - Progress Report 4

Simon Nam - May 03, 2026, 12:50 AM GMT+9

Title: 402 Progress Report 4

Date: 2026/02/17

Content by: Simon

Present: Whole Team

Goals: To write progress report for the weekly contributions and progress made for the design

Content:

See attached file below.

Conclusions/action items:

Discuss with advisor and clients for guidance and planning for future work and progress

Simon Nam - Mar 21, 2026, 1:09 AM GMT+9

Improving the precision of small human tissue biopsy processing

Date: 2/11/26-2/17/26

Client: Dr. Angelo Gibson
Advisor: Dr. Tracy Jane Pacinelli
Team:
- Ruhi Nagarkatte (Team Leader)
- Ella Lang (Communication)
- Gianna Inga (BSAC)
- Simon Nam (BWIG)
- Sarah Ibrahemtine (BPAG)

Problem Statement

In the treatment of extensive burns or wounds, patients rely on emerging treatment research in the field of tissue growth and healing. Currently, studies into the healing properties of porcine skin are conducted to visualize how viable epidermis cells migrate over the site of the wound to promote cell regrowth. However, once in a culture, the porcine tissue samples cannot remain viable unless all fat is removed and the cells are able to absorb the culture media. Additionally, this process of creating samples is not standardized, resulting in samples of varying sizes with jagged edges, which limits the efficiency of sample preparation. To solve this, fabricating a tool that incorporates multiple sample slots, with uniform sizing, and a fixed blade will help to streamline research efficiency and produce more viable samples that can be successfully imaged.

Brief Status Update

The team continued to consolidate research and testing data for the first draft of the article. Additionally, a time was scheduled to meet with the client on Friday, 2/20/26, to get feedback on the user interface with the design and observe tissue sampling methods. The team is hoping to get the materials for the new iteration of the biopsy press and start machining the week of 2/23/26.

Summary of Weekly Team Member Design Accomplishments

- Team
  - Scheduled a client visit for testing with tissue samples on 2/20/26
  - Continued to research sterilization methods and materials for the final design
  - Finalized material selection for ordering
- Ruhi Nagarkatte
  - Created journal article outline to divide among team members
  - Gathered research and potential testing data for the article
  - Helped plan a tissue testing time with the client
  - Prepared Progress Report #4
- Ella Lang

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2026/02/25 - Progress Report 5

Simon Nam - May 03, 2026, 12:50 AM GMT+9

Title: 402 Progress Report 5

Date: 2026/02/25

Content by: Simon

Present: Whole Team

Goals: To write progress report for the weekly contributions and progress made for the design

Content:

See attached file below.

Conclusions/action items:

Discuss with advisor and clients for guidance and planning for future work and progress

Simon Nam - Mar 21, 2026, 1:10 AM GMT+9

Improving the precision of small human tissue biopsy processing

Date: 2/18/26-2/24/26

Client: Dr. Angelo Gibson
Advisor: Dr. Tracy Jane Puccinelli
Team:
- Ruhi Nagarkatte (Team Leader)
- Ella Lang (Communicator)
- Gianna Inga (BSAC)
- Simon Nam (BWIG)
- Sarah Rankenstine (BPAG)
- Grace Spiegelhoff (MedTech)

Problem Statement

In the treatment of extensive burns or wounds, patients rely on emerging treatment research in the field of tissue growth and healing. Currently, studies into the healing properties of porcine skin are conducted to visualize how viable epidermis cells migrate over the site of the wound to promote cell regrowth. However, once in a culture, the porcine tissue samples cannot remain viable unless all fat is removed and the cells are able to absorb the culture media. Additionally, this process of creating samples is not standardized, resulting in samples of varying sizes with jagged edges, which limit the efficiency of sample preparation. To solve this, fabricating a tool that incorporates multiple sample slots, with uniform sizing, and a fixed blade will help to streamline research efficiency and produce more viable samples that can be successfully imaged.

Brief Status Update

The team continued to consolidate research and completed the first draft of the article. The team met with the client on Friday, 2/20/26, to discuss the new design and practice tissue sampling methods. Additionally, two polycarbonate sheets were ordered and received from Grainger. The team began machining the PC on Wednesday, 2/25/26, and is hoping to finalize the design by early next week.

Summary of Weekly Team Member Design Accomplishments

- Team
  - Met with the client to discuss and try out the new design
  - Ordered & picked up the polycarbonate slabs
  - Began brainstorming the PC sheets & scheduled a waterjet appointment
- Ruhi Nagarkatte
  - Met with the client to discuss and try out the new design
  - Picked up polycarbonate sheets from the client
  - Began machining the polycarbonate for the layered design
  - Completed assigned sections of the journal article draft

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2026/03/05 - Progress Report 6

Simon Nam - May 03, 2026, 12:50 AM GMT+9

Title: 402 Progress Report 6

Date: 2026/03/05

Content by: Simon

Present: Whole Team

Goals: To write progress report for the weekly contributions and progress made for the design

Content:

See attached file below.

Conclusions/action items:

Discuss with advisor and clients for guidance and planning for future work and progress

Simon Nam - Mar 21, 2026, 1:12 AM GMT+9

Improving the precision of small human tissue biopsy processing

Date: 2/23/26 - 3/4/2026

Client: Dr. Angelo Gibson
Advisor: Dr. Tracy Jane Puccinelli
Team:
- Ruhi Nagarkatte (Team Leader)
- Ella Lang (Communicator)
- Gianna Inga (BSAC)
- Simon Nam (BWIG)
- Sarah Rankenstine (BPAG)
- Grace Spiegelhoff (MedTech)

Problem Statement

In the treatment of extensive burns or wounds, patients rely on emerging treatment research in the field of tissue growth and healing. Currently, studies into the healing properties of porcine skin are conducted to visualize how viable epidermis cells migrate over the site of the wound to promote cell regrowth. However, once in a culture, the porcine tissue samples cannot remain viable unless all fat is removed and the cells are able to absorb the culture media. Additionally, this process of creating samples is not standardized, resulting in samples of varying sizes with jagged edges, which limit the efficiency of sample preparation. To solve this, fabricating a tool that incorporates multiple sample slots, with uniform sizing, and a fixed blade will help to streamline research efficiency and produce more viable samples that can be successfully imaged.

Brief Status Update

The team has been fabricating and finalizing the design over the last week. A waterjet was used to machine the polycarbonate sheets since the bandsaw was not precise enough. Additionally, a new 3D print was made that fuses the bottom two layers together to provide a more accurate cut

Summary of Weekly Team Member Design Accomplishments

- Team
  - Set up meeting with client and date to test the design with tissue samples
  - Combined and printed the bottom two layers of the design
  - Machined the polycarbonate sheets via waterjet
- Ruhi Nagarkatte
  - Assisted in waterjet planning and fabrication
  - Selected dates for client meeting and tissue testing
  - Prepared progress report #6
- Ella Lang
  - Organized the client meeting on March 4th and the upcoming tissue testing
  - Assisted in waterjet fabrication planning

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2026/03/11 - Progress Report 7

Simon Nam - May 03, 2026, 12:50 AM GMT+9

Title: 402 Progress Report 7

Date: 2026/03/11

Content by: Simon

Present: Whole Team

Goals: To write progress report for the weekly contributions and progress made for the design

Content:

See attached file below.

Conclusions/action items:

Discuss with advisor and clients for guidance and planning for future work and progress

Simon Nam - Mar 21, 2026, 1:13 AM GMT+9

Improving the precision of small human tissue biopsy processing

Date: 3/4/26 - 3/11/26

Client: Dr. Angelo Gibson
Advisor: Dr. Tracy Jane Puccinelli
Team:
- Ruhi Nagarkatte (Team Leader)
- Ella Lang (Communicator)
- Gianna Inga (BSAC)
- Simon Nam (BWIG)
- Sarah Rankenstine (BPAG)
- Grace Spiegelhoff (MedTech)

Problem Statement

In the treatment of extensive burns or wounds, patients rely on emerging treatment research in the field of tissue growth and healing. Currently, studies into the healing properties of porcine skin are conducted to visualize how viable epidermis cells migrate over the site of the wound to promote cell regrowth. However, once in a culture, the porcine tissue samples cannot remain viable unless all fat is removed and the cells are able to absorb the culture media. Additionally, this process of creating samples is not standardized, resulting in samples of varying sizes with jagged edges, which limit the efficiency of sample preparation. To solve this, fabricating a tool that incorporates multiple sample slots, with uniform sizing, and a fixed blade will help to streamline research efficiency and produce more viable samples that can be successfully imaged.

Brief Status Update

The team has been testing the finalized design over the past weeks. The new design incorporating multiple polycarbonate layers cut from waterjet was utilized for visibility enhancement for clients while cutting the samples. Few modifications still had to be made for the design based on clients' further feedback. More protocol surveys will be conducted with users of the device throughout the testing session with the clients.

Summary of Weekly Team Member Design Accomplishments

- Team
  - Met with the client and conducted protocol survey of the device
  - Revised the journal draft from the preliminary report feedback given
  - Arranged another testing meeting with the client
- Ruhi Nagarkatte
  - Finalized and machined the pieces of the design with the waterjet
  - Met with client and tested the new design with the porcine samples
  - 3D Printed some base designs in PLA
  - Revised journal based on advisor feedback

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2026/03/18 - Progress Report 8

Simon Nam - May 03, 2026, 12:51 AM GMT+9

Title: 402 Progress Report 8

Date: 2026/03/18

Content by: Simon

Present: Whole Team

Goals: To write progress report for the weekly contributions and progress made for the design

Content:

See attached file below.

Conclusions/action items:

Discuss with advisor and clients for guidance and planning for future work and progress

Simon Nam - Mar 21, 2026, 1:14 AM GMT+9

Improving the precision of small human tissue biopsy processing

Date: 3/12/26 - 3/18/2026

Client: Dr. Angelo Gibson
Advisor: Dr. Tracy Jane Puccinelli
Team:
- Ruhi Nagarkatte (Team Leader)
- Ella Lang (Communicator)
- Gianna Inga (BSAC)
- Simon Nam (BWIG)
- Sarah Rankenstine (BPAG)
- Grace Spiegelhoff (MedTech)

Problem Statement

In the treatment of extensive burns or wounds, patients rely on emerging treatment research in the field of tissue growth and healing. Currently, studies into the healing properties of porcine skin are conducted to visualize how viable epidermis cells migrate over the site of the wound to promote cell regrowth. However, once in a culture, the porcine tissue samples cannot remain viable unless all fat is removed and the cells are able to absorb the culture media. Additionally, this process of creating samples is not standardized, resulting in samples of varying sizes with jagged edges, which limit the efficiency of sample preparation. To solve this, fabricating a tool that incorporates multiple sample slots, with uniform sizing, and a fixed blade will help to streamline research efficiency and produce more viable samples that can be successfully imaged.

Brief Status Update

The team has been testing the finalized design over the past week. The latest testing results showed an average of thickness variation within ± 0.3 mm, which indicated better outcomes than previous designs. The final design will now incorporate nylon for the base component with few additional modifications based on its material property for improved, secured assembly based on previous design evaluation and feedback obtained.

Summary of Weekly Team Member Design Accomplishments

- Team
  - Conducted mass device testing with clients
  - Revised the journal draft from the preliminary report feedback given
  - Reprinted the final design with nylon
  - Conducted further analysis of survey data and FEA
- Ruhi Nagarkatte
  - Conducted design testing with clients
  - Started to analyze usability testing data
  - Began simulating forces on the components of the biopsy press

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2026/03/25 - Progress Report 9

Simon Nam - May 03, 2026, 12:52 AM GMT+9

Title: 402 Progress Report 9

Date: 2026/03/25

Content by: Simon

Present: Whole Team

Goals: To write progress report for the weekly contributions and progress made for the design

Content:

See attached file below.

Conclusions/action items:

Discuss with advisor and clients for guidance and planning for future work and progress

Simon Nam - May 03, 2026, 12:52 AM GMT+9

Improving the precision of small human tissue biopsy processing

Date: 3/18/26-3/23/26

Client: Dr. Angelo Gibson
Advisor: Dr. Tracy Jane Puccinelli
Team:
- Rishi Nagarkatte (Team Leader)
- Ella Lang (Communicator)
- Gianna Inga (BSAC)
- Simon Nam (BWIG)
- Sarah Rankenhorne (BPAG)
- Grace Spiegelhoff (MedTech)

Problem Statement

In the treatment of extensive burns or wounds, patients rely on emerging treatment research in the field of tissue growth and healing. Currently, studies into the healing properties of porcine skin are conducted to visualize how viable epidermis cells migrate over the site of the wound to promote cell regrowth. However, once in a culture, the porcine tissue samples cannot remain viable unless all fat is removed and the cells are able to absorb the culture media. Additionally, this process of creating samples is not standardized, resulting in samples of varying sizes with jagged edges, which limit the efficiency of sample preparation. To solve this, fabricating a tool that incorporates multiple sample slots, with uniform sizing, and a fixed blade will help to streamline research efficiency and produce more viable samples that can be successfully imaged.

Brief Status Update

The team finished the print in nylon and is waiting for the print to finish. Sterilizability testing was conducted on the polycarbonate pieces using GluGerm and nUV light. A final testing date with porcine samples was scheduled for April 10th with the client. Additionally, the team started analyzing data from the mobility test and FEA.

Summary of Weekly Team Member Design Accomplishments

- Team
  - Completed sterilization testing on the PC pieces
  - Scheduled a final testing date with porcine samples with the nylon base
  - Starting analyzing results from the completed testing
- Rishi Nagarkatte
  - Finalized 3D nylon print at the makerspace
  - Updated LabArchives with protocols, reports, and other team activities
  - Assisted in selecting a final testing date with the client
  - Conducted preliminary FEA testing
- Ella Lang

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biopsy_badgers_402_Progress_Report_9_1_.pdf (191 kB)

2026/04/08 - Progress Report 10

Simon Nam - May 03, 2026, 12:54 AM GMT+9

Title: 402 Progress Report 10

Date: 2026/04/08

Content by: Simon

Present: Whole Team

Goals: To write progress report for the weekly contributions and progress made for the design

Content:

See attached file below.

Conclusions/action items:

Discuss with advisor and clients for guidance and planning for future work and progress

Simon Nam - May 03, 2026, 12:54 AM GMT+9

Improving the precision of small human tissue biopsy processing

Date: 1/25/26-4/8/26

Client: Dr. Angelo Gibson
Advisor: Dr. Tracy Jane Puccinelli
Team:
- Ruhi Nagarkatte (Team Leader)
- Ella Lang (Communicator)
- Gianna Inga (BSAC)
- Simon Nam (BWIG)
- Sarah Rankenstine (BPAG)
- Grace Spiegelhoff (MedTech)

Problem Statement

In the treatment of extensive burns or wounds, patients rely on emerging treatment research in the field of tissue growth and healing. Currently, studies into the healing properties of porcine skin are conducted to visualize how viable epidermis cells migrate over the site of the wound to promote cell regrowth. However, once in a culture, the porcine tissue samples cannot remain viable unless all fat is removed and the cells are able to absorb the culture media. Additionally, this process of creating samples is not standardized, resulting in samples of varying sizes with jagged edges, which limit the efficiency of sample preparation. To solve this, fabricating a tool that incorporates multiple sample slots, with uniform sizing, and a fixed blade will help to streamline research efficiency and produce more viable samples that can be successfully imaged.

Brief Status Update

The team has been finalizing testing over the past couple of weeks. Images from the sterilization testing were preliminarily analyzed in ImageJ. The FEA analysis on the connectors and layers of the biopsy press was conducted. Additionally, a preliminary draft of the executive summary was completed. The team is preparing the final designs, with nylon as the base, for mobility testing with the client on 4/10.

Summary of Weekly Team Member Design Accomplishments

- Team
  - Completed sterilization testing and analysis on ImageJ
  - Completed first draft of the executive summary
  - Conducted an FEA on PC and nylon layers
- Ruhi Nagarkatte
  - Completed assigned portion of the executive summary
  - Conducted an FEA on the PC and nylon layers
  - Completed required trainings for autoclave use
- Ella Lang
  - Completed sterilization test procedure and analysis

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2026/04/16 - Progress Report 11

ELLA LANG - May 04, 2026, 11:49 AM GMT+9

Title: 402 Progress Report 11

Date: 2026/04/16

Content by: Simon and Ella

Present: Whole Team

Goals: To write progress report for the weekly contributions and progress made for the design

Content:

See attached file below.

Conclusions/action items:

Discuss with advisor and clients for guidance and planning for future work and progress

ELLA LANG - May 04, 2026, 11:49 AM GMT+9

Improving the precision of small human tissue biopsy processing

Date: 4/16-4/23

Client: Dr. Angelo Gibson
Advisor: Dr. Tracy Jane Puccinelli
Team:
- Ruhi Nagarkatte (Team Leader)
- Ella Lang (Communicator)
- Gianna Inga (BSAC)
- Simon Nam (BWIG)
- Sarah Rankenhorne (BPAG)
- Grace Spiegelhoff (MedTech)

Problem Statement

In the treatment of extensive burns or wounds, patients rely on emerging treatment research in the field of tissue growth and healing. Currently, studies into the healing properties of porcine skin are conducted to visualize how viable epidermis cells migrate over the site of the wound to promote cell regrowth. However, once in a culture, the porcine tissue samples cannot remain viable unless all fat is removed and the cells are able to absorb the culture media. Additionally, this process of creating samples is not standardized, resulting in samples of varying sizes with jagged edges, which limit the efficiency of sample preparation. To solve this, fabricating a tool that incorporates multiple sample slots, with uniform sizing, and a fixed blade will help to streamline research efficiency and produce more viable samples that can be successfully imaged.

Brief Status Update

The team has finalized the Biopsy Press design and has printed in both PLA and Nylon. This past week has been spent finalizing testing results, specifically, sample thickness, user survey and sanitization results. On 4/15 autoclave testing was completed, resulting in no damage or warpage to the device. Additionally, each team member has been working on the final poster and revising the executive summary. The team plans to continue to refine the final deliverables for upcoming deadlines.

Summary of Weekly Team Member Design Accomplishments

- Team
  - Completed all the testing for the final device
  - Completed executive summary
  - Completed rough draft of the final poster presentation
- Ruhi Nagarkatte
  - Completed testing with the client with the nylon base layer
  - Completed assigned section of final report
  - Printed PLA base layer
  - Tested nylon and polycarbonate with the autoclave

Download

biopsy_badgers_402_Progress_Report_11.pdf (189 kB)

2026/04/23 - Progress Report 12

ELLA LANG - May 04, 2026, 11:50 AM GMT+9

Title: 402 Progress Report 12

Date: 2026/04/23

Content by: Ella

Present: Whole Team

Goals: To write progress report for the weekly contributions and progress made for the design

Content:

See attached file below.

Conclusions/action items:

Discuss with advisor and clients for guidance and planning for future work and progress

ELLA LANG - May 04, 2026, 11:50 AM GMT+9

Improving the precision of small human tissue biopsy processing

Date: 4/15/26-4/22/26

Client: Dr. Angelo Gibson
Advisor: Dr. Tracy Jane Puccinelli
Team:
- Ruhi Nagarkatte (Team Leader)
- Ella Lang (Communicator)
- Gianna Inga (BSAC)
- Simon Nam (BWIG)
- Sarah Rankenstine (BPAG)
- Grace Spiegelhoff (MedTech)

Problem Statement

In the treatment of extensive burns or wounds, patients rely on emerging treatment research in the field of tissue growth and healing. Currently, studies into the healing properties of porcine skin are conducted to visualize how viable epidermis cells migrate over the site of the wound to promote cell regrowth. However, once in a culture, the porcine tissue samples cannot remain viable unless all fat is removed and the cells are able to absorb the culture media. Additionally, this process of creating samples is not standardized, resulting in samples of varying sizes with jagged edges, which limit the efficiency of sample preparation. To solve this, fabricating a tool that incorporates multiple sample slots, with uniform sizing, and a fixed blade will help to streamline research efficiency and produce more viable samples that can be successfully imaged.

Brief Status Update

In the past week, the team worked on analyzing the results from the usability, sterilizability, thickness consistency, and FEA testing. Additionally, the team completed final revisions of the executive summary and poster presentation. A new PLA base was printed to demonstrate the final design during the poster presentation. The team is ready to wrap up the semester and pass the final design off to the client in the next week.

Summary of Weekly Team Member Design Accomplishments

- Team
  - Completed and analyzed testing results
  - Completed final executive summary
  - Completed and printed final poster presentation
  - 3D printed new PLA base
- Ruhi Nagarkatte
  - 3D printed new PLA base
  - Completed assigned portion of the final poster presentation
  - Analyzed FEA results on the assembly and applicator

Download

biopsy_badgers_402_Progress_Report_12.pdf (196 kB)

01/29/2026 - Biopsy Device Market

RUHI NAGARKATTE - Jan 30, 2026, 5:53 AM GMT+9

Title: Biopsy Device Market: Key Players, Revenue Forecasts, and Analysis

Date: 1/29/26

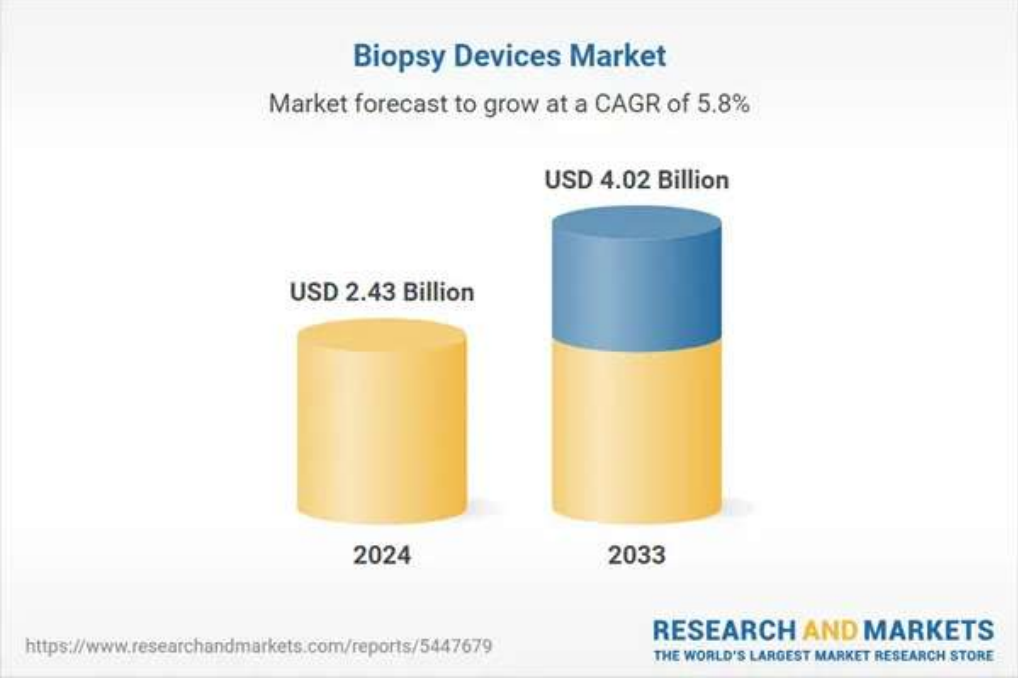
Content by: Ruhi Nagarkatte

Present: NA

Goals: To understand the growth market with biopsy processing devices

Content:

- Biopsy device market is expected to grow $1.8 billion from 2024 to 2033 with a CAGR (compound annual growth rate) of 5.75%
- Drivers of this include: increasing need for personalized care, the increasing prevalence of cancer and other diseases, and the need for minimally invasive treatments to enhance patient comfort and reduce recovery times
- biopsy equipment is crucial for disease identification and making early diagnosis and correct detection possible, allowing for timely and suitable treatment strategies.
- their role in modern medicine is huge!
    - Patient comfort, guiding treatment, and improving patient care
- revenue analysis: cardinal health, Hologic, Danaher Corp, BD, Olympus, Medtronic, Argon, Cook medical



S. Ghosh, “Biopsy Device Market Size and Share Forecast Outlook 2025 to 2035,” *Futuremarketinsights.com*, Oct. 23, 2025. https://www.futuremarketinsights.com/reports/biopsy-device-market (accessed Jan. 29, 2026).

Conclusions/action items:

A market analysis/ forecast for biopsy devices will help us quantify the commercial potential of our design. This research will help us improve certain areas of the design to make it more marketable.

2/25/26 - Use of Bandsaw in Polycarbonate Applications

RUHI NAGARKATTE - Mar 20, 2026, 11:52 PM GMT+9

Title: Machining Polycarbonate - Bandsaw Method

Date: 2/25/26

Content by: Ruhi

Present: NA

Goals: To learn fabrication and machining techniques that involve a bandsaw

Content:

- Bandsaw is an effective method for cutting PC, especially when there are irregular shapes or curves

- use a fine toothed blade (10-18 tpi) and a speed of 2500-3000 ft/min to achieve smooth edges

- Avoid melting and warping by maintaining a moderate feed rate that also prevents overheating

- this also avoids vibration

Avoid intersecting cuts

[1] art@vulcansonco.com, “How to Cut Polycarbonate Sheets: Tips, Tools, and Techniques,” *Vulcan Plastics*, Aug. 03, 2022. https://www.twpolycarbonate.com/polycarbonate-sheets-how-to-cut/ (accessed Mar. 20, 2026). [2] “Cutting Polycarbonate: The Complete Guide,” *Wee Tect*. https://www.weetect.com/cutting-polycarbonate/

Conclusions/action items:

- Review Bandsaw fabrication protocol

- Brush up on your bandsaw knowledge!

3/4/2026 - Use of Waterjet in Polycarbonate applications

RUHI NAGARKATTE - Mar 21, 2026, 12:03 AM GMT+9

Title: Using a Waterjet to Machine Polycarbonate

Date: 3/4/2026

Content by: Ruhi

Present: NA

Goals: To learn how to waterjet PC and if it's a better method than using a bandsaw

Content:

- ideal, cold-cutting process

- high precision, within +- 0.1 mm: avoids melting, cracking, or generating hazardous fumes

- great for complex and thick slabs: up to 250 mm; can produce clean, smooth edges

- no thermal damage or distortion or warpage!

- seems superior to bandsawing, in terms of accuracy and precision

[1] Chief Delphi, “Waterjetting polycarbonate question,” *Chief Delphi*, Feb. 12, 2022. https://www.chiefdelphi.com/t/waterjetting-polycarbonate-question/402861 (accessed Mar. 20, 2026). [2] W. Team, “Creating a Polycarbonate Tool Guard with a CNC Waterjet,” *WAZER*, Jan. 09, 2023. https://wazer.com/learn/how-to/waterjet-cutting-polycarbonate/ (accessed Mar. 20, 2026).

Conclusions/action items:

- Going forward, let's use the waterjet to machine the PC; it is more precise

- Book an appointment with the makerspace to use the waterjet.

10/25/25: CITI- Human Subjects Training Certificate

RUHI NAGARKATTE - Dec 10, 2025, 11:00 PM GMT+9

Download

citiCompletionCertificate_15019030_73199427.pdf (78.1 kB)

10/23/25 - Bloodborne Pathogens Research Training

RUHI NAGARKATTE - Dec 10, 2025, 10:57 PM GMT+9

Download

Screenshot_2025-10-23_152017.png (82.5 kB)

3/19/36 - Cryogen Safety Training

RUHI NAGARKATTE - Mar 21, 2026, 12:12 AM GMT+9

Title: Cryogen Safety Training

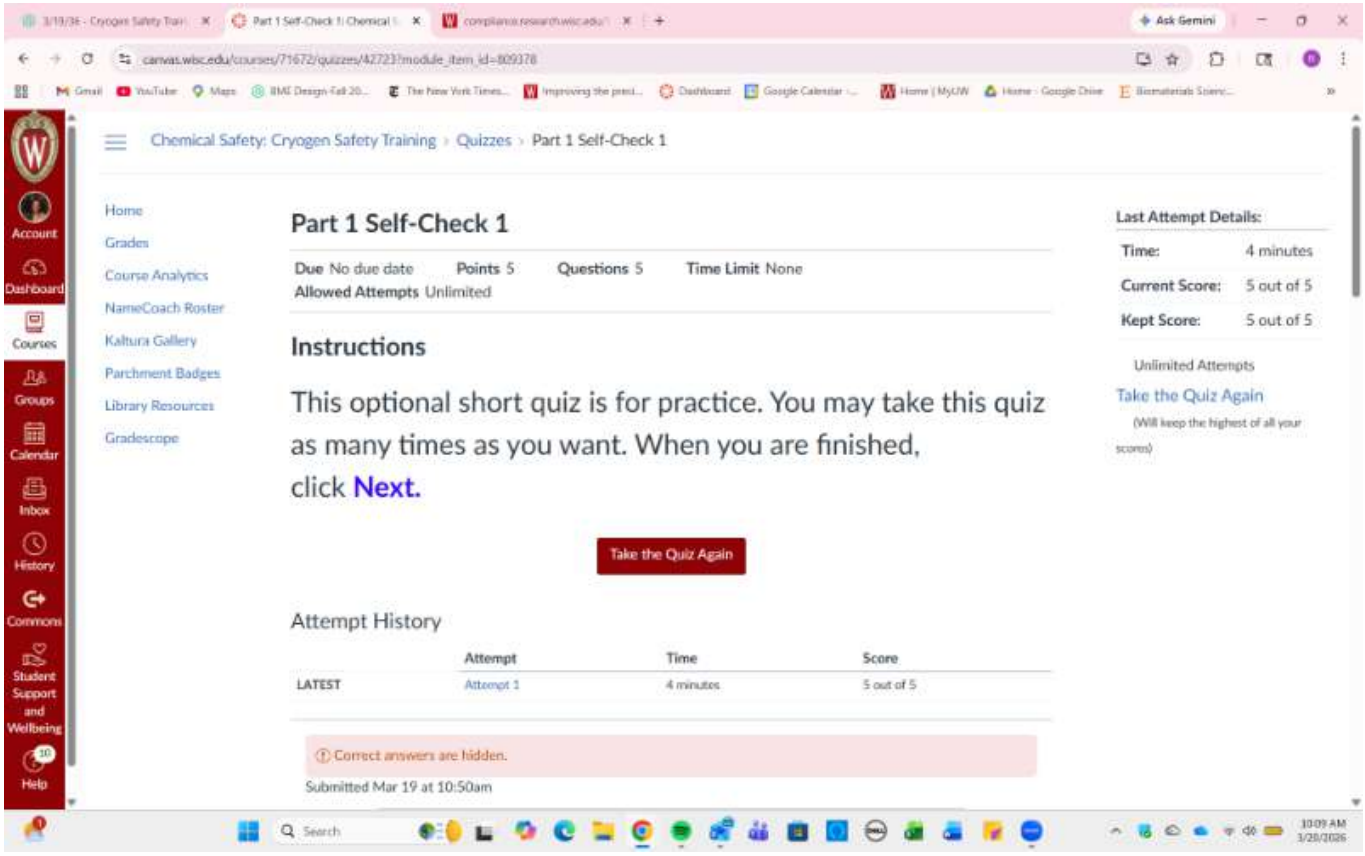
Date: 3/19/2026

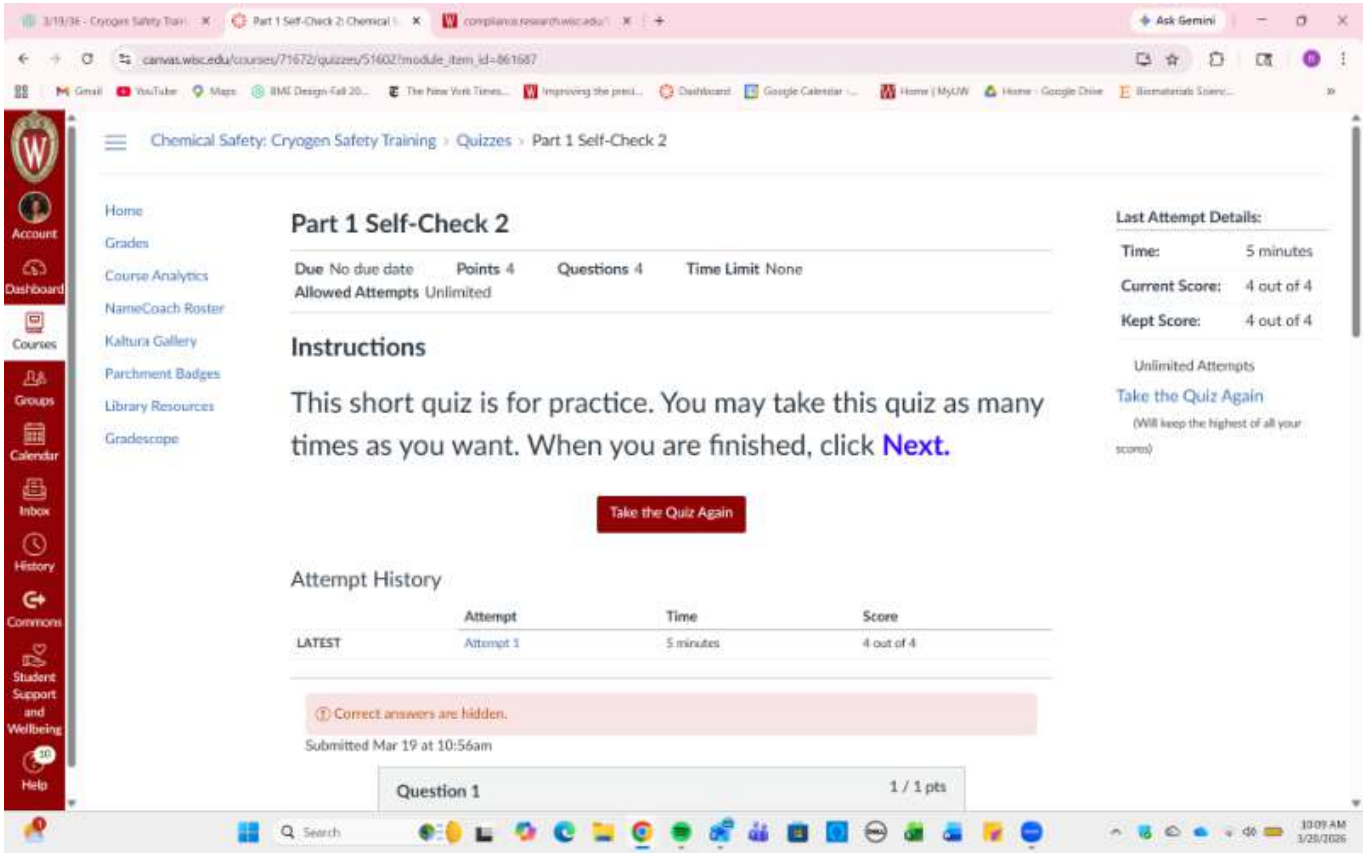
Content by: Ruhi

Present: NA

Goals: To get trained on cryogen safety to access the autoclave

Content:





Conclusions/action items:

- Cryogen Safety Training certification

- Update this with the certificate from TILT when it updates

- Need this for autoclave access

RUHI NAGARKATTE - Apr 09, 2026, 4:12 AM GMT+9


This certifies that Ruhi Nagarkatte has completed training for the following course(s):

Course	Assignment	Completion	Expiration
Biosafety 102: Bloodborne Pathogens for Laboratory and Research	Biosafety 102: Bloodborne Pathogens Safety in Research Quiz 2025	10/25/2025	10/25/2026
Biosafety 106: Autoclave Use	Biosafety 106: Autoclave Use: Safety and Efficacy - Verification Quiz	3/19/2026	No Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	3/9/2024	3/9/2029
Chemical Safety: Cryogen Safety Training	Part 1 Final Quiz	4/8/2026	4/8/2031
Chemical Safety: Cryogen Safety Training	Part 2 Final Quiz	4/8/2026	4/8/2031
Chemical Safety: The OSHA Lab Standard	Final Quiz	3/9/2024	
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	10/25/2025	10/25/2028

Data Last Imported: 04/08/2026 01:56 PM

Download

Screenshot_2026-04-08_141240.png (106 kB)

3/19/36 - Autoclave Use Training

RUHI NAGARKATTE - Mar 21, 2026, 12:06 A

Title: Autoclave Use Training

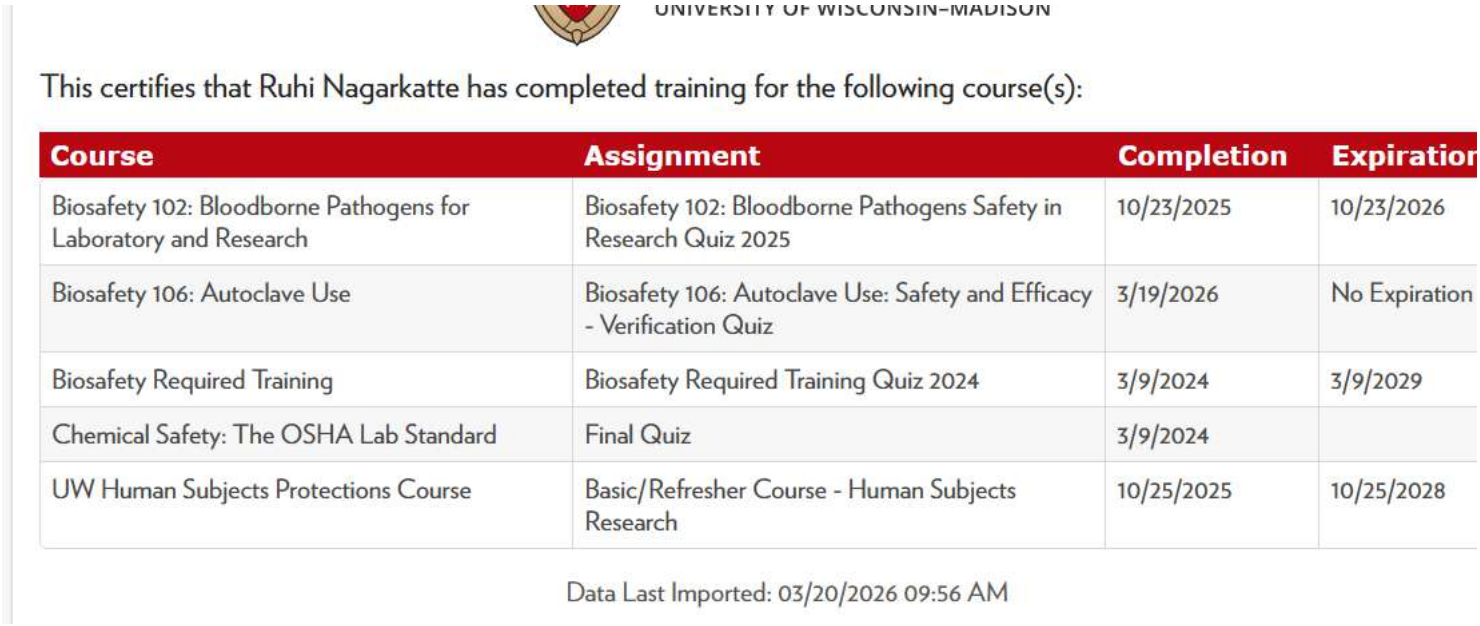
Date: 3/19/26

Content by: Ruhi

Present: NA

Goals: To learn how to use the autoclave

Content:



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This certifies that Ruhi Nagarkatte has completed training for the following course(s):

Course	Assignment	Completion	Expiration
Biosafety 102: Bloodborne Pathogens for Laboratory and Research	Biosafety 102: Bloodborne Pathogens Safety in Research Quiz 2025	10/23/2025	10/23/2026
Biosafety 106: Autoclave Use	Biosafety 106: Autoclave Use: Safety and Efficacy - Verification Quiz	3/19/2026	No Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	3/9/2024	3/9/2029
Chemical Safety: The OSHA Lab Standard	Final Quiz	3/9/2024	
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	10/25/2025	10/25/2028

Data Last Imported: 03/20/2026 09:56 AM

Conclusions/action items:

This will be valuable for one area of our sterilizability testing when we use the autoclave with the nylon base.

- Get room access to the autoclave room!

3/6/26 - Tong Lecture

RUHI NAGARKATTE - Mar 21, 2026, 12:38 AM GMT+9

Title: Tong Lecture by Professor Justin Williams

Date: 3/6/2026

Content by: Ruhi

Present: NA

Goals: To learn about Prof. Williams path to commercialization and innovation

Content:

- Unconventional path to engineering and stem - he didn't expect it
- Specializes in micro and nano technology in relation to neurology
- Focus on neurological disease and injury: Epilepsy, stroke, alzheimers, TBI
- Startups take time to build: consistency and persistency is important! Don't give up
- His project that started off simple for incisions in procedures ended up taking off and was impactful
- His work has been in greys anatomy!

Conclusions/action items:

- I think this was a really interesting lecture because I am really interested in the intersection of medtech and neuro - applications. Prof. Williams has experiences that span a lot of neurological problems and has been very successful in launching many solutions for these problems.
- I also liked hearing about his experience in startups; I think this would be a really interesting route for me to take in my career. One of my internships was at a startup incubator and I worked closely with this hydrocephalus startup, so it was really fun connecting the two.

2026/01/29 - Applications of PLA in Modern Medicine

SARAH RAUBENSTINE - Jan 30, 2026, 6:17 AM GMT+9

Title: Applications of PLA in Modern Medicine

Date: 1/29/26

Content by: Sarah Raubenstine

Goals: Learn about the use of PLA in medical settings

Content:

- PLA (Polylactic acid) a versatile biopolymer
  - biodegradable thermoplastic
  - applications in tissue engineering regenerative medicine, cardiac, dental, orthopedic uses
- Rapid prototyping and efficient manufacturing in 3D printed constructs
  - rapidly manufacture medical equipment
  - rapid production of PPE
- PLA can be derived from renewable resources and its degradation products are non-toxic to humans and the environment
- Varying mechanical properties by molecular weight, degree of crystallinity, and on a more macro scale, the infill of a product, the user can modify the PLA polymer backbone to achieve desired properties
  - improved mechanical properties with a semi-crystalline PLA rather than an amorphous assembly
  - semi-crystalline has modulus of 3 GPa, tensile of 50-70 MPa
  - Poor toughness, can be quire brittle, 10% elongation to breakage
    - limits the usage of PLA in fixation plates and screws
- High versatility, can be used with several fabricaiton methods, and additives can be incorporated to get different physical properties
- Polymer degredation rate will increase with an increasingly hydrophilic material, PLLA has a slower degredation rate than PDLLA due to regions of crystallinity
  - device geometry will impact biodegradation rate, relating to the surface area present to the solution of the bulk material
  - degredation rate will further decrease with higher molecular weight
  - Semicrystalline is less susceptible to degradation than amorphous, less hydrolysis
  - Basic molecules can neutralize carboxyl end groups and enhance degradation through base catalysis
  - Plasticizers increase water diffusion increasing degradation rate
  - Basically, degradation rate dependent on a lot of different factors
  - PLA is not soluble in water, alcohols, ethyl acetate, or linear hydrocarbons
- PLA can remain in vivo for 3-5 years, with degradation rate potentially accelerated with higher temperatures and acidity
  - proteins and cells can exhibit limited surface interaction with PLA due to its hydrophobicity, may instigate an inflammatory response of local tissue
- Article explores many applications of PLA in devices

Conclusions/action items: The main advantages of PLA in modern medicine lie in its ease of fabrication through 3D printing and its rapid prototyping abilities. The material itself is not ideal for longevity.

[1] V. DeStefano, S. Khan, and A. Tabada, “Applications of PLA in Modern Medicine,” *Engineered Regeneration*, vol. 1, no. 1, pp. 76–87, 2020, doi: https://doi.org/10.1016/j.engreg.2020.08.002.

2026/01/29 - Assessing skin viability

SARAH RAUBENSTINE - Jan 30, 2026, 5:57 AM GMT+9

Title: Methods for assessing skin viability in research

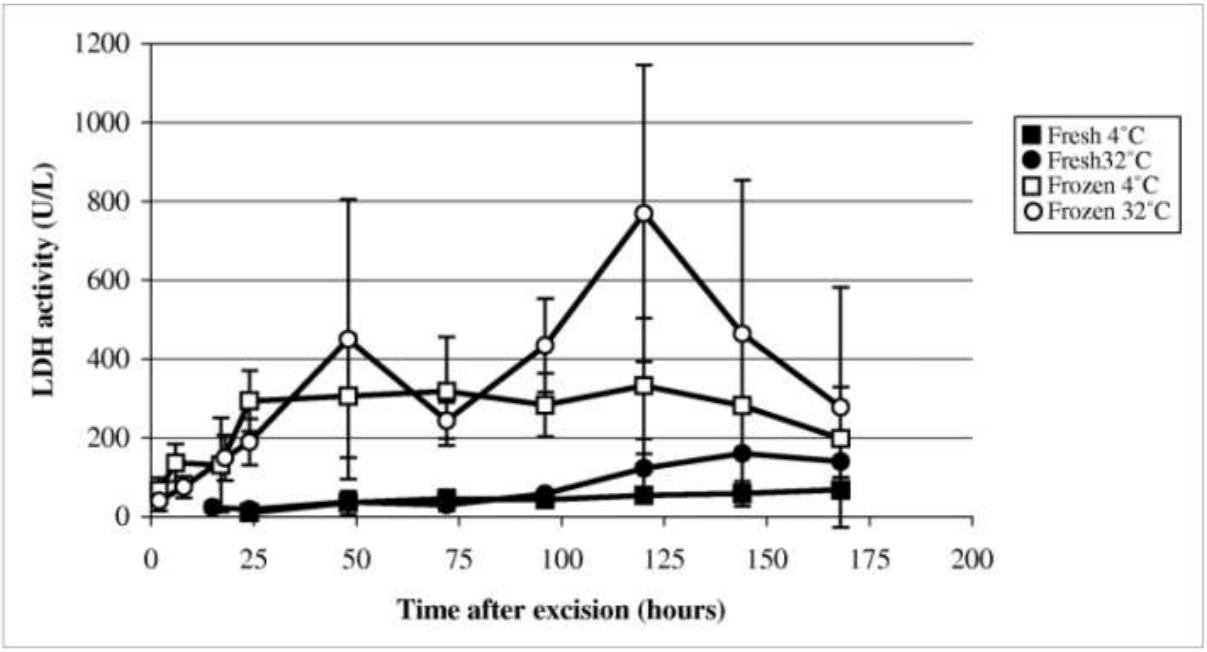
Date: 1/29/26

Content by: Sarah Raubenstine

Goals: Look into different methods for assessing skin viability

Content:

- Study aimed to follow different measures of skin viability and evaluate their usefulness as markers of viability
    - evaluate viability of skin samples fresh, frozen, and thawed
    - Tests done: histopathological appearance, LDH activity, oxygen consumption, skin pH
    - Samples used had well defined epidermis and dermis
- Skin viability can be difficult to assess and there are many different methods to gather viability information
- Fresh and thawed samples showed the highest respiration rates, though those stored for a long period of time had significantly lower oxygen consumption rates
- Skin samples ex vivo showed a significantly higher pH than human skin in vivo, fresh samples having lower pH than frozen or thawed samples
- Ex vivo skin shows variation of many parameters over time
    - overall recommended to use two or three techniques for skin viability evaluation, at least oxygen measurement and an enzyme (LDH) assay
- Methods
    - study uses human skin samples, thin sections 5 mm by 5 mm squares, placed in a buffer solution, stained, and prepared
    - LDH Activity
        - Epidermis is a major site of metabolism for the human skin
        - the enzymatic reaction that leads to the production of lactate from pyruvate is catalyzed by the enzyme LDH, requiring a hydrogen donor as well, during this reduction of pyruvate, NADH is oxidized to NAD, decreasing obsorbance, and this rate of decrease in absorbance is directly proportional to LDH activity in the sample
        - See article for equations converting absorbance to LDH activity
        - Measure of enzyme activity is used as an indicator of skin viability
        - Significant activity show in fresh and frozen samples, with activity lower in fresh than frozen samples
        - Activity increased with samples incubated at 32 degrees



Conclusions/action items: There are many methodologies for examining the viability of a skin sample, with oxygen consumption tests and pH measurements being the most simple and reproducible protocols. However, use of enzyme activity can give reliable information on tissue viability and is a great method to assess the skin tissue.

https://onlinelibrary.wiley.com/doi/full/10.1034/j.1600-0846.2003.00039.x

[1] S. Messager, A. C. Hann, P. A. Goddard, P. W. Dettmar, and J.-Y. . Maillard, “Assessment of skin viability: is it necessary to use different methodologies?,” *Skin Research and Technology*, vol. 9, no. 4, pp. 321–330, Oct. 2003, doi: https://doi.org/10.1034/j.1600-0846.2003.00039.x.

2024/09/22 - Machining and Shop Tools Certification

SARAH RAUBENSTINE - Sep 23, 2024, 12:24 PM GMT+9

Title: TEAMLab Training Documentation

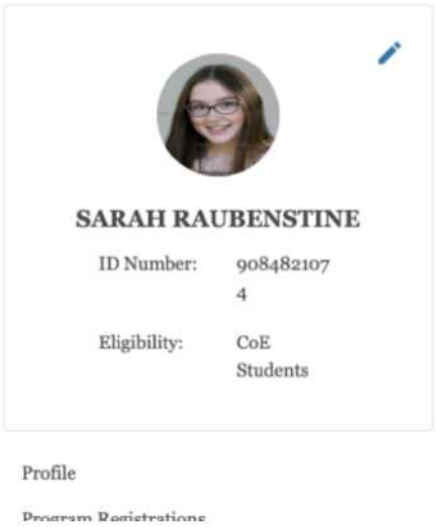
Date: 03/10/24

Content by: Sarah Raubensitne

Present: Sarah Raubenstine

Goals: TEAMLab Machine Training Certification

Content:



SARAH RAUBENSTINE

ID Number: 908482107 4

Eligibility: CoE Students

Profile

Program Registrations

My Memberships

Membership Type	Start Date	Expiry Date	Renew	Card Info
Lab Membership	Mon, Mar 4 2024	Sun, May 19 2024	Not Renewable	N/A
Machining	Sun, Jan 1 2023	Permanent	Not Renewable	N/A
Shop Tools - Training Eligible	Sun, Jan 1 2023	Tue, Dec 30 3000	Not Renewable	N/A
Lab Orientation	Sun, Jan 1 2023	Tue, Dec 30 3000	Not Renewable	N/A
Shop Tools	Sun, Jan 1 2023	Tue, Dec 30 3000	Not Renewable	N/A
Machining - Training Eligible	Sun, Jan 1 2023	Tue, Dec 30 3000	Not Renewable	N/A

2024/9/22 - OSHA and Biosafety Training

SARAH RAUBENSTINE - Sep 23, 2024, 12:21 PM GMT+9

Title: Biosafety Training Documentation

Date: 03/10/24

Content by: Sarah Raubensitne

Present: Sarah Raubenstine

Goals: OSHA and Biosafety Lab Training

Content:

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

This certifies that Sarah Raubenstine has completed training for the following course(s):

Course	Assignment	Completion	Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	3/8/2024	3/8/2029
Chemical Safety: The OSHA Lab Standard	Final Quiz	3/8/2024	

Data Last Imported: 03/10/2024 12:44 PM

2025/02/13 - BPAG Meeting

SARAH RAUBENSTINE - Feb 14, 2026, 3:22 AM GMT+9

Title: BPAG Meeting

Date: 2/13/25

Content by: Sarah Raubenstine

Present: BME BPAGs

Goals: Learn about best BPAG practices

Content:

- Get your client to purchase for you!!
  - this is what we do! :)
  - either way, have all expenses approved prior to purchase
  - anything over $1000 needs department approval as well as the client
- Other part of the job is to keep track of all purchases
  - ALL ORIGINAL RECEIPTS IN THE NOTEBOOK
- Our category - UW Affiliation, NOT BME
  - ask if they want to use UW funds, the answer is yes as we know
  - Need to follow UW purchasing rules
  - Client pays through a funding string
  - either makerspace teamlab or other UW services or through shop UW vendors
- Shop UW+
  - complete list of vendors online
  - client must be the one to order from shop UW
  - if we want elsewhere, need to show that the UW vendors will not get it here in time
  - Orders placed through shop UW must be shipped to a UW address
    - can ship these to Dr. P if you can't ship to client
- Design innovation lab
  - $50 dollar budget per team to 3D print
  - anyone on our team is approved to purchase
    - exceed the $50 budget, the client can set up a funding number, set up an account with a funding string
    - we fill out the team information excel sheet, they will have to upload that excel sheet to the form
    - only UW fund numbers can be used to set up funding accounts
  - INCLUDE THIS IN NEXT EMAIL, get Bailey to make an account, thank you queen
- Reimbursement
  - only the BPAG will be reimbursed
  - Basically, don't buy anything, have Bailey buy everything, we haven't had any problems with this
- Non-reimbursable expensess
  - notebook
  - poster
  - don't complain
- Update table
  - break it up into segments
  - will have to include last semester's purchase
  - make this usable and visually appealing
  - be in progress reports, notebook, and final report

Conclusions/action items: Email Bailey about setting up a purchasing account with the makerspace...

2025/10/23 - CITI Training Documentation

SARAH RAUBENSTINE - Oct 25, 2025, 7:02 AM GMT+9

Title: CITI training documentation

Date: 10/23/25

Content by: Sarah Raubenstine

Present: Self

Goals: Obtain human testing certification from CITI online training

Content:

CITI PROGRAM

Completion Date 22-Oct-2025
Expiration Date 22-Oct-2028
Record ID 73131917

This is to certify that:

Sarah Raubenstine

Not valid for renewal of certification through CME.

Has completed the following CITI Program course:

Basic/Refresher Course - Human Subjects Research
(Curriculum Group)
UW Human Subjects Protections Course
(Course Learner Group)
1 - Level 1
(Stage)

Under requirements set by:

University of Wisconsin - Madison

CITI
Collaborative Institutional Training Initiative
101 NE 3rd Avenue, Suite 320
Fort Lauderdale, FL 33301 US
www.citiprogram.org

Generated on 24-Oct-2025. Verify at www.citiprogram.org/verify/?wec1387f9-c175-4231-b26b-1b42325f919c-73131917

Conclusions/action items: Training needed to conduct human testing and move forward with IRB approval.

2025/10/26 - Biosafety 105 Training

SARAH RAUBENSTINE - Oct 29, 2025, 2:39 AM GMT+9

Title: CITI training documentation

Date: 10/26/25

Content by: Sarah Raubenstine

Present: Self

Goals: Certification of Biosafety 105 Training - Fume hood training

Content:

This certifies that Sarah Raubenstine has completed training for the following course(s):

Course	Assignment	Completion	Expiration
Biosafety 105: Biosafety Cabinet Use	Biosafety 105: Biosafety Cabinet Use Quiz	10/22/2025	No Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	3/8/2024	3/8/2029
Chemical Safety: The OSHA Lab Standard	Final Quiz	3/8/2024	
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	10/22/2025	10/22/2028

Data Last Imported: 10/28/2025 11:54 AM

Conclusions/action items: Upload training documentation.

2026/03/20 - Autoclave Training

SARAH RAUBENSTINE - Mar 21, 2026, 11:58 AM GMT+9

Title: Autoclave Training Documentation

Date: 3/20/26

Content by: Sarah Raubenstine

Present: Self

Goals: Certification of Biosafety 106 Training - Autoclave Use

Content:

This certifies that Sarah Raubenstine has completed training for the following course(s):

Expand All Collapse All

Course	Assignment	Completion	Expiration
Biosafety 105: Biosafety Cabinet Use	Biosafety 105: Biosafety Cabinet Use Quiz	10/22/2025	No Expiration
Biosafety 106: Autoclave Use	Biosafety 106: Autoclave Use: Safety and Efficacy - Verification Quiz	3/20/2026	No Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	3/8/2024	3/8/2029
Chemical Safety: The OSHA Lab Standard	Final Quiz	3/8/2024	
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	10/22/2025	10/22/2028

Data Last Imported: 03/20/2026 09:26 PM

Conclusions/action items: Upload training documentation.

3/20/2026 Show and Tell

ELLA LANG - May 04, 2026, 11:48 AM GMT+9

Title: Show and Tell

Date: 3/20

Content by: Ella Lang

Goals:

- Give groups advice on testing and design

Content:

39: Dynamic balance device

- Move the battery pack to the handle area to act as a counterweight

41: prosthetic finger

- For testing- try cyclic loading with the MTS machine

- Materials are well chosen- ensure it is concealable within the prosthetic

32: Pavlik Harness Kick Sensor

- Look into a thinner print material for thinner walls

3/6/2026 Tong Lecture Notes

ELLA LANG - Mar 07, 2026, 12:52 PM GMT+9

Title: Tong Lecture Notes

Date: 3/6/2026

Content by: Ella Lang

Goals:

- Learn more about Dr. Williams

- Gain inspiration and insight into the professional world of engineers in industry and academics

Content:

- Dr. Williams grew up in a small town, and upon going to college, he learned about biomedical engineering through a mentor. He became specifically interested in neuroscience-related applications and has developed various different start up companies throughout the years.

- A key takeaway from his speech, related to his start-up endeavors, is that he had multiple initial start-up companies fail, but he kept at it and remained hopeful in the process. Ultimately, his last startup company focused on epilepsy applications and became very successful and impactful in the medical industry. This speaks to how delving into your interests can lead to great success.

- Another idea that was mentioned was the importance of knowing your market and keeping it simple. Don't overcomplicate your ideas and truly know your audience and who you want to help. This will greatly help your designs and ensure that the main users are accommodated.

Conclusions/action items:

Overall, I appreciated the perseverance aspect of this lecture. A lot of people who do speeches like this sound as if they have always had it all figured out. Dr. Williams really dug into his start-up ups and downs, which was refreshing to hear.

01/28/2026 Effect of Chemical Cleaning on PLA

ELLA LANG - Jan 29, 2026, 12:04 PM GMT+9

Title: The Effect of Chemical Cleaning on Mechanical Properties of Three-Dimensional Printed Polylactic Acid

Date: 1/28/2026

Content by: Ella Lang

Goals:

- Understand the effect of sterilization on PLA

- Learn ways to improve PLA sterilization through different printing methods

Content:

Background:

- In healthcare settings, 3D-printed PLA medical tools may be reused and are exposed to chemical disinfectants when autoclaving isn't available for PLA due to its low Tg
- Goal: measure how chemical cleaning changes the stiffness, strength, and weight of PLA printed with different settings

Methods:

- PLA tensile specimens printed on Ultimaker 3 using Ultimaker PLA
- Cidex and chlorine soaks were used as disinfectants

Results:

- Mechanical properties change with chemical cleaning:
    - Median stiffness and strength can change by up to 13.6% and 12.5% after Cidex or chlorine exposure
- Absorption/weight gain happened in some cases, suggesting fluid uptake into the printed part:
    - Median weight increases range from small (1.8%) to larger amounts (8.3% and 6.8%) for certain cases

Design changes:

- Concern: chemical agent absorption and transfer to skin after soaking
- To reduce absorption, they recommend making prints less porous:
    - low print speed, high print temperatures
- Devices must sink in disinfectant baths for full surface contact; PLA's low density means we may need high infill so tools don't float

Fleischer, J.C. et al. (2020) "The Effect of Chemical Cleaning on Mechanical Properties of Three-Dimensional Printed Polylactic Acid." *Journal of Medical Devices* 14(1): 011109.

Conclusions/action items:

- Use higher infill and lower print speed if possible to make our device easier to clean and cause it to absorb less disinfectatant

01/29/2026 How to Sterilize PLA

ELLA LANG - Jan 30, 2026, 1:42 AM GMT+9

Title: How to Sterilize Polylactic Acid Based Medical Devices?

Date: 1/29/2026

Content by: Ella Lang

Goals:

- Understand more about how PLA should be sterilized and emerging new methods

- Understand the effects of sterilization on PLA

Content:

PLA sensitivities:

- PLA has a low glass transition temperature (55 to 65 C), making it likely to undergo heat and hydrolytic damage.
- Many sterilization methods can alter PLA structure, degrade polymer chains, or create toxic residues.

Sterilization methods review:

1. Autoclaving

- Uses high-temperature steam to kill microbes
- Advantages: Effective and inexpensive for tolerant materials
- Limitations for PLA: Often not suitable due to deformation and structural damage at high temperatures

2. Ethylene Oxide

- A low temp gas used for heat-sensitive materials
- Advantages: Good penetration
- Limitations:
    - Toxic, flammable, and potentially carcinogenic
    - Requires long aeration to remove residue
    - Can act as a plasticizer

3. Gamma Irradiation

- Good penetration and low temperature
- Can cause cross-linking, reducing molecular weight, and changing degradation
- Gamma is often used with limited impact on biocompatibility

4. Hydrogen Peroxide Gas Plasma

- Combines hydrogen peroxide chemistry with plasma energy at low temps
- Advantages: No toxic residues and suitable for heat-sensitive materials
- Limitations:
    - Penetrates less than EtO
    - Can change surface chemistry

S. Pérez Davila, L. González Rodríguez, S. Chiussi, J. Serra, and P. González, “How to Sterilize Polylactic Acid Based Medical Devices?,” *Polymers*, vol. 13, no. 13, p. 2115, Jun. 2021, doi: 10.3390/polym13132115.

Conclusions/action items:

- No perfect sterilization method exists for PLA

- Ultimately, the best method depends on the use application

02/12/2026 Proper Autoclave Use and Autoclave Mechanism

ELLA LANG - Feb 13, 2026, 5:06 AM GMT+9

Title: Proper Autoclave Use and Autoclave Mechanism

Date: 2/16/2026

Content by: Ella Lang

Goals:

- Understand how autoclaves work and how to do testing with them

Content:

Autoclave cycles:

- to be effective, the temp must reach a temperature of 121 C for at least 30 minutes using saturated steam under at least 15 psi of pressure

- Dry material can be treated in a fast exhaust cycle

- Avoid materials with tight or impermeable closures

Plastics to avoid putting in the autoclave:

- HDPE and LDPE

- Polystyrene

- Polyurethane

- good plastic: polycarbonate and polypropylene

Autoclave procedure:

1. Wear lab PPE, specifically heat-resistant gloves

2. Check inside the autoclave for any items left behind by previous users

3. Clean the drain strainer before loading the autoclave

4. Place items in a secondary container

5. Choose an appropriate cycle, which usually takes 1-1.5 hours

6. Check that the pressure is at a minimum of 15 psi

7. Check that the temp reaches 121 C

8. Once done, allow the autoclaved materials to cool before handling

“Autoclave Procedure | Office of Environmental Health and Safety,” *ehs.princeton.edu*. https://ehs.princeton.edu/laboratory-research/biological-safety/autoclave-use/procedure

Conclusions/action items:

- Utilize this procedure when writing the autoclave testing protocol

02/12/2026 Autoclave Validation

ELLA LANG - Fel

Title: Autoclave Validation

Date: 2/12/2026

Content by: Ella Lang

Goals:

- Understand methods of testing utilizing an autoclave

- Learn about ways to ensure the sanitization of instruments

Content:

Tape indicators:

- Autoclave tape has heat-sensitive chemical markers that change color when exposed to temps of 121 C

- Tape is not designed to prove that organisms have been killed, instead they only indicate temperature

Chemical indicator strips:

- Change color after exposure to temperatures above 121 C for several minutes

Tape indicator options:

Grainger- Steam Autoclave Indicator Tape: Latex-Free/Lead-Free/Solvent-Free, Steam

link: https://www.grainger.com/product/829T13?gucid=N:N:PS:Paid:GGL:CSM-2295:HUEIVK:20800606:APZ_1&gclsrc=aw.ds&gad_source=1&gad_campaignid=22472339918&gclid=CjwKCAiAkbbMBhB2EiwANbxtbfGEoYaPyvM_5H0_99a7_TigiYdaxjDScHbz2wEtej_w8n

Item	Mfr. Model
829T13	GRAING-T254-47-1

- Requires a cycle time of at least 30 minutes

- Color indicator before is green striped, color indicator after is black striped

- Price: $10.85/unit

“Autoclave Procedure | Office of Environmental Health and Safety,” *ehs.princeton.edu*. https://ehs.princeton.edu/laboratory-research/biological-safety/autoclave-use/proc

Conclusions/action items:

- Share my testing method with the team

- Purchase autoclave tape or inquire with Bailey to see if she has any

03/6/2026 Polycarbonate

ELLA LANG - Mar 21, 2026, 12:28 AM GMT+9

Title: Polycarbonate Material Properties and Applications

Date: 3/6/2026

Content by: Ella Lang

Goals:

- Understand more about the material

Citation:

Team Xometry, “All About Polycarbonate (PC),” *www.xometry.com*, May 07, 2022. https://www.xometry.com/resources/materials/polycarbonate/

Content:

- Polycarbonate (PC) is a thermoplastic polymer

- Key Properties:

- Very strong and impact-resistant
- Lightweight
- Transparent/high optical clarity
- Heat resistant
- Good dimensional stability (keeps shape under stress)
- Electrical insulator
- Flexible without cracking
- Durable for long-term use

Advantages:

- Can handle mechanical stress and frequent use
- Does not easily break or crack
- Maintains shape at high temperatures
- Good visibility for lenses and covers
- Easy to form and mold
- Works well in demanding environments

Disadvantages:

- Scratches easily (often needs coatings)

- Not always the best for optical clarity compared to some plastics

Widely used in: Medical industries, construction, electronics, automotive

Conclusions/action items:

- Waterjet PC sheets and look into coatings to reduce scratching

03/6/2026 PC Coatings

ELLA LANG - Apr 15, 2026, 3:42 AM GMT+9

Title: PC Coatings

Date: 3/6/206

Content by: Ella Lang

Goals:

- Look into ways to reduce PC scratches

- Improve part aesthetics

Content:

- Abrasion-resistant PC sheets are available for purchase

- PC is a hard plastic, making it difficult to fully prevent scratches

- Many companies will coat your part with a transparent ceramic to create a hard outer shell, however, these coatings are not generally available for purchase. Instead, they will only coat the part in store.

Abrasion = Wearing away of material through friction.

- Happens when a hard rough surface slides across a softer surface
- Damages equipment and structural surfaces
- Solution = Use abrasion-resistant coatings to protect surfaces and extend lifespan

Abrasion-Resistant Epoxy Coatings

- Epoxies = Chemically crosslinked thermoset polymers, commonly used as protective coatings
- Key properties = Excellent adhesion, chemical resistance, mechanical strength, and abrasion resistance
- How They Resist Abrasion = inorganic fillers increase hardness and improve wear resistance
- Can be applied in a single layer or multiple layers

Abrasion-Resistant Polyurethane Coatings

- Polyurethanes = More flexible and pliable than epoxies
- Key Properties = High abrasion resistance, toughness, impact resistance
- Resistant to erosion and corrosion
- How They Resist Abrasion = contain flexible backbones
- Can provide chemical resistance and UV stability
- Most commonly black

S. Vigue, “Abrasion Resistance with Epoxies and Polyurethanes - ITW Performance Polymers,” *ITW Performance Polymers*, Jun. 21, 2023.

https://itwperformancepolymers.com/blog/abrasion-resistance-with-epoxies-and-polyurethanes

Conclusions/action items:

- Both coatings protect against abrasion and wear
- Epoxies are best when strong adhesion and hardness are needed.
- Polyurethanes are best when flexibility and impact resistance are needed.

4/9/2026 Nylon Coatings

ELLA LANG - Apr 15, 2026, 4:24 AM GMT+9

Title: Nylon Coating: Smooth-On XTC-3D™ 20 3D Print Coating, 24 oz - Brush-On Coating for 3D Printed Parts

Date: 4/9/2026

Content by: Ella Lang

Goals:

- Analyze a 3D print coating

Content:

- Clear top coat for smoothing & finishing 3D printed parts
- Ideal for both SLA & SLS prints, as well as PLA, ABS, Laywoo, Powder Printed Parts, and other rigid media
- Mix Ratio of 2A:1B by Volume, working time of 10 minutes, cures to a hard, impact-resistant coating in 3.5 hours, 80D Shore Hardness
- Epoxy top coating self-levels out uniformly without leaving brush strokes
- Perform a small-scale test of your project materials to determine suitability and compatibility
- Cost: $18.02 for 6.4 fl oz on Amazon
- Unsure if this product is autoclavable, according to Google, most epoxy resins are as they can be used for aerospace applications

“Amazon.com: Smooth-On XTC-3Dtm 20 3D Print Coating, 24 oz - Brush-On Coating for 3D Printed Parts : Industrial & Scientific,” *Amazon.com*, 2026. https://www.amazon.com/Smooth-XTC-3D-Performance-Print-Coating/dp/B00PFXK4JY?th=1 (accessed Apr. 14, 2026).

Conclusions/action items:

- Determine if this is feasible to acquire before final presentations

- Determine if this would impact the thickness of the cutline and blade insertion

01/29/2026 FormLabs BioMed Clear Resin

ELLA LANG - Jan 30, 2026, 6:34 AM GMT+9

Title: FormLabs BioMed Clear Resin

Date: 1/29/2026

Content by: Ella Lang

Goals:

- Understand the pros and cons of BioMed Clear Resin

- Get a cost estimate for the use of Clear Resin

Content:

Volume of parts, version 6:

Part 2: 27.59 mL

Part 5: 44.72 mL

Part 6: 18.6 mL

Part 7: 28.76 mL

Cost calculation for all 4 base components: $50.40

Conclusions/action items:

3/10/2026 Biosafety, Chemical Safety, RECR and Disposing of Hazardous Chemicals

ELLA LANG - Mar 20, 2026, 4:35 AM GMT+9

Title: Biosafety, Chemical Safety, RECR, and Disposing of Hazardous Chemicals Training Documentation

Date: 3/10/2026

Content by: Ella Lang

Goals:

- Document my completed trainings

Content:

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

This certifies that Ella Lang has completed training for the following course(s):

Course	Assignment	Completion	Expiration
2023-24 HIPAA Privacy & Security Training	HIPAA Attestation	9/5/2024	
Biosafety Required Training	Biosafety Required Training Quiz 2024	1/26/2024	1/26/2029
Chemical Safety: The OSHA Lab Standard	Final Quiz	1/25/2024	
Disposing of Hazardous Chemicals	Final Quiz	3/10/2026	3/10/2031
Responsible and Ethical Conduct of Research (RECR)	RCR Certification	9/8/2025	No Expiration
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	10/24/2025	10/24/2028

Data Last Imported: 03/10/2026 04:25 PM

Most recent certification: 3/10/26, Disposing of Hazardous Chemicals

Conclusions/action items:

- Continue completing trainings to build my resume

10/24/2025 IRB Training Documentation

ELLA LANG - Mar 20, 2026, 4:38 AM GMT+9

Title: IRB Training Documentation

Date: 10/24/2025

Content by: Ella Lang

Goals:

- Document my IRB Training completion

Content:

Attached below

ELLA LANG - Oct 25, 2025, 4:45 AM GMT+9

Download

citiCompletionCertificate_15016513_73178835.pdf (77.9 kB)

1/1/2023 TeamLab Machining Certification

ELLA LANG - Mar 20, 2026, 4:39 AM GMT+9

Title: TeamLab Machining Certification

Date: 1/1/2023

Content by: Ella Lang

Goals:

- Document my Machining Certification

Content:

Attached Below

ELLA LANG - May 01, 2025, 4:02 AM GMT+9

Download

Machining_Permit_1__1_.pdf (583 kB)

2026/1/29 - 3D Printed Tolerances

Gianna Inga - Feb 03, 2026, 5:54 AM GMT+9

Title: 3D printed allowances

Date: 1/29/25

Content by: Gianna

Present: Gianna

Goals: Document the different tolerances with 3D printed materials to incorporate when we change material types.

Content:

Types of fit:

- clearance: easily slide in and out & rotate as a cylinder
- interference: won't fit unless forced
- transition: fit with minimal pressure

PLA & ABS (.4 mm nozzle)

- min thickness: 1 mm
- max thickness: 2.5 mm
- clearance: .25 mm
- interference: .05 mm (bigger)
- transition: .08 - .02 mm

NYLON 12

- vertical wall min thickness: .6 mm
- horizontal wall min thickness: .3 mm
- min diameter = .8 mm
- assembly tolerance: .2 - .4 mm

Conclusions/action items: I will utilize these tolerances when finalizing the design in PLA and nylon. We want to switch over to nylon for the final design because of its many materialistic advatages, however, the design is not directly able to be printed with both PLA and nylon. These tolerance changes will need to be made when converting.

Sources:

[1] “Formlabs Customer Support,” Formlabs Customer Support. Accessed: Jan. 29, 2026. [Online]. Available: http://support.formlabs.com/

[2] O. Galiki, H. Kondo, Z. Wilson, "3D Printing Tolerances: How to Test & Improve Them," ALL3DP. Accessed: Jan. 29, 2026. [Online]. Available: https://all3dp.com/2/3d-printing-tolerances-test-fdm/

[3] “Wall Thickness in 3D Printing: Recommendations, Minimum and Maximum Values,” Raise3D: Reliable, Industrial Grade 3D Printer. Accessed: Jan. 29, 2026. [Online]. Available: https://www.raise3d.com/blog/3d-printing-wall-thickness/

2026/2/4 - Sterilization packaging methods

Gianna Inga - May 04, 2026, 2:47 AM GMT+9

Title: Sterilization packaging methods

Date: 2026/2/4

Content by: Gianna

Present: Gianna

Goals: Document current ways that medical devices are sterilized in packaging

Citation:

“Medex Supply BIOPSY PUNCH 6 MM 25/BOX.” Accessed: May 03, 2026. [Online]. Available: https://www.fishersci.com/shop/products/biopsy-punch-6-mm-25-box/NC9543097

“Biopsy Punches | Fisher Scientific.” Accessed: May 03, 2026. [Online]. Available: https://www.fishersci.com/us/en/browse/90418006/biopsy-punches

Admin, “Types of Medical Device Packaging Formats and Materials,” HIGHPOWER Validation Testing & Lab Services. Accessed: May 03, 2026. [Online]. Available: https://highpowervtls.com/2024/10/types-of-medical-device-packaging-formats-and-materials/

Admin, “Types of Medical Device Packaging Formats and Materials,” HIGHPOWER Validation Testing & Lab Services. Accessed: May 03, 2026. [Online]. Available: https://highpowervtls.com/2024/10/types-of-medical-device-packaging-formats-and-materials/

CDC, “Sterilizing Practices,” Infection Control. Accessed: May 03, 2026. [Online]. Available: https://www.cdc.gov/infection-control/hcp/disinfection-sterilization/sterilizing-practices.html

Content:

- Disposable biopsy punches
  - gamma sterilized
  - ethylene oxide
- Reusable devices
  - tyvek sterilization pouches
  - paper sterilization pouches
  - SMS wraps
  - CSR wraps
  - aluminum cage
  - plastic containers
- Parts going into the autoclave should be disassembled and hinges should be open according to the CDC

Conclusions/action items: These packing sterilization methods could be utilized in the future for manufacturing. It is important that we keep these materials in mind to include for also autoclaving instructions.

2026/2/7 - Clear, machinable, autoclavable material

Gianna Inga - May 04, 2026, 2:5

Title: Clear, machinable, autoclavable material

Date: 2026/2/7

Content by: Gianna

Present: Gianna

Goals: Document clear, machinable, autoclavable materials

Citations:

“Plastic 3D Printing Service.” Accessed: May 03, 2026. [Online]. Available: https://www.xometry.com/capabilities/plastic-3d-printing/?utm_term=nylon%2012%203d%20printing&utm_campaign=
buyer_search_nonbrand_all_additive&utm_source=adwords&utm_medium=ppc&hsa_acc=3789459769&hsa_cam=23594019989&hsa_grp=192918376505&hsa_ad=798173353144&hsa_src=
332141190230&hsa_kw=nylon%2012%203d%20printing&hsa_mt=b&hsa_net=adwords&hsa_ver=3&gad_source=1&gad_campaignid=23594019989&gbraid=0AAAADn8J0_kvFqK-
gVN8I865o9OY8R_A&gclid=CjwKCAjw5NvPBhAoEiwA_2egfnGTMNEXE0hNEUekhvb853mAwH27R1LxHfieZLaqQY7drEiWXedn3hoCuuwQAvD_BwE

“Polycarbonate Sheet.” Accessed: May 03, 2026. [Online]. Available: https://www.grainger.com/product/Polycarbonate-Sheet-0-236-1ETY6

Content:

Polycarbonate sheets - Grainger

- clear, machinable, autoclavable
- cons: milling does decrease visibility
- thickness: .125"; 4x12"; price = $10
- thickness: .25"; 6x12"; price = $16.70

Nylon 12 - 3D machinable

- autoclavable, strong
- cons: not clear, weird texture, can only print on Fridays

Conclusions/action items: These materials will be implemented into the current design. This is to insure that the device is reusable and sterilizable. If these materials are unable to be utilized, be implemented, however, the device will thus have to be single use.

2026/2/24 - Polycarbonate specs

Gianna Inga - May 04, 2026, 2:53 AM GMT+9

Title: Polycarbonate specs

Date: 2026/2/26

Content by: Gianna

Present: Gianna

Goals: Document the material specs of the polycarbonate

Citation:

“Polycarbonate Sheet.” Accessed: May 03, 2026. [Online]. Available: https://www.grainger.com/product/Polycarbonate-Sheet-0-236-1ETY6

Content:

Thicknesses: .118" , .236"

Area: 12x12"

Color: Colorless

Tensile strength: 9,500 psi

Min temp: -211 degrees fahrenheit

max temp: 270 degree fahrenheit

Water absorption: .13%

scratch resistant

uv resistant

Conclusions/action items: This information will be utilized as the material will have to be sterilizable. This can include ethanol, gamma rays, and the gold standard which is the autoclave. Future testing will ensure that the material is able to be autoclaved.

2026/3/3 - Resin Cupping

Gianna Inga - May 04, 2026, 2:54 AM GMT+9

Title: Resin cupping blowout

Date: 2026/3/3

Content by: Gianna

Present: Gianna

Goals: Document cupping and best practice with resin printing so that we can try printing in bioresin.

Citation:

"Formlabs Customer Support," Formlabs Customer Support. Accessed: Mar. 19, 2026. [Online]. Available: http://support.formlabs.com/

Content:

- common resin issues:
  - layer delamination - layers split apart
  - support failure
  - layers sticking to the FEP sheet - blocking light and preventing curing
  - rashing - rough surface
- design limitations
  - single continuous surface
  - supports are required
  - hollow
- cupping blowout
  - convex portion acts like a suction cup and traps air while printing
  - the empty space increases and reduces the air pressure
  - walls can then buckle and blowout
  - causes
    - no drainage holes
    - model orientation

Conclusions/action items: When printing our trial piece in bioresin, we got the warning of cupping blowout, thus I did some research on it. The solution was to change the orientation or the part so that the hole would open horizontally rather than vertically. Otherwise, the print had no other issues and we were able to utilize the CAD model to print in solid resin.

2026/3/19 - Waterjet

Gianna Inga - May 04, 2026, 2:54 AM GMT+9

Title: Waterjet

Date: 2026/3/9

Content by: Gianna

Present: Gianna

Goals: Understand waterjet fabrication method and best practices before utilizing it.

Citations:

“Waterjet Cutting Guidelines,” SendCutSend. Accessed: Mar. 19, 2026. [Online]. Available: https://sendcutsend.com/guidelines/waterjet-cutting/

“What Is Waterjet Cutting Technology and How Does It Work | TECHNI WATERJET™,” TechniWaterjet. Accessed: Mar. 19, 2026. [Online]. Available: https://www.techniwaterjet.com/how-it-works/

“Polycarbonate,” SendCutSend. Accessed: Mar. 19, 2026. [Online]. Available: https://sendcutsend.com/materials/polycarbonate/

Content:

- formats (2D vector files)
  - dxf (preferred)
  - dwg
  - ai
  - eps
  - step
  - stp
- shapes, holes, cutouts must be wide enough for chosen material
  - if a piece is thicker, the water stream will be larger to accomodate and thus the design must be able to accomodate the stream diameter with corner radii
  - for .22" polycarbonate
    - CNC thickness: 5.6mm
    - cut tolerance will be: .005"
    - minimum part size: 1x2"
    - maximum part size: 44x30"
    - minimum hole size: .125"
    - minimum bridge size: .22"
    - minimum hole to edge distance: .066"
- no empty objects or open contours
- no intersecting lines
- cutting accuracy: .1-.2mm
- materials
  - stone, glass, metal, food, composite materials
- max thickness: 304mm

Conclusions/action items: This fabrication method should be very accurate for our polycarbonate layout. We will need to convert the onshape CAD file into a dxf to upload it into the waterjet. Also, we will have to check and ensure that the distance from the edge of the .5" hole is good for the machine as it is 2mm or .079".

2026/04/16 - Nylon 12 autoclave

Gianna Inga - May 04, 2026, 2:37 AM GMT+9

Title: Nylon 12 Autoclave

Date: 2026/04/16

Content by: Gianna

Present: Gianna

Goals: Document whey the nylon 12 could've swelled during autoclave testing and what that means for its usage

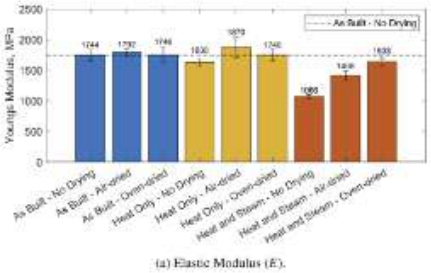
Citation:

J. R. Wingham, M. Omran, J. Shepherd, and C. Majewski, “Effect of steam autoclaving on laser sintered polyamide 12,” *Rapid Prototyping Journal*, vol. 27, no. 1, pp. 45–52, Jan. 2021, Accessed: May 03, 2026. [Online]. Available: https://eprints.whiterose.ac.uk/id/eprint/168168/

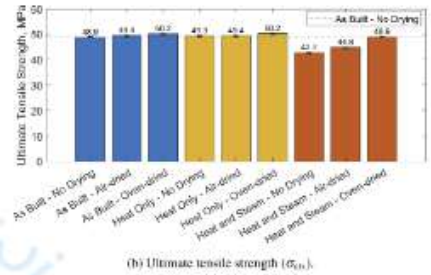
Content:

Overall

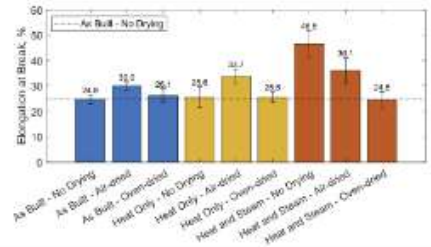
- Methods
  - conditions
    - control
    - heat & steam
    - heat only
  - drying
    - no drying
    - air dried
    - oven-dried



(a) Elastic Modulus ($\hat{E}$).



(b) Ultimate tensile strength (σ_{UTS}).



Sample Description		Water Content / %		
		Pre-Test	Post-Test	Average
As Built	A – No Drying	0.13	-0.02	0.05
	D – Air-dried	0.14	0.07	0.11
	G – Oven-dried	0	–	0
Heat Only	C – No Drying	0.13	-0.03	0.05
	F – Air-dried	0.07	0.06	0.07
	J – Oven-dried	0	–	0
Heat and Steam	B – No Drying	1.01	0.68	0.84
	E – Air-dried	0.60	0.48	0.54
	H – Oven-dried	0	–	0

Table 3: Calculated water content during testing, see Table 2 for methodology. All values are ±0.01.

- Results for heat & steam without oven-drying
  - 39% reduction in elastic modulus
  - 13% decrease ultimate tensile strength
  - 64% increase in elongation at break
- However, the original mechanical were recoverable after oven-drying
  - meaning that all the altered mechanical differences were due to the water content

Conclusions/action items: It is very likely that the nylon 12 part swelled in the autoclave and thus was why the parts didn't initially fit together. However, proven in this experiment and our device, oven drying and drying of the material ensures that it goes back to its original mechanical strength and size.

2026/04/16 - Polycarbonate Autoclave

Gianna Inga - May 04, 2026, 3:05 AM GMT+9

Title: Polycarbonate Autoclave

Date: 2026/04/16

Content by: Gianna

Present: Gianna

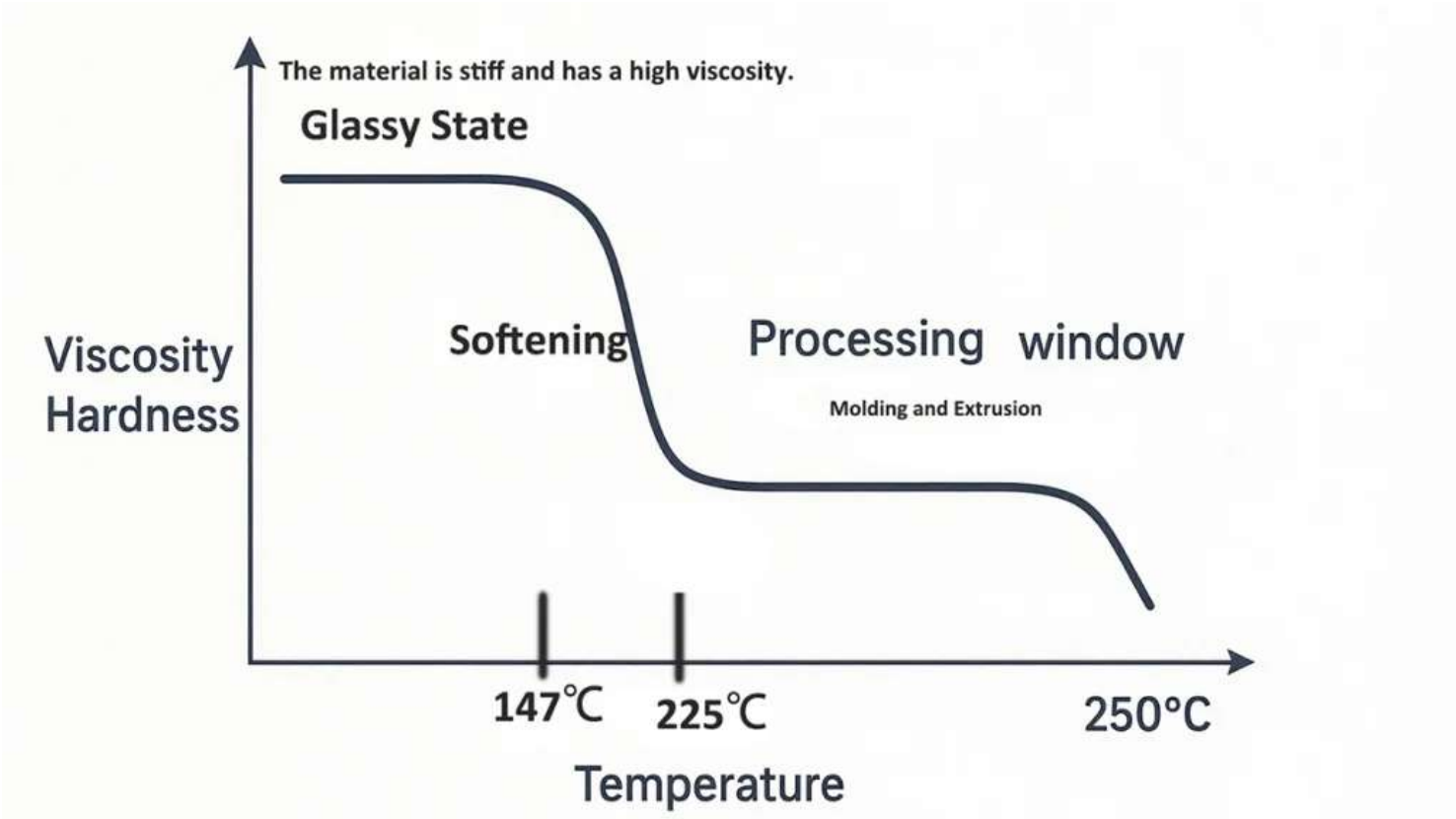
Goals: Document the possibility that the polycarbonate shrunk in the autoclave

Citation:

Tina, “melting point of polycarbonate: Heat Limits and Processing Guide,” Salesplastics.com. Accessed: May 03, 2026. [Online]. Available: https://salesplastics.com/polycarbonate-melting-point/

Content:

- lacks crystalline structure
  - does not have a distinct melting point
  - goes through gradual softening
- Softens 147-225 degrees celsius or (297-437 degrees F)



- flame retardants, UV stabilizers, reinforcing fills raise melting range by 5-10 degrees C
- excessive moisture may trigger hydrolysis
  - lowering melting range by up to 10 degrees C
- 280-300 degrees C
  - yellow discoloration
  - loss of mechanical strength
- low shrinking rate (.5-.7%)
  - poor cooling controls can lead to dimensional inaccuracies
- warping: uneven cooling or inconsistent wall thickness
- polycarbonate generally expands when heated

Conclusions/action items: From this information, it is unlikely that the polycarbonate altered dimensions in the autoclave. This concludes that it must be the nylon 12 that swelled and shrunk back to normal.

2026/03/20 - Autoclaving Certification

Gianna Inga - May 04, 2026, 3:10 AM GMT+9

Title: Autoclaving Certification

Date: 2026/03/20

Content by: Gianna

Present: Gianna

Goals: Document the training I received for the autoclave

Content:

OVCR Training Information Lookup Tool **University of Wisconsin-Madison**

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

This certifies that Gianna Inga has completed training for the following course(s):

Course	Assignment	Completion
Biosafety 106: Autoclave Use	Biosafety 106: Autoclave Use: Safety and Efficacy - Verification Quiz	3/20/2026
Biosafety Required Training	Biosafety Required Training Quiz 2024	3/3/2024

Conclusions/action items: I will utilize this certification when we do autoclave testing on our device. This is to ensure that the device can withstand the gold standard of sterilization.

Gianna Inga - May 04, 2026, 3:07 AM GMT+9

Download

Autoclave_training.pdf (47.5 kB)

2026/3/6 - Tong Distinguished Entrpreneurship

Gianna Inga - Mar 20, 2026, 1:56 AM GMT+9

Title: Tong Distinguished Entrepreneurship

Date: 2026/3/6

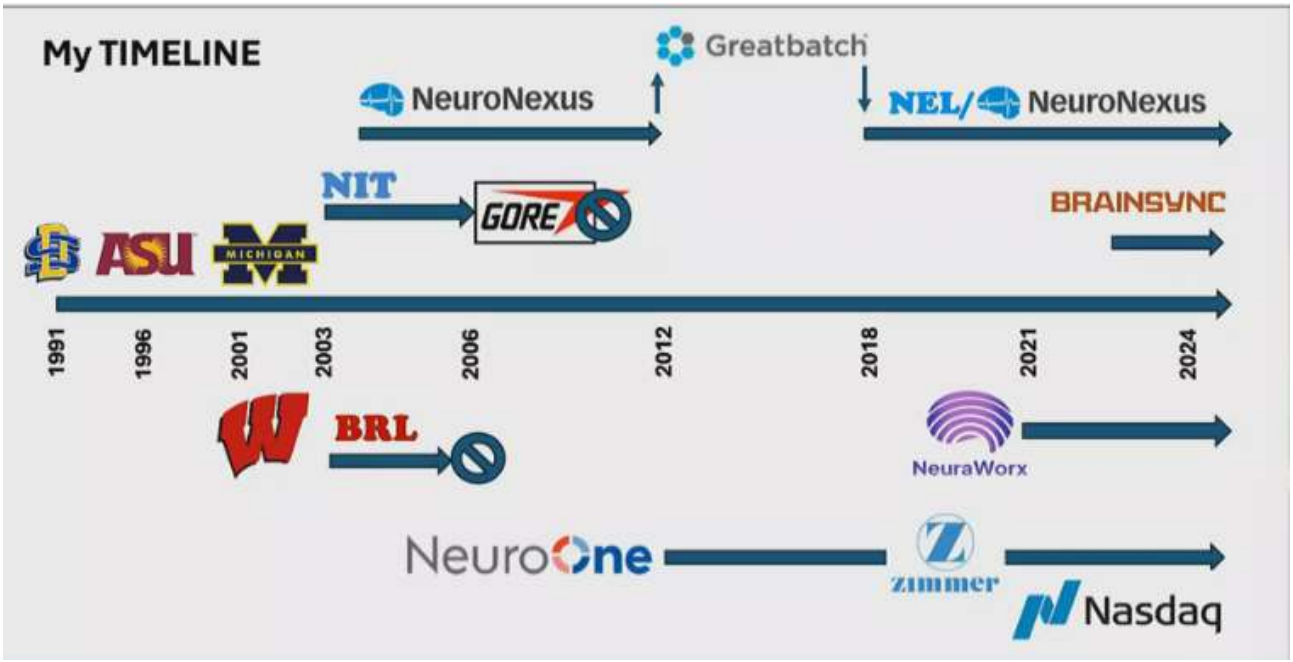
Content by: Gianna

Present: BME

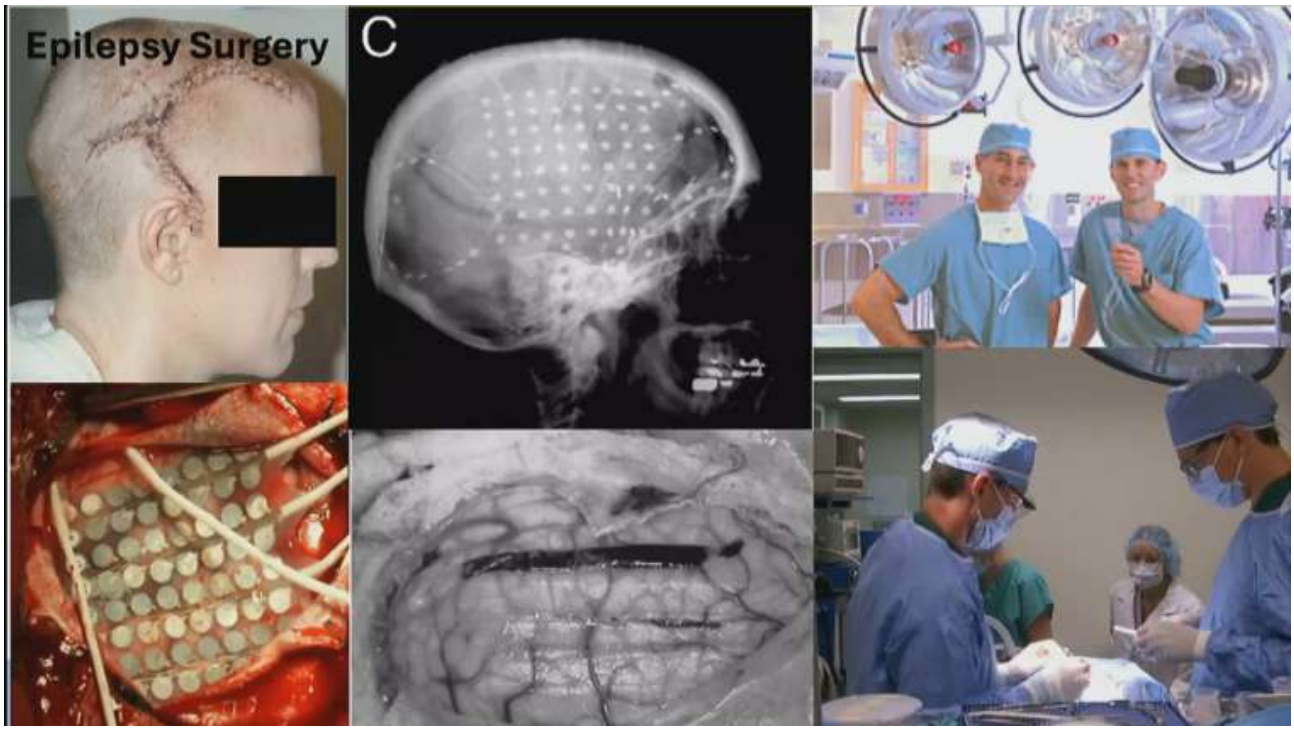
Goals: Document the tong distinguished lecture

Content:

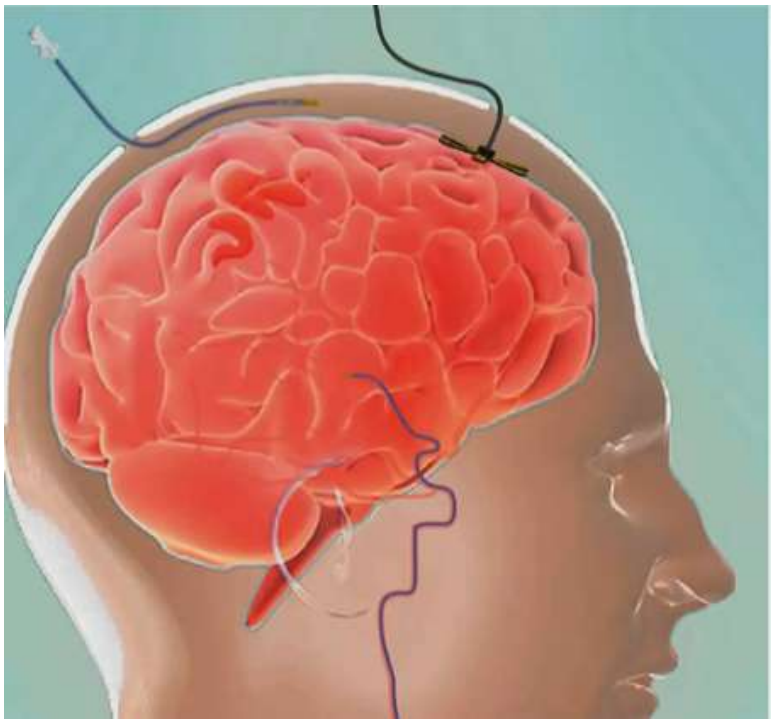
- From Imagination to Implantation: Turning Science Fiction into Brain Technologies
    - Justin Williams
    - neuroengineering
    - grew up in rural south dakota
    - wanted to go to college for mechanical engineering
    - started working at daktronics
        - huge industry
        - LED boards
    - didn't want to work for an industry forever
        - never got to make anything new
    - went back to school for BME

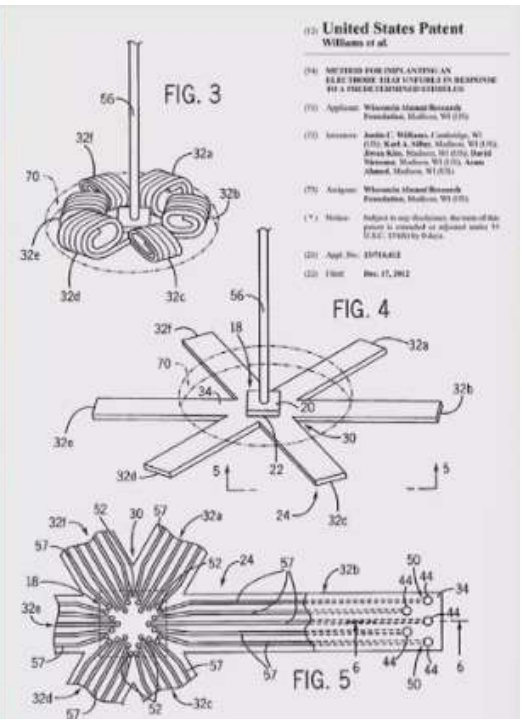


-
    - deep brain stimulator\
    - tried to create a start up
        - failed miserably
    - Neuronexus
        - got bought out by greatbatch and then bought back
    - neuroone
        - sometimes less is more
        - thin film electrodes = flexible to the curvature of the brain
        - 12% of epilepsy market
        - small incision and unfurls

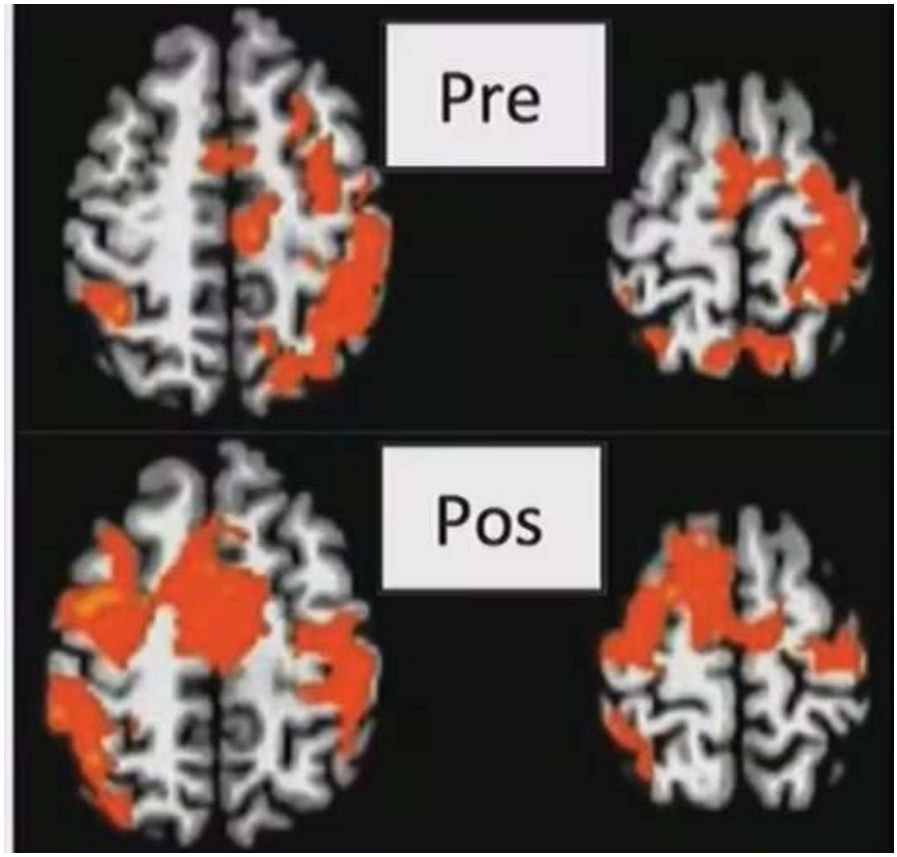

Epilepsy Surgery
C


NeuroOne
Peter Tong Distinguished Entrepreneurship Lecture
25 BME



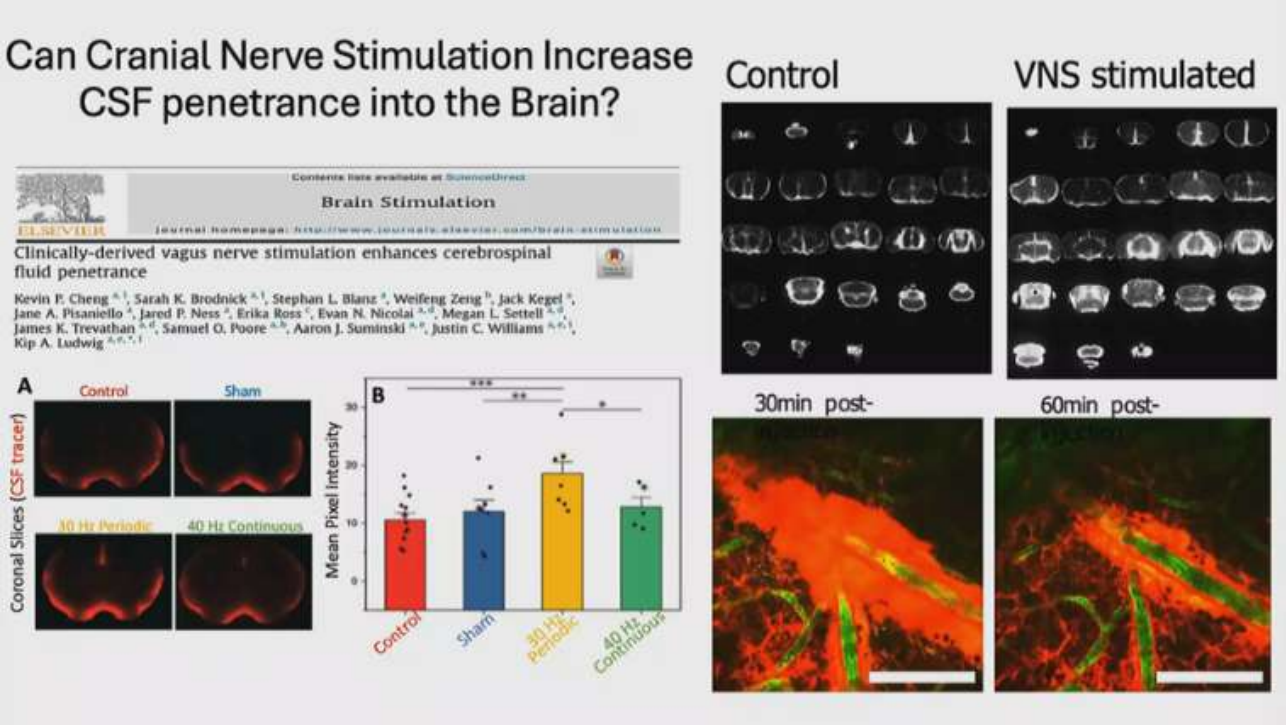


- brainsync
  - brain-computer interface
  - wearable device
  - could communicate through the device
  - ALS, stroke, spinal cord pt could use this to communicate
  - pivoted to stroke rehabilitation
    - big brain change



- PSP - build up of proteins in the brain

- discovered glymphatic system
- perisaltic movement
- wants to use device to activate the glymphatic system
  - mouthgaurd
  - headband



Conclusions/action items: This was a really cool presentation about his progress to where he is today. This relates a lot to the things I am learning in BME 640 about market approval and position. It was really interesting to learn about all his startups and especially that he failed at first, because I think the initial failure is always the hardest and weeds out the most people. Overall, his career is incredible and all the products he has worked on are very interesting.

2026/3/20 - Show & Tell

Gianna Inga - Mar 21, 2026, 2:28 AM GMT+9

Title: Show & Tell

Date: 2026/3/20

Content by: Gianna

Present: BME 301 & 402

Goals: Understand the calls to actions & give advice to 301 groups.

Content:

- 39: Dynamic balance device
  - put the battery pack at the handle
- 41: prosthetic finger
  - do cyclic loading on the MTS machine for testing
- 32: Pavlik Harness Kick Sensor
  - look into a different material that would be able to print thinner walls or create a lip that can implement bought materials like plastic or carbon fiber

Conclusions/action items: Overall, these groups had interesting call to actions and I hope they can implement some of the advice I gave. Overall, these were more material questions and how to best make the device efficiently.

2026/1/27- 3D-Printed PLA Medical Devices

Simon Nam - Jan 29, 2026, 5:03 PM GMT+9

Title: 3D-Printed PLA Medical Devices: Physicochemical Changes and Biological Response after Sterilization Treatments

Date: 1/27/26

Content by: Simon Nam

Present: N/A

Goals: To research further on PLA material properties with respect to tissue interaction and biomedical relevance

Search Key Terms: Material Properties of PLA in Tissue Contact

Link: https://www.mdpi.com/2073-4360/14/19/4117

Citation: S. Pérez-Davila et al., “3D-Printed PLA Medical Devices: Physicochemical Changes and Biological Response after Sterilisation Treatments,” Polymers, vol. 14, no. 19, p. 4117, Oct. 2022, doi: https://doi.org/10.3390/polym14194117.

Content:

This article evaluates how common medical sterilization methods impact the suitability of FDM 3D-printed PLA for biomedical device applications along with direct relevance to devices that may intermittently contact tissue and require repeated sterilization.

- Sterilization methods evaluated:
  - Saturated steam (SS)
  - Low-temperature steam with formaldehyde (LTSF)
  - Gamma irradiation (GR),
  - Hydrogen peroxide gas plasma (HPGP)
  - Supercritical CO_2 (SCCO)
  - All of the above were assessed to determine their effects on PLA’s surface chemistry, structure, mechanical properties, and biological response.
- Material and fabrication context:
  - PLA (Ingeo 3D850) was fabricated using FDM printing, a process known to introduce surface layering and micro-features.
  - This fabrication method is representative of prototyping approaches used in this project
  - Directly influences sterilization outcomes and tissue interaction risk.
- Surface chemistry changes:
  - GR and SCCO preserved PLA surface chemistry most closely to untreated controls, while SS, LTSF, and HPGP caused greater surface modification, including reduced oxygen-containing functional groups.
  - These changes are relevant because surface chemistry influences protein adsorption, tissue residue retention, and cleanability.
- Bond-level implications:
  - Increased C–C/C–H bonding and reduced oxygenated groups after SS, LTSF, and HPGP indicate reduced surface polarity
  - This may negatively affect wettability and increase the likelihood of biological material adherence during tissue contact.
- Crystallinity effects:
  - SS, LTSF, and SCCO significantly increased PLA crystallinity, with saturated steam producing the largest effect.
  - Increased crystallinity correlates with higher stiffness but also increased brittleness and thermal deformation, which is undesirable for precision biomedical tooling.
- Thermal and dimensional stability:
  - Saturated steam sterilization caused major thermal restructuring
  - Loss of glass transition behavior and visible deformation of printed parts.
  - This confirms that autoclaving is unsuitable for maintaining dimensional accuracy in PLA-based devices.
- Mechanical performance:
  - Most sterilization methods caused only minor changes in hardness and elastic modulus,
  - Except for SS, which significantly increased stiffness due to crystallization.
  - While increased stiffness may seem beneficial, it is accompanied by distortion and loss of geometric fidelity.
- Wettability considerations: All PLA samples remained hydrophilic;

    - Reduced wettability may hinder effective cleaning and increase retention of tissue fluids or media in surface features.
- Biological response (in vitro):
    - Extracts from all sterilized PLA samples maintained fibroblast viability above ISO cytotoxicity thresholds,
        - This indicates that sterilization-induced chemical changes do not inherently cause cytotoxic effects.
    - Direct contact testing using zebrafish embryos showed no adverse developmental effects for GR- or SS-sterilized PLA
        - This supports PLA's general biocompatibility despite the physicochemical changes.

Conclusions/action items:

- While PLA is biocompatible and can tolerate several low-temperature sterilization methods, gamma irradiation is the most suitable option for preserving PLA's structural integrity, surface chemistry, and dimensional accuracy.
- In contrast, saturated steam sterilization introduces unacceptable deformation and material changes.
- These findings support the use of PLA primarily for prototyping and early testing

Simon Nam - Jan 29, 2026, 5:03 PM GMT+9

polymers

Article

3D-Printed PLA Medical Devices: Physicochemical Changes and Biological Response after Sterilisation Treatments

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polymers-14-04117.pdf (4.61 MB)

2026/1/28 - Osteogenic and Biocompatibility of PLA

Simon Nam - Jan 29, 2026, 5:20 PM GMT+9

Title: Osteogenic and Biocompatibility Potential of Polylactic Acid-Based Materials: A Systematic Review of Human Primary Cells Studies

Date: 1/28/2026

Content by: Simon Nam

Present: N/A

Goals: To further investigate PLA limitations in relevant to biological contact

Search Key Terms: PLA Limitations Relevant to Biological Contact

Link: https://www.mdpi.com/2079-4983/17/1/34

Citation: M. Guerrero-Torres, S. M. Becerra-Bayona, M. L. Arango-Rodríguez, and E. A. Cafferata, “Osteogenic and Biocompatibility Potential of Polylactic Acid-Based Materials: A Systematic Review of Human Primary Cells Studies,” Journal of Functional Biomaterials, vol. 17, no. 1, pp. 34–34, Jan. 2026, doi: https://doi.org/10.3390/jfb17010034.

Content:

This systematic review synthesizes 26 in vitro studies evaluating how PLA/PLGA surfaces interact with human cells.

Although focused on guided bone regeneration, the findings are directly applicable to short-term tissue contact, biofouling risk, and surface–cell interactions relevant to our project.

Core material takeaway:

- Native PLA/PLGA are consistently biocompatible but bioinert.
- They support cell viability without inducing toxicity, but do not actively promote strong cell adhesion or tissue integration on their own.

Implication for tissue-contact tools:

- For devices intended to contact tissue temporarily and be cleaned or sterilized, PLA’s bioinert behavior is acceptable from a safety standpoint but undesirable for surface cleanliness, as weak adhesion can still allow protein and tissue residue retention in surface features.

Cell adhesion behavior:

- Unmodified PLA commonly exhibits reduced initial cell adhesion and spreading compared with collagen or tissue-culture polystyrene.
- This supports concerns that native PLA surfaces do not discourage biological attachment, particularly when combined with FDM surface roughness.

Role of surface modifications:

- Functionalization (e.g., ceramic fillers, protein coatings, nano-layers) substantially improves cell attachment and biological activity.
- However, such modifications are outside the scope of this project and incompatible with rapid fabrication, low cost, and repeated sterilization goals.

Topography effects:

- Micro- and nano-scale surface features strongly influence cell behavior.
- While engineered nanopatterns can direct cell responses, uncontrolled FDM layer lines and grooves may unintentionally promote tissue retention rather than prevent it.

Fibroblast interaction insight:

- Gingival fibroblasts readily survive on PLA but often show poor spreading and migration on smooth, unmodified PLA.
- This reinforces that PLA does not actively repel tissue interaction and relies heavily on surface finish quality.

Surface energy considerations:

- While beneficial for implants, this behavior is undesirable for a reusable cutting device, where minimizing biological adherence is preferred.

Degradation considerations:

- PLA degradation products are acidic and generally well tolerated in regenerative contexts, but long-term exposure and residue accumulation could complicate repeated cleaning in laboratory tools.

Quality and consistency of evidence:

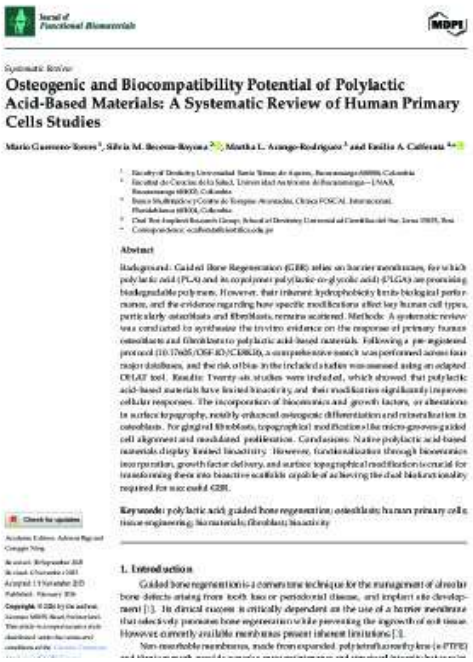
- The review highlights variability in testing protocols and surface treatments, limiting direct performance comparison.
- However, the consistency of results across studies strengthens the conclusion that PLA alone is passive and surface-dependent.

Conclusions/action items:

The literature emphasizes PLA's suitability as a biodegradable scaffold, not as a repeatedly sterilized, reusable, tissue-contact instrument. Its reliance on surface modification to control biological response limits its practicality for final device deployment.

These findings support using PLA for early prototyping and proof-of-concept testing, where biocompatibility is sufficient. However justify excluding PLA from the final design in favor of materials (ex. Nylon 12) with more stable surfaces, better cleanability, and lower risk of biological residue retention.

Simon Nam - Jan 29, 2026, 5:20 PM GMT+9



Osteogenic and Biocompatibility Potential of Polylactic Acid-Based Materials: A Systematic Review of Human Primary Cells Studies

Download

jfb-17-00034.pdf (476 kB)

2026/2/2 - Nylon PA12

Simon Nam - Feb 05, 2026, 1:22 PM GMT+9

Title: Nylon PA 12: Ideal for High-Performance 3D Printing Materials

Date: 2/2/2026

Content by: Simon Nam

Present: N/A

Goals: To dive deeper into application usage of Nylon PA 12 & compatibility with surgical blades

Search Key Terms: Nylon 12 interacting with blades

Link: https://jlc3dp.com/blog/pa12-nylon-high-performance

Citation: “Nylon PA12: Ideal for High-Performance 3D Printing Materials,” *Jlc3dp.com*, 2025. https://jlc3dp.com/blog/pa12-nylon-high-performance (accessed Feb. 02, 2026).

Content:

- High mechanical toughness:
  - PA12 exhibits significantly higher toughness and impact resistance than brittle thermoplastics like PLA.
  - This makes it well suited for holding and constraining a metal blade without cracking at stress concentrations.
- Balanced stiffness and ductility:
  - Unlike PLA, PA12 combines sufficient stiffness with elastic deformation capability.
  - This allows secure blade retention through press-fit or clamping features while tolerating repeated loading and unloading.
- Excellent wear and abrasion resistance:
  - PA12 resists surface wear under repeated contact and friction, which is critical for blade slots, guides, and interfaces that experience mechanical abrasion during use and blade replacement.
- Dimensional stability under load:
  - PA12 maintains geometry under mechanical stress better than PLA.
  - This reduces the risk of slot widening, creep, or fracture over repeated cutting cycles.
- Low moisture absorption compared to other nylons:
  - While nylon materials absorb moisture, PA12 has relatively low water uptake,
  - Improves dimensional stability and reducing swelling when exposed to cleaning agents or humid lab environments.
- Chemical resistance:
  - PA12 shows good resistance to common laboratory chemicals, including alcohols, making it compatible with routine wipe-down cleaning using 70% ethanol.
- Thermal stability:
  - PA12 withstands higher temperatures than PLA without softening or deforming,
  - This supports broader sterilization compatibility and reducing risk of thermal distortion during cleaning or handling.
- Isotropic mechanical performance (powder-based printing):
  - When printed using powder-bed fusion (e.g., SLS or Fuse 1), PA12 exhibits more uniform mechanical properties than FDM-printed PLA, reducing weak planes near blade interfaces.

- Proven use in functional, load-bearing parts:
    - The article highlights PA12 as a material commonly used for functional mechanical components, not just prototypes,
    - Therefore this aligns with the requirements of a final, reusable device for lab

Conclusions/action items:

The properties described in this product page support Nylon PA12 as a superior material choice over PLA for a device that must securely integrate a #11 scalpel blade withstand repeated mechanical loading, maintain dimensional accuracy, and tolerate frequent cleaning and sterilization.

2026/2/25- Polycarbonate effect on tissue sample

Simon Nam - Mar 21, 2026, 12:16 AM GMT+9

Title: Material characterization and biocompatibility of polycarbonate-based polyurethane for biomedical implant applications

Date: 2026/2/25

Content by: Simon Nam

Present: N/A

Goals: To learn about compatibility of Polycarbonate sheet material type with porcine skin tissue sample

Search Key Terms: effect of tissue sample on polycarbonate sheet material

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC11927772/#:~:text=Abstract,their%20use%20in%20medical%20devices.

Citation: F. Sadeghi, Y. Zamani, K. L. Bear, and A. Kheradvar, "Material characterization and biocompatibility of polycarbonate-based polyurethane for biomedical implant applications," *RSC advances*, vol. 15, no. 11, pp. 8839–8850, Spring 2025, doi: https://doi.org/10.1039/d5ra00568j.

Content:

Polycarbonate (PC) Material Properties (Replacing PLA)

- Medical-grade polycarbonate
  - Biocompatible under ISO 10993 standards for skin, tissue, and short-term blood contact
  - Approved for direct skin contact applications
- Exhibits:
  - High mechanical strength and impact resistance
  - Good thermal stability and sterilization compatibility
  - Smooth, non-porous surface --> reduced bacterial adhesion and easier cleaning
- Polycarbonate-based polymers such as PCU, show stable interaction with biological tissues and resistance to degradation in biomedical environments.

Interaction Between Porcine Tissue & Polycarbonate

- Hybrid biomaterial studies (porcine tissue + polycarbonate-based polymers) demonstrate that;
  - Feasible integration without acute adverse biological responses
  - Potential for stable mechanical coupling in device environments
- Key interaction considerations:
  - Polycarbonate is bioinert
    - meaning minimal chemical reactivity with tissue
    - reduces risk of toxicity
  - Lack of inherent bioactivity --> does not actively promote tissue bonding unless surface-treated
- Surface properties are critical:
  - Native PC surfaces are hydrophobic, which may limit cell adhesion
  - Surface modification (ex. plasma treatment, coatings) may be needed to enhance tissue compatibility

Design Implications (Replacing PLA with PC)

- Advantages over PLA:
  - Improved durability and resistance to deformation under physiological conditions
  - Better long-term stability and sterilization tolerance
- Considerations:
  - Ensure biocompatibility testing (ISO 10993) for final assembled device, not just raw material
  - Evaluate surface roughness and wettability for optimal tissue interaction
  - Maintain strict hygiene and sterilization protocols to protect porcine samples

Bottom Line

- Porcine skin is biologically compatible and reliable for testing tissue-device interaction

- Medical-grade polycarbonate is safe for direct contact with biological tissues, making it a strong replacement for PLA.
- The interaction is generally stable and non-toxic, but surface engineering may be required to optimize tissue adhesion and functional integration.

Conclusions/action items:

Implement PC into the upper layers of the design for better visibility during the slicing of tissue samples procedure. Receive further feedbacks from clients about the incorporation of new materials and testing its viability for producing accurate sample thickness cuts

2026/3/13 - Scalpel #11 durability & technique for slicing

Simon Nam - Mar 21, 2026, 12:23 AM GMT+9

Title: Highly Polished Scalpel Blades Reduce Incisional Wound Scar Variability in Duroc Pigs

Date: 2026/3/13

Content by: Simon Nam

Present: N/A

Goals: To know the effects of scalpel blade becoming dull and figuring out better ways to preserve blade conditions for during its porcine skin cutting

Search Key Terms: scalpel blades for porcine skin layer durability

Link: https://juniperpublishers.com/oajs/OAJS.MS.ID.555833.php

Citation: H. Chen, T. Vincer, J. A. Hicks, R. C. Lee, and C. L. Spiro, "Highly Polished Scalpel Blades Reduce Incisional Wound Scar Variability in Duroc Pigs," *Open Access Journal of Surgery*, vol. 12, no. 2, Oct. 2020, doi: https://doi.org/10.19080/oajs.2020.12.555833.

Content:

- Scalpel #11 blade is designed for precise, pointed incisions, but not optimized for prolonged or repeated cutting through dense tissue.
- Porcine skin presents high toughness due to:
  - Dense collagen fibers
  - Multi-layered structure (epidermis + dermis)
- Repeated incisions lead to:
  - Rapid edge degradation (dulling)
  - Increased cutting force required over time
  - Reduced precision and risk of tearing rather than clean incisions

Mechanisms of Blade Dulling

- Primary causes during porcine tissue cutting:
  - Mechanical abrasion from collagen-rich dermis
  - Micro-chipping of the blade edge under repeated stress
  - Accumulation of biological debris (fat, tissue residue) along the edge
- Blade sharpness decreases significantly after multiple consecutive cuts, even within a single session.

Indicators of Blade Degradation

- Increased resistance during incision
- Less smooth, more jagged cuts
- Tissue deformation before penetration
- Need for greater applied force → reduces experimental consistency

Best Practices to Preserve Blade Sharpness

- Minimize repeated passes: Use a single, continuous incision per cut instead of multiple strokes
- Control cutting angle: Maintain a consistent shallow angle to reduce edge stress
- Reduce contact pressure: Let sharpness perform the cut rather than forcing the blade
- Clean the blade between cuts: Remove tissue buildup using sterile wipes or saline to reduce drag and abrasion
- Segment workload: Assign a limited number of cuts per blade and replace proactively
- Use proper support surface: Avoid cutting against hard backings that accelerate dulling

Techniques to Extend Blade Endurance

- Pre-tensioning the porcine skin: Stretching the sample reduces resistance and improves cutting efficiency
- Hydration control: Slightly hydrated tissue is easier to cut than dry tissue, reducing wear

- Use of alternative blade types when appropriate: While #11 is precise, other blades (#10 or #22) may offer longer edge retention for longer cuts
- Frequent blade replacement protocol: Ensures consistency across trials and avoids variability from dull blades

Conclusions/action items:

Expect progressive loss of cutting performance during repeated porcine skin incisions. Implement standardized blade usage limits in protocols to maintain data reliability

2026/04/06 - Surgical Blades types for clinical research

Simon Nam - May 04, 2026, 12:19 PM GMT+9

Simon Nam - April 6, 2025, 8:28 PM CDT

Title: Surgical Blades

Date: 4/06/25

Content by: Simon Nam

Present: N/A

Goals: To learn more about cutting options and figure out which specific type of surgical blade may be the most optimal for the project's aim (to replace it with razor blade*)

Link: **https://www.usamedicalsurgical.com/blog/surgical-blades-which-scalpel-is-right-for-your-operating-room?srsltid=AfmBOooWUse1Hssg8d6NDnmQuOVQemiAHi9sO08ozmU-z-Y38Ndl3g6D**

Citation: "Surgical Blades: Which Scalpels Are Right for Your Operating Room?," *USA Medical and Surgical Supplies*, 2018. https://www.usamedicalsurgical.com/blog/surgical-blades-which-scalpel-is-right-for-your-operating-room?srsltid=AfmBOooWUse1Hssg8d6NDnmQuOVQemiAHi9sO08ozmU-z-Y38Ndl3g6D (accessed Dec. 06, 2025).

Content:

Razor Blade

Surgical blades offer higher precision and consistency than razor blades

- Designed for controlled, repeatable incisions, unlike consumer razor blades which vary in sharpness and bevel geometry.
- Made from surgical-grade stainless steel or carbon steel, providing better edge retention and cleaner cuts on biological tissue.
- Sterile, single-use, and standardized—allowing reproducible cutting thickness during porcine biopsy trimming.

Relevant blade sizes and their advantages for porcine skin cutting

Blade #10

- Curved cutting edge.
- Optimized for large, smooth cutting strokes through soft tissue.
- Good for removing bulk sections, but less ideal for fine thickness-controlled slicing, since the curvature reduces contact consistency.

Blade #11

- Elongated triangular blade with a very sharp, pointed tip.
- Used for precision punctures and initiating incisions.
- Not appropriate for long slicing motions or uniform sectioning.

Blade #12

- Hooked blade for suture removal and narrow spaces.
- Not suited for straight, controlled biopsy slicing.

Blade #15 — *Best match for the project requirements*

- Small, curved edge designed for short, precise, shallow cuts.
- Provides high control over depth and minimizes tissue dragging.
- Frequently used in procedures requiring fine dissection and consistent thin-layer removal, making it ideal for uniform-thickness biopsy samples.
- Works well with a scalpel handle (#3 handle), giving improved grip and angle control during cutting motions.

Why Blade #15 is the strongest candidate

- Produces cleaner, smoother edges on soft tissues like porcine skin.
- Offers more control during downward-press slicing mechanisms compared to a flexible razor blade.
- Reduces risk of blade wander, improving reproducibility of cut thickness.
- Industry standard for small-scale precision cuts, making performance more predictable and validated.
- Enhances safety: rigid spine prevents bending and reduces lateral motion inside the blade slot.

Conclusions/action items:

Discuss with client furthermore about deciding on a specific type of blade to proceed with for actual implementation

2026/2/25 - Stoelting™ Tissue Slicer

Simon Nam - Mar 21, 2026, 1:00 AM GMT+9

Title: Stoelting™ Tissue Slicer

Date: 2026/2/25

Content by: Simon Nam

Present: N/A

Goals: To see if there are any existing competing designs in commerical market that the team can incorporate some of the aspects into the latest design

Search Key Terms: porcine skin small tissue slicer machine

Link: https://www.fishersci.com/shop/products/tissue-slicer-2/10000127

Citation: "Stoelting Tissue Slicer Tissue slicer | Buy Online | StoeltingTM | Fisher Scientific," *Fishersci.com*, 2026. https://www.fishersci.com/shop/products/tissue-slicer-2/10000127 (accessed Feb 25, 2026).

Content:

- Designed for sectioning biological tissue samples into controlled, repeatable slices:
- Features:
  - rigid frame and blade guidance system
  - adjustable thickness settings for uniform cuts
  - compatibility with soft tissues (e.g., liver, brain, skin)
- Emphasizes precision, repeatability, and user control in laboratory environments

Advantages of This Design

- High precision and repeatability: Fixed blade path reduces inconsistencies compared to handheld cutting
- User safety improvements: Blade is partially enclosed and guided → lowers risk of accidental injury
- Adjustable thickness control: Enables standardized sample preparation for experiments
- Reduced blade wear variability: Controlled motion leads to more uniform blade usage
- Minimal skill requirement: Less dependent on operator technique compared to freehand scalpel use

Disadvantages / Limitations

- Limited geometric flexibility:
  - primarily supports straight, planar cuts
  - not suitable for complex shapes or hole-making (relevant to peg-based design)
- Integration constraints:
  - Standalone unit, not inherently designed to integrate with:
    - Custom fixtures
    - Polycarbonate structural systems
- Material compatibility constraints:
  - optimized for soft tissue only, not hybrid operations involving polymers
- Cost and accessibility:
  - higher cost compared to simple scalpel-based setups
- Cleaning and hygiene considerations:
  - more components → increased cleaning complexity when working with biological samples

Comparison to the team's design approach

- Team's latest design (polycarbonate + controlled cutting + peg assembly):
  - offers greater customization and modularity
  - can integrate multi-material components (PLA, nylon, PC)
- Competing slicer:

- inferior for multi-functional or integrated device workflows

Conclusions/action items: The Tissue Slicer is a strong benchmark for precision and repeatability in tissue cutting, but it is not optimized for integrated, multi-material, or geometry-specific applications down to 2 - 3mm scale. It is a useful reference for improving cutting consistency and safety, but the current team’s design better supports the broader design requirements of the project in terms of functionality.

2026/3/04-Water jet cutting on polycarbonate

Simon Nam - Mar 21, 2026, 12:37 AM GMT+9

Title: Water jet cutting on Polycarbonate

Date: 2026/3/04

Content by: Simon Nam

Present: Team

Goals: To obtain more knowledge on how to cut holes with precise diameters on polycarbonate to assemble with other material layers of the final, iterated design

Search Key Terms: water jet cutting hole in polycarbonate sheet

Link: https://www.vichor.com/waterjet-cutting-machines/water-jet-cutting-polycarbonate-precision-advantages-and-best-practices/

Citation: WJ, "7 Essential Facts About the Water Jet Tool: Technology, Applications, and Selection," *VICHOR Waterjet*, Sep. 03, 2025. https://www.vichor.com/waterjet-cutting-machines/water-jet-cutting-polycarbonate-precision-advantages-and-best-practices/ (accessed Mar. 4, 2026).

Content:

Water jet Cutting Accuracy for Polycarbonate:

- This technqiue provides high precision cutting with typical tolerances around ±0.003–0.005 in (±0.08–0.13 mm) depending on setup and thickness.
- No heat-affected zone (HAZ), which is critical for **Polycarbonate**:
  - Prevents melting, warping, or internal stress
  - Maintains dimensional integrity of holes and edges

Hole and Peg Fit Considerations:

- Water jet can produce clean, accurate circular holes, HOWEVER --> slight taper (kerf taper) may occur from top to bottom surface
- For peg-based assemblies (PLA, nylon, etc.):
  - Must account for clearance or interference fit depending on design intent
  - Typical design adjustments:
    - Clearance fit → hole slightly larger than peg diameter
    - Press/interference fit → hole slightly smaller, accounting for material compliance

Tolerance Design for Multi-Material Fit:

- When interfacing with materials like PLA and Nylon, consider material deformation:
  - Nylon → more flexible → can tolerate slight interference
  - PLA → rigid, low flexibility → requires tighter tolerance control
- Recommended approach:
  - Add tolerance margin (~0.001–0.003 in) depending on fit type
  - Validate with test cuts before final fabrication

Best Practices for Precision Hole Cutting:

- Use optimized cutting parameters: Proper pressure and feed rate to minimize taper and roughness
- Apply lead-in/lead-out strategies: Prevents imperfections at hole entry/exit
- Use piercing control: Reduces risk of edge damage when starting cuts
- Maintain consistent material support: Prevents vibration or movement that affects dimensional accuracy
- Water jet produces smooth edges, but may require minor finishing (reaming/sanding) for tight tolerance fits

Conclusions/action items: Water jet is well-suited for repeatable, high-precision fabrication of polycarbonate components in assemblies. Therefore, possible implementation of tolerance stack-up analysis for multi-part assemblies may be needed; essential to perform prototype iteration to fine-tune peg-hole fit across different materials.

2026/3/12- Use of applied of mass block: future design idea

Simon Nam - Mar 21, 2026, 12:59 AM GMT+9

Title: Use of applied of mass block: future design idea

Date: 2026/3/12

Content by: Simon Nam

Present: Team

Goals: During the testing on 3/12, one user giving feedback suggested a feasible idea for additionally inputting a mass block system for applying consistent pressure on to the sample from the top instead of using hand-held pressure applicator.

Therefore, further design idea research was performed regarding this suggestion

Search Key Terms: applying weight system to tissue sample while cutting

Link: https://precisionary.com/learn-the-step-down-process-to-cutting-thin-tissue-slices/

Citation: A. Chu, "'Step Down' Process for Cutting Thin Tissue Slices," *Precisionary*, Oct. 24, 2022. https://precisionary.com/learn-the-step-down-process-to-cutting-thin-tissue-slices/ (accessed Mar. 12, 2026).

Content:

Step-Down (Weighted) cutting mechanism:

- the cutting process relies on gradual, controlled downward force rather than manual pressing.
- A weight or guided load system ensures consistent pressure is applied across the tissue during slicing.
- this can eliminate variability introduced by inconsistent hand-applied force.

Advantages of Using a Weight System:

- improved consistency and repeatability: uniform force leads to more consistent slice thickness and cleaner cuts
- reduced tissue deformation: gradual loading minimizes compression and distortion of soft tissues like porcine skin
- enhanced cutting precision: allows blade to engage tissue more naturally rather than forcing penetration
- reduced operator dependence: minimizes variability between users and across trials
- better blade longevity: controlled force reduces edge stress compared to abrupt manual pressure

This idea can be further implemented using:

- calibrated weights (such as commonly found from Physics labs for Newtonian mechanics mass block system)
- spring-loaded or gravity-driven systems
- enables quantifiable force control, which is valuable for experimental repeatability
- easily integrated into rigid structures like Polycarbonate frames
- supports alignment with guided cutting paths such as rails or slots?

Conclusions/action items: Incorporating a weight-based system can certainly improve standardization of cutting conditions and enhance data reliability for testing. This would also work well with polycarbonate structural design with allowing stable mounting and guided motion. This should should be paired with blade guidance system and adjustable weight increments for optimization.

3/08/2026 Training Documentation

Simon Nam - Mar 13, 2026, 1:23 PM GMT+9

Title: Training Documentation

Date: 3/8/2026

Content by: Simon Nam

Goals: Documented my required new training for Spring 2026 semester;

Title of training: Responsible and Ethical Conduct of Research 3/8/26

Content:

OVCR Training Information Lookup Tool **University of Wisconsin-Madison**

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This certifies that Simon Nam has completed training for the following course(s):

Course	Assignment	Completion	Expiration
2024-2025 HIPAA Privacy & Security Training	2024-2025 HIPAA Privacy & Security Training	1/17/2025	
Biosafety Required Training	Biosafety Required Training Quiz 2024	3/7/2024	3/7/2029
Chemical Safety: The OSHA Lab Standard	Final Quiz	3/7/2024	
Responsible and Ethical Conduct of Research (RECR)	RCR Certification	3/8/2026	No Expiration
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	9/6/2025	9/6/2028

Data Last Imported: 03/08/2026 05:25 PM

Conclusions/action items:

Continue completing trainings and apply research code of conduct and skills obtained from training for the publication of journal article for BME 402.

2026/03/06-Tong Distinguished Lecture Series

Simon Nam - Mar 07, 2026, 11:54 AM GMT+9

Title: Tong Distinguished Lecture Series

Date: 3/6/2026

Content by: Simon Nam

Present: Prof. Justin Williams

Goals: To learn more about the past career and success of one of our BME faculty representative involved in teaching and research in neuroengineering

Content:

Dr. Justin Williams' Tong Distinguished Lecture highlights how a biomedical engineer can translate ideas from "science fiction" into impactful brain technologies over a long, nonlinear career path.

Speaker background and career records:

- Dr. Williams is a biomedical engineering professor and neuroengineering leader at UW–Madison, with co-founder roles in multiple neurotechnology companies and institutes focused on translational neuroengineering.
- He grew up in a small rural town with limited access to technology and initially did not envision a career in science
    - but mentors and opportunities led him to engineering, graduate school, and ultimately to neurotechnology focused on neurological disease and injury.
- Over ~25 years at UW, he has combined micro- and nanotechnology with novel experimental approaches to understand and treat neurological disorders such as epilepsy, stroke, Alzheimer's disease, and traumatic brain injury
    - received major awards and recognition for his inventions and entrepreneurial work.

Themes of the lecture: BME roles and design process

- Biomedical engineers can fill many roles across the product life cycle
    - research and development, system engineering, design quality, verification/validation, manufacturing quality, supplier quality, post-market and clinical engineering—making BME a "jack of all trades" field.
    - The medical device pathway is iterative:
        - classify the product
        - plan the design and requirements
        - prototype
        - manage risks
        - verify and validate against user and design needs
        - move to final design, manufacturing, and commercialization, with cycles of redesign based on complaints and post-market feedback.
- System engineers oversee the big picture so nothing is lost, while specialized engineers ensure devices meet standards, are usable in clinical environments, and remain safe and effective once deployed.

Entrepreneurship, failure, and perseverance:

- Dr. Williams repeatedly emphasized that many of his companies and devices began as earlier projects that were initially shelved or bought out,
    - start-ups often do not "boom" right away.
- He showed how he and a startup team developed several designs that were acquired by larger corporations,
    - how he kept starting new efforts until one succeeded, reinforcing the importance of not giving up after setbacks.
- An example project was a simple but impactful device for epilepsy and surgical incisions, which ultimately worked very well,
    - gained significant visibility (including a NYC billboard and appearances in popular media)
    - demonstrated that straightforward, well-timed ideas can have large clinical and commercial impact.

Key takeaways about innovation and impact:

- Networking and repeatedly working with the same trusted collaborators can accelerate innovation and company building over time.

- Sometimes “less is more”: simpler, easier-to;-understand devices may be more marketable and acceptable than complex technologies that the public or clinicians are not yet ready to embrace.
- Knowing your market and timing is crucial;
    - companies are more likely to support devices that can help large patient populations
    - so aligning design goals with broad impact increases the chance of support and translation.

Conclusions/action items:

This lecture broadened the view of what BME careers can look like. It renewed my interest in bioinstrumentation and neuroengineering, inspired me to explore opportunities like the Wisconsin Institute for Neuroengineering. It also highlighted the importance of relationships, continual learning, and building good habits over time.

2014/11/03-Entry guidelines

John Puccinelli - Sep 06, 2016, 3:18 AM GMT+9

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

John Puccinelli - Nov 04, 2014, 6:20 AM GMT+9

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items:

2014/11/03-Research Entry Template

Simon Nam - Jan 29, 2026, 4:04 PM GMT+9

Title:

Date:

Content by:

Present:

Goals:

Search Key Terms:

Link:

Citation:

Content:

Conclusions/action items:

BME Design - FALL 2025 - Notebook

RUHI NAGARKATTE - Jan 24, 2026, 4:31 AM GMT+9

BME Design-Fall 2025 Biopsy Press
Complete Notebook

Simon Nam

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