BME Design-Fall 2025 - Lydia Miller Complete Notebook

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Janice Amornthanomchoke - Sep 05, 2025, 2:06 PM CDT

Last Name	First Name	Role	E-mail	Phone	Office Room/Building
Williams	Justin	Advisor	jwilliams@engr.wisc.edu		
		Client			
King	Catilin	Leader			
Miller	Lydia	Leader			
Lee	Megan	Communicator			
Amornthanomchoke	Janice	BSAC			
Vegesna	Varenya	BWIG			
Stroshane	Emma	BPAG			

Lydia Miller - Sep 08, 2025, 11:57 AM CDT

Course Number: BME 200/300

Project Name: GVI: Straw Stamp and Slicer

Short Name: Stamp and Slicer

Project description/problem statement:

Farmers who manage herds of cattle are increasingly using genomics to make breeding decisions and improve the genetics of their herds. Artificial insemination of high-quality bull semen is crucial to their goals. We run a QC program to perform genetic testing on bull semen to ensure it meets quality standards. Semen is provided in artificial insemination straws, which are about the size of a coffee stir-stick, and are sealed on one end with cotton plugs on the other. Currently, removing the contents for testing involves cutting one end, and using a straightened paper clip to push out the sample. This is a tedious, manual process, and we aim to increase efficiency with these proposed devices.

The straw slicer is a lever-mechanism device designed to cut a set of 12 straws at a time avoiding any cross contamination between straws. The slicer should have a jagged-tooth design similar to a tube cutter, and include blade guards with openings to place and align each straw. Each component of the straw slicer should be able to come out for washing/cleaning.

The straw stamper will be designed with plungers to push bull semen out of artificial insemination straws in bulk. The device should be able to stably hold 96 plastic straws over a 96-deep well plate, and push out the contents, avoiding any punctures or deformation of the straws, as well as avoiding any cross-contamination between samples.

About the client:

"Genetic Visions-ST™ performs genotyping of production animals using DNA from hair, tissue, semen or blood ... Genetic Visions-ST™ also conducts sequencing services for Quality Control (QC) program for semen straws. Sequences are analyzed through partnership with STgenetics® and other outside vendors to provide sequence data to customers which reports whether DNA is detected from bulls other than the one listed on the semen straw" [1].

Citation:

[1] Genetic Visions-ST, "Genetic Visions-ST," *Geneticvisions.com*, 2016. https://www.geneticvisions.com/about-us.aspx (accessed Sep. 08, 2025).

MEGAN LEE - Sep 15, 2025, 9:50 AM CDT

Title: First Client Meeting

Date: 9/12/2025

Content by:

Present: Entire group

Goals: To ask our client questions to understand the project and any requirements/preferences they have

Content:

Design requirements

1. Physical and Operational Characteristics

1. Performance requirements - Lydia

1. How often will this device be used per day...per week? 8-10 per week

2. Safety - Lydia

1. What are the current and anticipated safety concerns with this device? Cutting concerns, blade guards

3. Accuracy and Reliability - Lydia

- 1. Is there a goal time reduction you are looking to achieve? Current:1-1.5 hours, cut down in half is possible. Precision is crucial!
- 2. How important is the precision of the device?

4. Life in Service - Catie

- 1. How many days of the week/how many times per day will this device run for?
 - 1.
- 2. How long do you expect this device to last for before replacement? Replaceable blades, plungers, etc?
 - 1. Regular scissors are breaking after about a year, ideally as durable as possible (based on budget)

5. Shelf Life - Megan

- 1. Does this device need to be stored at a certain temperature?
 - 1. standard
- 2. Should this device be electronic? Or all mechanical?
 - 1. No preference, budget is flexible

6. Operating Environment - Megan

- 1. Where will the device be used? What are the conditions there?
- 2. Will the straws be frozen when they're cut?
 - 1. They're shipped room temp or cold, will be fridge or room temp

7. Ergonomics - Megan

- 1. What is the force needed to apply on the straws in order to stamp them?
 - 1. A pound?

8. Size - Emma

- 1. What is the approximate largest you would want the slicer to be?
 - 1. Look at lab to see area
- 2. Is there a place where the tool would be stored when not in use?
 - 1. On benches.

9. Weight - Emma

- 1. Are there one or two hands ideally involved?
 - 1. Precision over time
- 2. What is the weight limit for how heavy the tool should be?
 - 1. No, have other heavy materials

10. Materials- Emma

- 1. Is there a preferred material that has already been predetermined?
 - 1. No porous and able to be cleaned (bleach or alcohol)
- 2. Any materials that should not be used that can interfere with the process?
 - 1. No porous materials
- 3. What conditions does the device need to withstand?
 - 1. Is at room temperature and would just need to be cleaned

11. Aesthetics, Appearance, and Finish - Varenya

1. Any preferences of appearance? No

2. Production Characteristics

1. Quantity - Janice

- 1. How many devices are you expected to use at a time during production? Janice
- 2. How many devices are you expected to have? Janice
 - 1. Only one

2. Target Product Cost - Janice

- 1. How much is the budget for the device? Janice
 - 1. 50-1000\$ for now
- 2. How do we gain access to the budget and materials provided? Janice
 - 1. Can provide rd straws, mail to us, just reach out to them
- 3. What's the average cost of the device/How much was the device you are currently using? Janice
 - 1. 20,000 similar products for plating
 - 2. Not really any for cutting and dispensing

3. Miscellaneous

1. Standards and Specifications - Catie

- 1. Would FDA approval be required for this device?
- 2. Is there a specific standard regarding the cross contamination aspect of this device?

- 3. Are there any standards regarding the sterilization process/do we need to use parts that are autoclavable?
- 4. Are there any other standards or regulations that you know of that this device must follow? (ISO, ASTM, etc)
 - 1. ISO accredited, but no standards need to be followed

2. Customer - Catie

1. Are there any features on existing products that you like and would like us to incorporate? Any that you absolutely do not want?

1.

What would make this device easier for you to clean/sterilize in between uses? (ex. Size/shape of components)

1.

3. Patient-related concerns- Varenya

- 1. Does the device need to be sterilized in between uses? What needs to be done before the next one?
 - 1. Cleaned, not cross contaminated
- 2. What do you value the most, size, weight, materials, etc.
 - 1. Whatever is precise precision is the most important.
- 3. Any preferences on appearance?

4. Competition- Varenya

- 1. What are you using right now?
 - 1. Scissors to cut individually

Additional Questions:

Do you have a vision for what you want the device to look like?

- $\frac{1}{4}$ and $\frac{1}{2}$ cc, get mostly $\frac{1}{4}$ cc straws
- · Diff studs have different viscosities, so testing they can send us filled and empty semen straws for testing

Already have a device created?

- · ST sorts female semen
- · Semen QC: extracting DNA from straws and running with sequency; compared with the expected one
- If the straw doesn't contain the semen expected, it's trashed
- · There's a vacuum in one end of the straw
- Currently: Foil seal, pierce it, and pushed through
 - Need to clean scissors, paperclip
- · Wants a mechanism that can hold the straw (silicone?) and then a hing to stamp it all together
- Minimize user error or contamination
- Seconds part is cutting the straws
- · Evidence of contamination: run through sequencer found through initial blood testing
- · Wants something to clamp and holds the stamp in place

- · Should straws be placed individually still? Not sure, open to ideas
- · Should we make separate devices or two? One would be fine, just make sure there's no contamination
- · Would the stamp have to be disassembled to clean? Any part that touches the straw needs to be cleaned
- Why do you want the jagged tooth edge? To further minimize contamination, straw will be placed in tooths to isolate each other
- · Wear gloves when dealing with the semen straws
- · Different viscosity for different studs
- · Put semen straws in fridges to stop bacteria growth
- · Cleaning scissors and paper clip in ethanol and bleach
- Currently, there is 5% contamination
- · Straws shouldn't touch the bottom of the well

Conclusions/action items:

After meeting with our client, we were able to answer some of our questions that are related to our PDS. We also learned that contamination is their biggest problem, and the biggest priority that this device should have. Our next steps will be to finish our PDS and start drafting design ideas.

Lydia Miller - Oct 22, 2025, 9:38 AM CDT

Title: Client Update Meeting

Date: 10/22/2025

Content by: Lydia Miller

Present: Entire group

Goals: Update GVI on our progress and show them our prototypes. Create space for them to give us feedback and ask any necessary questions. Take feedback and use to inform future design.

Content:

- · We presented ideas from the preliminary presentation as well as displayed SolidWorks ideas
- · GVI asked questions about the loading process, and we were able to answer this by showing our 3D printed prototype
- · Questions about sanitization were also asked
- We went over the payment plan again and let them know we would reach out when needed
- GVI is overall happy with the progress of the design

Post meeting

- · Go over frame ideas again and discuss the potential errors in the design
- · Discuss contamination test and materials needed
- · Catie showed her stamper idea, this will need to be printed

Conclusions/action items: The finalized ideas for the stamper/frame must be 3D printed in the upcoming week. Testing should begin this weekend/early next week. We will meet again later this to continue fabrication and testing.

MEGAN LEE - Sep 12, 2025, 12:52 PM CDT

Title: Advisor Meeting 1

Date: 9/12/2025

Content by: Team

Present: Team

Goals: To review the progress report from week 1 and get any feedback

Content:

- Every Thursday night, progress report and notebooks will be checked
- Everything from this class should be on the notebook in a timely fashion
- Make sure everything in the google drive is in the notebook
- Date you did something should match the notebook date
- Document team meetings and why you haven't had one yet
- Advisor meetings will talk about budget, ordering issues, etc.
- Design ideas due in 2 weeks; get started soon to get feedback
- Next week: Draft PDS (can send to get advice)
- October 3 Prelim Presentation will be during class time in ME

Conclusions/action items: Advisor meetings will go over progress reports and notebooks, as well as going over any questions we have. Make sure that everything is taken in the notebooks and are timely and in full detail. Next steps is to come up with design ideas to go over next advisor meeting and prepare for the preliminary design ideas.

Lydia Miller - Sep 19, 2025, 1:05 PM CDT

Title: Advisor Meeting 2

Date: 09/19/2025

Content by: Lydia Miller

Present: Entire group and Dr. Williams

Goals: Review PDS and progress report. Cover GVI trip and any questions we have remaining. Make a plan for the future.

Content:

- · Go over PDS draft
 - Find places to add "testable" numbers ... think about end goals and how to show success through quantifiable achievements
- · Discuss progress report 2
 - GVI trip and their preferences
 - Show prototype, discuss workflow of procedure process
 - Discuss possible issues and ideas (2 devices or 1?)
 - · Focus on 1 device for now, in the future, try to combine into one device
 - Force of stamping/straws, force needed to cut (difference between jagged and smooth blade?)
 - Emphasis on timed test (most important to clients)
 - · Ease of disassembly
 - · Consider materials (cost, ease of use, durability, shelf life)
- · Stamp ideas
 - Frame, slider (Janice has research on this)
 - Stamping each row at a time rather than 96
 - o Concerns with stamping all 96, flimsy straws
- · Slicer ideas
 - Guillotine idea to reduce cross-contamination
- Budget around \$1000, they order and ship to us

Conclusions/action items: For now, we are going to focus on slicing and stamping one row at a time. Additionally, we will make 2 devices and consider making 1 device later. Begin to think about the design matrix and feasible design ideas.

CAITLIN KING - Sep 26, 2025, 1:00 PM CDT

Title: Advisor Meeting 3

Date: 9/26/2025
Content by: Catie

Present: Group + Professor Williams

Goals: Go over design matrix and ask fabrication logistics questions with professor williams.

Content:

Advice for Preliminary Presentations

- · Practice beforehand more seamless presentation
- · Invite client to preliminary presentation and final poster presentation

Design Matrix Notes

· Good to show winning design is best in multiple categories and most important category

Q + A for Fabrication

- · Best material for smallest tolerance and to allow for consistent exposure to ethanol
 - · Nylon things don't stick, easier to clean, pretty resistant to ethanol
 - Can expand and contract as straw is sliding through
 - · PLA similar benefits to Nylon
 - Metal requires very tight contact
- · Printers
 - · SOA layer by layer building from spool of material
 - Less precise with melting and re-hardening of material
 - · Photolithic graphic light that guides printing
 - Much smaller tolerances good
 - May be more difficult to get material back out of it
- Blade for "The Compartments"
 - · Singular sharp blade not as reusable
 - · Blade that can vibrate requires less force
 - Micromotor
 - Replaceable razor blade that can slide into mechanism

Misc.

- Notebook is static don't use links, directly paste image in
- Don't need to focus too heavy on tolerance, can always make prototype to larger scale (ex. McDonald's straw) and then scale down for final design

Conclusions/action items: Make sure to practice preliminary presentation with each other and invite clients to the presentation. Also, think about making matricies and sending to Professor Williams in the future for the slicer and stamper components. Look into materials for "the compartments" frame and see if this material will hold straws snugly enough and be easily sanitizable.

MEGAN LEE - Oct 10, 2025, 12:59 PM CDT

Title: Advisor Meeting 4

Date: 10/10/2025

Content by: Team

Present: Team + Professor Williams

Goals: Go over our preliminary presentation and what our next steps are

Content:

- Show and tell on 10/31 in the same meeting room
- 4 weeks until final presentation
- · Presentation feedback:
 - Slide order (make sure there's enough background)
 - A picture of the existing device sooner would help
 - · More numbers on the PDS and linking them to what we're going to test
 - · Fonts were small on figures
- Check in with client on our testing procedure (will these results be useful to you?)
- · Could make a bigger-sized frame with a bigger straw to easily solve any problems
- · For contamination testing:
 - UV light idea: would be more definitive, make sure straw doesn't light up (could use a dye with a different wavelength ex. fluorescein)
 - Every microscope in the teaching lab has a fluorescein detector in the microscopes, used in blood, FDA safe
 - Could also use fluorescent beads, easier to quantify
 - Ask Dr. Pucenilli if he can help us use the microscope and if we already have dye
 - · Color dye: Might not show up, harder to interpret
- · Aluminum wire could be better for the prongs instead of stainless steel
- · Bring any prototypes to meeting next week

Conclusions/action items:

The next deliverable due is on Halloween, which is the Show and Tell. Our next steps are printing the frame and stamp, possibly on a larger scale. We will also need to figure out how to quantify contamination testing, which we can do using the microscope in the Teaching Lab.

CAITLIN KING - Oct 17, 2025, 12:50 PM CDT

Title: Advisor Meeting 5

Date: 10/17/2025

Content by: Catie

Present: Whole team

Goals: Meet with advisor and show the 3D printed prototype. Get more advice on rod material

Content:

- · Test prototypes with different heights of triangular cross section (force required to push straw through)
- "Manifold edges" setting in meshing software that is causing this?
- · Euler's formula (modulus of elasticity) to correctly predict length, diameter, and material of rod
- · Inform makerspace of printing issue of stamper to get some help
 - Could also redraw handle, or find way to print as assembly, probably don't superglue
- · Make sure to test out purchasing some materials through the client
- Plan for slicer seems reasonable (simple paper slicer design with replaceable razor blades)
 - Feel free to cc advisor on emails with Dr. P so he knows we are scheduling things

Conclusions/action items: Make sure to keep going with prototyping and 3D printing. make sure to purchase something with the clients so we have that process down.

MEGAN LEE - Oct 24, 2025, 12:54 PM CDT

Title: Advisor Meeting 6

Date: 10/24/2025

Content by: Megan

Present: Team + Professor Williams

Goals: To update on our progress and discuss what to show at Show and Tell

Content:

- Fluorescent beads are expensive; could use fluorescent dye instead
 - Don't need to necessarily quantify; have a yes or no test
 - · One well with fluorescent, one without
 - Fluorescein could be a good option; the only problem would be getting it the right concentration
 - Sanitation testing: fluorescent microscope any dye remaining after sanitation protocol?
 - Ultrasonic cleaner could buy a jewelry cleaner for sanitation
- · Could 3D print a test fixture for MTS testing
- GVI might have an account set up for a company try to ask for the dye (Fisher, Sigma are the big university companies)



Conclusions/action items:

Fluorescein would be the best bet to use for our contamination testing. Our next steps will be to order dye and write and perform our protocol. We will also want to reprint our components.

MEGAN LEE - Oct 31, 2025, 5:01 PM CDT

Title: Show and Tell

Date: 10/31/2025

Content by: Team

Present: Team

Goals: To get advice on our slicing mechanism and share our project.

Content:

- Slicer
- · Squeeze mechanism in the stamper to cut all at once
- Blades on either side of compartment and clip on the side to cut
 - · hard to sanitize
- · Safety concerns with the vibrating blade
- · Bagel slicer type of design
- · Cutting board style for slicing (too much shear force and bending of straws when cutting if it is hanging off)
 - Small divot for blade to go down through the straw on the "cutting board"
- · Nail clipper idea
- · Small individual blades for each straw
- · Possibly have it built into the compartments (individual slicer for each straw that pushes forward briefly for each straw)
- · Pizza cutter?
- Pliers?
- Testing

Materials

- · When switching materials, look at how easy it is to print
 - · Tweak it to print how you want it to
- Sanitation
- · Sheath around the straw or a compartment that is removable to reduce cross-contamination

Conclusions/action items:

Some possible slicing mechanisms that we could look into are nail clippers, pizza cutter, and pliers.

MEGAN LEE - Nov 07, 2025, 1:31 PM CST

Title: Advisor Meeting 7

Date: 11/7/2025

Content by: Megan

Present: Team + Professor Williams

Goals: To touch base and make sure our timeline matches with when the presentation is due

Content:

- Gutter idea for the cutter?
- Make sure the blade isn't too short
- Could start working on the poster now
- Start with fluorescence excitation and emission and go from there
- Request with the company to get more specs

Conclusions/action items:

Cutter is good, just try to print something which catches the ends of the straws. Next steps will be to do testing.

Lydia Miller - Nov 14, 2025, 12:51 PM CST

Title: Advisor meeting 8

Date: 11/14/25

Content by: Lydia Miller

Present: GVI group

Goals: Show progress on new stamper, frame, and compartments. Discuss MTS testing. Discuss future plans for cross-contamination testing and MTS data analysis.

Content:

- Poster set up: 10-11
- · Presentation order: 2nd
- Make 2 poster printing appointments (Wednesday before presentations)
- Final report and lab notebook due dates approaching!
- Might need to use a resin printer to get more accuracy with compartment holes (maybe use TPU for friction) ... more expensive and time consuming
- · Get trained and make appointment on plate reader
- · Discuss cutter plans and gutter idea
 - 3D print replacement or attachment onto cutting board part of knife
 - · Cup design "u shape"
 - · Hole puncher
 - Use tough material because we might have to replace the cutting board ... nylon-infused polymers (nylon also easy for cleaning)
- · Force to push straws would scale linearly

Conclusions/action items: Contamination testing, create gutter, data analysis for MTS data.

CAITLIN KING - Nov 21, 2025, 1:00 PM CST

Title: Advisor Meeting 9

Date: 11/21/2025
Content by: Catie

Present: Group + Dr. Williams

Goals: To get guidance for poster printing and fill Dr. Williams in on our plan

Content:

- 122 x 182 cm (LxW) is the poster stand
- 48 x 72 inches for poster
- · Can ask specific questions about poster, but advisor does not have time for long review of it

How to put fluorescence solution in straws

- · Solution of fluorescent dye, place straw in fluorescent solution, have some sort of suction mechanism to pull up dye into the straw
 - · Make sure to place straw at uniform height, hydrostatic pressure will push air out
 - Capillary action works in some cases, (surface energy to overcome hydrostatic pressure)
- · Could find dye that is water soluble (difficult)
- · Could make argument that challenge we are having inserting dye isn't too different from challenges of semen in general (not uniform)
- · Vacuum sealer used to pull air out of chamber (can put all straws and whole set up in there)

Slicer mechanism

- · Will 6in blade create correct amount of force?
 - Force of paper cutter is determined by force of user and lever arm
 - Use statics to calculate force generated for different length cutters (lever arms)
 - Will 6 inch blade be able to generate enough force to cut straws
 - Figure out how much force is needed to cut through straw
 - If it doesn't work, just make handle longer (not size of blade, it is length of lever)

Payment account

- · Can they pay by credit card?
- We can go over \$50 by a little bit as long as we are not blindly spending

MTS testing and analysis

- · We get result of force to push straw, how do we use result to convey something?
 - o Is that force greater than or less than breaking force or bending force of pins
 - Euler's to calculate force it takes for steel rod to bend/deflect/etc.
 - Force needs < force to bend/break steel rod

Conclusions/action items: We are okay to go slightly over budget for the 3D printing. Make sure to add value and context to force testing, show it takes less force to push straws than it does for steel rod to break. Continue with contamination and sanitation tests. Figure out how to insert fluorescence into straws.

MEGAN LEE - Sep 15, 2025, 10:05 AM CDT

Title: First team meeting

Date: 9/15/25

Content by: Lydia Miller

Present: entire group

Goals: Begin work on the PDS, making sure each group member fully understands the requirements for each section. Talk about client meeting and reflect on notes. Think about work for the upcoming week.

Content:

Notes for the PDS

- Quantify when possible
- 3rd person
- No casual language
- Have done by Wednesday night so we can send to Dr. Williams

Design

- Create 2 separate design pieces
- Plan to brainstorm at least 1 idea per group member
- Possibly have detachable parts so we can interchange between straw sizes
- OR: make the device compatible with both straw sizes
- Something to keep the straws in place when pushing down
- Something to keep the straws from hitting the bottom of the wells
- Ask Dr. Williams about the blades (purchase or make somehow?)
- Possibly move away from jagged tooth blade design
- Get 2 more research entries done by Thursday

Conclusions/action items: Went over important reminders about PDS. Planned work for the upcoming week, including finishing the PDS and beginning brainstorming of ideas. Reflected on the client meeting. Went over any question the group had about the PDS.

MEGAN LEE - Sep 22, 2025, 11:08 AM CDT

Title: Design Idea Meeting

Date: 9/22/2025

Content by: Team

Present: Team

Goals: To discuss our individual design ideas to come up with our designs for the matrix.

Content:

- Stamper mechanisms are all very similar; just need a way to stabilize the straws
- 3 mechanisms: frame, blade, slicer
- Horizontal slicer idea could be hard to move to the well plate
- Frame compartment idea could be difficult since the dimensions are so small
- Could have some mechanism where one wall is stationary and one is adjustable
- Maybe have notches on horizontal idea?
- For slicer, need 2 forces: one to push down the straw and one to push the liquid through
- Final 3 frame design ideas for the preliminary matrix: horizontal idea, vertical compartments, vertical with stamper
- Will meet later this week to discuss the criterion and rank the designs

Conclusions/action items:

From our meeting today, we overall concluded that we will start with discussing the frame ideas to hold the straws in place for it to be cut and stamped. Our 3 ideas are a horizontal one, a vertical compartment one, and another vertical one which can attach to the stamper.

MEGAN LEE - Sep 24, 2025, 10:02 PM CDT

Title: Preliminary Design Matrix Ideas Meeting

Date: 9/24/2025

Content by: Everyone

Present: Everyone

Goals: To go over our 3 final designs for the preliminary design matrix

Content:

Lydia and Janice's idea:

- Handle on top with frame to encompass the bottom part
- Holes on the side to serve as a resting spot for stamp
- Ease of fabrication: simple shape but cut out could be hard
- Make frame taller so it doesn't touch the bottom of the well
- Problem is will it work for all 96?

Megan and Varenya's idea:

- Problem is that we need the top part to be very snug and precise
- Can we find a 3d printer that is precise enough to make a 2mm hole?
- What is the best way to get rid of the left over straw pieces at the end?
- A compartment holding each straw and having a small divet to cut the straws at once
- If it's 3d printed, need to make sure it won't degrade when cleaned with ethanol

Catie and Emma's idea:

- Screw to twist the holders in place
- Horizontal cutter
- How would screw keep it together?
- Some sort of scoring method to keep it in it's spot

Conclusions/action items:

We met to discuss our 3 main design ideas. Overall, we decided that design 3: the compartment idea, is the most feasible. We ranked our designs in the preliminary matrix and this will be used to justify why we picked design 3.



9/29/2025-Design and preliminary presentation meeting

Lydia Miller - Sep 29, 2025, 10:54 AM CDT

Title: Design and preliminary presentation meeting

Date: 9/29/2025

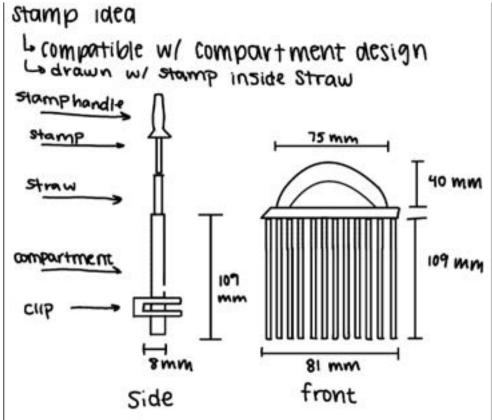
Content by: Lydia Miller

Present: GVI Group

Goals: Share design ideas for stamp. Pick 2 ideas to make a mini design matrix. Run through the preliminary presentation to make sure everyone's sections are going well.

Content:

- · Through our conversation, we decided that there were 2 main ideas we are considering for the stamp handle
- · The first design is similar to the prototype design, which includes a handle with 12 prongs to push the contents of the straw into the well
- The second design is built to be clipped to the compartment/frame and has a retractable component that can push each straw through the foil
- · For the design matrix, we replaced contamination risk with durability
 - · We replaced contamination risk as each design posed little to no risk of cross-contamination
 - · We added durability because of the repetitive use of the prongs and the force needed to use it



Prong design:

Conclusions/action items: The prong design won using our design matrix. We are going to write the justifications for the design matrix so it can be added to our preliminary presentation. We will continue to work on the design matrix as well as the preliminary presentation.

MEGAN LEE - Oct 08, 2025, 9:56 AM CDT

Title: Design Consultation Meeting

Date: 10/8/2025

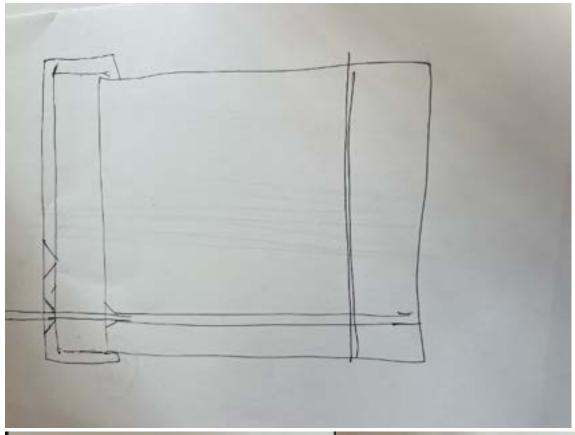
Content by: Megan

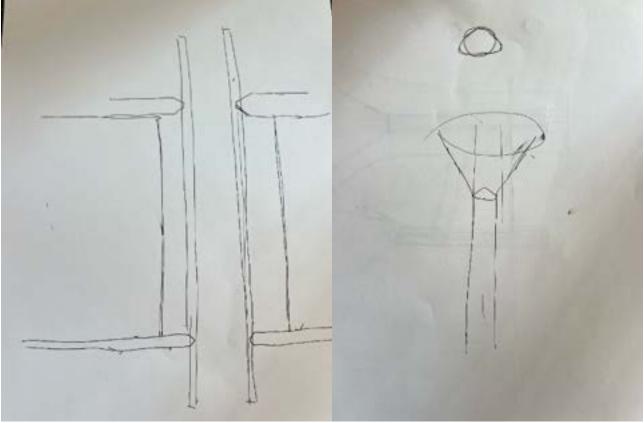
Present: Megan, Varenya, Catie, Emma, Jesse

Goals: To meet with Jesse to get feedback and advice on our design idea.

Content:

- Bamboo and PLA for 3D printing prototypes
- Could make the whole stamper replaceable
- Add off centered shape on the top, running down the whole bottom to add grip
- Use Mcmaster to order materials





- Left sketch is the stamper + frame idea to make it more in alignment, was also thinking that we could put groves on the side of the frame which would attach to the stamper handle
- Middle sketch is an idea for if we want to machine the design instead of 3D printing it
- Right sketch is the 3D printed frame idea, where we could have a triangle to oval opening, which would help to grip the straw better

Conclusions/action items:

After our consultation meeting, we are thinking about making the frame have a funnel-type opening with an oval or a triangle extrusion. Our next step will be to make the design on SolidWorks and print it using one of the bamboo printers for the initial prototypes.

10/13/2025 - 3D Printer and Material Order Meeting

MEGAN LEE - Oct 13, 2025, 10:48 AM CDT

Title: 3D Printer and Material Order Meeting

Date: 10/13/2025 **Content by:** Team

Present: Team

Goals: To look over our 3D print and decide what materials we want to order

Content:

- Scheduled meeting with our client for next Wednesday
- First 3D print for frame holes were too small
 - Reprinted with 2.5 and 3 mm hole dimensions
- Ordered aluminum rod
- Printed stamper holder bottom part

Conclusions/action items:

We started to 3D print our first prototypes. Our next steps are testing them and checking in with the client.

10/20/2025-Handle Creation SolidWorks

Lydia Miller - Oct 20, 2025, 10:59 AM CDT

Title: Handle Creation SolidWorks

Date: 10/20/2925

Content by: Lydia Miller

Present: Entire group

Goals: Remake handle in solid works in order to print. Plan activities for the week. Decide if new frame/stamper idea needs to be created

Content:

- The team began by splitting up and doing a SolidWorks demo to teach the 200s more about SolidWorks during handle re-creation
- After difficulties, we decided not to use a handle
- We are no longer using "clips" to attach the frame
- We made a new frame idea utilizing square holes to allow for alignment during stamping and slicing
- We planned to write mechanical testing plans this week so we can begin testing once our new frame/handle is printed

Conclusions/action items: Finalize our SolidWorks design for the frame utilizing the square guiding holes. We will write the MTS testing plans this upcoming week. Begin printing of new frame.

Lydia Miller - Oct 24, 2025, 9:29 AM CDT

Title: Meeting with Dr. P

Date: 10/24/2025

Content by: Lydia Miller

Present: Entire group

Goals: Discuss options for executing the contamination test. Determine if a microscope or a plate reader is a better option. Discuss dye/fluorescent bead options.

Content:

- · Use both fluorescent microscope and plate reader
- Plate reader more quantifiable
- · Make sure correct filters available
- · Will have to buy our own dye
- Alexa 488, expensive, dilute bottle
- · Use fluorosceine, look under microscope and plate reader they might not have in ECB
- · Fluorescent dextran 10k and 3k molecular weight
- Use microscope by MTS machines
- Use BME 201 manual on how to use microscopes and software
- · Use FITC likely
- · Can use dextran for sanitation test as well, do at least 3 trials

Conclusions/action items: We need to determine if we want to use a dye or beads in the test, and purchase the final choice as soon as possible. We will contact Dr. P when we are ready to perform the test procedure to get help. We will likely end up using the microscope and plate reader with multiple trials.

2025/10/27-MTS testing and brainstorming

Lydia Miller - Oct 27, 2025, 11:39 AM CDT

Title: MTS Testing and brainstorming

Date: 10/27/2025

Content by: Lydia Miller

Present: Entire group

Goals: Practice MTS testing with an empty straw to familiarize ourselves with the system. Order new rods and dye. Discuss ideas for slicer more in depth to plan for future design/testing.

Content:

- · Utilized BME 201 compression test (custom template) to practice compressing the rod/paperclip into the straw
- We taped the straightened the paper clip to the load cell to keep in place
- The 200s worked on creating a testing fixture to hold the rod on the load cell in a more secure way
- Ran 1 test run and saved data, will redo more tests now that we are familiar with the procedure and will have the test fixture made soon
- Notified client of the rods and dye we would like to purchase
- · Looked into slicer ideas such as large scissors, long razor blades, and a paper cutter
 - We are planning to go to a library to see how the paper cutter method would work

Conclusions/action items: Print test fixture and redo MTS testing. Finalize order once client approves. See if paper cutter works to slice the straws.



11/3/2025 slicer planning and dimensioning

Lydia Miller - Nov 03, 2025, 11:19 AM CST

Title: Slicer planning and dimensioning

Date: 11/3/2025

Content by: Lydia Miller

Present: entire group

Goals: Pick slicer idea. Redo dimensions so we can reprint frame.

Content:

- · Brainstormed slicer ideas
- · Found kitchen knife cutting board scissors that could work
- · Remeasured well plate
 - Length of well plate (not including solid side pieces ... just wells): 109 mm
- Planned new dimensions of frame
- · Modify compartment design to reprint.

Conclusions/action items: Reprint frame and compartments. Print stamper handle. Email GVI which slicer we want to buy.



11/17/2025 - Well Plate Reader and Gutter Brainstorming

MEGAN LEE - Nov 17, 2025, 10:38 AM CST

Title: Well Plate Reader and Gutter Brainstorming

Date: 11/17/2025

Content by: Team

Present: Team

Goals: To finalize our testing plans

Content:

- How will we inject the fluorescence into the straws?
 - Use a syringe to inject through cotton
- Email Dr. P about how to use it, what materials we're able to do
- · How to clean it?
- Gutter design figured out, emailed the client to see if they like it
- · Need to reprint the compartments with a stickier material

Conclusions/action items:

Our plan this week is to finish well plate testing and finish printing everything. We have emailed our client to see what they think of our gutter design, as well as emailed Dr. P about the well plate reader.

2025/11/22-Cross-contamination pre-testing

Lydia Miller - Nov 22, 2025, 11:43 AM CST

Title: Cross-contamination pre-testing

Date: 11/22/25

Content by: Lydia

Present: Lydia, Catie, Janice

Goals: Determine the best method of cross-contamination testing using suggestions from Dr. P, Dr. Williams, and group members. Document procedure and plan for future test. Perform rod bending test.

Content:

- · Capillary actions method did not work
- · Syringe method did work!
 - Cut straw and push semen out of straw into a 1 mil tube
 - Make dye + water (maybe oil) mixture, using a .625 concentration
 - Mix dye mixture with semen using a 1:1 ratio
 - · Push cotton back up straw
 - Fill syringe with dye + semen
 - Inject straw with dye + semen
 - Mimic experiment by re-cutting straws and re-pushing contents into well plate
- · Rod bending test:
 - Use BME 201 compression test same test we used for force of straw bending
 - Set rate to .02 mm/sec slower to ensure accuracy
 - 5 trials
 - Stop when force plateaus ... and see a visual bend

Conclusions/action items: We will carry out cross-contamination testing according to the procedure above on Monday with 5 trials (12 straws each). We will then record data collected. The data from the MTS test today will also have to be analyzed and compared to the straw force data.

9/25/2025 Preliminary Frame Design Matrix

Title: Preliminary Frame Design Matrix

Date: 9/25/2025

Content by: Team

Present: Team

Goals: To create 3 design ideas for the frame of the straw stamp and slicer device.

Content:

Criteria The Clamp The Stamp

| 140 M/M | 140

Criteria (Weight)	Raw Score	Weighted Score	Raw Score	Weighted Score
Contamination risk (25)	n3/5	15	2/5	10
Sanitation (25)	4/5	20	4/5	20
Ease of use (20)	3/5	12	3/5	12
Ease of fabrication (15)	3/5	9	4/5	12
Safety (10)	4/5	8	4/5	8
Cost (5)	4/5	4	4/5	4
Total (100)	68		66	

Contamination risk: Contamination was weighted one of the highest as the client expressed that contamination was one of their biggest concerns. If contamination is detect was rated the highest because in this design, each straw would have its own compartment, so the risk of contamination was the lowest. The Clamp was rated as the secon as the straws would also be closer together and would be exposed to the air more, which would be an additional cause of contamination.

Sanitation: Sanitation was weighted as one of our highest criteria due to our client's requests for the device to be easy to clean between uses. Currently the process include proposed cleaning methods from the client were wiping the tool with a sanitizing liquid or dipping into alcohol and drying off. The Clamp and the Stamp designs were rated screws. This makes cleaning quick and easy since the main step would be wiping down the flat surfaces between each set of 12 straws, contributing to a higher score. The coming off a main piece, allowing for dipping in alcohol and letting air dry or using a dryer to speed up that process. The Compartments received the lowest score for sanita in diameter and would require an additional tool.

Ease of Use: Ease of use was the third most important criterion because the clients requested products that required minimal effort to use to decrease procedure duration. It to make the stamp semen pushing easier, and must only require one person to perform the semen pushing. The Clamp, the Stamp, and the Compartments were all ranked frame allowing for set placement of the clamp component, requiring minimal thinking to align the straws with the rows. However, the clamp might cause issues while loading design pushes all 96 straws at a time, theoretically reducing pushing time, but it requires more time to load all 96 straws into the well plate and align each straw with each pushing time, but it requires more time to load all 96 straws in the same design, however, it may have required more work to hold the frame in place while stamping the semen straws at the same time.

Ease of Fabrication: Ease of fabrication was determined based on the materials, available tools, and length of creating them. The Stamp and the Compartments were rated Makerspace to 3-D print the designs. The Clamp would be more difficult to design because it would most likely be made out of metal which would be more difficult to cut, fil in the thin clamp pieces to adjust the tightness to hold the straws.

Safety: Safety was weighed as the second lowest as this device has a low safety risk, with the only concern being the blade that cuts the straws. All of the designs were equand the Stamp, the straws will be cut horizontally, minimizing exposure to the sharp side of the blade. For the Compartments, the blade will only be exposed to the side that

Cost: The cost category was weighted the lowest, as all of the designs will likely utilize PLA from the 3D printing machines in the Makerspace which is inexpensive relative the designs will be around 125 cm³. PLA has a density of 1.24 g/cm³, so the design will be around 157 g. According to the Makerspace's 3DP Cost Calculator, the PLA w risk exceeding the budget.

Conclusions/action items:

We created 3 design ideas for the frame of our device. They are the Clamp, the Stamp, and the Compartments. From ranking it with our criteria, we found that the Compartments had the highes slicer.

Lydia Miller - Sep 29, 2025, 10:59 AM CDT

Title: Stamp Design Matrix

Date: 9/29/25

Content by: team

Present: team

Goals: Create 2 unique designs for stamping component.

Content:

	Retractable S	tamper	Removable Priparty into	Omenus what design
Criteria (Weight)	Raw Score	Weighted Score	Raw Score	Weighted Score
Ease of use (25)	4/5	20	3/5	15
Sanitation (25)	4/5	20	5/5	25
Durability (20)	3/5	12	4/5	16
Ease of fabrication (15)	2/5	6	5/5	15
Safety (10)	5/5	10	5/5	10
Cost (5)	4/5	4	5/5	5
Total (100)	72		86	

Conclusions/action items: We came up with 2 ideas for the stamping component, called the retractable stamper and removable prong. Although the retractable stamper would be easier to use, the removable prong device won the design matrix mainly due to its ease of sanitation and durability. We will begin coming up with fabrication plans.



2025/10/22 - Compartments, Well Plate Frame, Stamper Together

MEGAN LEE - Nov 12, 2025, 9:04 PM CST

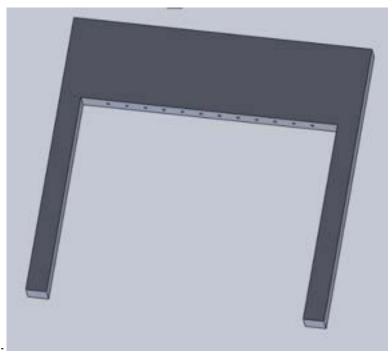
Title: Compartments, Well Plate Frame, and Stamper Together

Date: 10/22/2025
Content by: Team

Present: Team

Goals: To create a cohesive design with three parts: compartments, well plate frame, and stamper.

Content:

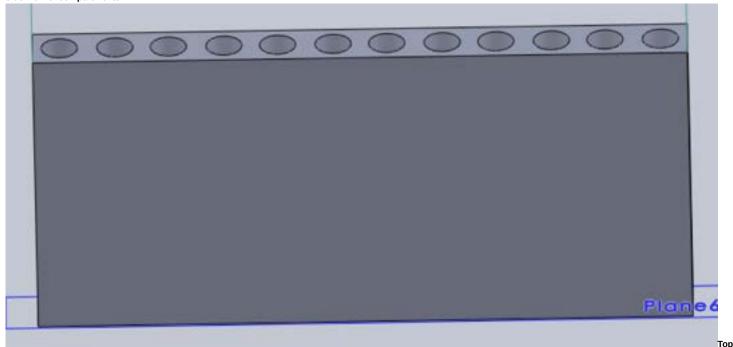


Stamper -

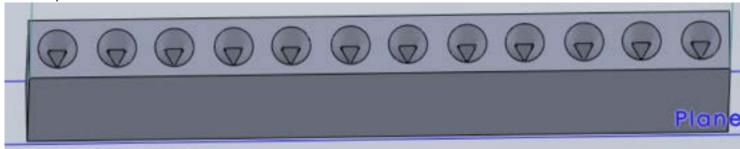
- There are twelve holes that are 25mm deep to hold the 6 inch prongs, allowing the prongs to have around 5 inches of length to push through the straws
- The columns on the side will be for alignment of the prongs with the compartments, as they will slide into an extruded hole on the sides of the compartment

Compartments -

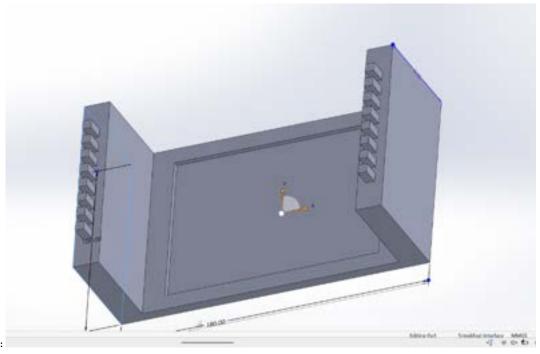
side view of compartments



view of compartments



- The compartments serve as a holder for all 12 straws while they are being cut and sliced. The opening has been modified with fillets to make sure that there are no gaps when the straws are being stamped. The next steps will be to add a rectangular hole on both sides so that the stamper and well plate holder can connect to it.



Well Plate Frame:

- 5mm lip on two parallel edges to prevent the well plate from slipping and aid in uniform measurements between each sample
- The two walls on the other sides have 8 notches that are in the center of each row, so that we can line the compartment design up with this piece

Conclusions/action items:

These designs show the individual components of our full design. Our next steps will be to add them in an assembly to make sure they align and also add handles to the compartments. We will also try to 3D print them in ABS.



11/12/2025 Full Compartments, Well Plate Frame, and Stamper

MEGAN LEE - Nov 12, 2025, 9:00 PM CST

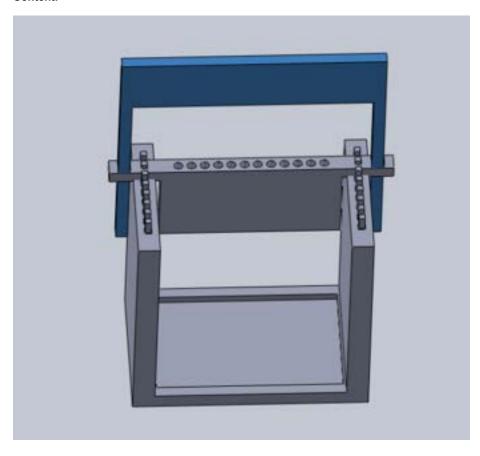
Title: Full Compartments, Well Plate Frame, and Stamper

Date: 11/12/2025
Content by: Team

Present: Team

Goals: To create an assembly showing all the components together

Content:



Conclusions/action items:

This assembly shows how the well plate holder, stamper, and compartments will fit together. The next steps will be to print them and fix any dimensions that are off.

Emma Stroshane - Sep 26, 2025, 12:34 PM CDT

Title: BPAG Meeting

Date: 9/26/2025

Content by: Emma

Present: Emma

Goals: Understand the process and job of BPAG.

Content:

- -If you pay, you must keep receipts to get money back from the client
 - · Can't get reimbursed for taxes
- -Over \$1000 must have departmental and client approval
- -For non-UW Affiliation:
 - · not a prepaid project, so client pays or BPAG pays
 - ONLY BPAG PAYS!
- -Shop UW+:
 - If using and not available, must show in the notebook as not available, and choose a different vendor
- -Each team gets \$50 per team
 - · Account Name: BMEDesign
 - · The client can set up their own account with a funding string
- -If you have to be reimbursed:
 - ONLY BPAG
 - Invoice, NOT SCREENSHOT
 - · Electronically submitted
 - 90-day rule!
- -Table:
 - · Shrink the link
 - · Links should be clickable

Conclusions/action items:

- -All expenses must be approved before purchase
 - Over \$1000 must get departmental approval
- -Online Template
- -ONLY BPAG
- -Table in progress reports, notebook, and report

Emma Stroshane - Oct 10, 2025, 12:38 PM CDT

Title: Proposed Budget as of October 10th, 2025		
Date: 10/10/2025		
Content by: Emma		
Present:		
Goals:		
Content:		
Current estimated budget as of October 10th, 2025. Nothing bought, but proposed what we will need for the Stamper and Frame.		
Conclusions/action items:		
Emma Stroshane - Oct 10, 2025, 12:36 PM CDT		



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GVI_Straw_BPAG_Expense_Spreadsheet_-_Sheet1.pdf (39.7 kB)

Emma Stroshane - Oct 16, 2025, 1:17 PM CDT

Emma Stranhana - Oot 16 - 2025 - 1:17 PM CDT
Conclusions/action items:
Current expenses as of October 16th, 2025. Printed single prototypes using the BME Design \$50.00 project account.
Content:
Goals:
Present:
Content by: Emma
Date: 10/10/2025
Title: Current Expenses as of October 16th, 2025



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GVI_Straw_BPAG_Expense_Spreadsheet_Updated_10_10_2025_-_Sheet1.pdf (36.2 kB)

Emma Stroshane - Oct 22, 2025, 5:49 PM CDT

Title: Current Expenses as of October 22th, 2025
Date: 10/22/2025
Content by: Emma
Present:
Goals:
Content:
Current expenses as of October 22th, 2025. Printed ABS models using the BME Design \$50.00 project account. This week, we printed all 12 compartments placed together to test all compartments next to each other.
Conclusions/action items:
Emma Stroshane - Oct 22, 2025, 5:48 PM CDT



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GVI_Straw_BPAG_Expense_Spreadsheet_Updated_10_10_2025_-_Sheet1_1_.pdf (38 kB)

Emma Stroshane - Oct 30, 2025, 11:09 AM CDT

Title: Current Expenses as of October 27th, 202	25	
Date: 10/27/2025		
Content by: Emma		
Present:		
Goals:		
Content:		
Current expenses as of October 27th, 2025. Pri single compartment protoype with smaller hole Amazon.		
Conclusions/action items:		
		Emma Stroshane - Oct 30, 2025, 11:10 AM CDT



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GVI_Straw_BPAG_Expense_Spreadsheet_Updated_10_10_2025_-_Sheet1_2_.pdf (45.6 kB)

Emma Stroshane - Nov 13, 2025, 6:17 PM CST

Title: Current Expenses as of November 13th, 2025		
Date: 11/13/2025		
Content by: Emma		
Present:		
Goals:		
Content:		
Current expenses as of October 27th, 2025. Printed ABS models using the BME Design \$50.00 project account. Since the last update, we reprinted the test fixture with larger diameters and printed the well plate frame, stamper, and compartment pieces to all fit toegther.		
Conclusions/action items:		

Emma Stroshane - Nov 13, 2025, 6:17 PM CST



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GVI_Straw_BPAG_Expense_Spreadsheet_Updated_10_10_2025_-_Sheet1_3_.pdf (47.9 kB)

Emma Stroshane - Nov 20, 2025, 11:44 AM CST

Title: Current Expenses as of November 20th, 2025		
Date: 11/20/2025		
Content by: Emma		
Present:		
Goals:		
Content:		
Current expenses as of 11/20. Printing using \$50 budget from school.		
Conclusions/action items:		

Emma Stroshane - Nov 20, 2025, 11:45 AM CST



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GVI_Straw_BPAG_Expense_Spreadsheet_-_Sheet1_1_.pdf (48.4 kB)

Emma Stroshane - Dec 08, 2025, 10:19 AM CST

Title: Current Expenses as of December 8th, 2025
Date: 12/8/2025
Content by: Emma

Goals:

Present:

Content:

Final expenses as of 12/8

Conclusions/action items:

Emma Stroshane - Dec 08, 2025, 10:20 AM CST



Download

GVI_Straw_BPAG_Expense_Spreadsheet_-_Sheet1_2_.pdf (57.1 kB)

MEGAN LEE - Oct 16, 2025, 10:30 PM CDT

Title: 3D Printed Frame

Date: 10/16/2025

Content by: Megan

Present: Megan

Goals: To create a 3D printed frame component to hold the straws while they are being cut and stamped.

Content:



Conclusions/action items:

This printed frame consists of a circular hole which tapers into a triangular hole that goes all the way down. This was our 3rd print iteration of this model, where we tried different dimensions for the height of the triangle (2 mm, 2.5 mm, 3 mm). This was the 3 mm height one, which was the most successful. The straw is able to go through all the way but is also pretty snug.

MEGAN LEE - Nov 12, 2025, 9:02 PM CST

Title: Printed Assembly

Date: 11/12/2025
Content by: Team

Present: Team

Goals: To 3D print our assembly

Content:



- Everything is printed with ABS
- Stamper had to be sanded down as it was a little too tight with the compartments

Conclusions/action items:

This is our 3D printed design using ABS. The next steps will be to make the holes on the compartments a little bigger and make the well plate frame a little bigger as well. We also want to find a way to make the straws fit more snug into the compartments.



12/6/2025 Resin Stamper and Compartments

MEGAN LEE - Dec 08, 2025, 1:14 PM CST

Title: Resin Stamper and Compartments

Date: 12/6/2025

Content by: Team

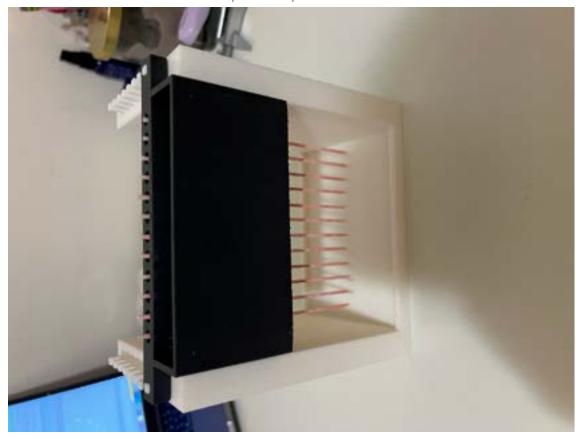
Present: Team

Goals: To create a final prototype of the new stamper and compartments in resin.

Content:







- The top picture shows the full assembly of the new resin-printed compartments and stamper with the straws.
- The well plate frame is still ABS printed since it won't need to be disinfected
- Middle picture shows the new resin-printed stamper without the handles
- Bottom picture shows the resin-printed compartments with straws intact
- Some of the compartment holes were too small, so we needed to do some post-processing and use the 3/16" and drill some of the material out
- Some of the stamper holes were too small, so drilled the holes using a 1/16" drill bit

Conclusions/action items:

These images show our final print of the compartments and stampers, which are compatible with the old design of the well plate frame. Some things to try to fix in the future are to keep playing around with the triangle dimensions as they weren't a perfect fit. We also want to find a better way to align the prongs of the stamper with the straws.

CAITLIN KING - Dec 04, 2025, 2:15 PM CST

Title: Standard Curve Protocol

Date: 11/19/2025

Content by: Team

Present: Team

Goals: To determine a concentration of fluorescein to use that retrieves consistent fluorescent intensity results

Content:

1. Perform 5 serial dilutions and enough for 5 replicates

1. 5 uL/mL: 9.995 DI water, 5 uL of dye

2. 2.5 uL/mL: 5 mL DI water, 5 mL of stock a

3. 1.25 uL/mL: 5 mL DI water, 5 mL of stock b

4. 0.625 uL/mL: 5 mL DI water, 5 mL of stock c

5. 0.3125 uL/mL: 5 mL DI water, 5 mL of stock d

6. 0.15625 uL/mL: 5 mL DI water, 5 mL of stock e

- 2. Add 250 uL of each concentration to well (reference plate map)
- 3. Log into computer with cae and click spark software
- 4. Hit edit method and select 96 well flat black plate and fluorescein (adjust emission/excitation wavelength as needed)
- 5. Select wells on plate map and read from top
- 6. Collect and analyze fluorescent intensity and make standard curve

Conclusions/action items: Run this procedure to determine good concentrations, then you can use this knowledge for the contamination tests

2025/12/01 - Contamination Testing Protocol

CAITLIN KING - Dec 04, 2025, 2:05 PM CST

Title: Contamination Testing Protocol

Date: 12/1/2025

Content by: Catie

Present: Catie, Lydia, Megan

Goals: To develop a procedure to determine if the GVI procedure with our design causes contamination

Content:

- 1. Cut 40 straws and empty all contents into a 10 mL centrifuge tube
- 2. Vortex the semen and resuspend with eppendorf pipette
- 3. Prepare correct semen and fluorescein solutions (concentrations: 0 uL/mL and 0.625 uL/mL)
 - 1. Disperse half of the semen (2.25 mL) into a second centrifuge tube
 - 2. 0.625 uL/mL: add 1.41 uL of fluoroscein to 2.25 mL of semen in the first centrifuge tube
 - 3. Vortex and resuspend both solutions
- 4. Draw up each solution into two separate 1 mL syringes with a 20 gauge needle
- 5. Dispense 50 uL of fluorescein solution into six straws and 50 uL of 100% semen solution into a separate six straws
- 6. Perform GVI procedure (time it)
 - 1. Load straws into the compartments, alternating fluorescein and no fluorecein
 - 2. Lay compartments down on the paper cutter and cut ~0.20 in off each straw
 - 3. Place compartments on the well plate holder hovered above a black 96-well plate
 - 4. Align stamper prongs with the straws and push all contents into the well plate
 - 5. Tap 96-well plate on hard surface to pop bubbles in solution
 - 6. Run in microplate reader (535 emission 485 excitation 30 flashes top read)
- 7. Repeat to get three valid trials
- 8. Run a control trial
 - 1. Use eppendorf pipette to dispense 50 uL of each solution into wells (alternating)
 - 2. un in microplate reader (535 emission 485 excitation 30 flashes top read)
- 9. Analyze results

Conclusions/action items: Procedure will compare wells that are supposed to have fluorescein with them and wells that are not supposed to have fluorescein in them. It will also utilize a control trial by using an eppendorf pipette ensuring no contamination.

Lydia Miller - Dec 04, 2025, 3:16 PM CST

Title: MTS testing protocol

Date: 12/4/25 (originally written 10/29)

Content by: Lydia Miller

Present: Lydia Miller

Goals: Document protocol for MTS testing. Ensure usability by incorporating clear directions on how to use MTS machine.

Content:

MTS Testing protocol

- 1. Unlock machine
- 2. Place compartment and straw onto bottom of the MTS machine
- 3. Place 3D printed testing fixture onto the load cell
- 4. Place rod into testing fixture
- 5. File > New Custom Test > BME 201
- 6. Set strain rate to 3 mm/sec
- 7. Adjust load cell so the rod is just above and aligned with the straw
- 8. Zero cross head and load
- 9. Lock machine
- 10. Enter diameter on the monitor tab
- 11. Press play
- 12. Press stop once the rod has caused the cotton in the straw to move
- 13. Export data
- 14. Turn off machine

NOTE: for rod bending analysis, utilize same set up without the straw/compartments. Stop data collection when rod visibly bends and the force plateaus.

Conclusions/action items: We were able to carry out testing for 1 straw in the MTS machine. We completed 5 test runs. After we analyzed the max and initial force required to push contents of straw. Rod force testing was also completed with 5 runs and then analyzed.



2025/11/19 - Standard Curve for Fluoroscein

CAITLIN KING - Nov 19, 2025, 11:49 PM CST

Title: Standard Curve for Fluoroscein

Date: 11/19/2025

Content by: Catie

Present: Team

Goals: To find a good concentration for fluoroscein that yields consistent and in-range fluorescent intensities.

Content:

Conclusions/action items: Concentrations of 0.625 and 0.3125 uL/mL yield consistent and in-range results on the microplate reader. We will use these concentrations for fluorescence testing for the contamination and sanitation tests

CAITLIN KING - Nov 19, 2025, 11:50 PM CST



Download

GVI_Fluoroscein_mth_Modified__20251119_172643.pdf (189 kB) Plate map and Results

2025/12/04 - Contamination Testing Results

CAITLIN KING - Dec 04, 2025, 2:10 PM CST

Title: Contamination Testing Results

Date: 12/3/2025

Content by: Catie

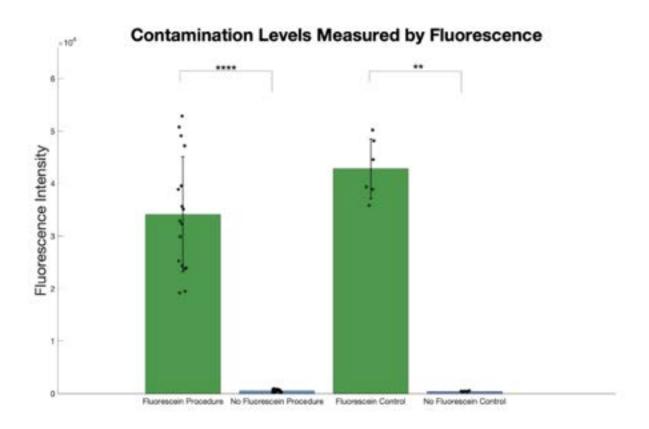
Present: Catie, Lydia, Megan

Goals: To analyze results from contamination testing and derive a meaning from it.

Content:

```
data = readtable("Contamination Curve Plate Map and Concentrations - Organized Data for MATLAB.csv");
fp = table2array(data(2:18,2));
nfp = table2array(data(2:18,3));
fc = table2array(data(23:28,2));
nfc = table2array(data(23:28,3));
avg_std_data = data(1:4, 7:8);
avg_std_array = table2array(avg_std_data);
% bar graph of straws and controls
figure(1)
hold on
b = bar(avg_std_array(:,1));
b.FaceColor = 'flat';
b.CData = [0.3 \ 0.6 \ 0.3;
  0.4 0.55 0.75;
  0.3 0.6 0.3;
  0.4 0.55 0.75;];
errorbar(1:4,avg_std_array(:,1),avg_std_array(:,2), 'k.', 'LineWidth', 1.5);
rng(1);
x1 = ones(size(fp)) + 0.1*(rand(size(fp)) - 0.5);
x2 = 2*ones(size(nfp)) + 0.1*(rand(size(nfp)) - 0.5);
x3 = 3*ones(size(fc)) + 0.1*(rand(size(fc)) - 0.5);
x4 = 4*ones(size(nfc)) + 0.1*(rand(size(nfc)) - 0.5);
scatter(x1, fp, 40, 'filled', ...
  'MarkerFaceColor', 'k', 'MarkerEdgeColor', 'k', 'MarkerFaceAlpha', 0.6);
scatter(x2, nfp, 40, 'filled', ...
  'MarkerFaceColor', 'k', 'MarkerEdgeColor', 'k', 'MarkerFaceAlpha', 0.6);
scatter(x3, fc, 40, 'filled', ...
```

```
'MarkerFaceColor', 'k', 'MarkerEdgeColor', 'k', 'MarkerFaceAlpha', 0.6);
scatter(x4, nfc, 40, 'filled', ...
        'MarkerFaceColor', 'k', 'MarkerEdgeColor', 'k', 'MarkerFaceAlpha', 0.6);
set(gca, 'XTick', 1:4, 'XTickLabel', {'Fluorescein Procedure', 'No Fluorescein Procedure', 'Fluorescein Procedure', 'Fluorescein Procedure', 'Fluorescein Procedure', 'No Fluorescein Procedure', 'No 
Control', 'No Fluorescein Control'});
ylabel('Fluorescence Intensity');
title('Contamination Levels Measures by Fluorescence');
% p-tests
[p,h,stats] = ranksum(fp,nfp); % straws compare
% p=7.05e-7, h=1
[p,h,stats] = ranksum(fc,nfc); % controls compare
% p=0.0022, h=1
[p,h,stats] = ranksum(fp,fc); % fluorescein straw vs fluorescein control
% p=0.0742, h=0
[p,h,stats] = ranksum(nfp,nfc); % no fluorescein straw vs no fluorescein control
% p=0.7002, h=0
```



Conclusions/action items: There was a significant difference between fluorescein wells and 100% semen wells for the straw procedure which is good, because it shows groups are significantly different from each other, therefore low chance of contamination. Also, there was no significant

eam activities/ resting and Results/Experimentation/2025/12/04 - Contamination resting Results	62 01 32
difference between fluorescein straws and fluorescein control group as well as no significant difference between no fluorescein straws and no fluorescein control groups, implying that there was no significant contamination.	
CAITLIN KING - Dec 04, 2025, 2:09 F	M CST

Download

Contamination_Curve_Plate_Map_and_Concentrations.pdf (109 kB)



2025/12/04-MTS force data analysis

Lydia Miller - Dec 04, 2025, 3:17 PM CST

Title: MTS force data analysis

Date: 12/4/25 (originally written 11/16/25)

Content by: Lydia Miller

Present: Lydia, Janice, Varenya

Goals: Analyze the MTS data from the force needed to push the contents of the straw into the well plate. Determine the maximum force required. Teach 200s how to use MATLAB to analyze data.

Content:

Initial forces

Test run 1: 0.6493 N

Test run 2: 0.7136 N

Test run 3: 0.4774 N

Test run 4: 0.6966 N

Test run 5: 0.4363 N

Average initial force: 0.5946 ± 0.1288 N

```
Code:
```

```
close all;
clear all;

[file, path] = uigetfile({'*'});

fullpath = fullfile(path, file);

data = readtable(fullpath);

disp=data(:,1);

force=data(:,2);

time=data(:,3);

force = table2array(force);

time = table2array(time);

figure;

plot(time,force);

xlabel("time (s)")

ylabel("force (N)")
```

```
mask = time >= 0 & time <= 1;
maxForce = max(force(mask));</pre>
```

Note: this code only finds the max force within the first 1 second of data collection, representing the initial force needed to push the cotton

Max Forces

Test run 1: 2.8296 N

Test run 2: 1.0295 N

Test run 3: 0.7077 N

Test run 4: 0.8492 N

Test run 5: 0.5647 N

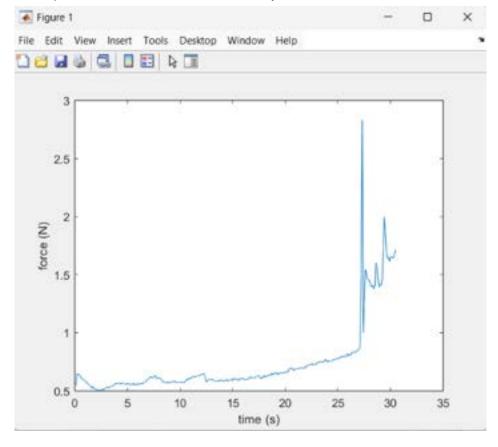
Average max force: 1.1962 ± 0.9292 N

Changes made in code

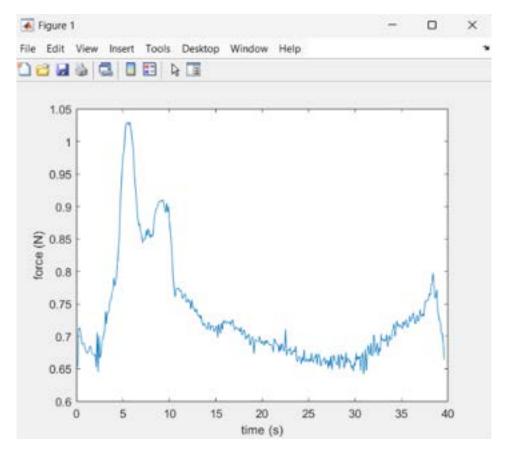
```
mask = time >= 0 & time <= 1;
maxForce = max(force(mask));</pre>
```

Note: this code finds the max force from the entire time the rod pushed the contents of the straw

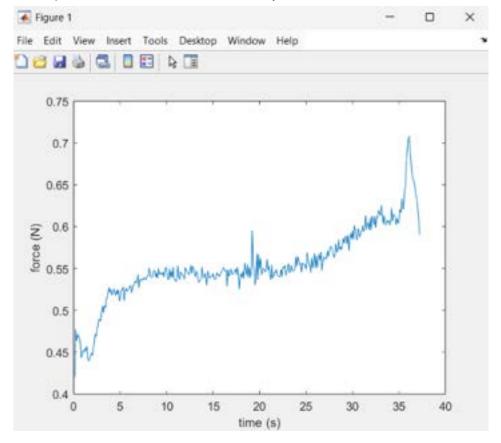
Graphs:



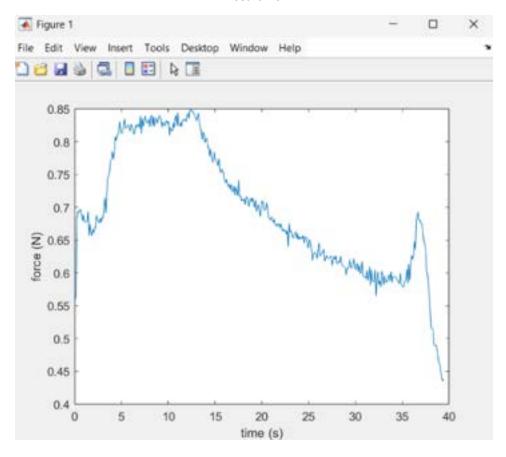
Test run 1



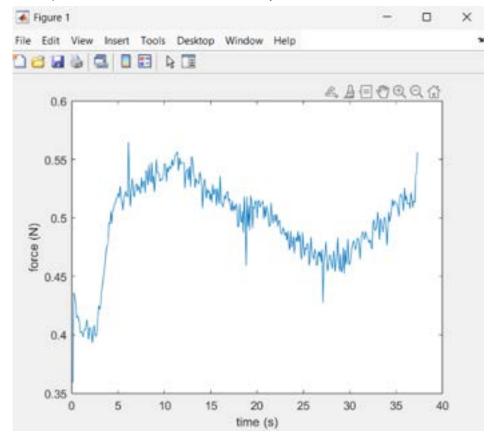
Test run 2



Test run 3



Test run 4



Test run 5

Conclusions/action items: The MTS machine gave us unusual data that doesn't perfectly match a normal force diagram. Because of this, we found the initial force required to push the cotton, as well as the total maximum force needed. The strange graphs could be due to noise in the MTS machine, or other issues with how the straw was set up.



2025/12/04-Rod bending data analysis

Lydia Miller - Dec 04, 2025, 3:17 PM CST

Title: Rod bending data analysis

Date: 12/4/25 (originally written 11/23/25)

Content by: Lydia Miller

Present: Lydia Miller

Goals: Analyze the max force the rods can withstand before they begin to bend. Create a graph that demonstrates the average force required to bend. Determine if results show that the force required to push the contents of the straws is less than the force to bend the straws.

Content:

Code:

```
close all;
clear all;

[file, path] = uigetfile({'*'});
fullpath = fullfile(path, file);
data = readtable(fullpath);
disp=data(:,1);
force=data(:,2);
time=data(:,3);
force = table2array(force);
time = table2array(time);

figure;
plot(time,force);
xlabel("time (s)")
ylabel("force (N)")
max_force = max(force)
```

Max Forces

Test run 1: 6.7424 N

Test run 2: 6.4713 N

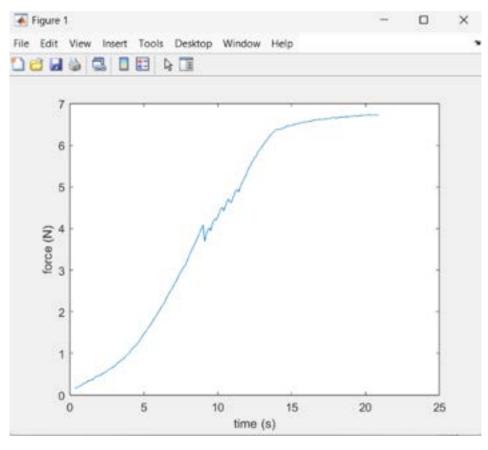
Test run 3: 6.5168 N

Test run 4: 6.4810 N

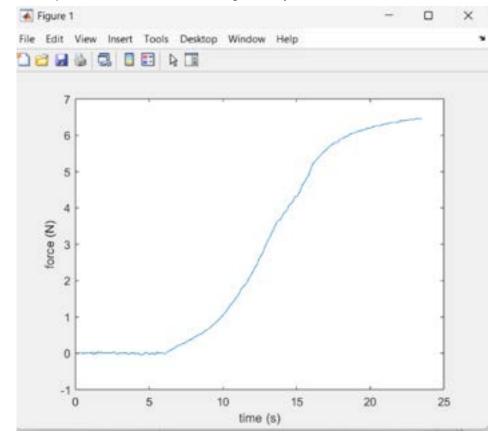
Test run 5: 6.5130 N

Average max force: 6.5449 N

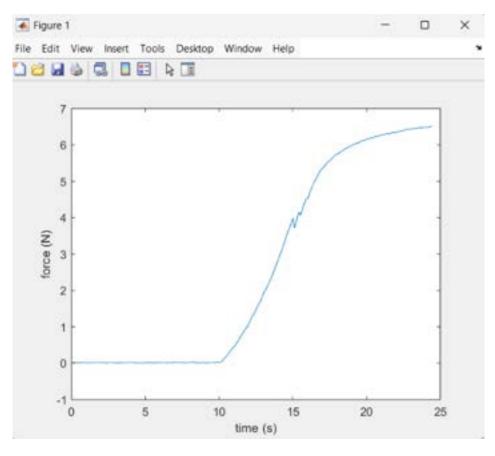
Graphs:



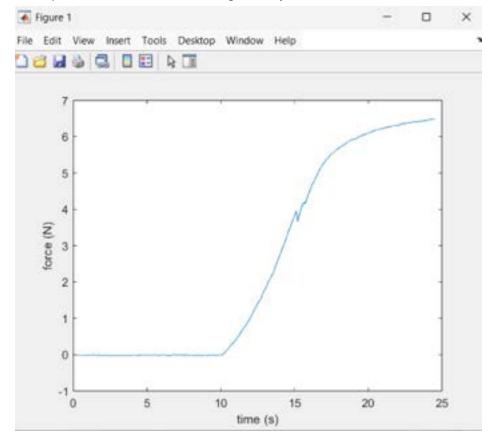
Test run 1



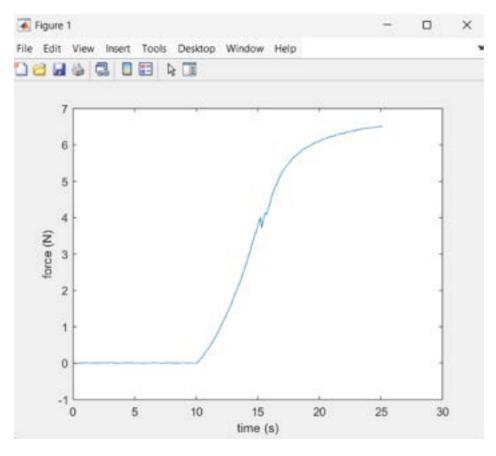
Test run 2



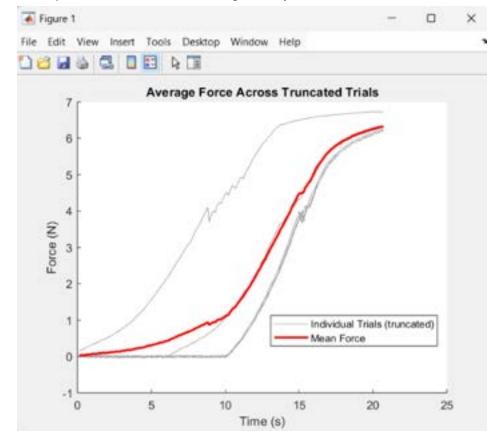
Test run 3



Test run 4



Test run 5



Code to make this graph - used chat

```
close all; clear all;
% Ask user to select multiple trial files
[files, path] = uigetfile({'*'}, 'Select all trial files', 'MultiSelect', 'on');
numTrials = length(files);
all_forces = {};
all_times = {};
% --- Load all force/time vectors ---
min_length = Inf;
for i = 1:numTrials
  fullpath = fullfile(path, files{i});
  data = readtable(fullpath);
  force = table2array(data(:,2));
  time = table2array(data(:,3));
  % store temporarily
  all_forces{i} = force;
  all_times{i} = time;
  % update the minimum length
  min_length = min(min_length, length(force));
```

```
% --- Truncate all trials to the smallest length ---
forces_trunc = zeros(min_length, numTrials);
times_trunc = zeros(min_length, numTrials);
for i = 1:numTrials
  forces_trunc(:,i) = all_forces{i}(1:min_length);
  times_trunc(:,i) = all_times{i}(1:min_length);
end
% --- Use the first trial's truncated time vector as the shared time ---
common_time = times_trunc(:,1);
% --- Compute mean force curve ---
mean_force = mean(forces_trunc, 2);
figure; hold on;
% --- Plot all individual truncated curves and save handle ---
h_trials = plot(common_time, forces_trunc, 'Color', [0.6 0.6 0.6]);
% --- Plot mean force and save handle ---
h_mean = plot(common_time, mean_force, 'r', 'LineWidth', 2);
xlabel("Time (s)")
ylabel("Force (N)")
title("Average Force Across Truncated Trials")
% --- Legend with correct colors ---
legend([h_trials(1), h_mean], ...
      {"Individual Trials (truncated)", "Mean Force"}, ...
      'Location', 'best');
```

Conclusions/action items: We stopped data collection when the force reached a plateau and we visually saw a slight bend in the straw. The reason for this is because even a slight bend could impact the ease of use and safety of the procedure. We determined that since the force (\sim 6.5 N) is greater than the force needed to push the semen out (\sim 2 N), there will be NO bend in the straws, and the procedure is therefore safe. FOS: 6.5/2 = 3.25



2025/12/09-UPDATED MTS force results

Lydia Miller - Dec 09, 2025, 2:32 PM CST

Title: Updated MTS force results (stamping)

Date: 12/9/25 (originally wrote 12/3)

Content by: Lydia Miller

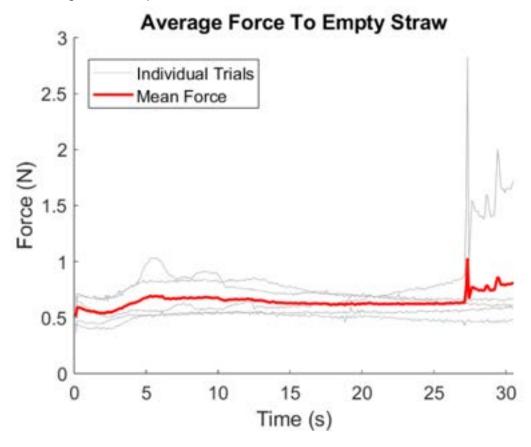
Present: Lydia Miller

Goals: Redo the code for the stamping MTS test so that all of the graphs are analyzed onto one plot, rather than 5 separate graphs. Add to final poster.

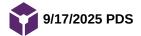
Content:

```
%% mts push all graphs
close all;
clear all;
% --- Ask user to select 5 trial files ---
[files, path] = uigetfile({'*'}, ...
'Select 5 trial files', 'MultiSelect', 'on');
% If the user selects only one file, MATLAB returns a char instead of a cell
if ischar(files)
files = {files};
end
numTrials = length(files);
all_forces = cell(1, numTrials);
all_times = cell(1, numTrials);
% --- Load all force/time vectors ---
min_length = Inf;
for i = 1:numTrials
fullpath = fullfile(path, files{i});
data = readtable(fullpath);
force = table2array(data(:,2));
time = table2array(data(:,3));
all_forces{i} = force;
all_times{i} = time;
% Track smallest trial length
min_length = min(min_length, length(force));
end
% --- Truncate all trials to the shortest one ---
forces_trunc = zeros(min_length, numTrials);
times_trunc = zeros(min_length, numTrials);
```

```
for i = 1:numTrials
forces_trunc(:,i) = all_forces{i}(1:min_length);
times_trunc(:,i) = all_times{i}(1:min_length);
end
% Shared time vector = time from the first trial
common_time = times_trunc(:,1);
% --- Compute mean force curve ---
mean_force = mean(forces_trunc, 2);
% --- Plot ---
figure; hold on;
% Plot all trials in light gray
h_trials = plot(common_time, forces_trunc, 'Color', [0.7 0.7 0.7]);
% Plot mean in red
h_mean = plot(common_time, mean_force, 'r', 'LineWidth', 2);
xlabel("Time (s)");
ylabel("Force (N)");
title("Average Force To Empty Straw");
% Legend with proper colors (only need one gray handle)
legend([h_trials(1), h_mean], ...
{"Individual Trials", "Mean Force"}, ...
"Location", "best");
print('myFigure','-dpdf')
```



Conclusions/action items: Graphs are now combined for easier comparison of each trial. Update final report with this information.



Title: Preliminary Design Specifications

Date: 9/17/2025

Content by: Team

Present: Team

Goals: To understand the background and requirements of the GVI: Straw Stamp and Slicer device.

Content:



GVI: Straw Stamp and Slicer - BME 200/300

Product Design Specifications

BME 200/300 Design

September 18, 2025

Clients: Sarah Hanson, Brett Breidor, and Ben Goss

Advisor: Professor Justin Williams
University of Wisconsin-Madison
Department of Biomedical Engineering

Team:

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Leader: Lydia Miller - lbmiller3@wisc.edu

Communicator: Megan Lee - mjlee45@wisc.edu

BSAC: Janice Amornthanomchoke - amornthanomc@wisc.edu

BWIG: Varenya Vegesna - vvegesna@wisc.edu BPAG: Emma Stroshane - stroshane@wisc.edu Currently, Genetic Visions-ST sequences semen from artificial insemination straws, ensuring that the DNA detected matches the bull that is listed on the straw [1]. This qual semen straws per 96-well plate. The clients have requested two devices: a slicer and a stamp. The slicer must uniformly cut the ends of 12 straws without cross-contamination be incorporated for safety. The stamp must accurately push bull semen out of 96 straws at once without any punctures or deformation to them.

Client requirements

- · A device capable of cutting the ends of 12 insemination straws at a time.
- A mechanism to push the contents of the straws in bulk to a 96-well plate.
- · Both devices must have removable components for cleaning.
- · Both devices should minimize user error and eliminate any chances of contamination between the straws.
- Reduce the procedure time from 1 hour to a final time of 30 minutes.

Design requirements:

1. Physical and Operational Characteristics

- Performance requirements: The device must consist of a cutting component to cut 12 straws at a time, as well as a stamping component that holds 9 straw into a well plate. The device is intended to be used 8-10 times per week, and the estimated loading for the device is 0.32 N [2] per use. Des and each component of the device must be able to be disassembled for sterilization [3].
- 2. Safety: Blade guards must be included to cover blades when the device is not in use to prevent any injury to the user. A warning label may be user transmission during straw slicing and stamping is rare due to lab safety procedures, cattle vaccination, and antibiotic treatment for samples, howe followed, diseases such as Foot-and-Mouth disease or Leptospirosis could infect the user if they were cut by the blade [4]. Utilizing blade guards, effective ways to reduce the risk of infection.
- 3. Accuracy and Reliability: The slicing component must cut off at least 0.20 inch and at most 0.50 inch of each straw, and the stamping component she consistency in collection. To maintain precision for slicing and stamping, the straws must be held in place to prevent movement or bending [3].
- 4. Life in Service: This device must function accurately and consistently for a minimum of one year, performing 8-10 procedures per week. The straw of per use, while the straw stamp will be used once per procedure for about 10 minutes per use [3].
- 5. Shelf Life: All of the components of the device must have a shelf-life of at least one year. They will be replaced if they show signs of corrosion or de removable components, replacing specific components could increase the device's overall longevity. This device will be used multiple times during Genetic Visions-ST wet laboratory.
- 6. Operating Environment: This device will be used in the Genetic Visions-ST wet laboratory and operated by one of the clients. The Food and Drug Ad temperature for wet labs is 68 °F and 77 °F (20°C and 25 °C) with humidity levels between 30% and 50% [5]. The device will come in contact with fridge at ideal temperatures of 4-18 °C to prevent bacteria growth [6].
- 7. **Ergonomics**: The device should be easily operable by one of the Genetic Visions-ST's employees. For efficiency and user comfort, the device shou performing this task repeatedly through the week. The main force needed will be the one to overcome the straw's vacuum seal and push the sem the force needed to push the contents of a 0.002 meter diameter straw is 0.32 N [2].
- 8. Size: The client supplied prototypes to display the functional requirements of the tool. The first prototype, a slicer, measured 11 inches in length an originating from the base plate and extending upwards approximately 7 inches. The second prototype was a rectangular stamp measuring 5 inche length. This stamp was designed to interface with straws positioned within a transparent base plate of similar size. When not in operation, both to measuring 3 feet by 2 feet. As the workbench is shared with other tasks, it is essential that the slicing and stamping tools do not obstruct or interfe
- 9. Weight: The client has not specified an optimal weight range for the device. If the equipment is placed in a holder, the holder should not exceed me transport of the holder between floor level to work bench height. The device itself will be placed on a workbench when not in use. It must be suffice shoulders without physical strain. For a repetitive task at this height, the maximum weight of the tool should be between 11kg and 14kg [7].
- 10. Materials: The tool must be disinfected after each use, either by immersion in a bleach or alcohol-based solution and through surface wiping. Addit repeated exposure to these harmful chemical agents. As the client requested, it should be a non-porous material. Various grades of steel exist, in exposed to moisture or oxygen. By applying a chromium oxide coating to the surface, the chances of corrosion can be greatly reduced. Stainless resistance, while those in the 300 series are noted for weldability [8]. The material must withstand harsh conditions, maintain functionality, and pre
- 11. Aesthetics, Appearance, and Finish: There are no preferences for the appearance of the device, however, the aesthetics of the device should not impe

2. Production Characteristics

- 1. Quantity: The client is aiming to have one straw stamper device and one straw slicer device to work with. The client does not have a preference on as long as the devices can be easily disassembled for cleaning [3].
- 2. Target Product Cost: The overall budget is \$1000. The average cost of the jagged tooth blades is around \$20 but will need to be modified based on pack of 250 [10]. Currently, there does not seem to be other similar products for the straw stamper. The straw slicers have other similar products a slicer at a cost of \$6.38 [11]. Valley Vet is selling their straw slicer for \$13.29 [12]. However, the current straw slicer products only cut one straw at

3. Miscellaneous

1. Standards and Specifications: The straw slicer and stamp must follow international standards that correspond to laboratory devices. Since the bull se components that will contact the bull semen should not cause DNA damage and must exhibit biocompatibility. ISO 10993 defines this as "the abili appropriate host response in a specific application" [13].

In addition to biocompatibility of the device materials, each material's resistance to corrosion relates to the longevity and accuracy of the device. If corrosion set by ASTM F1089, outlining the boil and copper sulfate test, which assess corrosion and copper plating respectively [14].

The safety of the straw slicer and stamp is also a major factor of the design process. ISO 12100, a standard that covers the safety precautions, risk assessment, stamp [15]. This will help identify the risks of each design and implement safety components such as a blade guard, better grip material, etc.

- 2. Customer: The main priorities of the client are to reduce the procedure time from 1 hour to < 30 minutes, while maintaining precision of the devices. For tooth blade to reduce cross contamination between the 12 straws during each cut. The presence of a blade guard with 12 opening holes for the straws favored. They strongly prefer the straw slicer to have removable components, allowing for easier and more thorough sterilization. No preferences were</p>
- 3. Patient-related concerns: As there is much concern about the risk of cross contamination, the device will need to be sterilized after each use. Because of easy cleaning. The product would also need to be able to withstand a cleaning solution, such as bleach after each use. Additionally, the clients value pr [3].
- 4. Competition: Currently the clients are using straws to cut each individual straw, and a paperclip to stamp each straw. There are other competing products available. To use this product, the straw is inserted and then a button is pushed which turns a disk inside the mechanism to cut the straw. This product or product needs However, their straw cutter is only for ¼ cc, while the clients requested the product to work for both ¼ cc and ½ cc straws. Also, this straw be able to cut 12 straws at the same time [16]. There are many similar products to this plastic semen cutter on the market.

Another product on the market is the MiniCutter for Semen Straws by Nasco Education. This product is lightweight and has an ergonomic handle for east for the straw to be cut. However, unlike the Agtech cutter, this product is able to cut both ¼ cc and ½ cc straws. The disadvantage to this straw cutter is that it needs [17].

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Conclusions/action items:

From our design matrix, we identified the main requirements for our device, which were mainly given by the client. Some of the main requirements are that there can't be contamination between mechanism for slicing the straws and stamping the semen into the well plate. They also want it to reduce time as much as possible. Looking at the requirements and our research, we will use th

Lydia Miller - Dec 04, 2025, 12:39 PM CST

Title: Preliminary report

Date: 12/4/25

Content by: GVI group

Present: GVI group

Goals: Outline background, preliminary designs, fabrication plan, testing plans, and future work for project.

Content:

Attached

Conclusions/action items: We decided to fabricate a multi-piece device utilizing the stamper idea and the compartment frame idea. We will 3D print the majority of our pieces using ABS. Ideas for the slicer are unknown.

Lydia Miller - Dec 04, 2025, 12:39 PM CST



GVI: Straw Stamp and Slicer - BME 200/300

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GVI_Preliminary_Report.pdf (7.46 MB)

Lydia Miller - Dec 04, 2025, 12:35 PM CST

Title: Preliminary presentation

Date: 12/4/25

Content by: GVI group

Present: GVI group

Goals: Provide a detailed overview of our initial progress and future plans for the device design.

Content:

Attached

Conclusions/action items: We demonstrated our frame and stamper ideas, as well as the design matrix used to make the idea. Background, PDS requirements, and future work also highlighted.

Lydia Miller - Dec 04, 2025, 12:35 PM CST



Download

GVI_Preliminary_Presentation.pdf (1.77 MB)

Lydia Miller - Dec 04, 2025, 10:47 AM CST

Title: Final presentation

Date: 12/4/25

Content by: GVI group

Present: GVI group

Goals: Provide a comprehensive presentation detailing the design process throughout this semester. Include information on background, PDS requirements, final design, testing, results, and future work.

Content:



Conclusions/action items: We created a stamping device, a compartment device, and incorporated a slicer to create a functioning model to optimize GVI's genetic sequencing procedure. This design satisfied the client's specifications for the device. Looking forward, some improvements can be made to further increase the ease of use for this device.

Title: Final Report

Date: 12/10/2025

Content by: Team

Present: Team

Goals: To create a final report showing our design process and results from this semester.

Content:

GVI: Straw Stamp and Slicer - BME 200/300

Final Report

BME 200/300 Design

December 10, 2025

Clients: Sarah Hanson, Brett Breidor, and Ben Goss

Genetic Visions-ST

Advisor: Professor Justin Williams

University of Wisconsin-Madison - Department of Biomedical Engineering

Team:

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 $BSAC: Janice\ Amornthanomchoke\ -\ amornthanomc@wisc.edu$

BWIG: Varenya Vegesna - vvegesna@wisc.edu
BPAG: Emma Stroshane - stroshane@wisc.edu

Abstract

Increasing global demand for animal products has encouraged the use of artificial insemination to reduce environmental effects. Genetic Visions-ST conducts a quality contrensure the DNA matches the bull listed on the straw, for artificial insemination. The current 1 hour process requires cutting individual straws, pushing the contents into the w straw. The team aimed to significantly reduce procedure time by creating a frame, stamper, and slicer. The 3-D printed frame had twelve compartments to hold the straws, an above the well plate. The slicer mimicked a paper cutter to effectively cut 12 straws simultaneously. The stamper has a 3D curved printed handle with 12 steel prongs to push to determine the force to push the semen, cross contamination test with a fluorescein solution, and timed test to confirm protocol time reduction. The results showed that the force of the prongs. The procedure and control groups had no significant difference while having a significant difference between the procedural groups, indicating there was was reduced from 1 hour to 26 minutes. Some future improvements include preventing the straws from launching after cutting, easier strategies to align the stamper over the stay sterile.

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```

Introduction

Motivation and Global Impact

As the population increases, there will also be an increase in global demand for animal derived products [1]. Genetically improved animals can help this growing issue by pr decreasing the environmental harm likely to be caused. To genetically improve animals, artificial insemination is used. At Genetic Visions, they process and control the quali process. However, the current quality control procedure takes around an hour a plate, and eight to ten plates are processed a week, so this procedure can take up to ten hours help increase the plates processed per week, increasing the efficiency and making the whole artificial insemination process faster.

Furthermore, the semen in each straw is tested to make sure it matches the DNA listed on the straw to make sure no cross contamination occurred. The stamper and slicer materials used.

Existing Devices and Current Methods

Currently at Genetic Visions, the clients are using a pair of scissors to cut each straw individually. Then, each straw is stamped individually by using a paperclip to push the c straw and into the well plate. Although these methods are accurate, this method is quite time consuming as all 96 straws are processed individually.

One example of a competing product is the MiniCutter for Semen Straws by Nasco Education as depicted in Figure 1 [2]. This is a lightweight product and has an ergonomic this product, the straw is placed inside the hole, and a notch is pushed to cut the straw. This straw cutter is able to cut both ¼ and ½ cc straws, which is what the client reques time, and can not empty the contents of the straw, so a stamper would still be needed. There is not currently a straw stamper on the market that fits the clients requirements.

Figure 1: MiniCutter for AI Straws [2]

The clients at Genetic Visions also provided potential design ideas as seen in Figure 2. The first prototype was a stamper, featuring a top plate, with 96 prongs coming out of once, however, the prongs are too large to fit into the straws.

Figure 2: GVI Stamp Prototype

The second prototype was for a cutter. This prototype, as presented in Figure 3, was a paper cutter-like design, featuring a back wall and an arm that can lift up and down. The contamination can be minimized. Even so, there is still a contamination risk since each straw is cut using the same blade. Also, the blade would have to be quite sharp to be a risk.

Figure 3: GVI Slicer Prototype

Problem Statement

Currently, quality control procedures investigating quality of bull semen for artificial insemination are time and labor intensive. The process involves cutting and pushing bulclip, and transferring the contents to a 96-well plate. This process takes one hour, with 8-10 plates being processed per week. The purpose of the project is to optimize these cashould be able to cut 12 straws at a time Additionally, a straw stamper is needed to push bull semen out of the straws in bulk, avoiding cross contamination. All devices shou

Background

The clients for this project are Sarah Hanson (lab manager), Brett Breidor (lab technician), and Ben Goss (sequencing technician), who are all employees at Genetic Visions-production animals as well as sequencing services for a quality control program to ensure the DNA detected from the artificial insemination straws match the bull labeled on

Genetic Visions-ST uses low-pass sequencing (0.5x coverage), then bioinformatics, to detect if the sperm cells in the straw match the bull that is labeled on the straw with contamination if > 5% of the DNA in the sample came from another source [3]. Low pass sequencing is the process of sequencing a genome at a low depth so not every base comparison to reference data to form a reconstructed genotype [4]. The low-pass sequencing and imputation combination results in a cost-effective alternative to typical sing resources and time [4].

To prepare for the low-pass sequencing, each end of the artificial insemination straws are cut off and the contents in each straw are pushed into a 96-well plate. This requires stamper to push the contents of the straws into the well, and a frame to hold the straws in place during the procedure. Each device must conform to the dimensions of the 96-mm x 44.1 mm [5].

A main consideration of Genetic Visions-ST while performing the protocol is the prevention of cross-contamination. DNA sample contamination is a common problem in DI misclassification [6]. Genotype misclassification may lead to inaccurate identification of sperm cells in the artificial insemination straws. The emphasis on lack of cross-cont materials. The slicer, stamper, and frame design must prevent the contents of one straw from seeping into another straw or another straw's designated well on the 96-well pla removable components for sanitation and replacement over time.

According to the PDS, the overall goal of the client is to cut down the procedure time from 1 hour to <30 minutes, as 8-10 plates are processed per week. As for design speci of each straw, guaranteeing a uniform length for all 12 straws. The slicer must also have a blade guard to cover the blade while not in use. Additionally, the straws must not b insemination straw has a diameter of 0.002 meters, so 0.32 N of force is required to break the seal and push the contents out of the straw [7]. Furthermore, cross-contaminati component of the slicer, stamper, or frame that contacts the inside of the straw must be made of non-porous material and must be removable for sanitation by ethanol or blea over one year and there is a \$1000 budget for research and fabrication for all the devices. Additional information regarding the device specifications can be found in Append

Preliminary Designs

Frame Design 1: The Clamp

Figure 4: The Clamp

Frame design 1, demonstrated by Figure 4, incorporates a pinching mechanism that holds 12 straws between two plates, with a consistent 8 mm gap between each straw. I mm in height. At both ends of the plates, screws with nuts, approximately 42 mm long, will be placed to bring the plates together and tighten. A separate component of this d tall walls and two side pieces. The two tall walls are 90 mm in length and 145 mm in height, and the two side pieces are 125 mm.

The process of loading this design is that the clamp piece is initially positioned outside of the well plate. The user will load the straws and then tighten. Next, the whole clam parts are complete, the clamp piece will be placed in the notches in the frame. This is self-tightening, meaning a snug grip can be provided. However, the straws are 2 mm in it will be difficult to place the straws in their designated position and tighten while maintaining precision.

Frame Design 2: The Stamp

Figure 5: The Stamp

As seen in Figure 5, frame design 2 utilizes a stamping mechanism to efficiently hold and process all 96 straws simultaneously. The piece that will hold the straws is 140 r faces the well plate, there will be caps that are 2 mm in diameter and will fit around the tip of the straw. It features an ergonomic handle of 40 mm in height for ease of opera well plate and spans 40 mm in height. On this track, there are two cutouts approximately 10 mm between each other, which allows the user to place a stopper. The stamper p to move down until where the stopper is placed.

This frame idea will be loaded outside the well plate, and all 96 straws will be cut in the holder. Once cut and snug in the holder, it will be moved to the frame track and lo out. The user can control the height of the holder using the stopper. This design allows all 96 straws to be done at once, improving efficiency. However, due to the close spac align the straws accurately within their designated area.

Frame Design 3: The Compartments

Figure 6: The Compartments

Frame design 3, illustrated in Figure 6, has individual compartments to hold 12 straws at a time. Each compartment is 109 mm in height, 12 mm in width, and 8 mm in ler snugly fit into. A cutout of 2 mm in height will allow a blade to slice the straws, but note that the back wall will be present to allow for a uniform cut. The 12 compartments ϵ overall length of 127 mm. At the bottom of the compartments. There will be a 3 mm by 4 mm cutout at the bottom to catch the clippings of the straws. The compartments wi height piece placed on the bottom of the design.

The process of this design is similar to the other designs since the straws will be placed into their individual compartments, and then a blade will slice the 12 straws. Once lining up with the slots of the row, then stamped and the process will repeat. Due to the individual compartments, there is less open space between each straw and therefore l be done at a time, and it will be difficult to determine the sizing of the hole. The straws need to be snug when stamping, but need to require minimal effort to remove them or

Stamp Design 1: The Retractable Stamper

Figure 7: The Retractable Stamper

Figure 7 shows stamp design 1 which incorporates 12 retractable prongs, designed to push the contents of the straws out efficiently. The overall design is 130 mm in lengt prongs out is 110 mm in length. This design includes side pieces that slide into the existing frame for alignment. The handle would have springs allowing the prongs to sit in the handle is pushed.

Before using the stamper, the straws would be in the frame and already cut. The stamper would attach to the frame and push the contents out. The user can line up the cas for an easier alignment. When not in use, the prongs are retractable, reducing contamination risk. The prongs would additionally be removable due to them being fragile. Sin will be difficult to sanitize after each row. The user would have to support the component while pushing the handle down.

Stamp Design 2: The Removable Prongs

Figure 8: The Removable Prongs

Stamp design 2, as shown in Figure 8, features 12 stationary, removable prongs that remain open to the space. The overall stamp design is 80 mm in length and 149 mm in the ergonomic handle is 40 mm in height and 75 mm in length. A clip at the bottom of the design allows it to securely attach to the compartment frame.

Once the cut straws are secure in the compartments and attached to the well plate, the prongs of the stamper will line up with each straw. This process will require the assista location. The user will utilize the ergonomic handle to reduce strain and push the contents out. Only 12 straws will be done at a time, and the device will need to be efficientl be simple and quick to dip the prongs in a sanitizing liquid. The prongs would be easily removable, allowing them to be replaced as needed. However, the prongs are long an

Preliminary Design Evaluation

Straw Stamp and Slicer Frame Design Matrix

Criteria The Clamp The Stamp The Compartments

Criteria (Weight)	Raw Sco	reWeighted Sco	reRaw Sco	reWeighted Sco	reRaw Sco	reWeighted Score
Contamination risk (25	5)3/5	15	2/5	10	5/5	25
Sanitation (25)	4/5	20	4/5	20	2/5	10
Ease of use (20)	3/5	12	3/5	12	3/5	12
Ease of fabrication (15	5) 3/5	9	4/5	12	4/5	12
Safety (10)	4/5	8	4/5	8	4/5	8
Cost (5)	4/5	4	4/5	4	5/5	5
Total (100)	68		66		72	

Table 1: Straw Stamp and Slicer Frame Design Matrix

The main criteria chosen were contamination risk, sanitation, ease of use, ease of fabrication, safety, and cost as seen in Table 1. Contamination risk was identified as a high samples do not come in contact with each other since this can ruin the DNA sequence result. Sanitation additionally was a high determining factor because it is vital that the contamination. Ease of use was key to the design as the client requested a device that would create a more efficient process while maintaining precision and a simple design. enough straws without having to manage multiple components. Ease of fabrication was critiqued based on the type of materials required, the mechanism of each component, device. Safety was judged based on the frame's ability to prevent the blade from coming in contact with the client's hand. Lastly, cost was ranked last as most of the devices device would most likely not be able to exceed the budget.

Overall, the Compartments scored the highest out of all the devices, shown in Table 1. One large evaluation was that the compartments would reduce the contamination risk. while the other designs have the straws out in the open. The compartments in the design would be easy to use, as it would have notches on the side to allow the user to align touching the bottom. The other devices would require some adjustment in order for the straw to stay secure. The Compartments also rank higher in ease of fabrication and cc print at the Makerspace for around \$7.80, which is easily accessible and replicated to create multiple compartments. Since there would be a small gap only for the blade to cc contact with the client's hand, which allows us to rank the Compartments high in safety.

Straw Stamp Design Matrix

	Retractable Stampe	er	Removable Prongs		
Criteria (Weight)	Raw Score	Weighted Score	Raw Score	Weighted Score	
Ease of use (25)	4/5	20	3/5	15	
Sanitation (25)	4/5	20	5/5	25	
Durability (20)	3/5	12	4/5	16	
Ease of fabrication (15)	2/5	6	5/5	15	
Safety (10)	5/5	10	5/5	10	
Cost (5)	4/5	4	5/5	5	
Total (100)	72		86		

Table 2: Straw Stamp and Slicer Frame Design Matrix

The main criteria chosen were ease of use, sanitation, durability, ease of fabrication, safety, and cost. Table 2 illustrates the design rationale. Ease of use was identified as on the device can easily push out all the bull semen. This process will be repeated among different rows and multiple times a week and should work without experiencing any is cleaned between uses to prevent contamination, so sanitation was additionally ranked as a high concern. Durability was another priority because the client expected to use th device should be durable enough to last for a long period of time. Ease of fabrication was determined based on the type of materials needed, the mechanism of each compon device. Safety was judged based on the physical strain it would have on the client's hand, as they are expected to use the same motion to push out numerous straws. Lastly, c simple materials, and the cost for each device would most likely not be able to exceed the budget.

The Removable Prongs was chosen out of the two stamps, as seen in Table 2. It ranked higher in sanitation because the prongs could be easily removed to disinfect, clean, has more components to disassemble to clean. The Removable Prongs were more durable because the prongs could be easily replaced once they are near the end of their life Retractable Stamper has more components and mechanisms like springs and casing that require more attention to maintain. The Removable Prongs was ranked higher in cos modeled with the materials at the Markerspace for roughly \$4.34, which is significantly less than the set budget.

Final Proposed Design

Figure 6: The Compartments

Figure 8: The Removable Prongs

The final proposed design is a combination of the Compartments and the Removable Prongs designs. Both designs sufficiently fulfilled the client's main concern of contain separating the straw into their individualized sections and disassembling the devices for cleaning. Each of the straws would be cut at the crimped edge to create an opening for to secure itself to the side of the well plate. The clamp allows for easy placement of straws into each section while maintaining proper alignment, as seen in Figure 6. The straw indicated height. The Removable Prongs Stamp would sit on top of the compartments and clip to the side to secure them as seen in Figure 7. Once the prongs are properly all push all the bull semen from the 12 straws into the well plate. The client could unclip all the stamps and frames and quickly sanitize them for the next set of straws.

Final Design

In the final design, four primary components are present in the overall process. As shown in Figure 9 and Figure 11, the elements are the compartments, well plate frame, sunit with 12 holes for the straws to be inserted into and pushed until the uncrimped end of the straw is barely visible at the top. As seen in Figure 10, each hole begins as a 3 extends 46 mm downward. The triangle is equilateral with all sides measuring 3.41 mm. This triangular geometry provides a snug but non-deforming fit around the straw, wl pressure placed on the straw from rigid walls. Both sides of the compartment unit have one 4.4 mm square hole designed to interface with the pegs of the well plate frame. It the compartments. This feature allows the user to place the compartments in line with the slicer height, which helps distribute the cutting force and improve operational effic

Figure 9: Final printed assembly of well plate frame, compartments, and stamper

Figure 10: Dimensioned CAD model drawing of well plate frame and compartments

Once the straws are positioned in the compartments, the user cuts off the crimped ends using a 5-inch guillotine-style paper cutter, as shown in Figure 11. The compartment straws align with the blade, and approximately 0.20 inches are removed from the crimped section.

Figure 11: Mini Slicer

After cutting, the compartments are positioned in the well plate frame for stamping. The frame holds the compartments above the wells and maintains proper alignment so well. As seen in Figure 10, the well plate frame is box-shaped and includes two walls measuring 153 mm in length and spaced 106.14 mm apart. Small lips along the bottom supporting surface. Each wall contains eight even spaced pegs corresponding to the rows of the well plate. In addition, when the loaded compartments are placed on the pegs discharge the contents without contacting the bottom of the well.

The final step involves expelling the semen out of the straws and into the wells. Illustrated in Figure 12 and Figure 13, the final stamper design consists of a curved handle mm with the underside containing 12 circular 1.1 mm holes to seat 1 mm stainless steel rods. As shown in Figure 9, the stamper can be used to simultaneously stamp 12 strar one at a time.

Figure 13: Dimensioned CAD Stamper Bottom View

Throughout the process, the well plate frame and compartments interface directly, while the stamper and slicer function as support components. The compartments and sta ethanol, suitability for components requiring frequent cleaning. The well plate frame was printed out of ABS, as it does not directly contact the straws. Collectively, these for process.

Fabrication

Materials

To fabricate the design, the well plate frame, compartments, and the stamper handle were 3D printed. Initial prototypes were printed in ABS filament on Bambu Printers in durability, and ease of printing, which enabled multiple iterations to be printed. For the final design, the compartments and stamper were printed in Tough 1500 Resin on For chosen as it is resilient and has mechanical properties comparable to polypropylene [8]. Additionally, since it is comparable to polypropylene, it has better chemical resistance disinfected with ethanol or bleach without being damaged [9]. Non-printed components included the prongs for the stamper, which were fabricated from stainless steel rods resistance to ethanol and mechanical similarity to the paper clip currently being used.

For the slicing mechanism, a 5-inch guillotine style paper cutter was purchased. This mechanism because all 12 straws can be cut at once unlike the current scissors they are disinfected after cutting a row of straws unlike a scissor which needs to be disinfected after every use. Purchasing a pre-manufactured slicer was more cost effective and provin place because of the sharp blade. The costs for all of the materials are seen in Appendix B.

Methods

The design process began with brainstorming the compartment piece, as this feature dedicated the configurations of the remaining components. The compartment design v designing the well plate frame and stamper. The first printed iteration of the compartments consisted of a single compartment intended to evaluate the fit of the straw within prototype for early testing allowed for minimal fabrication time and was easily modified. Once a snug fit was observed, the single compartment design was duplicated in ord

While printing the compartments, the well plate frame was modeled and printed to verify dimensional accuracy for the well plate interface. The frame includes eight pegs into these holes and have a uniform fit.

Figure 14: Initial stamper

Figure 15: Initial printed assembly with old stamper

As shown in Figure 14, the initial stamper was modeled as a rectangle with 12 circular holes to fit the stainless-steel rods. The holes were designed to fit flush with the stainl compartment design with the goal for the stamper to align with these tabs. Each side of the stamper has a rectangular piece that slides into the compartment design, as seen it easier to align the prongs with the straws.

The compartment design is fundamental to holding the straws, so it was crucial to design in a timely manner, since the other components work around this. Once the compart the current high-risk piece. At this stage, all three major components, well plate frame, compartments, and stamper, were modeled but none of the dimensions finalized. An a plate frame. A simple box dimensioned to the well plate size mocked the well plate, and was inserted into the assembly to finalize the well plate frame dimensions. The 12 co assembly environment to incorporate two side holes. One would interface with the pegs on the frame and the other with the stamper. Subsequently, the stamper was inserted compartments.

After the finalized prototype iteration was printed and assembled, testing revealed that the well plate frame was undersized by 2 mm. This resulted in revising the dimension inserting the straws and testing the full procedure, problems arose with the stamper. Instead of facilitating alignment, the two side parts of the slicer seemed to impede position new iteration was created to omit these side pieces and was replaced with a top oval cutout to act as a handle instead. When printing this new handle, the bottom holes were a dimension size. Therefore, a drill with a 1/16" drill bit was used to fully create these holes.

Figure 16: Cutting-board knife combo

Near the end of development, efforts were heavily focused on testing, as well as determining an effective slicing mechanism. Initially, a cutting-board combo knife was us straws simultaneously took a high amount of force and was not ergonomic to the user. Therefore, a 5-inch guillotine paper cutter was purchased and the compartment design

All CAD modeling was completed in SolidWorks. Early prototypes were printed in ABS to minimize cost and print time. For the final designs given to the clients, the upd This resin was more expensive but had better overall physical properties, making up for the increase in price.

Testing and Results

To evaluate the efficiency and functionality of the straw stamper and slicer, multiple tests were conducted. These tests include an MTS test to measure the force to push th bend the steel rods in the stamper, a timed test to measure process duration reduction, and a contamination test to ensure minimal cross-contamination.

Although included in the preliminary plan for testing, a test to measure the force to slice the straws was not executed due to its lack of feasibility and relevance. The blade paper cutter, making it difficult to attach to the MTS machine. Additionally, the cutting force for a paper cutter is likely comparable to that of scissors, suggesting that further

Figure 17: Average Force To Empty Straw

In order to measure the force required to push the contents of the straw into the well plate, a mechanical force test was performed using the MTS machines. The procedure plan for MTS testing to accommodate for the limitations of the MTS machines available. The load cell measures 53 mm in diameter, while the length of one row of straws is load cell. In order to accommodate, only a single straw was tested. This decision was made under the assumption that the force would linearly increase with the addition of n trials, the maximum force required to empty the straw was 1.120 ± 0.929 N. Converting to lbf, the force required is around 0.25 lbf which is well below the original requiren

Figure 18: Setup for Rod Bending Force Test

Figure 19: Visual Result of Rod Bending

Figure 20: Average Force To Bend Steel Rod

An additional force test was performed to determine the force required to bend the steel rods. This test was included to ensure that the rods would not bend or deform as the of the rods is important for the functionality of the device and ensuring a user-friendly procedure. The rod strength test follows the procedure outlined in Appendix G, except the rod to be placed directly on the MTS base. Once a slight visual bend was observed as seen in Figure 18 and 19, and the force on the monitor plateaued, data collection we bend the rod was 6.54 ± 0.100 N. This value is greater than the force required to empty the straws, meaning the rods will not bend during the procedure, fulfilling the PDS re

A time test was conducted to determine the duration of the procedure in order to assess if the duration reduction goal of 50% was met. The procedure was performed as G' only a single row was tested due to material limitations. The 12 straws were loaded, cut, and stamped using the fabricated devices, over the course of 4 minutes and 30 secon plate) would yield a total experiment duration of 36 minutes. Overall, a 40% time decrease was achieved, making the procedure 6 minutes longer than the original goal.

Figure 21: Standard curve of fluorescein for concentrations up to 5 uL/mL

One of the most important design considerations expressed by GVI was ensuring an absence of cross-contamination, as their low-pass sequencing devices can detect contamination, as their low-pass sequencing devices can detect contamination.

As seen in Figure 21, a standard curve for fluorescein was established to determine the desired concentration of fluorescein to use in the contamination test. A desired contrials and a fluorescence intensity value within a readable range for the microplate reader. As seen in Appendix C, six concentrations of fluorescein ranging from 0.15625-5.0 plate and evaluated with a microplate reader at 535 emission and 485 excitation to determine their fluorescence intensity. All tested concentrations had relative fluorescence reader. The concentrations 0.3125 and 0.625 uL/mL had fluorescence intensity values of 1000.83 ± 86.99 and 1444.67 ± 175.51 (mean±standard deviation), respectively. The fluorescence intensities with the smallest variances. 0.625 uL/mL was the concentration chosen to proceed with for the contamination test because it generated consistent mi produce using the 1-10 uL eppendorf pipette provided in the lab and the limited semen provided by GVI for testing.

Figure 22: Contamination levels measured by fluorescence

Figure 23: Contamination protocol final design set up

Figure 24: 96-well plate sample containing fluorescein in odd numbered columns and no fluorescein in even numbered co

Figure 22 displays the fluorescence intensities from the contamination test using the 0.625 uL/mL concentration determined from the standard curve protocol. Before perfand the GVI procedure, as seen in Figure 23, positive and negative controls needed to be established to draw comparisons to a condition with no contamination. To begin the centrifuge tube to create a 4.5 mL stock solution of semen. Two fluorescein concentrations were created from the stock solution: 0.0 uL/mL and 0.625 uL/mL. For the contro solutions were dispensed into one row of the 96-well plate with an eppendorf pipette (alternating 0.0 uL/mL and 0.625 uL/mL), ensuring the entirety of the contents were on condition required a syringe to inject the 0.0 uL/mL and 0.625 uL/mL solutions into their respective straws. These straws were loaded into the compartments (alternating flut slicer design, secured to the well plate holder, and pushed with the stamper. The plate was then processed in a microplate reader (535 emission and 485 excitation) and their the fluorescence from one straw transferred into any wells that are not supposed to have any fluorescein. A more detailed contamination testing protocol can be found in App

The 0.0 uL/mL and 0.625 uL/mL solutions had fluorescence intensities of 501.53 ± 244.62 and 34131.24 ± 10965.66 , respectively, for the GVI procedure, and 426.17 ± 7 trial. The Wilcoxon Rank Sum Test was used for analysis to determine if there were any significant differences between the groups because the data is not normally distribute independent. Notably, there were significant differences between the procedural fluorescein and no fluorescein wells (p=7.05e-7), and control fluorescein and no fluorescein differences between the fluorescein wells for control and procedure groups, and no fluorescein control and procedure groups. This implies that the control and procedure gro final design did not cause any significant cross-contamination during the GVI procedure.

Discussion

The results of aforementioned tests indicate areas of improvement for the fabricated devices. Such areas for improvement include design, procedure, and material modification procedure can be completed with minimal effort. As the stamper only requires ~ 1 N of force to operate, little strength is needed to empty the straws, minimizing user fatigue bend, the ease of procedure is ensured by preventing deformating and instability of the rods as they push through the straw. Further, utilizing Euler's Buckling Formula can procedure is ensured by preventing deformating and instability of the rods as they push through the straw. Further, utilizing Euler's Buckling Formula can procedure is ensured by preventing deformating and instability of the rods as they push through the straw. Further, utilizing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula can procedure is ensured by preventing Euler's Buckling Formula

I=r44I=(0.0005m)44=4.910-14m4

 $P_{\text{cr=2EI(KL)2}}P_{\text{cr=2}(193GPa)}*(4.910-14m4)(.7*0.13462m)=10.5N$

Figure 25: Euler's Buckling Formula Calculation

The results of the timed test suggest areas for improvement that would decrease experiment duration and increase the ease of the experiment. The primary issue is the excess straw holes. To address this issue, the funnel height of the compartments could be increased, or additional funnels attached to the straws could be implemented to guide the r

could be stamped individually, which is expected to be faster than aligning all 12 prior to stamping. Additionally, to improve the ease of procedure, the handle on the slicer c straws

Contamination levels as low as 1% can have a significant impact on DNA sequencing results [6], highlighting the importance of performing this test. Specifically, GVI has a analysis results using the Wilcoxon Rank Sum Test, implies that all devices used in the experiment (slicer, compartments, well plate holder, and stamper) comply with the PI while performing the GVI procedure. However, the standard deviations were relatively large for all of the groups, and some changes could be made to the procedure. For exa solution into the straw, and performing the experiment into the dark to reduce the exposure of light to the fluorescent dye, which could alter results.

It is important to consider the possible sources of error in the tests performed above to ensure accuracy and efficiency of the device. As stated earlier, the mechanical force te assumption that when stamping 12 straws, the force would linearly increase with the addition of each straw. However, due to user error or slight design inconsistencies, the f different results for the force applied to each straw. Ultimately, since the force required to stamp one straw is minimal, and the force to bend one rod is 6 times greater than the issues. The distribution of dye in the semen poses another source of error. To create a homogenous solution of fluorescein dye and semen, the solution was vortexed before be However, the dye used did not mix well with the semen due to its oil-content, causing an unevenly distributed mix of semen and dye within the straw. As a result, each straw of dye, further causing issues with the plate-reader results. Again, this issue is negligible because of the small amount of dye used and had minimal effects on the cross-conta were created in row D, columns 5, 7, 8, 11, and 12 during the stamper pushing portion of the GVI procedure. The bubbles may have led to errors during the microplate reading the micro

Throughout the course of the project, ethical design choices were made to prioritize user safety, accessibility, and environmental consciousness. As stated in ISO 12100, whe performed to reduce posed harm [12]. In order to comply with this standard, a rectangular extrusion was added to the side of the compartments, allowing the device to lay flat reduces risk of injury. In terms of accessibility, the device should be able to be used by all lab members including those with differing hand mobility or size. Given the small handle on the stamper, the stamping process is suited for a diverse range of users. Although the stamper provides benefits to users, the precise motor skills needed to align the improved in the future to further increase accessibility. In addition to user-focused considerations, ethical sourcing and use of test materials were prioritized. Although the testing, it still exhibited the same physical properties as typical QC samples. Using material that would have otherwise been discarded ensured ethical and sustainable use. A by limiting the need for replacements. Initially, ABS and resin were used to create prototypes, however, ideally nylon would be used. Although resin provides friction and eth the 3D printed components of the device. Nylon is durable, structurally stable, and "resistant to the sterilization process" [13], so overtime, the pieces will not degrade or def

Conclusions

The team was tasked with developing a device able to hold, cut the ends, and push bull semen out of 96 straws into a 96 well plate with a simpler procedure. The final des stamper, and a slicer. The twelve individualized compartments feature funnels to guide the straw into the hole, while keeping the straws separated during slicing and stampin The compartments also featured a hollow base to ensure the top surface aligns with the slicer, so the user does not have to manually keep them level. The final slicer includes straws simultaneously.

The compartments are able to snap into the well plate frame by aligning the side cutout of the compartments into the small protrusions of the edges of the wells for ease of removable prongs, for easy cleaning. The stamper design also included an ergonomic curved handle that would allow the user to freely move to adjust each prong into the in

Testing demonstrated the ability to stamp and slice the straws effectively, while avoiding cross contamination. MTS testing was done to find the force needed to expel the exceed the force to bend the rods of the stamper. Contamination testing was also done to address the client's largest concern, cross contamination. This testing found that the and controls, though a significant difference was observed between the fluorescein and non-fluorescein sample when the GVI procedure was performed. This result confirms Possible sources of error were considered in the analysis of testing results. The force testing was only done using one straw, so forces needed to stamp 12 straws simultaneou dye may have been unevenly distributed in the semen, skewing the results. A timed test was also done to see if the designs reduced the time it takes to complete the procedur per row, totaling around 36 minutes for the full well plate, significantly reducing the current time of an hour to complete the procedure. Further timed testing of the full procedure with the devices. Nevertheless, the current testing still provided an accurate baseline for the efficiency of the devices.

Future improvements include optimizing the design to be able to stamp and slice multiple rows at once, reducing the procedure time further. Furthermore, it is currently di at once, so a better way to align these could be designed. More modifications are needed for the slicer device as some straw segments were propelled unpredictably during cu concerns. Potential solutions include creating a barrier that would stop the straws' pieces from propelling or a latch to hold them down before cutting. Since the client stresse product should be determined while ensuring the material does not deteriorate easily. The end goal is for GVI to perform the full procedure using these designs, and provide

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Appendix

Appendix A- GVI: Straw Stamp and Slicer PDS

GVI: Straw Stamp and Slicer - BME 200/300

Product Design Specifications

BME 200/300 Design

September 18, 2025

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Function

Currently, Genetic Visions-ST sequences semen from artificial insemination straws, ensuring that the DNA detected matches the bull that is listed on the straw [1]. This quali to cut and push 96 semen straws per 96-well plate. The clients have requested two devices: a slicer and a stamp. The slicer must uniformly cut the ends of 12 straws without be removable, and a blade guard must be incorporated for safety. The stamp must accurately push bull semen out of 96 straws at once without any punctures or deformation

Client requirements

- · A device capable of cutting the ends of 12 insemination straws at a time.
- A mechanism to push the contents of the straws in bulk to a 96-well plate.
- · Both devices must have removable components for cleaning.
- · Both devices should minimize user error and eliminate any chances of contamination between the straws.
- Reduce the procedure time from 1 hour to a final time of 30 minutes.

Design requirements:

- 1. Physical and Operational Characteristics
 - 1. Performance requirements: The device must consist of a cutting component to cut 12 straws at a time, as well as a stamping component that holds 9 semen out of each straw into a well plate. The device is intended to be used 8-10 times per week, and the estimated loading for the device is 0.32 minimization of cross-contamination, and each component of the device must be able to be disassembled for sterilization [3].
 - 2. Safety: Blade guards must be included to cover blades when the device is not in use to prevent any injury to the user. A warning label may be user blade. Disease transmission during straw slicing and stamping is rare due to lab safety procedures, cattle vaccination, and antibiotic treatment for

posed. If safe practices are not followed, diseases such as Foot-and-Mouth disease or Leptospirosis could infect the user if they were cut by the t gloves, and carefully operating the device are all effective ways to reduce the risk of infection.

- 3. Accuracy and Reliability: The slicing component must cut off at least 0.20 inch and at most 0.50 inch of each straw, and the stamping component shiplate to maintain consistency in collection. To maintain precision for slicing and stamping, the straws must be held in place to prevent movement (
- 4. Life in Service: This device must function accurately and consistently for a minimum of one year, performing 8-10 procedures per week. The straw of for about 1 minutes per use, while the straw stamp will be used once per procedure for about 10 minutes per use [3].
- 5. Shelf Life: All of the components of the device must have a shelf-life of at least one year. They will be replaced if they show signs of corrosion or dethere will be removable components, replacing specific components could increase the device's overall longevity. This device will be used multiple use, it will be stored within the Genetic Visions-ST wet laboratory.
- 6. Operating Environment: This device will be used in the Genetic Visions-ST wet laboratory and operated by one of the clients. The Food and Drug Ad that the optimal temperature for wet labs is 68 °F and 77 °F (20°C and 25 °C) with humidity levels between 30% and 50% [5]. The device will com straws, which are stored in the fridge at ideal temperatures of 4-18 °C to prevent bacteria growth [6].
- 7. Ergonomics: The device should be easily operable by one of the Genetic Visions-ST's employees. For efficiency and user comfort, the device shou support operators performing this task repeatedly through the week. The main force needed will be the one to overcome the straw's vacuum seal Using the pressure equation P = F/A, the force needed to push the contents of a 0.002 meter diameter straw is 0.32 N [2].
- 8. Size: The client supplied prototypes to display the functional requirements of the tool. The first prototype, a slicer, measured 11 inches in length an mechanism originating from the base plate and extending upwards approximately 7 inches. The second prototype was a rectangular stamp meas with spring-loaded pins of 2-inch length. This stamp was designed to interface with straws positioned within a transparent base plate of similar siz intended to be stored on a personal workbench measuring 3 feet by 2 feet. As the workbench is shared with other tasks, it is essential that the slic or interfere with daily activities [3].
- 9. Weight: The client has not specified an optimal weight range for the device. If the equipment is placed in a holder, the holder should not exceed me and efficient transport of the holder between floor level to work bench height. The device itself will be placed on a workbench when not in use. It no operation using the forearms and shoulders without physical strain. For a repetitive task at this height, the maximum weight of the tool should be I
- 10. Materials: The tool must be disinfected after each use, either by immersion in a bleach or alcohol-based solution and through surface wiping. Addit withstanding repeated exposure to these harmful chemical agents. As the client requested, it should be a non-porous material. Various grades of is susceptible to corrosion when exposed to moisture or oxygen. By applying a chromium oxide coating to the surface, the chances of corrosion c in the 300 and 500 series exhibit enhanced corrosion resistance, while those in the 300 series are noted for weldability [8]. The material must with functionality, and prevent cross contamination.
- 11. Aesthetics, Appearance, and Finish: There are no preferences for the appearance of the device, however, the aesthetics of the device should not impe

2. Production Characteristics

- 1. Quantity: The client is aiming to have one straw stamper device and one straw slicer device to work with. The client does not have a preference on combined into a singular as long as the devices can be easily disassembled for cleaning [3].
- 2. Target Product Cost: The overall budget is \$1000. The average cost of the jagged tooth blades is around \$20 but will need to be modified based on around \$5 for a pack of 250 [10]. Currently, there does not seem to be other similar products for the straw stamper. The straw slicers have other s \$10. ABS Global is selling their straw slicer at a cost of \$6.38 [11]. Valley Vet is selling their straw slicer for \$13.29 [12]. However, the current straw time.

3. Miscellaneous

1. Standards and Specifications: The straw slicer and stamp must follow international standards that correspond to laboratory devices. Since the bull se process, the components that will contact the bull semen should not cause DNA damage and must exhibit biocompatibility. ISO 10993 defines this material to perform with an appropriate host response in a specific application" [13].

In addition to biocompatibility of the device materials, each material's resistance to corrosion relates to the longevity and accuracy of the device. If corrosion follow the guidelines set by ASTM F1089, outlining the boil and copper sulfate test, which assess corrosion and copper plating respectively [14].

The safety of the straw slicer and stamp is also a major factor of the design process. ISO 12100, a standard that covers the safety precautions, risk assessment, designing the blade and stamp [15]. This will help identify the risks of each design and implement safety components such as a blade guard, better grip materi

- 2. Customer: The main priorities of the client are to reduce the procedure time from 1 hour to < 30 minutes, while maintaining precision of the devices. For proposed jagged-tooth blade to reduce cross contamination between the 12 straws during each cut. The presence of a blade guard with 12 opening ho ensure equal cut length (~¼ inch) is favored. They strongly prefer the straw slicer to have removable components, allowing for easier and more thorou the straw stamp other than a light-weight design [3].
- 3. Patient-related concerns: As there is much concern about the risk of cross contamination, the device will need to be sterilized after each use. Because of easily disassembled for easy cleaning. The product would also need to be able to withstand a cleaning solution, such as bleach after each use. Addition other attributes such as cost and materials [3].
- 4. Competition: Currently the clients are using straws to cut each individual straw, and a paperclip to stamp each straw. There are other competing products a straw cutter also available. To use this product, the straw is inserted and then a button is pushed which turns a disk inside the mechanism to cut the s cleaned, which the clients specified the product needs However, their straw cutter is only for ½ cc, while the clients requested the product to work for be cutter can only cut one straw at a time, but the client needs to be able to cut 12 straws at the same time [16]. There are many similar products to this pl

Another product on the market is the MiniCutter for Semen Straws by Nasco Education. This product is lightweight and has an ergonomic handle for easy a notch that is pushed for the straw to be cut. However, unlike the Agtech cutter, this product is able to cut both ¼ cc and ½ cc straws. The disadvantage to thi time, thus it would not work for the clients needs [17].

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Appendix B- BPAG Table

Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date Ç	TY	Cost Each	Total			Link
									Materials		
single compartment prototype, \emptyset 2mm straw hole	-	-	Makerspace	-	10/10/2025	3.81	\$0.05	\$0.19		https://docs.google.com/spreadsheets/d/125EWYr0a	ojDuu0BGfzzt-Y
single compartment prototype with Ø 2.5mm nd Ø 3mm straw hole. Stamper rod holder	ı -	-	Makerspace	-	10/13/2025 1	16.23	\$0.05	\$0.81		https://docs.google.com/spreadsheets/d/125EWYr0a	.ojDuu0BGfzzt-Y

12 compartments together prototype with $\ensuremath{\mathcal{O}}$ 3mm straw hole.	-	-	Makerspace	<u>.</u>	10/22/2025 31.4	\$0.05	\$1.57	https://docs.google.com/spreadsheets/d/125EWYr0aojDuu0BGfzzt-Y
'S test fixture, updated single compartment ype with smaller diameter hole, and well plate frame	-	-	Makerspace	<u> </u>	10/27/2025 45.8	\$0.05	\$2.29	https://docs.google.com/spreadsheets/d/125EWYr0aojDuu0BGfzzt-Y
s 1 mm x 300 mm 304 Stainless Steel Round Metal Shaft, Stainless Steel Smooth Rods for y, Metalworking Hobbies and DIY Crafts (12, 1mm x 300mm)	Lyrlidr	-	Amazon	B0F8VG5HJ	V 10/27/2025 1	\$6.45	\$6.45	https://www.amazon.com/Lyrlidr-Stainless-Industry-Working-Ho
ercool UV Leak Detection Dye, 1 oz. Multi- purpose, Total Dye	TSI Supercool	672264016525	5 Amazon	B008PKV07	O 10/27/2025 1	\$7.46	\$7.46	https://www.amazon.com/UV-Leak-Detection-Dye
fTS Test Fixture (updated diameter sizes)	-	-	Makerspace	e -	11/6/2025 31.13	\$0.05	\$1.56	https://docs.google.com/spreadsheets/d/125EWYr0aojDuu0BGfzzt-Y
12 compartments, base well plate frame, and stamper	-	-	Makerspace	· -	11/10/2025 212	\$0.05	\$10.60	https://docs.google.com/spreadsheets/d/125EWYr0aojDuu0BGfzzt-Y
12 compartments reprint with smaller holes	-	-	Makerspace	e -	11/17/2025 31.2	\$0.05	\$1.56	https://docs.google.com/spreadsheets/d/125EWYr0aojDuu0BGfzzt-Y
ABS frame reprint with wider base	-	-	Makerspace	· -	11/17/2025 208.2	\$0.05	\$10.41	https://docs.google.com/spreadsheets/d/125EWYr0aojDuu0BGfzzt-Y
llotine Paper Cutter Mini 6 Inch Cut Length ll Paper Trimmer Non Slip Compact Curved Scrapbooking Tool Portable for Coupon Craft								https://www.amazon.com/dp/ΒΟΓ
Paper Card Photo	DNAMYJME	-	Amazon	B0D44S821	T 11/25/2025 1	\$19.99	\$19.99	ref=cm_sw_r_cp_ud_dp_3R02TNW9PH42SEXFWNK3&ref_=cm_sw_r_cp_ud_dp_3R02TNW9PH42SEXFWNTAW0PH42SEXFWNK3&ref_=cm_sw_r_cp_ud_dp_3R02TNW9PH42SEXFWNK3&ref_=cm_sw_r
ABS Print	-	-	Makerspace	e -	11/25/2025 20.8	\$0.05	\$1.04	https://docs.google.com/spreadsheets/d/125EWYr0aojDuu0BGfzzt-Y
ABS Print	-	-	Makerspace	· -	11/25/2025 243.6	\$0.05	\$12.18	https://docs.google.com/spreadsheets/d/125EWYr0aojDuu0BGfzzt-Y
ABS Print	-	-	Makerspace	e -	11/25/2025 12.6	\$0.05	\$0.63	https://docs.google.com/spreadsheets/d/125EWYr0aojDuu0BGfzzt-Y
ABS Print	-	-	Makerspace	e -	11/25/2025 175.6	\$0.05	\$8.78	https://docs.google.com/spreadsheets/d/125EWYr0aojDuu0BGfzzt-Y
Resin Final Print	-	-	Makerspace	e -	11/25/2025100.54	\$0.24	\$24.13	https://docs.google.com/spreadsheets/d/125EWYr0aojDuu0BGfzzt-Y
Resin Final Print	-	-	Makerspace	<u> </u>	11/25/2025 147	\$0.24	\$35.28	https://docs.google.com/spreadsheets/d/125EWYr0aojDuu0BGfzzt-Y

TOTAL: \$144.93

Appendix C - Fluorescein Standard Curve Protocol

- 1. Perform 5 serial dilutions
 - 1. 5 uL/mL: 9.995 DI water, 5 uL of dye
 - 2. 2.5 uL/mL: 5 mL DI water, 5 mL of stock a
 - 3. 1.25 uL/mL: 5 mL DI water, 5 mL of stock b
 - 4. 0.625 uL/mL: 5 mL DI water, 5 mL of stock \ensuremath{c}
 - 5. 0.3125 uL/mL: 5 mL DI water, 5 mL of stock d
 - 6. 0.15625 uL/mL: 5 mL DI water, 5 mL of stock e
- 2. Add 250 uL of each concentration to its designated well
- 3. Tap 96-well plate on hard surface to pop bubbles in solution
- 4. Run in microplate reader (535 emission 485 excitation 30 flashes top read)
- ${\bf 5}.$ Collect and analyze fluorescence intensity and make standard curve

Conc (uL/mL)Trial 1Trial 2Trial 3Trial 4Trial 5Trial 6avg

std

5557882250812406161481037527079**24050.66667**18660.64206

2.5 2932 3252 2935 5690 1614 3102**3254.166667**1485.299902

1.25 2576 699712167 1797 3374 5801 **5452**4283.759295

0.625 1237 1652 1345 1314 1558 1562**1444.666667**175.5069799

0.3125 953 1095 911 1109 1039 898**1000.833333** 86.9873554

0.15625 1033 808 553 445 397 735**661.8333333**267.8884096

Appendix E - Contamination Testing Protocol

- 1. Cut 40 straws and empty all contents into a 10 mL centrifuge tube
- 2. Vortex the semen and resuspend with eppendorf pipette
- 3. Prepare correct semen and fluorescein solutions (concentrations: 0 uL/mL and 0.625 uL/mL)
 - 1. Disperse half of the semen (2.25 mL) into a second centrifuge tube
 - 2. 0.625 uL/mL: add 1.41 uL of fluorescein to 2.25 mL of semen in the first centrifuge tube
 - 3. Vortex and resuspend both solutions
- 4. Draw up each solution into two separate 1 mL syringes with a 20 gauge needle
- 5. Dispense 50 uL of fluorescein solution into six straws and 50 uL of 100% semen solution into a separate six straws
- 6. Perform GVI procedure (time it)
 - 1. Load straws into the compartments, alternating fluorescein and no fluorescein
 - 2. Lay compartments down on the paper cutter and cut $\sim\!\!0.20$ in off each straw
 - 3. Place compartments on the well plate holder hovered above a black 96-well plate
 - 4. Align stamper prongs with the straws and push all contents into the well plate
 - 5. Tap 96-well plate on hard surface to pop bubbles in solution
 - 6. Run in microplate reader (535 emission 485 excitation 30 flashes top read)
 - 7. Sanitize the prongs and compartments
- 7. Repeat to get three valid trials
- 8. Run a control trial
 - 1. Use eppendorf pipette to dispense 50 uL of each solution into wells (alternating)
 - 2. un in microplate reader (535 emission 485 excitation 30 flashes top read)
- 9. Analyze results

Appendix F - Contamination Testing Results and Code

Procedure with Straws Avg Std

Fluoroscein (FP)No Fluoroscein (NFP) FP 34131.2352910965.65613

24347 834 NFP 501.5294118244.6198882

19480 315 FC 42841.166675689.244639

38896 263 NFC426.166666777.88816769

49088 704

	19217	325
	50786	316
	32882	753
	39557	305
	32307	349
	35123	770
	52859	310
	47198	951
	29893	285
	23906	405
	25244	816
	23800	268
	35648	557
Average	34131.23529	501.5294118
Std	10965.65613	244.6198882

Controls with micropipette

Fluoroscein (FC)No Fluoroscein (NFC)

	50213	566
	35846	416
	38914	382
	48133	340
	39361	452
	44580	401
Average	42841.16667	426.1666667
Std	5689.244639	77.88816769

```
data = readtable("Contamination Curve Plate Map and Concentrations - Organized Data for MATLAB.csv");
fp = table2array(data(2:18,2));
nfp = table2array(data(2:18,3));
fc = table2array(data(23:28,2));
nfc = table2array(data(23:28,3));
avg_std_data = data(1:4, 7:8);
avg_std_array = table2array(avg_std_data);
% bar graph of straws and controls
figure(1)
```

hold on

```
b = bar(avg_std_array(:,1));
b.FaceColor = 'flat';
b.CData = [0.3 \ 0.6 \ 0.3;
       0.4 0.55 0.75;
       0.3 0.6 0.3;
       0.4 0.55 0.75;];
errorbar(1:4,avg_std_array(:,1),avg_std_array(:,2), 'k.', 'LineWidth', 1.5);
rng(1);
x1 = ones(size(fp)) + 0.1*(rand(size(fp)) - 0.5);
x2 = 2*ones(size(nfp)) + 0.1*(rand(size(nfp)) - 0.5);
x3 = 3*ones(size(fc)) + 0.1*(rand(size(fc)) - 0.5);
x4 = 4*ones(size(nfc)) + 0.1*(rand(size(nfc)) - 0.5);
scatter(x1, fp, 40, 'filled', ...
     'MarkerFaceColor', 'k', 'MarkerEdgeColor', 'k', 'MarkerFaceAlpha', 0.6);
scatter(x2, nfp, 40, 'filled', ...
     'MarkerFaceColor', 'k', 'MarkerEdgeColor', 'k', 'MarkerFaceAlpha', 0.6);
scatter(x3, fc, 40, 'filled', ...
     'MarkerFaceColor', 'k', 'MarkerEdgeColor', 'k', 'MarkerFaceAlpha', 0.6);
scatter(x4, nfc, 40, 'filled', ...
     'MarkerFaceColor', 'k', 'MarkerEdgeColor', 'k', 'MarkerFaceAlpha', 0.6);
set(gca, 'XTick', 1:4, 'XTickLabel', {'Fluorescein Procedure', 'No Fluorescein Procedure', 'Fluorescein Control', 'No Fluorescein Control', 'No Fluo
ylabel('Fluorescence Intensity');
title('Contamination Levels Measures by Fluorescence');
% p-tests
[p,h,stats] = ranksum(fp,nfp); % straws compare
% p=7.05e-7, h=1
[p,h,stats] = ranksum(fc,nfc); % controls compare
% p=0.0022, h=1
[p,h,stats] = ranksum(fp,fc); % fluorescein straw vs fluorescein control
% p=0.0742, h=0
[p,h,stats] = ranksum(nfp,nfc); % no fluorescein straw vs no fluorescein control
% p=0.7002, h=0
```

Appendix G - MTS Testing Protocol

- 1. Unlock machine
- 2. Place compartment and straw onto bottom of the MTS machine*
- 3. Place 3D printed testing fixture onto the load cell
- 4. Place rod into testing fixture
- 5. File > New Custom Test > BME 201
- 6. Set strain rate to 3 mm/sec
- 7. Adjust load cell so the rod is just above and aligned with the straw** $\,$
- 8. Zero cross head and load
- 9. Lock machine

- 10. Enter diameter on the monitor tab
- 11. Press play
- 12. Press stop once the rod has caused the cotton in the straw to move
- 13. Export data
- 14. Turn off machine
- * If completing rod bending test, skip step 2
- ** If completing rod bending test, lower the rod so it is just barely touching the base of the MTS machine

Appendix H - MTS Stamping Force Testing Results and Code

```
Initial forces
```

Test run 1: 0.6493 N

Test run 2: 0.7136 N

Test run 3: 0.4774 N

Test run 4: 0.6966 N

Test run 5: 0.4363 N

Average initial force: $0.5946 \pm 0.1288 \text{ N}$

```
Code:
```

```
close all;
clear all;
[file, path] = uigetfile({'*'});
fullpath = fullfile(path, file);
data = readtable(fullpath);
disp=data(:,1);
force=data(:,2);
time=data(:,3);
force = table2array(force);
time = table2array(time);
figure;
plot(time, force);
xlabel("time (s)")
ylabel("force (N)")
mask = time >= 0 & time <= 1;
maxForce = max(force(mask));
```

Max Forces

Test run 1: 2.8296 N

Test run 2: 1.0295 N

Test run 3: 0.7077 N

Test run 4: 0.8492 N

Test run 5: 0.5647 N

Average max force: $1.1962 \pm 0.9292 \text{ N}$

```
%% mts push all graphs
close all;
clear all;
% --- Ask user to select 5 trial files ---
[files, path] = uigetfile({'*'}, ...
   'Select 5 trial files', 'MultiSelect', 'on');
% If the user selects only one file, MATLAB returns a char instead of a cell
if ischar(files)
   files = {files};
end
numTrials = length(files);
all_forces = cell(1, numTrials);
all_times = cell(1, numTrials);
% --- Load all force/time vectors ---
min_length = Inf;
for i = 1:numTrials
   fullpath = fullfile(path, files{i});
   data = readtable(fullpath);
   force = table2array(data(:,2));
   time = table2array(data(:,3));
   all_forces{i} = force;
   all_times{i} = time;
  % Track smallest trial length
   min_length = min(min_length, length(force));
end
% --- Truncate all trials to the shortest one ---
forces_trunc = zeros(min_length, numTrials);
times_trunc = zeros(min_length, numTrials);
for i = 1:numTrials
   forces_trunc(:,i) = all_forces{i}(1:min_length);
   times_trunc(:,i) = all_times{i}(1:min_length);
end
% Shared time vector = time from the first trial
common_time = times_trunc(:,1);
% --- Compute mean force curve ---
mean_force = mean(forces_trunc, 2);
% --- Plot ---
figure; hold on;
% Plot all trials in light gray
h_trials = plot(common_time, forces_trunc, 'Color', [0.7 0.7 0.7]);
% Plot mean in red
h_mean = plot(common_time, mean_force, 'r', 'LineWidth', 2);
xlabel("Time (s)");
ylabel("Force (N)");
```

Conclusions/action items:

The team was tasked with developing a device able to hold, cut the ends, and push bull semen out of 96 straws into a 96 well plate with a simpler procedure. The final design and a slicer. The twelve individualized compartments feature funnels to guide the straw into the hole, while keeping the straws separated during slicing and stamping, and tri compartments also featured a hollow base to ensure the top surface aligns with the slicer, so the user does not have to manually keep them level. The final slicer includes a grainful stamping is simultaneously.

Future improvements include optimizing the design to be able to stamp and slice multiple rows at once, reducing the procedure time further. Furthermore, it is currently di at once, so a better way to align these could be designed. More modifications are needed for the slicer device as some straw segments were propelled unpredictably during cu concerns. Potential solutions include creating a barrier that would stop the straws' pieces from propelling or a latch to hold them down before cutting. Since the client stresse product should be determined while ensuring the material does not deteriorate easily. The end goal is for GVI to perform the full procedure using these designs, and provide

Lydia Miller - Sep 08, 2025, 12:17 PM CDT

Title: 96 deep-well plate

Date: 09/08/2025

Content by: Lydia Miller

Present: Lydia Miller

Goals: Understand the specifications and measurements of the well plates used by Genetic Visions. Identify any design elements of the well plates that will impact the design process of the straw slicer. Identify advantages and disadvantages of using these well plates.

Content:

• "Raised rims enhance sealing and reduce cross contamination" [1]

Dimensions: 127.8 mm x 85.5 mm x 44.1 mm (L,W,H)
 Temperature range: -86° C to 125° C (-123° F to 257° F)

· Volume: 1.0 mL

• Material: Polypropylene

· Brand: PlateOne

· Note: this brand as well as other brands produce similar wells with different volumes

Citation:

[1] "PlateOne Deep 96-Well 1 mL Polypropylene Plate - USA Scientific, Inc," *Usascientific.com*, 2019.

https://www.usascientific.com/plateone-96-deep-well-1ml/p/PlateOne-96-Deep-Well-1mL (accessed Sep. 08, 2025).

Conclusions/action items: It is important to verify that these are the specific well plates (1 mL) that GVI uses during their artificial insemination processes. Likely no issues to arise as a result of the type of well-plates used. Use this information to create measurements for the straw stamper/slicer so that it aligns with the well plate measurements.



2025/09/08-Artificial Insemination Straws Research

Lydia Miller - Sep 08, 2025, 12:46 PM CDT

Title: Universal Insemination Straw

Date: 09/08/2025

Content by: Lydia Miller

Present: Lydia Miller

Goals: Record specifications/dimensions of insemination straw. Utilize this information to inform design process. Identify and potential issues that could arise due to straws.

Content:

Animal group: cattle

• Length: 445 mm

· Diameter: 4 mm

• Brand/supplier: MS Schippers

"Split or unsplit"

· Compatible with universal probe



Conclusions/action items: It is important to verify these are the types of straws (or a similar type of straw) that GVI uses in their artificial insemination process. The diameter of the straws is very small, this will need to be taken into consideration when creating a device to hold 96 straws. I am curious about the material of the straws as well as how flexible or delicate the straws are.

2025/09/16-The dangers of disease transmission by artificial insemination and embryo transfer

Lydia Miller - Sep 16, 2025, 10:43 PM CDT

Title: "The dangers of disease transmission by artificial insemination and embryo transfer"

Date: 09/16/2025

Content by: Lydia Miller

Present: Lydia Miller

Goals: Understand if there are any risks associated with the process of artificial insemination for cattle. Use information to write safety section of the PDS. Reflect on implications of risk and considerations that will inform future design.

Content:

- Most cows are vaccinated before being selected for artificial insemination
- Most semen is treated with antibiotics to reduce risk of disease
- There have been a few circumstances where artificially inseminated cows have certain diseases as a result of the original cow having that virus or bacertia
- For Leptospirosis, detecting the bacteria using a blood test does not always yield accurate results in carrier bulls
- Also relating to Leptospirosis, "treatment is not always fully effective" [1]
- Foot-and-Mouth disease "presents a real risk for transmission by AI" [1]

Citation:

[1] M. Philpott, "The dangers of disease transmission by artificial insemination and embryo transfer," British Veterinary Journal, vol. 149, no. 4, pp. 339–369, Jan. 1993, doi: 10.1016/S0007-1935(05)80075-2.

Conclusions/action items: The risk for disease transmission with artificial insemination is very low, however it is not zero. A small risk is present for disease transmission, especially if antibiotics are not put in the semen sample. This information will be used for the safety section of the PDS. The article emphasizes the importance of creating a device that can be disassembled for cleaning and one that includes blade guards.

2025/10/08-Correcting for Sample Contamination in Genotype Calling of DNA Sequence Data

Lydia Miller - Oct 08, 2025, 4:52 PM CDT

Title: Correcting for Sample Contamination in Genotype Calling of DNA Sequence Data

Date: 10/8/25

Content by: Lydia Miller

Present: Lydia Miller

Goals: Understand the implications of contamination in genomic sequencing. Relate the findings of this paper to the GVI straw stamp/slicer and how it could affect this project. Use article to inform future design.

Content:

- Contamination levels as low as 1-5% can cause quality issues for DNA sequencing
- · Shared tools or surfaces are most common causes of cross-contamination
- · Properly sealing of containers prevents cross-contamination
- · Correction of contamination in DNA sequencing is possible, but prevention is more effective and reliable
- One-directional flow of liquid is an effective way to prevent contamination
- The more samples processed can yield an increased chance of contamination

[1] M. Flickinger, G. Jun, Gonçalo R. Abecasis, M. Boehnke, and H. Kang, "Correcting for Sample Contamination in Genotype Calling of DNA Sequence Data," *American Journal of Human Genetics*, vol. 97, no. 2, pp. 284–290, Aug. 2015, doi: https://doi.org/10.1016/j.ajhg.2015.07.002.

Conclusions/action items: Since even a small amount of contamination can cause major issues for DNA sequencing, our group should prioritize a design that limits contamination risk. While this paper found that correction of contamination is possible, this process is not within the scope of our project, given the resources and timeframe. Additionally, prevention of cross-contamination is more efficient than correction.

2025/10/08-Detecting and Estimating Contamination of Human DNA Samples in Sequencing and Array-Based Genotype Data

Lydia Miller - Oct 08, 2025, 4:51 PM CDT

Title: Detecting and Estimating Contamination of Human DNA Samples in Sequencing and Array-Based Genotype Data

Date: 10/8/25

Content by: Lydia Miller

Present: Lydia Miller

Goals: Understand the possible methods of detecting contamination of samples during DNA sequencing. Identify advantages and disadvantages of these methods. Determine how these methods may be helpful to our group/if they can inform our testing processes.

Content:

- · Lack of methods to detect cross-contamination within a certain species for DNA sequencing
- · This study highlights 3 ways to detect cross-contamination including:
 - Sequence Data and Array-Based Genotype Data
 - Use this equation

$$P(b_{ij}|g_{i}^{1},g_{i}^{2},e_{ij};\alpha) = (1-\alpha)P(b_{ij}|g_{ij}^{1},e_{ij}) + \alpha P(b_{ij}|g_{i}^{2},e_{ij})$$

to determine likelihood of overlapping bases (contamination site represented by "i' and "a")

- Sequence data only
 - Uses "Illumina Infinium assay"
- · Array-based data only
 - Utilizes "GenomeStudio software"
- · Underestimating contamination is more harmful than overestimating it

[1] G. Jun et al., "Detecting and Estimating Contamination of Human DNA Samples in Sequencing and Array-Based Genotype Data," American Journal of Human Genetics, vol. 91, no. 5, pp. 839–848, Nov. 2012, doi: https://doi.org/10.1016/j.ajhg.2012.09.004.

Conclusions/action items: This article highlights 3 methods for detecting contamination during DNA sequencing of individuals from the same species (in this case, humans). While the results showed that contamination was able to be detected, these methods are not readily available to us. Considering the resources and timeline of this project, these methods might not be ideal for detecting contamination.



2025/10/08-'VIOLET': a fluorescence-based simulation exercise for training healthcare workers in the use of personal protective equipment

Lydia Miller - Oct 08, 2025, 5:08 PM CDT

Title: 'VIOLET': a fluorescence-based simulation exercise for training healthcare workers in the use of personal protective equipment

Date: 10/8/25

Content by: Lydia Miller

Present: Lydia Miller

Goals: Identify feasible methods of detecting contamination. Learn about "Violet" technology and how it is used within the healthcare industry. Find potential points of relation to our project.

Content:

- · Violet: Visualising Infection with Optimised Light for Education and Training
- · Simulation for healthcare workers to practice using PPE
- · Utilizes UV-fluorescent tracers that are incorporated into simulated bodily fluids
- Simulation involves a mannequin being covered in various fluids (containing the UV tracers), healthcare workers cleaning the mannequin, and using a UV light to determine how much residue is left
- UV fluorescence markers have been used to assess "compliance with hand hygiene" and are now being used to assess contamination risk in the "environment and equipment"
- · Bodily fluids are fluorochrome-based and include UV tracers that are invisible to the naked eye
 - Other materials included in the model bodily fluids are flour, water, salt, and glycerol
- · Large UV light frame used as well as UV handheld "torch"
- [1] B. Poller *et al.*, "'VIOLET': a fluorescence-based simulation exercise for training healthcare workers in the use of personal protective equipment," *Journal of Hospital Infection*, vol. 99, no. 2, pp. 229–235, Jun. 2018, doi: https://doi.org/10.1016/j.jhin.2018.01.021.

Conclusions/action items: The article highlights a simulation done with healthcare workers to model how to properly use PPE when involved with contaminated bodily fluids. This method of identifying contamination is a more feasible option than previously researched articles. We will consider this approach when conducting contamination testing.



2025/09/08-Straw Cutter Competing Research

Lydia Miller - Sep 08, 2025, 12:39 PM CDT

Title: Straw Cutter Competing Design

Date: 09/08/2025

Content by: Lydia Miller

Present: Lydia Miller

Goals: Understand the design and mechanism of a similar product to the one we are tasked to create. Identify advantages and disadvantages of current design. Use this information in inform future design.

Content:

- Cuts off the end of .25cc sealed straws
- "quickly and uniformly" [1]
- "After insertion of straw, a push of a button cuts the straw at the proper length"
- · Can be taken apart for cleaning/disinfecting
- · Includes disk that turns to cut the straw
- · No information on sizing/dimensions





Citation:

[1] "Straw cutter, 0.25cc, red, each," *Agtech Inc*, 2024. https://store.agtechinc.com/collections/cattle-artificial-insemination-ai/products/straw-cutter?zCountry=US (accessed Sep. 08, 2025).

Conclusions/action items: The advantages of this product include: ability to be disassembled, uniform cutting, and easy use. The disadvantages include: cannot be used on multiple straws at a time. I am curious to know more about the inner workings of this product, and what mechanisms



2025/09/16-MiniCutter for Semen Straws

Lydia Miller - Sep 16, 2025, 11:13 PM CDT

Title: MiniCutter for Semen Straws

Date: 09/16/2025

Content by: Lydia Miller

Present: Lydia Miller

Goals: Find additional competing designs for insemination straw cutters. Find flaws or areas for improvement in competing designs. Identify what works well in this design, and how we can incorporate this into our design.

Content:

- · The design includes an ergonomic handle for easy grip
- The MiniCutter only cuts one straw at a time (disadvantage)
- · Weight: 0.07 lb
 - Lightweight
- · Appears to have a lever/notch that extends off the device to cut with the press of the user's other hand
- · Slot for the cut end to escape/fall out of
- "precise cut of 0.25 and 0.5 ml straws" [1]
- "Easy to keep clean" [1]
- \$16.99
- · Appears to be made of plastic (unsure what kind)



Citation:

[1] "MiniCutter for Semen Straws - Nasco Education," *Main Website*, 2025. https://www.nascoeducation.com/minicutter-for-semen-straws-c34970.html?srsltid=AfmBOooAJzskkeMdGUNuBYcqlLmR9K1i_VBuahL9tAZxTU4y23CiJqpubKs (accessed Sep. 17, 2025).

Conclusions/action items: Similar to the other design I found, this only cuts one straw at a time. Additionally, there is no component to push out the contents of the straws. Something to learn from the device is how lightweight it is, and the ergonomic handle.

Lydia Miller - Sep 28, 2025, 2:10 PM CDT

Title: Standard Mechanical Tolerance Table Charts For Shaft-Hole Fits

Date: 09/28/25

Content by: Lydia Miller

Present: Lydia Miller

Goals: Explore the tolerances allowed for holes and bolts in engineering design. Use information to inform design in terms of the hole diameter for the compartments. Determine the recommended hole diameter for our project.

Content:

- 5 total classes that categorize the allowed tolerance for a specific type of hole
- · Class I is for a loose fit, while Class V is for an interference fit
- · Class II: Free fit, used in applications with running speeds over 600 rpm and journal pressures over 500 psi
 - Parts can turn and slide freely
 - · Accuracy not "essential"
- · Class III: Medium fit, used in applications with running speeds under 600 rpm and journal pressures under 600 psi
 - · Less "wobble" or shake between parts
- · Charts only measure holes .125 in and above
 - Proportionally, the tolerance for a hole of 0.08 in for class III would be between 0.000128 and 0.001024 in (0.0260096 mm to 0.0032512 mm)
 - · Class II is within a similar range

Citation:

[1] "General Tolerance Table Charts for Standard Shaft Hole Fits | Engineers Edge," www.engineersedge.com.

https://www.engineersedge.com/general tolerances.htm

Conclusions/action items: These tolerances are extremely low, so the team will need to consider if it is necessary to abide by these recommendations. Determination of the compartment diameter may depend on experimental testing rather than analytical. Will share this information with the team.



2025/10/12-Fluorescent beads research

Lydia Miller - Oct 12, 2025, 10:44 PM CDT

Title: General Fluorescent Bead Standards

Date: 10/12/25

Content by: Lydia Miller

Present: Lydia Miller

Goals: Learn about the fluorescent beads for use in a lab setting. Assess if these beads are compatible with the goals of the experiment and if they could be used to quantify contamination in the AI procedure. Determine if these are readily available to our group.

Content:

- Kit of fluorescent beads from Bangs Labs includes "five individual populations of ~8 μm polystyrene microspheres"
- · Dyed with fluorophore
- ~1.5 x 107 beads /mL in a 1 mL bottle
- Spec range: 7-9 μm
- \$577 per kit
- · Green and red color
- The 5 individual populations vary with increasing amount of fluorophore
- · Bangs Labs sells more fluorescent microspheres including:
 - · Fluorescent Carboxyl Polystyrene
 - Fluorescent Plain Polystyrene
 - Fluorescent Magnetic Carboxyl Polymer
 - Fluorescent Streptavidin-Coated
 - General Fluorescent Bead Standards

Conclusions/action items: While these beads may be suitable for the purpose of the project, they are too expensive for the benefit we would gain from using them. An action item would be to follow up with Dr. P to find out if there are any other options in ECB. Otherwise, more research should be conducted to find out if there are other options for fluorescent beads.



2025/10/22-Fluorescent microscope research

Lydia Miller - Oct 22, 2025, 9:24 PM CDT

Title: Fluorescence Microscopy

Date: 10/22/25

Content by: Lydia Miller

Present: Lydia Miller

Goals: Learn more about fluorescent microscopes. Understand function and advantages/disadvantages. Assess the feasibility of using this for our project.

Content:

- Advantages
 - · High sensitivity and specificity
 - Can use multiple different fluorophores simultaneously (different colors can be detected at once)
 - · High resolution
 - Allows for quantitative analysis
 - · Compatible with a wide range of fluorescent probes and dyes
- · Disadvantages
 - Photobleaching of fluorophores: limits duration of imaging session
 - "Intrinsic fluorescence from biological samples or nonspecific binding of fluorophores can contribute to background signals, reducing image contrast"
 - · Equipment cost and complexity
 - Artifact generation

Citation:

[1] "Fluorescence Microscopy," www.microscopeworld.com. https://www.microscopeworld.com/p-4814-fluorescence-microscopy.aspx

Conclusions/action items: The advantages and disadvantages demonstrate that a fluorescent microscope could be a highly effective tool when measuring fluorescence. These advantages and disadvantages will have to be compared with the pros/cons of a plate reader. We will continue to look into these facts.



2025/10/22-Plate reader research

Lydia Miller - Oct 22, 2025, 9:39 PM CDT

Title: Benefits of Portable Fluorescence Microplate Readers in Lab Settings

Date: 10/22/2025

Content by: Lydia Miller

Present: Lydia Miller

Goals: Learn about fluorescent microplate readers. Assess if this device could be used for our project. Compare with microscope to determine best option.

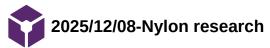
Content:

- · Flexibility: portable device
- · Lower cost
- · Consume low amount of energy (environmental impact)
- · Quick set up
- · Minimal training

Citation:

[1] "Benefits of Portable Fluorescence Microplate Readers | Danaher Life Sciences," *Danaher Life Sciences*, 2025. https://lifesciences.danaher.com/us/en/products/microplate-readers/topics/benefits-portable-fluorescence-microplate-readers.html (accessed Oct. 23, 2025).

Conclusions/action items: The plate reader offers a portable benefit, as well as a reduced negative environmental impact. While the plate reader has many benefits, it is unsure if it will outweigh the advantages of the microscope. We will need to ask Dr. P or Dr. Williams about their thoughts on this matter to come to a conclusion.



Lydia Miller - Dec 08, 2025, 12:37 PM CST

Title: Nylon research

Date: 12/8/25

Content by: Lydia Miller

Present: Lydia Miller

Goals: Gain deeper understanding of properties of Nylon. Use information to guide final report writing and justify future design choices.

Content:

- High tensile strength, durable
- Longevity
- · Low moisture absorption
- Structurally stable ... will not change shape overtime
- Excellent lubricity > easy sliding/movement
- · "resistance to the sterilization process"

Citation

[1] "A Guide to the Properties and Applications of Nylon Resin," *Thogus* | *Family-Owned High Volume Injection Molding*Manufacturer for Ohio and Beyond. https://www.thogus.com/blog/post/a-guide-to-the-properties-and-applications-of-nylon-resin/

Conclusions/action items: Nylon is an ideal material to use for the 3D printed components of our device because of its durability, lubricity, and resistance to sterilization. I will include this information in the discussion of the final report to justify future design plans.

2025/09/24-Preliminary design idea

Lydia Miller - Sep 24, 2025, 11:27 PM CDT

Title: Preliminary design idea

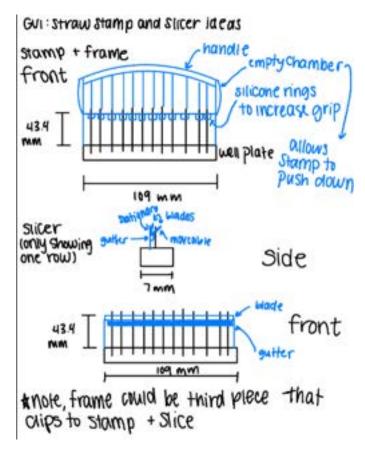
Date: 9/24/25 (design originally drawn 9/22)

Content by: Lydia Miller

Present: Lydia Miller

Goals: Create initial design for straw stamp and slicer. Incorporate a frame, the stamp component, and slice component. Consider PDS requirements when designing idea.

Content:



Conclusions/action items: The advantages of this design are that it has an ergonomic grip and the slicer mechanism would limit cross-contamination. The disadvantages of this design are that it would be difficult to use the slicer component, and the gutter is complicated to fabricate.



2025/09/24-Modified design (for design matrix)

Lydia Miller - Sep 24, 2025, 11:31 PM CDT

Title: Modified design

Date: 9/24/25 (design originally drawn 9/23, then modified again on 9/24)

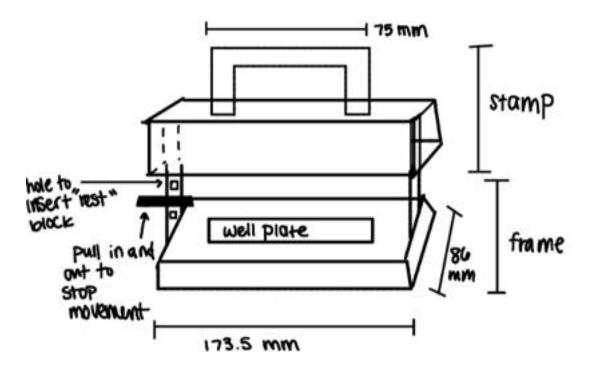
Content by: Lydia Miller, Janice Amornthanomchoke

Present: Lydia Miller, Janice Amornthanomchoke

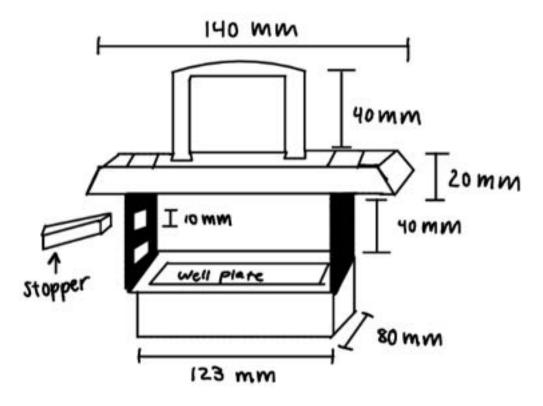
Goals: Modify drawings from initial brainstorming session. Create design to be used in the design matrix. Consider PDS requirements when drawing.

Content:

First drawing:



Second drawing:



Conclusions/action items: This drawing incorporates an idea that Janice had brought up during the initial brainstorming session (utilizing a frame with a sliding stamper). I modified this drawing on 9/24 to update the dimensions to be more accurate and to clean up the design. We will not assess the design in the design matrix.

Lydia Miller - Sep 28, 2025, 1:47 PM CDT

Title: Stamp Idea

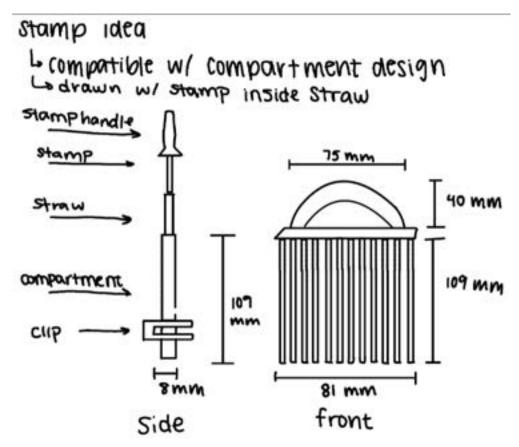
Date: 09/28/25

Content by: Lydia Miller

Present: Lydia Miller

Goals: Create idea for stamping design to be considered for a mini design matrix. Must be compatible with the compartment design. Design must stamp 12 straws simultaneously.

Content:



Conclusions/action items: This design is similar to the prototype presented by GVI in the initial client meeting. However, this design has a curved handle for an ergonomic grip. This stamp will be a completely separate piece from the compartment/frame/slicer component and will function by simply aligning the straws in the prongs and pushing down.

Lydia Miller - Oct 12, 2025, 9:58 PM CDT

Title: Stamp Handle in SolidWorks

Date: 10/12/25

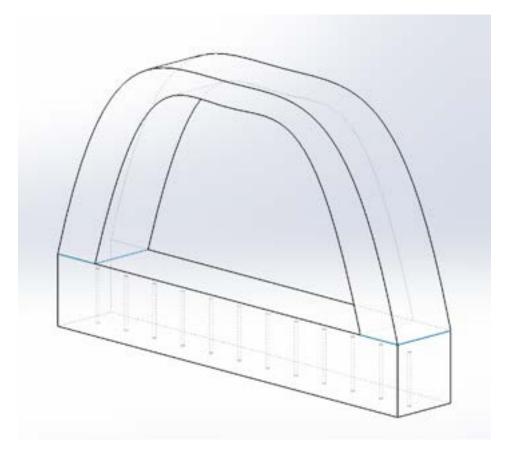
Content by: Lydia Miller

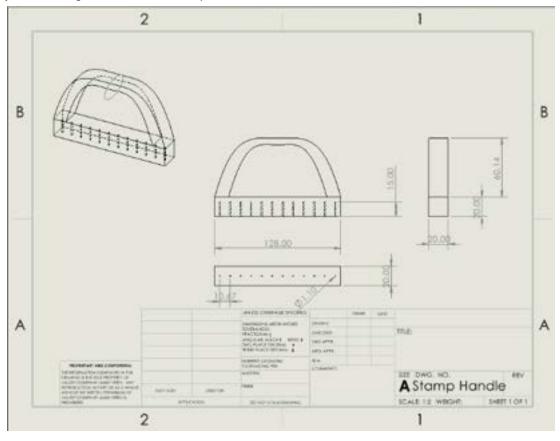
Present: Lydia Miller

Goals: Create CAD model of the stamp handle. Handle should include an ergonomic grip. Handle should include 12 holes for the stamping rods to go

in.

Content:





Conclusions/action items: In the SolidWorks assembly and drawing, the handle is shown with 12 holes along the bottom of the handle for the rods to be inserted in. Dimensions are also shown. The diameter of the rods is 1.1 mm to allow for a snug fit, but loose enough where the rod can still be inserted (subject to change). The handle provides an ergonomic grip, but the comfort level should be tested.

2025/10/29-Updated Testing Protocols

Lydia Miller - Oct 29, 2025, 11:25 PM CDT

Title: Updated testing protocols

Date: 10/29/25

Content by: Lydia Miller

Present: Lydia Miller

Goals: Create a more detailed guide to testing protocols than previously written in the preliminary report. Ensure a user/scientist who is unfamiliar with the procedure could execute the test solely based on these protocols. Determine force needed to push contents of straw into well plate. Determine the risk of contamination during the procedure.

Content:

MTS Testing protocol

- 1. Unlock machine
- 2. Place compartment and straw onto bottom of the MTS machine
- 3. Place 3D printed testing fixture onto the load cell
- 4. Place rod into testing fixture
- 5. File > New Custom Test > BME 201
- 6. Set strain rate to 1 mm/sec
- 7. Adjust load cell so the rod is just above and aligned with the straw
- 8. Zero cross head and load
- 9. Lock machine
- 10. Enter diameter on the monitor tab
- 11. Press play
- 12. Press stop once the rod has caused the cotton in the straw to move
- 13. Export data
- 14. Turn off machine

Contamination test protocol

- 1. Inject straws with water and flour mixture to mimic properties of semen
- 2. Inject every other straw with fluorescein dye, noting which straws have the dye
- 3. Set up materials according to experimental procedure
 - 1. Place 12 straws in their respective compartments, place well plate in frame, align stamper and slicer as needed
- 4. Perform procedure as GVI employees would
 - Cut off ends of straws by placing the straws in their compartments horizontally and cutting in a downward and vertical motion

- 2. Place straws and compartments into well plate
- 3. Stamp contents of straw into wells
- 4. Disinfect slicer and stamper using ethanol
- 5. Unload compartments and replace with 12 new straws
- 6. Repeat procedure with each row, cleaning in between each row
- 5. Place well plate under plate reader
- 6. Turn on plate reader, ensuring the settings can detect the correct wavelength of the fluorescein dye
- 7. Determine if any wells have been contaminated by observing which wells fluoresce

Conclusions/action items: As we have practiced using the MTS machine and have ordered UV dye, we need an updated version of the testing protocols to ensure a clear plan for testing. We must execute these tests as soon as the 3D printed pieces are reprinted. Once all materials arrive, the contamination test must be performed as well.

Lydia Miller - Nov 05, 2025, 9:21 PM CST

Title: Modified testing fixture

Date: 10/31/25

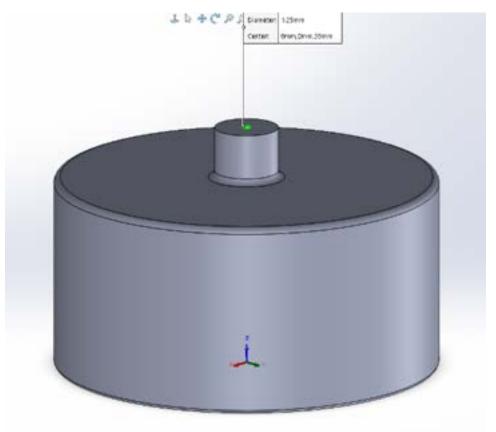
Content by: Lydia Miller

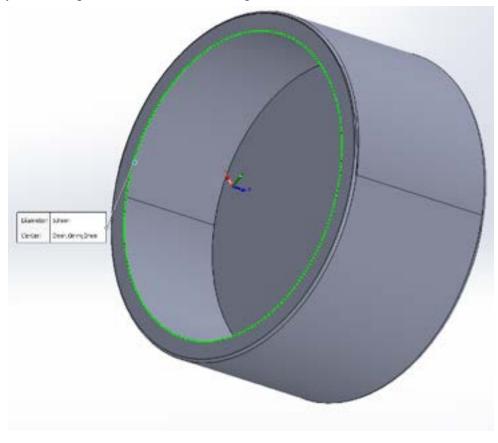
Present: Catie, Megan, Lydia

Goals: Change the dimensions of the "small hole" on the testing fixture so it will not be filled by the 3D printer. Change dimensions of "main hole" so it can properly fit the load cell of the MTS. Remove fillets. Reprint piece.

Content:

When we originally printed the testing fixture, the hole got filled in because we did not account for the tolerances of the 3D printing machines. Additionally, the main diameter was not big enough for the load cell. We modified these dimensions by increasing them slightly to account for the tolerances. We also got rid of the fillets on the sides to create a simpler design and reduce any risk of errors with 3D printing.





Conclusions/action items: We have begun printing this item. We will try again to fit it into the load cell and redo testing.

Lydia Miller - Nov 19, 2025, 2:29 PM CST

Title: Knife cover solidworks model

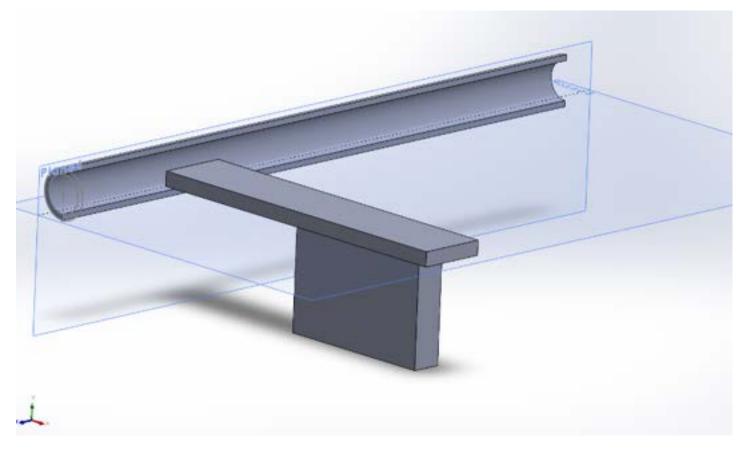
Date: 11/15/25

Content by: Lydia Miller

Present: Lydia Miller

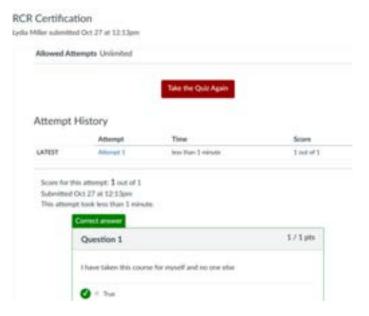
Goals: Create a solution for the ends of straws that fly out when cut. Make it attachable to the knife and easy to use. Ensure it will catch the ends of straws, which can fly out unpredictably.

Content:



Conclusions/action items: This design incorporates a small rectangle that can slide into the hole in the cutting board so it can stay attached to the knife. It includes a semi-circular component that will catch the straws when cut. The mating of the "gutter" will need to be re-mated with the rectangular piece if this design is chosen. Additionally, the gutter part could be modified tro be a a larger radius, and possibly more oval-shpaed rather than circular to span a wider area and catch more straws. Update: we did not end up choosing this design.

Lydia Miller - Oct 29, 2025, 11:21 PM CDT



Download

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Lydia Miller - Sep 10, 2025, 2:07 PM CDT

Title: BME Career Prep

Date: 9/10/25

Content by: Lydia Miller

Present: 300 Lecture

Goals: Learn more about the career fair. Be prepared to talk to recruiters. Become familiar with ECS and its resources.

Content:

Job Search Tips

- Connect before you are a candidate
- Follow up 2-3 weeks later (use ECS to find alum, etc to connect with)

Resume and Cover Letter Tips

- Tailor between positions
- List design projects with out years/semesters
- Outline of cover letter: intro (who are you, applying for, where you found it, and thesis statement "Based on my experience in A and B, I believe I would be able to make a difference in the X role at Y company"), paragraph about A, B, why this employer/role + closing/next steps
- Demonstrate employer knowledge

Career fair advice for BME

- Identify your purpose, more than just an internship
- Looking beyond the obvious, overlap with other disciplines
- Research the employer, feedback from our partners
- Develop your "value added" statement, why you?

Other advice

- Skills: soft skills into the experience section, stick with technical, use job posting
- Give a "soft ball' question (you know the answer to and can show more about yourself based on that)

Conclusions/action items: Attend more career fair prep events. Continue to tweak resume. Prepare elevator pitches.

Lydia Miller - Sep 17, 2025, 2:06 PM CDT

Title: Finding your research style

Date: 09/17/2025

Content by: Lydia Miller

Present: Lydia Miller

Goals: Learn about different leadership styles. Understand how I can be a good leader to the 200s. Find my own leadership style

Content:

- · Talk about what makes a leader
 - Self-awareness
 - · Bringing others up (rather than dominating conversations)
 - Visionary
 - Transparency
 - Communication
 - Decision-making
 - Empathy
 - Take initiative
- · Practice leadership at various levels
 - Personal: self-awareness, management, competency, goals
 - interpersonal: recognizing and responding to others' needs, active listening, building trust, engaging in difficult conversations
 - o team: facilitate team interactions, support other's development, empower others
 - o organizational: collaborate beyond individual teams, contribute to culture
- · Leadership styles
 - · Power: control, "great man theory", hierarchy
 - Servant: mutual service, sharing power, listening, understanding, empathetic
 - · Authentic: genuineness, honesty, transparency, emotional intelligence, self-awareness
 - Ex: camp directors are authentic, few examples of power style, but most of the time the power style is a more negative experience (rather than the positive experience we had with servant and authentic leaders)
- · More on leadership styles
 - People-oriented leader: relationship builder
 - o Process-oriented leader: sets the pace for the team, willing to work alongside everyone
 - o Thought-oriented leader: sees the big picture and anticipates the future
 - · Impact-oriented leader: set the bar high and push for excellence
- Explore and define how you want to lead
 - Self-assess
 - Observe and reflect
 - When do your leadership qualities benefit or disadvantage you?
 - Seek out feedback
- Goal setting
 - What leadership do I want to develop: My goal for this semester is to empower and lift up other group members.
 Specifically, I want to mentor the 200s in my group to become better engineers and eventually their own team leaders
 - How will I practice that skill: I want to find new opportunities to teach/mentor the 200s. An example of this might include teaching them about a new technical skill they are unfamiliar with. This could also include asking for their input on ideas and making sure their voices are heard.
 - What would success look like: Success would look like a group where all members feel confident in the project and have learned from each other!

Conclusions/action items: I learned about the different leadership styles, and that I thrive in environments where I am surrounded by authentic leaders. I also set goals to develop my own leadership skills. I will use this information to work towards my goals when working with my team.

Lydia Miller - Sep 24, 2025, 2:08 PM CDT

Title: Peer mentoring

Date: 09/24/2025

Content by: Lydia Miller

Present: BME 300 lecture

Goals: Learn how to best mentor 200 students. Understand how mentorship helps 200 and 300 students. Use skills to help 200 students succeed.

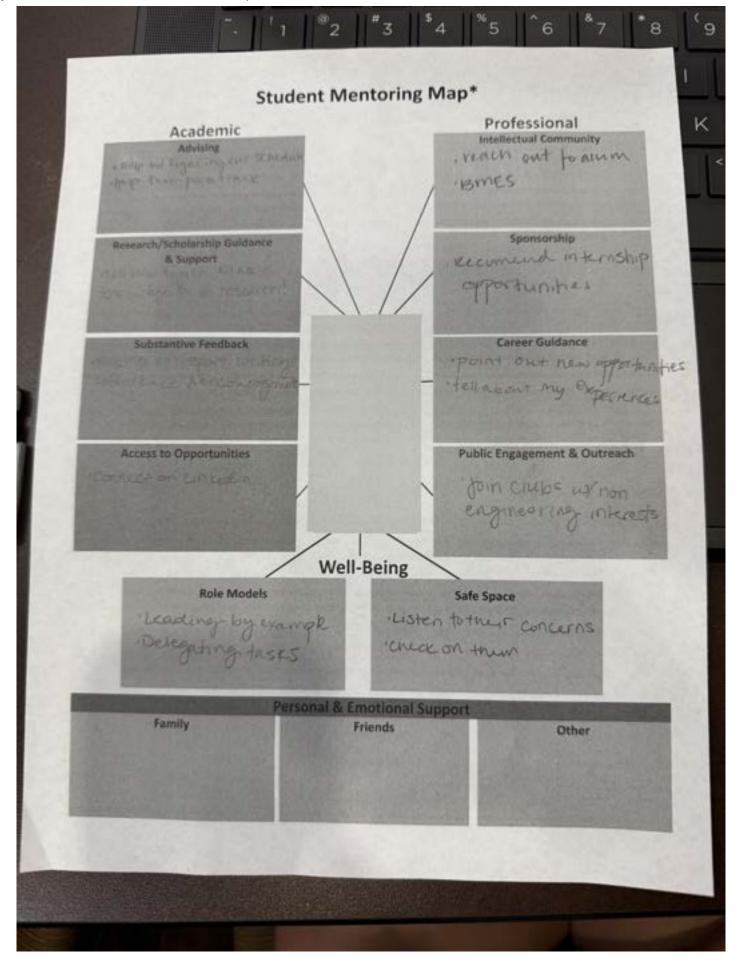
Content:

- · Why are we mentoring 200 students?
 - · We have technical and interpersonal skills to help them!
 - We understand what they are going through and can relate to them
 - · Career development...there will always be those on a team who are experienced and those who are less experienced
 - More approachable than faculty, mentees are more willing to ask questions
 - We can share experiences (extracurriculars, internships, classes, etc)
 - · Increases belonging
 - · Mutual benefits transferrable skills
- Transferrable skills
 - Leadership
 - Communication
 - · Active listening
 - Study practices
 - Self awareness
 - Interpersonal skills
- · General benefits of mentoring
 - Increased self-esteem/confidence
 - Increased patience
 - · Build positive habits
 - · Foster personal growth
- What does it mean to be a good mentor?
 - o Inclusivity, being a friendly/familiar face, supportive, psychological safety, enthusiasm
 - Interested in mentee as a person (not just a group member)
 - · Being there to answer questions and helping in ALL ways
 - Communicative and organized
 - · Sharing your knowledge
 - Building trust
 - Reliability
 - Humanizing their challenges, be their coach
- · Listening effectively
 - o Get rid of distractions
 - Stop talking
 - Act like you are interested
 - Look at the other person!
 - Get the main idea and ask questions
 - · Check for understanding
 - · React to ideas, not to the person
 - Avoid judgement
- What I wish I knew in BME 200
 - · It's ok to not know how to do things
 - · The role of our advisor and how they can help us

- How TeamLab can help, and generally what resources are available
- Internship search, how BME skills can help your resume/interviews

Conclusions/action items: Consider what I wish I knew as a 200 to inform my mentorship. Continue to serve as a positive role model. Give academic and professional advice

Lydia Miller - Sep 24, 2025, 2:10 PM CDT



Lydia Miller - Oct 01, 2025, 1:59 PM CDT

Title: Sustainability in BME

Date: 10/1/2025

Content by: Lydia Miller

Present: BME 300 lecture

Goals: Learn more about sustainability in engineering. Hear from Andrea Hicks from the environmental engineering department and learn about her research/work. Understand how this can translate to BME 200/300 projects.

Content:

- Sustainability: social, environment, economic factors
- · Circular economy: keep resources circulating in the economy, rather than wasting them
 - · Benefits: economic reasons (bottle bills)
- · Life cycle assessment: quantify environmental impact
 - Carbon footprint
 - Water footprint
 - · Assess disposal, raw material extraction, use, manufacturing, distribution
 - · Can reveal "hidden" sources of waste/inefficiencies
 - · Highlights the environmental and economic benefits/disadvantages of certain products
- · How can we use tools to engineer a more sustainable world?
 - · Research differences/marginal benefits of reusable vs disposable products
 - · Assess if the cost of waste is greater or less than the cost of washing/reusing a product
- · How this relates to our project?
 - · Consider reusable vs disposable debate
 - How much energy does it take to clean?
 - What materials will we use?
 - · Consider lifetime of device
 - What designs might make the device more prone to breaking?
 - · How much energy does fabrication take? Do certain 3D printers use more energy?

Conclusions/action items: I learned how environmental impact is measured for engineered products. I also learned that reusable products are not always more environmentally friendly than disposable ones. I will keep this information in mind when creating my device and consider how environmentally friendly it is.



2025/10/08-Intro to WARF, IP, Disclosing, and Licensing

Lydia Miller - Oct 08, 2025, 2:01 PM CDT

Title: Intro to WARF, IP, Disclosing, and Licensing

Date: 10/8/25

Content by: Lydia Miller

Present: 300 lecture

Goals: Hear from Jeanine Burmania and Justin Anderson from the IP team at WARF. Learn about IP/licensing and how it relates for our designs,

Content:

Warf

· Serve innovation on campus by protecting inventions and getting products to market

Technology transfer

- · Moving research results from campus to market
- · WARF facilitates securing IP rights and commercial licenses
- EX: IP license, industry sponsored research, consulting arrangements, fee for service

IP overview

- · 4 types
 - Patents
 - Copyrights
 - Trademarks
 - o Trade secrets
- · Other, WARF IP
 - Biomaterials
 - Techniques
 - o Data
- Copyright
 - o Protection for creative works that are expressed in a tangible medium
 - · Wide range of subject matter, including software code
- Trademarks
 - o Protection for names, marks, logos, dress, etc
 - · Requires use in commerce
 - · Source-identifying function
- · Trade secrets
 - Can be used to protect anything of value
 - · Protection is good so long as the concept is not generally known
- Patent
 - Property right, granted by a governmental agency
 - · Patent holder has the right to exclude others from making, using, selling, or importing the claimed invention
 - Design: 15 year term, limited to ornamental features
 - · Plant: new variety, 20 year term, asexually reproducing, non-tuber
 - Utility: provisional (1 year place-holder), nonprovisional (20 year term, can claim priority to a provisional)
- · Nonprovisional patents
 - · Invention of a new and useful process, machine, manufacture, or composition of matter
 - Quid pro quo with the USPTO and the public
 - Limited monopoly on invention (20 years)
 - Applicant must teach others how to make and use claimed invention
 - · Often takes 2-5 years to issue after filing

- o Costs, on average, \$30k-mostly attorney's fees
- 90% of patents issued by USPTO are non-provisional utility patents
- · Requirements for patenting
 - 101: eligible cannot be a product of nature, abstract idea, or natural phenomenon
 - o 102: novel must be new
 - 103: Non-obvious cannot be simple modification or combination of existing concepts
 - · 112: enabled and described provide enough detail to teach others how to make or use the invention
 - o Patent examiners hired to review patent applications for the above requirements

Disclosing an innovation to WARF

- Disclosing
 - Describe the innovation
 - · Identify advantages and applications
 - Name contributors
 - · Provide funding and public disclosure details
- · Meeting with WARF
 - · Discuss the innovation in more detail
 - · Ask questions about WARF and patenting processes
 - Discuss next steps

Assessing university inventions

- · Consider...
 - Type
 - o Breadth and strength
 - Public disclosure
 - Stage of development
 - Applications
 - · Likelihood of identifying commercial partner
 - · Likely return from licensing

Marketing and Licensing

- · Market analysis
 - · Market status established, emerging, new
 - Size and type large and growing, medium and contracting, etc
 - · Potential licensees companies in market
- · License negotiation
 - Type and terms
 - Consideration
- · Ongoing tech development, enforcement, amendment, termination
- · Value of licensing
 - Benefits to company: reduced costs, improved time to market, opportunity to enter new markets, new features
 - · Determining value: tech application, key selling points, tech trends, market size/trend/competition, industry standards

AI and IP

- Patents
 - · Can AI invent? NO
 - South Africa is exception
 - · Al likely can assist in inventing (evolving process/decision)
- · Copyright
 - Original works of human authorship
 - Al must be incidental to conception/creation
 - · No Al prompts, concept is human created
 - · No traditional elements of authorship generated by AI

Conclusions/action items: Intellectual property include patents, copy rights, trademarks, and trade secrets. WARF is an organization that assists students/faculty with protecting their intellectual property. Most patents are non-provisional patents, if we were to submit an application for a patent it would likely fall under this category

2025/10/15-Bioengineer It. Protect It.

Lydia Miller - Oct 15, 2025, 2:09 PM CDT

Title: Bioengineer It. Protect It.

Date: 10/15/2025

Content by: Lydia Miller

Present: Lydia Miller

Goals: Learn about how to patent inventions and protect your ideas. Learn about the legal side of engineering. Understand how we might use this information if we decide to patent our idea.

Content:

- · Importance of IP for BMEs
 - · Allows research to transfer into products, processes, or systems
 - · Investment, partnerships, ethical competition
- · Legal career paths for engineers in IP
 - · Technical advisor no law degree or patent bar
 - · Patent agent patent bar
 - Creating broad patents
 - Patent examiner patent bar (eventually)
 - Want smaller/niche patents
 - · Patent attorney law degree + patent bar
 - · Patent litigator law degree
 - IP License attorney law degree
 - · Tech transfer manager stem degree
 - · Engineer that works with IP lawyers to protect inventions stem degree
- Skills from engineering to IP
 - Research
 - · Analytical reasoning
 - Technical writing
 - Communication
 - Creativity
 - Collaboration
 - Project management
- · IP ownership and responsibility
 - · University normally owns IP, license possibility
 - Employer normally owns IP
 - With start ups, you own your own IP
- · Timing and Publication
 - · Disclose internally first
 - Publishing before filing and offers for sale = lost patent rights abroad and possible loss of rights in the US
 - Posters or abstracts can count as public disclosure
 - · First to file system (not first to invent)
- · Legal and ethical duties of engineers
 - · Respect others' IP
 - · Keep invention notebooks
 - Understand inventorship vs authorship
 - · Maintain confidentiality agreements
- · IP Checklist
 - Invent
 - · Conduct patentability search
 - File patents early

- use NDAs
- · File trademarks/obtain domain names
- Form business entity
- · Types of IP
 - Patent
 - Trademark
 - Copyright
 - Trade secret
- · Patent protection
 - Novel
 - Non-obvious
 - · Utility (must work)
 - Enablement describe how to make and use
- · What is a patent?
 - · Creates monopoly
 - Utility
 - Protect how product works/is made
 - Design
 - Protects unique visual appearance
- Trademarks
 - Logo, words, fonts, colors, smells, sounds, symbols
 - Distinguishable
- · Copyright
 - · Expression of work
 - o Manuals, music, papers
- · Trade secret protection
 - o No filing, just keep it a secret
 - · NDAs and security measures
 - Issues: reverse engineering, revealing secrets
- · Counterfeit products
 - Threaten patient safety
 - \$200-432 billion per year
 - Fake Ozempic

Conclusions/action items:

Lydia Miller - Oct 15, 2025, 2:39 PM CDT

conclusion: As a biomedical engineer, there are lots of ways to become involved with IP and the legal field. We learned about the process of IP protection as well as the career options for BMEs. Our group may consider a patent if we think it fits the requirements.

Lydia Miller - Oct 22, 2025, 1:56 PM CDT

Title: Fall Post Grad Planning

Date: 10/22/2025

Content by: Lydia Miller

Present: Group 3

Goals: Learn about different paths after graduation. Learn about the benefits of higher education. Consider my future plans.

Content:

- · Use undergraduate experience to build a story
- Get a big picture of who you are/who you want to be
- Think about reference letters
- Personal statement
 - o Thesis: what do you want to do
 - Narrow experiences, how do those apply to broad experiences
 - Specific to each position/place you apply
 - Show what you will achieve at University X
 - · What you want to do afterwards, faculty interest
- · Grad school
 - o Masters, PhD, med school
 - Reasons: rewrite your story, desirable, more experiences
 - Slightly higher pay
- · 3 masters programs
 - Research: 1.5-2 years, thesis required
 - · Accelerated coursework based: 1 year
 - o BIDE accelerated: project based, partner with bschool
- · Applying:
 - Statement of purpose, 12/15 deadline, special consideration to bme underdgrads with 3.0

Conclusions/action items: I have learned about the different types of post graduate degrees and the steps needed to accomplish them. I should begin thinking about getting letters of recommendation (in case I decide to go to another school for grad school), and whether I want to participate in the normal masters or BIDE. I will continue to keep graduate school in mind when considering post grad plans.

Lydia Miller - Oct 29, 2025, 1:57 PM CDT

Title: To regulate, or not to regulate, that is the question

Date: 10/29/2025

Content by: Lydia Miller

Present: Lydia Miller

Goals: Learn from Dr. Kip Ludwig about regulations in the medical device industry. Consider how we can apply this information to our project.

Content:

- 3 centers in FDA
- · CDRA Center for devices and radiological health
- CBR Center for biologics
- CDR
- · Drugs receptor engagement
- · Want benefits to outweigh risks
- · Regulatory pathway
 - · Class 1: low risk
 - Generally exempt from FDA
 - · Class 2: moderate/controlled risk
 - 510(k), De Novo, HDE
 - · Class 3: high risk
 - HDE, PMA
 - Consider general controls, special controls, clinical data
- · Usually, issues cause regulations to be made
- · Recalls yield minimal market repercussions (little impact on company decline)

Conclusions/action items: Some sectors of the FDA are thought to be under-regulated, while others are thought to be over-regulated, and there is a lot of discourse over even the need for the FDA at all. Regulations usually come about as a result of complications. Complications have little impact on market value of a company.

Lydia Miller - Nov 05, 2025, 2:10 PM CST

Title: Regulatory strategy

Date: 11/5/25

Content by: Lydia Miller

Present: 300 lecture

Goals: Learn about the framework guiding advanced therapeutic product development. Learn about regulations in biotech. Understand how this can relate to our project.

Content:

- · Important to understand regulatory and quality control side of the industry
- · FDA structure
 - Devices (CDRH)
 - Premarket approval
 - 510(k)
 - IDE
 - o Drugs (CDER)
 - NDA new drug application
 - IND investigational new drug
 - Biologics (CBER)
 - BLA
 - IND
 - Genome editing, gene delivery, cell therapy
- Implications: 351 vs 361
 - o 351
 - Biologic
 - FDA approval required for marketing
 - Labeling claims indicated for a specific therapeutic use
 - Potency, bioactivity, purity assured
 - Novel
 - High barrier to entry
 - 361
 - HCT/P
 - FDA approval not required
 - No claims for homologous use
 - Potency, bioactivity, purity not assured/tested
 - Commodity
 - Low barrier to entry
- Each phase of the product development cycle faces its on challenges and risks
- Target product profile ... like the PDS
 - Core
 - · Clinical development planning
 - CMC
- Time = \$
- · Quality management system
 - · Document policies, processes, internal rules, procedures, and other records to ensure consistent quality
 - Document everything!! Otherwise the process is useless

Conclusions/action items: The regulation process for drugs, biologics, and medical devices is extremely thorough and complex. Documentation is very important in the quality side of engineering because it demonstrates the process of product development. We should keep these ideas in mind as we move forward with the design process by clearly documenting our ideas/work.

Lydia Miller - Nov 07, 2025, 12:50 PM CST

Title: Building a Career a Impact: Why Healthcare needs more engineers

Date: 11/7/25

Content by: Lydia Miller

Present: BME lecture

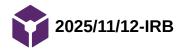
Goals: Hear from Kristin Myers about her path from BME to business school to a career as a COO at Blue Cross Blue Shield. Understand how healthcare systems can be improved by engineers. Hear Kristin Myer's advice for us.

Content:

- · Run towards the hard problems, they are the ones that change the world
- · Career journey
 - Foundation: college, solve problems
 - UW-Madison, various jobs and internships
 - Medtronic: marketing and sales
 - Harvard MBA
 - Skyline venture: investor in healthcare startup
 - Arboretum ventures: investor in healthcare startup technology
 - · Growth curve: combine EQ and IQ to multiply impact and reach
 - · Aetna: chief of staff to CEO, president
 - Unified women's healthcare: president and COO
 - · Build and transform: drive system-level impact through innovation and scale
 - Hopscotch health: founded and CEO advanced primary care for rural communities
 - Blue Cross Blue Shield: COO, enable access affordability, outcomes and experience for 1 in 3 americans
- You don't need to know your final destination just follow hard problems and build skills that allow you to make an impact
- Improve provider experience, patient experience, patient outcomes, lower cost of care
- · US ranked last on equity, access, and outcomes
- Lower life expectancy
- 10x maternal mortality rate
- · Archaic system of healthcare, many things need to change
 - · IT and infrastructure
 - Misaligned incentives
 - Inequities
- · Healthcare isn't broken because people don't care, it was just never designed to work as one system
- Build integrated system to enable health and wellness for all
- What is required to build a better healthcare system?
 - · Interoperable data infrastructure
 - Human centered design
 - Aligned incentives
 - Connected care delivery platforms
 - · Simplified and automated infrastructure
 - · Systems thinking, analytical rigor, design and iteration, process optimization, reliability and safety
- Advice
 - Work hard and build range: take on the hardest projects, classes and experiences you can find. Effort and range are your foundation
 - Work in an office (not remote) if possible
 - Seek diverse exposure: explore different sectors, teams, and geographies. Gain perspective and learn how systems connect, not just how parts work. Meet new people!
 - · Choose your people wisely: surround yourself with curious, driven, high-integrity people. They will shape who you become.
 - Know your values and protect them: define what matters to you. Make decisions that align based on your values.

- Embrace challenge and keep growing: run towards hard problems. Growth lives on the edge of discomfort, where big impact starts.
 - Don't be afraid of not being good enough
 - Be curious, take on big challenges!
 - Give yourself grace
- · Energy flows, find balance

Conclusions/action items: The healthcare system is facing large, deeply rooted challenges; engineers can use their problem-solving skills and analytical thinking to solve these problems. Embrace challenges and always push yourself to take on new challenges. Understand your own values and surround yourself with people you admire/value/love.



Lydia Miller - Nov 12, 2025, 1:58 PM CST

Title: Introduction to the IRB

Date: 11/12/25

Content by: Lydia Miller

Present: BME 300 lecture

Goals: Learn about IRB history. Learn about IRB composition and requirements. Learn what kinds of research requires IRB. Learn about creating a study.

Content:

- · Problematic research studies in past ... purposely infecting patients ... vulnerable patients
- · Nuremberg code, declaration of Helsinki aim to protect patients
- · National research act lead to creation of institutional review board
- · Belmont report
 - Respect for persons/autonomy
 - Beneficence
 - Justice
- · Applying Belmont principles
 - o DHHS: common rule
 - Criteria for approving research
 - Protections for vulnerable groups
 - Requirements for IRB operations
 - Revised common rule (2018)
 - Modifications to reduce administrative burden
- IRB composition
 - Diversity of membership: race, gender, cultural backgrounds
 - · Scientific expertise (MD, PhD, MPH, faculty, clinicians) and non scientists (community members, IRB staff)
- IRB Purpose
 - Protect rights and welfare of people enrolled in research, participants/subjects
 - · IRBs review human research according to:
 - ethical principles
 - federal regulations, HIPAA, FERPA
- IRB review requirements
 - · Required IRB review of all research involving human subjects
- · Common rule criteria
 - Risks
 - Benefits
 - · Risk: benefit ratio
 - Equitable selection of subjects
 - Informed consent
 - · Privacy and confidentiality
- · Common rule definitions
 - Systematic investigation, including a research development, testing, and evaluation, designed to develop or contribute to generalizable knowledge
 - · A living individual about whom an investigator
- · Ex of applicable research
 - Drugs, devices, or products developed through research in humans
 - Data from surveys
 - · Employment records
 - Educational records

- Medical records
- Bodily materials
- · Not considered research
 - QI/PE (quality improvement) does not meet definition of research, may not be generalizable
- · De-identifying data
 - o Directly identifiable: no identifiers removed
 - · Coded/indirectly identifiable: identifiers removed from data but linked via study ID code
 - o Anonymized: all identifiers removed
- · Research requiring IRB review
 - Exemptions: can use category tool to determine if your research is exempt
- · Creating a study
 - Use ARROW
 - · Protocol based application
 - Can amend an existing study by revising form in ARROW
- · IRB review process
 - · Administrative review
 - IRB Pre-Review
 - · Committee or non-committee review

Conclusions/action items: We learned about the IRB, and all of the requirements that play a factor in reviewing research. We also learned about what kinds of research requires an IRB and what the history of the IRB is. We can keep this information in mind as we continue progress on our device.



2025/11/19-Product development in industry

Lydia Miller - Nov 19, 2025, 1:56 PM CST

Title: Product development in the medical device industry

Date: 11/19/25

Content by: Lydia Miller

Present: 300 lecture

Goals: Understand how new opportunities are selected. Understand how NPD projects are managed. Identify challenges and barriers.

Content:

- · NDP in medical devices
 - Highly regulated
 - Expensive
 - Resource intense
 - Competitive
- · Selecting projects
 - · Corporate business strategy
 - Understand markets, political environment, strategic planning
 - · Product portfolio review
 - Define product categories and which to continue/eliminate
 - · Project review
 - · Budgeting and resource allocation
- · Types of NPD projects (increasing risk)
 - Line extensions
 - Additional sizes and configurations
 - · Product improvements
 - Use market feedback and customer needs
 - New-to-company
 - Not necessarily new to market
 - New-to-world
 - Completely new market/product
- · NPD team members
 - · Engineer, marketing, project management, quality assurance, clinical/regulatory assurance, manufacturing, etc
- · Managing NPD: stage-gate process
 - Stage 0: ideation
 - · Stage 1: exploration
 - Narrow down ideas
 - Market research
 - Rough business plans, talking to customers and clinicians
 - · Stage 2: concept development
 - Narrow down again
 - Continue conversations internally and externally
 - Go/no-go devision
 - o Stage 3: design development
 - Designing ideas
 - Testing development
 - · Stage 4: design confirmation
 - Clinical testing
 - Verification and validation
 - Design freeze
 - · Stage 5: design transfer and commercialization

- Commercialization plan via marketing and sales
- Launch
- Post-market surveillance
- · Gate reviews throughout
- · Case study: fluid management solutions for high volume cases
 - · Manual vs automated
 - · Wanted cleaner and simpler option than automated system
 - · Stage 0: choose area of opportunity, review market trends, initial research, high-level and rough ideas
 - Stage 1: defining problem, screening list of ideas, develop business case, preliminary technical scouting, IP landscaping
 - Stage 2: concept definition, 1 leading concept, robust business case, IP examination, next step is "go/no-go" decision
 - Stage 3: design development, functional prototype, iterative design process, initial testing, confirm regulatory pathway, form design control documentation
 - Design control: risk management, documentation of customer needs, design requirements, etc
 - Stage 4: design confirmation, verification/validation, finalize product and component drawings, manufacturing process (make vs buy), freeze design at end of stage, submit regulatory documentation
 - Stage 5: design transfer and commercialization, finish testing, final design changes, build molds, assembly/test equipment, create instructions for use/manuals, develop service plan and resource, finalize market strategy
 - Post market surveillance: account sales, business and regulatory issues observed, complaints, product and process improvement opportunities

Conclusions/action items: Medical device development is an expensive, complex and highly collaborative effort. Processes like stage-gate to reduce risk and increase probability of success are necessary with limited resources. Good product design and development is necessary for commercial success but not sufficient.

Lydia Miller - Nov 16, 2025, 8:39 PM CST

Title: MTS force data analysis

Date: 11/16/25

Content by: Lydia Miller

Present: Lydia, Janice, Varenya

Goals: Analyze the MTS data from the force needed to push the contents of the straw into the well plate. Determine the maximum force required. Teach 200s how to use MATLAB to analyze data.

Content:

Initial forces

Test run 1: 0.6493 N

Test run 2: 0.7136 N

Test run 3: 0.4774 N

Test run 4: 0.6966 N

Test run 5: 0.4363 N

Average initial force: 0.5946 ± 0.1288 N

```
Code:
```

```
close all;
clear all;

[file, path] = uigetfile({'*'});
fullpath = fullfile(path, file);
data = readtable(fullpath);
disp=data(:,1);
force=data(:,2);
time=data(:,3);
force = table2array(force);
time = table2array(time);

figure;
plot(time,force);
xlabel("time (s)")
ylabel("force (N)")
```

```
mask = time >= 0 & time <= 1;
maxForce = max(force(mask));</pre>
```

Note: this code only finds the max force within the first 1 second of data collection, representing the initial force needed to push the cotton

Max Forces

Test run 1: 2.8296 N

Test run 2: 1.0295 N

Test run 3: 0.7077 N

Test run 4: 0.8492 N

Test run 5: 0.5647 N

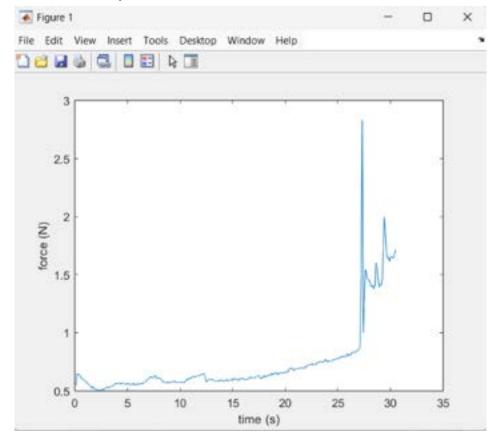
Average max force: 1.1962 ± 0.9292 N

Changes made in code

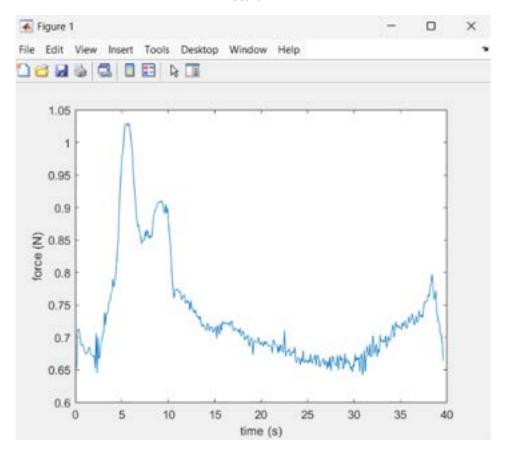
```
mask = time >= 0 & time <= 1;
maxForce = max(force(mask));</pre>
```

Note: this code finds the max force from the entire time the rod pushed the contents of the straw

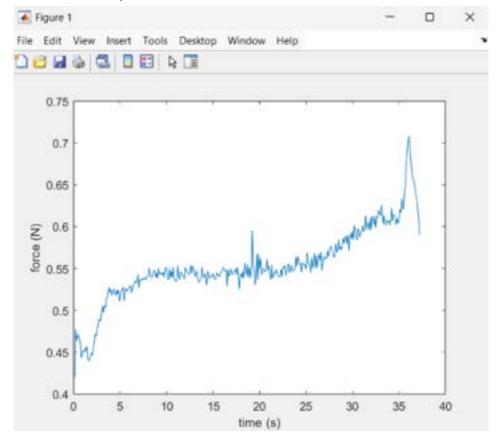
Graphs:



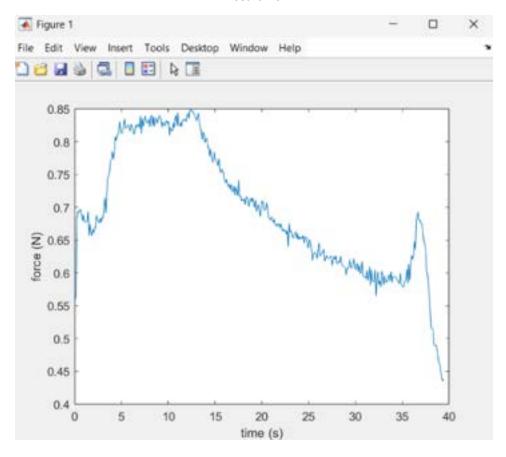
Test run 1



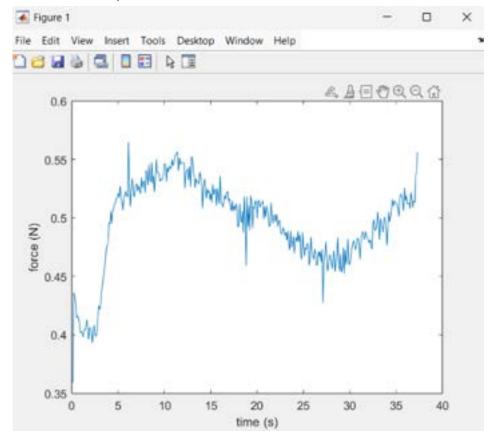
Test run 2



Test run 3



Test run 4



Test run 5

Conclusions/action items: The MTS machine gave us unusual data that doesn't perfectly match a normal force diagram. Because of this, we found the initial force required to push the cotton, as well as the total maximum force needed. The strange graphs could be due to noise in the MTS machine, or other issues with how the straw was set up.

Lydia Miller - Nov 19, 2025, 2:34 PM CST

Title: MTS testing protocol

Date: 11/19/25 (originally written 10/29, but was not put in my testing folder)

Content by: Lydia Miller

Present: Lydia Miller

Goals: Document protocol for MTS testing. Ensure usability by incorporating clear directions on how to use MTS machine.

Content:

MTS Testing protocol

- 1. Unlock machine
- 2. Place compartment and straw onto bottom of the MTS machine
- 3. Place 3D printed testing fixture onto the load cell
- 4. Place rod into testing fixture
- 5. File > New Custom Test > BME 201
- 6. Set strain rate to 3 mm/sec
- 7. Adjust load cell so the rod is just above and aligned with the straw
- 8. Zero cross head and load
- 9. Lock machine
- 10. Enter diameter on the monitor tab
- 11. Press play
- 12. Press stop once the rod has caused the cotton in the straw to move
- 13. Export data
- 14. Turn off machine

Conclusions/action items: We were able to carry out testing for 1 straw in the MTS machine. We completed 5 test runs. After we analyzed the max and initial force required to push contents of straw.



2025/11/23-Rod bending data analysis

Lydia Miller - Nov 23, 2025, 5:24 PM CST

Title: Rod bending data analysis

Date: 11/23/25

Content by: Lydia Miller

Present: Lydia Miller

Goals: Analyze the max force the rods can withstand before they begin to bend. Create a graph that demonstrates the average force required to bend. Determine if results show that the force required to push the contents of the straws is less than the force to bend the straws.

Content:

Code:

```
close all;
clear all;

[file, path] = uigetfile({'*'});
fullpath = fullfile(path, file);
data = readtable(fullpath);
disp=data(:,1);
force=data(:,2);
time=data(:,3);
force = table2array(force);
time = table2array(time);

figure;
plot(time,force);
xlabel("time (s)")
ylabel("force (N)")
max_force = max(force)
```

Max Forces

Test run 1: 6.7424 N

Test run 2: 6.4713 N

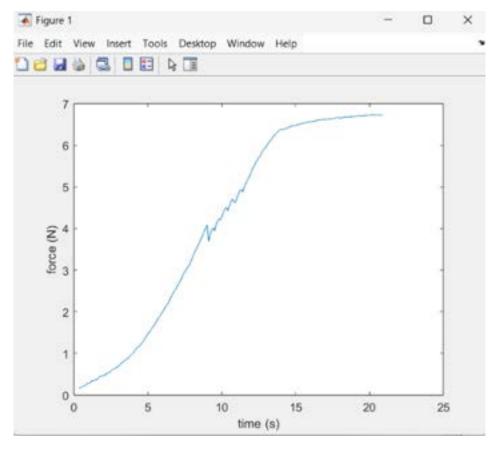
Test run 3: 6.5168 N

Test run 4: 6.4810 N

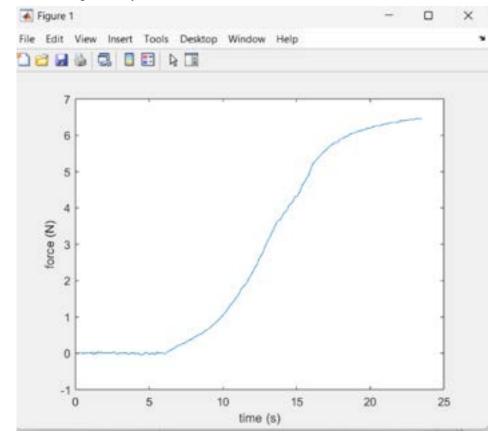
Test run 5: 6.5130 N

Average max force: 6.5449 N

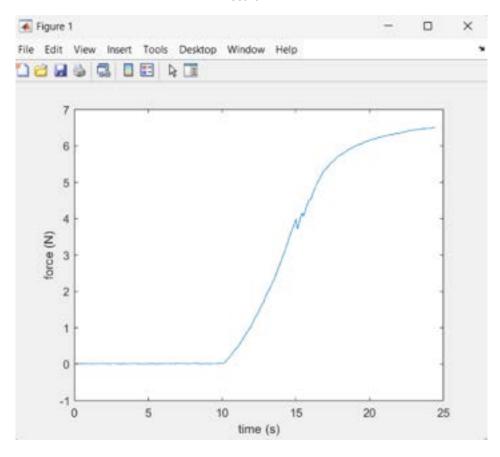
Graphs:



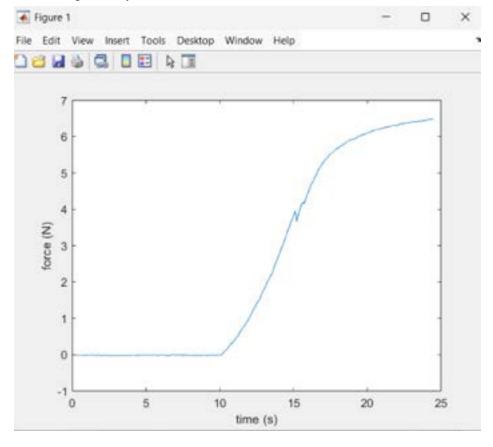
Test run 1



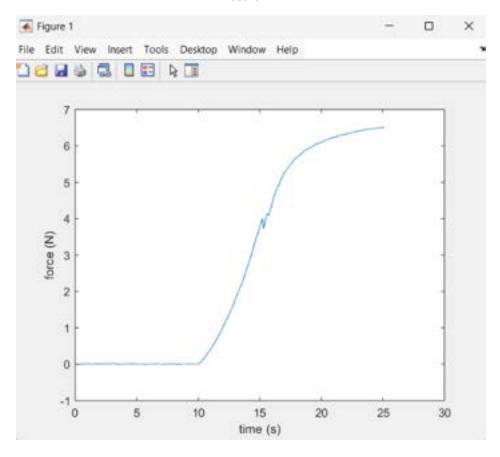
Test run 2



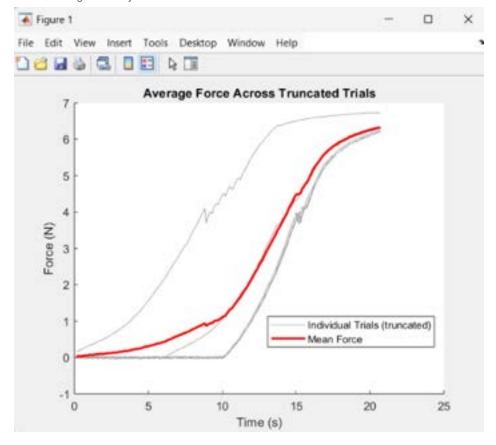
Test run 3



Test run 4



Test run 5



Code to make this graph - used chat

```
close all; clear all;
% Ask user to select multiple trial files
[files, path] = uigetfile({'*'}, 'Select all trial files', 'MultiSelect', 'on');
numTrials = length(files);
all_forces = {};
all_times = {};
% --- Load all force/time vectors ---
min_length = Inf;
for i = 1:numTrials
  fullpath = fullfile(path, files{i});
  data = readtable(fullpath);
  force = table2array(data(:,2));
  time = table2array(data(:,3));
  % store temporarily
  all_forces{i} = force;
  all_times{i} = time;
  % update the minimum length
  min_length = min(min_length, length(force));
```

```
% --- Truncate all trials to the smallest length ---
forces_trunc = zeros(min_length, numTrials);
times_trunc = zeros(min_length, numTrials);
for i = 1:numTrials
  forces_trunc(:,i) = all_forces{i}(1:min_length);
  times_trunc(:,i) = all_times{i}(1:min_length);
end
% --- Use the first trial's truncated time vector as the shared time ---
common_time = times_trunc(:,1);
% --- Compute mean force curve ---
mean_force = mean(forces_trunc, 2);
figure; hold on;
% --- Plot all individual truncated curves and save handle ---
h_trials = plot(common_time, forces_trunc, 'Color', [0.6 0.6 0.6]);
% --- Plot mean force and save handle ---
h_mean = plot(common_time, mean_force, 'r', 'LineWidth', 2);
xlabel("Time (s)")
ylabel("Force (N)")
title("Average Force Across Truncated Trials")
% --- Legend with correct colors ---
legend([h_trials(1), h_mean], ...
      {"Individual Trials (truncated)", "Mean Force"}, ...
      'Location', 'best');
```

Conclusions/action items: We stopped data collection when the force reached a plateau and we visually saw a slight bend in the straw. The reason for this is because even a slight bend could impact the ease of use and safety of the procedure. We determined that since the force (\sim 6.5 N) is greater than the force needed to push the semen out (\sim 2 N), there will be NO bend in the straws, and the procedure is therefore safe. FOS: 6.5/2 = 3.25

2025/12/09-UPDATED MTS force results

Lydia Miller - Dec 09, 2025, 2:32 PM CST

Title: Updated MTS force results (stamping)

Date: 12/9/25 (originally wrote 12/3)

Content by: Lydia Miller

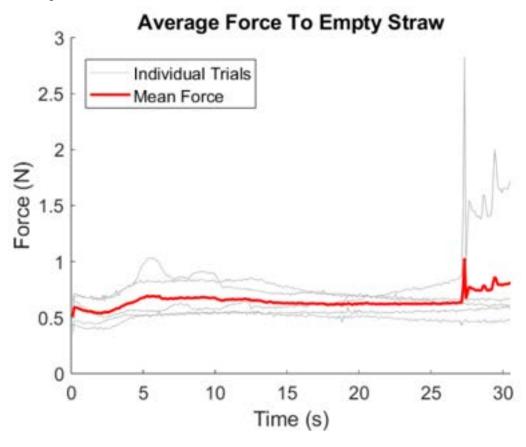
Present: Lydia Miller

Goals: Redo the code for the stamping MTS test so that all of the graphs are analyzed onto one plot, rather than 5 separate graphs. Add to final poster.

Content:

```
%% mts push all graphs
close all;
clear all;
% --- Ask user to select 5 trial files ---
[files, path] = uigetfile({'*'}, ...
'Select 5 trial files', 'MultiSelect', 'on');
% If the user selects only one file, MATLAB returns a char instead of a cell
if ischar(files)
files = {files};
end
numTrials = length(files);
all_forces = cell(1, numTrials);
all_times = cell(1, numTrials);
% --- Load all force/time vectors ---
min_length = Inf;
for i = 1:numTrials
fullpath = fullfile(path, files{i});
data = readtable(fullpath);
force = table2array(data(:,2));
time = table2array(data(:,3));
all_forces{i} = force;
all_times{i} = time;
% Track smallest trial length
min_length = min(min_length, length(force));
end
% --- Truncate all trials to the shortest one ---
forces_trunc = zeros(min_length, numTrials);
times_trunc = zeros(min_length, numTrials);
```

```
for i = 1:numTrials
forces_trunc(:,i) = all_forces{i}(1:min_length);
times_trunc(:,i) = all_times{i}(1:min_length);
end
% Shared time vector = time from the first trial
common_time = times_trunc(:,1);
% --- Compute mean force curve ---
mean_force = mean(forces_trunc, 2);
% --- Plot ---
figure; hold on;
% Plot all trials in light gray
h_trials = plot(common_time, forces_trunc, 'Color', [0.7 0.7 0.7]);
% Plot mean in red
h_mean = plot(common_time, mean_force, 'r', 'LineWidth', 2);
xlabel("Time (s)");
ylabel("Force (N)");
title("Average Force To Empty Straw");
% Legend with proper colors (only need one gray handle)
legend([h_trials(1), h_mean], ...
{"Individual Trials", "Mean Force"}, ...
"Location", "best");
print('myFigure','-dpdf')
```



Conclusions/action items: Graphs are now combined for easier comparison of each trial. Update final report with this information.



2025/9/10 - Artificial Insemination Process

Janice Amornthanomchoke - Sep 11, 2025, 12:54 AM CDT

Title: Artificial Insemination Process

Date: 2025/9/10

Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to understand the steps in artificial insemination, the conditions needed to maintain artificial insemination, and tools used for the process.

Content:

- need to be inseminated within 6-8 min of thawing
- 0.25ml have large surface-to-volume ratio as opposed to 0.5ml leading to more vulnerable rapid temperature fluctuations
- · only take 3 seconds for moving 0.25ml
- · liquid nitrogen storage tank containing clearly labelled straws
- · removing straw with forceps, remove any excess liquid nitrogen
- · pre warming artificial insemination gun
- · Batch thawing
 - o at least 10 straws can be safely thaw simultaneously
 - · does not seem to reduce probability of pregnancy

Conclusions/action items:

The process of effective artificial insemination can be affected by temperature, volume, the time it takes to transport the semen, the sterilization, and the thawing of the semen. Overall, the semen should be stored at low temperature, thawed for a short amount of time, and the equipment should be kept sterile. The next step is to understand the production of semen straw pushing.

Citation:

[1] M. G. Diskin, "Review: Semen handling, time of insemination and insemination technique in cattle," *Animal*, vol. 12, 2018. doi:10.1017/s1751731118000952



2025/9/17 - Multifunctional tool knife Properties

Janice Amornthanomchoke - Sep 17, 2025, 4:48 PM CDT

Title: Multifunctional tool knife Properties

Date: 9/17/2025

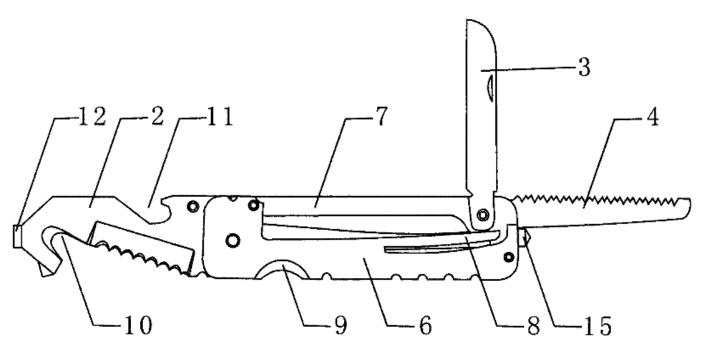
Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to look at the properties of how they implemented the serrated blade on the knife and figure out how to incorporate it into our design.

Content:

- · blade is fixed on the end by a nail
- · blade can move back and forth to access other blade
 - o able to fold at the into the top of the handle
- · the handle is at a fixed point to allow movement with the other blades and ensure it is not loose
- · handle made out of out handle sheet and inner handle sheet



Conclusions/action items:

Overall, they made the serrated blade adjustable by screwing the knife at a fixed point at the top of the handle and folding the blade in. This design could help figure out how to move the blade up and down to cut the straws without concerns of it moving outside its axis. The next steps would be to design a handle for the straw cutter and figure out where to get the blades.

刘笋 "CN201941017U - Multifunctional Tool Knife," Google Patents, https://patents.google.com/patent/CN201941017U/en? q=%28serrated%2Butility%2Bblades%29&oq=serrated%2Butility%2Bblades%2B.

Janice Amornthanomchoke - Sep 17, 2025, 5:37 PM CDT

Title: Multifunctional tool knife Properties

Date: 9/17/2025

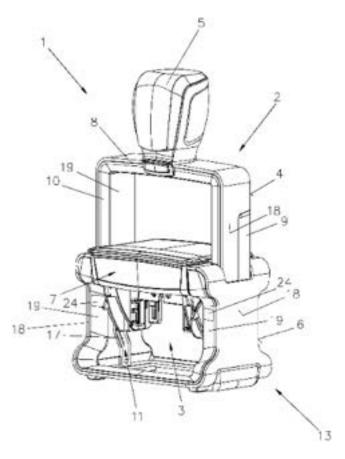
Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to look at the mechanism of the stamp and figure out how to incorporate it into our design.

Content:

- · top is a bow shape with stamping insert
- The stamp insert has a slide track to move up and down
 - o connected by a shaft
 - o rigid so it does not move around
- a bow spring element to return to the top
- · projecting shaft to remove the ink
- exchange channel can be closed with a cap
- · exchange channel is located in the upper region which is arranged perpendicularly to the slide track
 - o allows the slide to stay rigid
- the latch allows for freely moving the ink insert to remove it



Conclusions/action items:

Overall, they made the stamp with a sliding track that allows the stamp insert to move up and down. The exchange channel is attached to the upper and bottom portions, which allows for the stamp to move in only one direction to ensure it does not slip. This design could help figure out how to move

the stamp without having concerns of it moving outside its axis and ensure the pins accurately aim at the straws. The next steps would be to figure out how to implement the pins inside the stamp to push the cotton buds into the straw.

[1] K. Riegler, M. Zehetner, and H. Linder, "US11090964B2 - stamp and stamping insert, especially as a replacement part for a stamp," Google Patents, https://patents.google.com/patent/US11090964B2/en?q=%28ink%2Bstamps%29&oq=ink%2Bstamps (accessed Sep. 17, 2025).



2025/10/30 - Box Cutter with deflectable safety shield

Janice Amornthanomchoke - Oct 30, 2025, 10:19 AM CDT

Title: Box Cutter with deflectable safety shield

Date: 10/30/2025

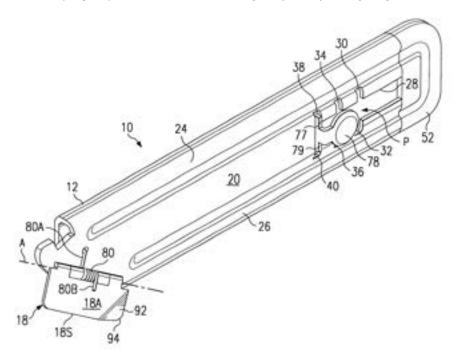
Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to look at the mechanism of the box cutter and figure out how to incorporate it into our design. Mainly, we want to focus on how they implement the safety shield to figure out how to create a guard on our slicer device.

Content:

- a carton opener including a fixed guide portion for guiding the blade at a fixed distance along the corner edge of a carton
 - · acts as a safety shield
- · movable shield rotatably attached to the box opener handle
- shield rotates away from the cutting edge of the blade when the shield contacts a surface at about a 90° angle
- a guard including a shielding portion mounted on the handle at the front end of the handle along one side of the blade
- · guard extends transversely across a cutting plane of the blade
- a spring coupled to the handle and to the guard yieldably biasing the guard for movement toward the protective position.



Conclusions/action items:

Overall, they made the box cutter with a rotating guard to protect someone from the blade. This design could help figure out how to cover the blade from someone's hand while still being able to cut the straws. The next steps would be to figure out how to implement the blades in the device so that we could figure out how to rotate the guard around the blade.

[1] R. E. Davis, "Box cutter with Deflectable Safety Shield," Google Patents, https://patents.google.com/patent/US6637112B2/en? q=%28hand%2Bpaper%2Bcutter%29&oq=hand%2Bpaper%2Bcutter (accessed Oct. 30, 2025).



2025/10/8- 3-D Printing Materials Durability

Janice Amornthanomchoke - Oct 09, 2025, 12:43 AM CDT

Title: 3-D Printing Materials Durability

Date: 10/8/2025

Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to conduct research on the effects of orientation on the durability during 3-D printing. This could help us decide how we want to 3-D model our devices to ensure it is strong enough to withstand the forces of the stamp.

Content:

- · Tested printing angles
 - 0, 15, 30, 45, 60, 75, 90
- · Ultimate Tensile strength (UTS) decreases as the angle decreases
 - o set 90 as the standard
- UTS decreases as the thickness decreases within the same angle
- · In-layer fracture most likely happens with smaller, more homegenous printing layers
- · interlayer fracture occurs as thickness increases

Table 2. Fracture forms of specimens.

Layer thickness (mm)	Fracture forms				
	In-layer fracture	Interlayer fracture			
0.1	30°, 60°, 75°, 90°	0°, 15°, 45°			
0.2	60°, 75°, 90°	0°, 15°, 30°, 45°			
0.3	75°, 90°	0°, 15°, 30°, 45°, 60°			

Fig. 12. UTS comparison between theoretical data based on two types of theoretical models and TAD.

Table 4. UTSRC (TAD) for 3D printing materials.

Layer thickness (mm)	0°	15°	30°	45°	60°	75°	90°
0.1	47.71%	51.36%	56.36%	57.73%	63.71%	76.67%	100.00%
0.2	48.15%	53.01%	54.71%	57.80%	70.55%	84.50%	100.00%
0.3	52.54%	59.83%	61.80%	64.43%	76.54%	85.22%	100.00%

Conclusions/action items:

Overall, the paper talks about the quantification of measuring the tensile strength of the 3D-printing material based on the angle of the device. The device tends to fracture more often if the angle is near 0 and has a thinner size. We could 3-D print our device based on these parameters to ensure we can maximize its durability so that the client can used it for a long time.

[1] T. Yao, Z. Deng, K. Zhang, and S. Li, "A method to predict the ultimate tensile strength of 3D printing polylactic acid (PLA) materials with different printing orientations," *Composites Part B: Engineering*, vol. 163, pp. 393–402, Apr. 2019. doi:10.1016/j.compositesb.2019.01.025



2025/10/16 - Microbial Contamination Testing

Janice Amornthanomchoke - Oct 16, 2025, 1:54 AM CDT

Title: Microbial Contamination Testing

Date: 10/16/2025

Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to learn how labs tend to test for contamination in the workspace. We would like to adapt those practices to test the possible spread of contamination. We also want to know how much contamination spread in the lab.

Content:

- · Instrumentation for testing contamination
 - · fluorescent marker, GloGerm powder
 - tested samples on three different types of chemistry analyzers
 - UV flashlight was used to observed surface before and after contamination
 - lab areas and workers were swabbed before and after use of the lab
- · Assess where the fluorescent powder traveled throughout the lab
 - Most common areas
 - gloved hands
 - loading and centrifuge racks
 - computers
 - computer accessories
- · no guidelines exist on where surfaces should be decontaminated

Conclusions/action items:

Overall, the most contaminated places tend to be places where workers frequently used like gloves and loading racks. The materials the study uses to test for contamination is GloGerm powder, which could be a possible method we could use to test the contamination in our product, as it is small enough to spread in the small holes in our device. However, it would be difficult to quantify the amount of contamination, as we would have to assess based on approximating the surface area being covered by the contamination.

Janice Amornthanomchoke - Oct 23, 2025, 12:18 AM CDT

[1] C. W. Farnsworth et al., "Evaluation of the risk of laboratory microbial contamination during routine testing in automated clinical chemistry and Microbiology Laboratories," Clinical Chemistry, vol. 66, no. 9, pp. 1190–1199, Aug. 2020. doi:10.1093/clinchem/hvaa128

Janice Amornthanomchoke - Oct 23, 2025, 12:32 AM CDT

Title: Flow Cytometry

Date: 10/23/2025

Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to understand the functions and uses of flow cytometry. My PI advisor recommended using flow cytometry, so I wanted to figure out how we would implement it in our testing for contamination or sanitation. I want to compare our other options for testing to see which one is more viable.

Content:

- · analyzes single cells or particles as they pass single/multiple lasers while suspended in a buffered salt-based solution
 - · used for immunology, virology, molecular biology, cancer biology, and infectious disease monitoring
- · samples prepared for fluorescence through fluorescent proteins, dyes, or antibodies
 - o Multiple laser systems could be used for 96 96-well loader for bead analysis
 - mass spectrometry and flow cytometry combination
- · uses filters to detect wavelength
 - o detect samples at a specific wavelength
- · can sort cells to purify samples
 - based on charges
- · bead array analysis
 - · analyzing large amounts of analytes in small volumes based on the associated specific bead
- · Absolute cell counting
 - uses fluorescent beads of known concentration to analyze and gate a number of cells for the population of interest and compares with the number of beads acquired in the same sample
 - basically find a concentration of cells in the sample

Conclusions/action items:

Overall, the flow cytometer could be a viable option for testing contamination because we could test the concentration of fluorescent beads in the solution after the sample is pushed through the compartments and into the well plate. It would also give us quantifiable data since it would be based on the concentration of the bead, and we could find ways to decrease the concentration in the nearby wells to prevent contamination. However, we would need to find a lab that would allow us access to the flow cytometer, run samples through our devices, and figure out where to get the fluorescent flow cytometer beads.

[1] K. M. McKinnon, "Flow cytometry: An overview," Current Protocols in Immunology, vol. 120, no. 1, Jan. 2018. doi:10.1002/cpim.40

2025/11/05- Stress Analysis of Blade

Janice Amornthanomchoke - Nov 06, 2025, 12:04 AM CST

Title: Stress Analysis of Blade

Date: 11/05/2025

Content by: Janice Amornthanomchoke

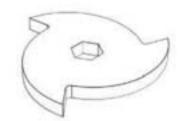
Present: N/A

Goals: The goal is to understand how to calculate the stress of a shredder blade to cut plastic. This could help us determine the best way to shape the blade to cut the plastic straws for our project. This could also help us calculate the possible force of the blade applied to the straw.

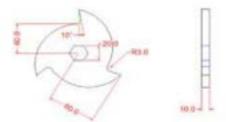
Content:

- used a motor of 2.2KW and 2820rpm
- · shed plastic bottles
- · made blade with low carbon steel
- · used the ANSYS 19.2 software
- applied calculation on heat treat mild steel
 - o diameter of 100mm
 - o thickness 5mm
 - o max stress 2.5MPa
 - o max strain 1.2*10-5
 - max deformation 4*10-6

0



3a: Isometric



3b: Planes Views Figure 3: Detailed geometry of the shredder blade (Dimensions are in mms)

Breaking strength can be assumed as the ultimate strength multiplied by a factor of safety 1.5

Breaking strength of PET plastic material:

$$\tau_{bv)plastic} = 1.5 * 80 = 120 MPa$$

The cross-sectional area of the material to be cut is

$$A = w^*t \tag{1}$$

Where: w = Width of cutting blade edge,

t = Thickness of the plastic material

The cutting force required for cutting the plastic bottles

$$F_c = \tau_{br)\,slavic} * A$$
 (2)

Conclusions/action items:

Overall, they were able to calculate the blade stress using a calculation based on the plastic's breaking strength, the area to be cut, and the material's thickness. We could use these equations to calculate the force to cut the plastic straws as a potential way to test the blade's strength. However, they are using a motor to spin the blades like a shredder would, while we are using manual cutting the knife, which could deviate from how they calculated their force.

[1] M. Nasr and K. Yehia, "Stress analysis of a shredder blade for cutting waste plastics," *Journal of International Society for Science and Engineering*, vol. 0, no. 0, pp. 0–0, Dec. 2019. doi:10.21608/jisse.2019.20292.1017



2025/12/05- Future Contamination Testing

Janice Amornthanomchoke - Dec 05, 2025, 1:38 AM CST

Title: Future Contamination Testing

Date: 12/05/2025

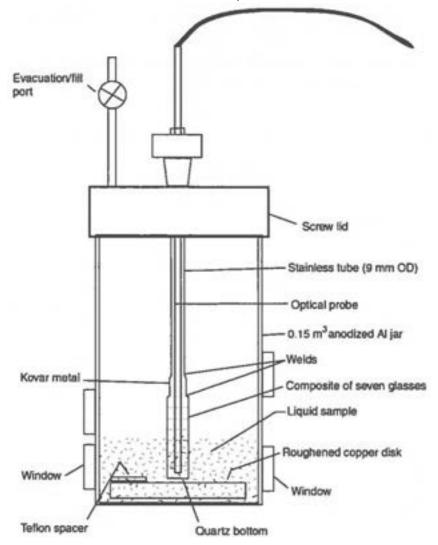
Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to understand how the paper calculates the contamination in the water with their method. This could be a better future alternative to the contamination testing instead of our current methods. This could also gives us another method to find more quantitative results for contamination testing.

Content:

- · isolating the wavelength of light that the contaminant fluoresces, its intensity can be used to identify its mass
- Beer-Lambert-Bougher law
- perpendicular traverse of the flow stream with the measurement probe
- · calibrate the mass fraction of diesel to the fluorescent intensity
- main use of the calibration is to solve for these parameters



$$F = \frac{F_{\rm r} - F_0}{F_{100} - F_0}$$

•

$$F=2.3I_o\varepsilon cl\Phi \rightarrow [\varepsilon cl \leq 0.05]$$

Conclusions/action items:

Overall, they were able to calculate by using equations to correlate the mass of the contaminants with the wavelength that the contaminants emit with the fluorescence. We could use these equations to determine the possible contamination in each well as a future potential way to collect quantitative data based on the concentration of the contamination. However, they were collecting data on water contaminants and used a large volume and concentration while we are focusing on biological contamination which would lead to different results.

[1] M. Kedzierski, "A Fluorescence Based Measurement Technique to Quantify Water Contaminants at Pipe Surfaces During Flow," *Int J Transp Phenom*, vol. 14, no. 4, pp. 283–296, 2017.



2025/10/10- BSAC Meeting Preliminary Presentation

Janice Amornthanomchoke - Oct 10, 2025, 11:44 AM CDT

Title: BSAC Meeting Preliminary Presentation

Date: 10/10/2025

Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to be updated about the new topics in the biomedical program. We are expected to find new ways to improve the biomedical program. Also, we want to talk about the projects we are working on.

Content:

- · Possibly adding 200 lectures
 - maybe asynchronous
 - o possibly Monday and Wednesday
- · Training throughout curriculum form
 - add suggestions to the possible training to improve
 - training should take an average of 90+ minutes
 - · more track-based curriculum
 - · explain how it can contribute
- · talk about updates with mentor and mentee
 - · better topics to discuss
 - · better access to resources for mentees
- · Projects
 - presentation went well
 - encouraging more people to ask questions
 - preliminary report took a long time, especially during the midterm season, and the deadline was on Wednesday instead of usually Thursday
 - · started getting materials or designing a prototype
 - always ask about things you want to be a part of the project
 - Show and Tell
 - presenting the project and finding feedback to improve the project
 - · inconsistent feedback depending on advisor
 - some groups seem unsure about expectations or ways to improve since some advisors do not consistent feedback

Conclusions/action items:

Overall, the projects are going well for everyone. Some things to improve are pushing back some deadlines, better communications about expectations on assignments and talking with new mentees, and training suggestions.

Janice Amornthanomchoke - Oct 24, 2025, 11:45 AM CDT

Title: BSAC Meeting Prototyping

Date: 10/24/2025

Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to be updated about the new topics in the biomedical program. We are expected to find new ways to improve the biomedical program. Also, we want to talk about the projects we are working on.

Content:

- · Some people started prototyping, and others are still waiting for materials
 - o issues with finding the right materials with client, getting confirmation, and figuring out ordering process for materials
 - o order as soon as possible so can troubleshoot process as you ordering
- · using piazza if having question about testing if unsure and need more advice
 - grabbit
 - database of all advisors with different expertise
 - wcnt
 - database of all instrumentation to possible test with
- · using statistics in testing protocol
- talking to upperclassmen about rigor and concepts in classes
 - o ME 350, 432
 - · certain one only during spring
 - · some classes have restrictions for priority ME/EC
 - o emphasizing the different things you can do in each track

Conclusions/action items:

Overall, the projects are going well for everyone. Everyone is either ordering their materials or already prototyping. Some things to improve are trying to ensure that there is better communication to understand how to order materials, such as shipping material to the college and talking to other advisors to find ways to test.

Janice Amornthanomchoke - Nov 07, 2025, 11:53 AM CST

Title: BSAC Meeting Show and Tell

Date: 11/7/2025

Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to be updated about the new topics in the biomedical program. We are expected to find new ways to improve the biomedical program. Also, we want to talk about the projects we are working on.

Content:

- · cannot switch 201 and 200 to different semesters
- · cannot change the deadline for the report since it allows people to get ready to start prototyping
- · Show and tell went well for most people
 - o others got the feedback they needed
 - · some were ideas that they already previously had
 - · some groups did not have enough experience to provide feedback
 - o some groups were confused about the structure so some people presented to 3 groups while other presented to none
- · most people are adjusting their devices, but they are getting ready to test
- physics 208 easier to physics 202
- · biomaterials only offer during the spring

Conclusions/action items:

Overall, the projects are going well for everyone. Everyone is already prototyping and getting ready to test. Some things to improve are trying to ensure that there is better communication to talking to other groups to get more advice on projects.



2025/9/20- Stamp and Slicer Design Ideas

Janice Amornthanomchoke - Sep 25, 2025, 12:39 AM CDT

Title: Stamp and Slicer Design Ideas

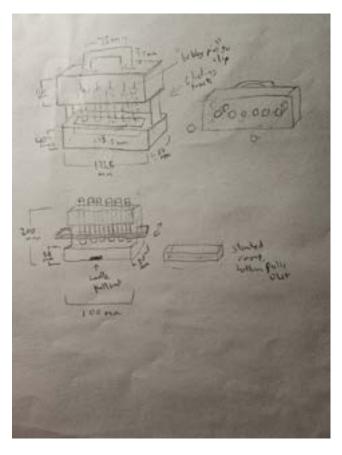
Date: 9/20/2025

Content by: Janice Amornthanomchoke

Present: N/A

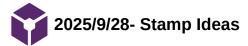
Goals: The goal is to design the stamp and the slicer based on previous research and the client's requirements. These designs will be evaluated to decide which ones we want to use for the design matrix.

Content:



Conclusions/action items:

Overall, the main components of the stamper are including a track to push the cotton buds and a frame to hold the container. The main components of the slicer are moving the blade forward and backward to cut the straw and having a bottom container to dispose the cut pieces. The next step is to present my design to the group and get feedback on whether or not this is a viable idea.



Janice Amornthanomchoke - Sep 28, 2025, 2:38 PM CDT

Title: Stamp Ideas

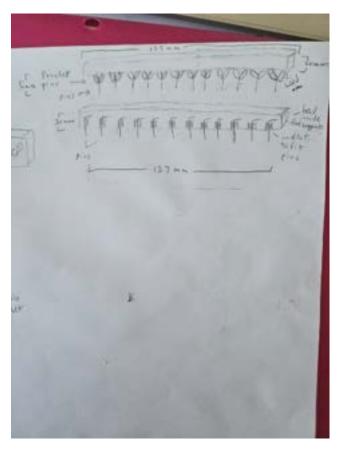
Date: 9/28/2025

Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to design the stamp based on previous research and the client's requirements. The stamp will be implemented with the frame design we picked last week. These designs will be evaluated to decide which ones we want to use for the design matrix.

Content:



Conclusions/action items:

Overall, the main components of the stamper are having frame and having something to hole the pins. The main difference between the design is how the pin will be secure into the a frame to hold all the pins. One design has a clip to pinch the pins while the other has a indent to secure the pins into the frame. The next step is to present my design to the group and get feedback on whether or not this is a viable idea.

Janice Amornthanomchoke - Oct 22, 2025, 12:42 AM CDT

Title: Solidworks Frame Design

Date: 10/19/2025

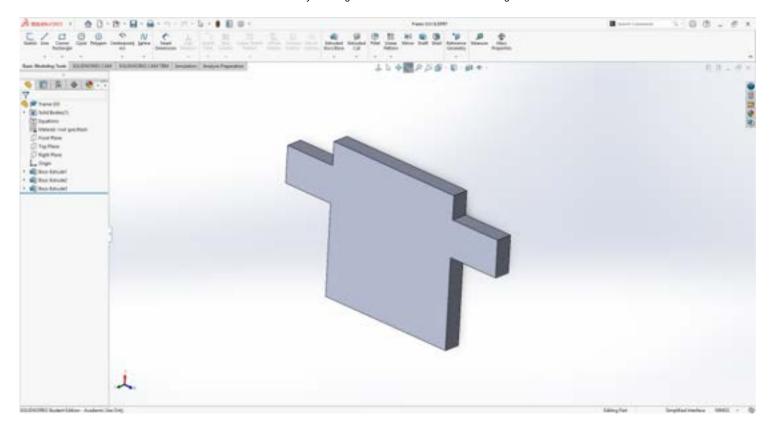
Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal was to create a mockup idea of how the frame would sit on top of the well plate. We are mainly focusing on being able easily move the frame up and down and figuring out how to properly align it to the stamper. I also wanted to work on developing my SolidWorks skills since I have never used it.

Content:

- · Double check dimensions since it looks tall and the handle seems long
- · Unsure if there are easier method with making it symmetrical without adjust each side
- · Confused about how the handles would work or best way to design them and if I would need to design a slide track



Conclusions/action items:

Overall, I learned how to design basic shapes and extrude my design in SolidWorks. I need to double-check the dimensions with my teammates and show them what I have so far. I also need to figure out if there are better tools to recreate similar designs quickly.



2025/10/22- Solidworks Frame Design Updated Handles

Janice Amornthanomchoke - Oct 22, 2025, 12:52 AM CDT

Title: Solidworks Frame Design Updated Handles

Date: 10/22/2025

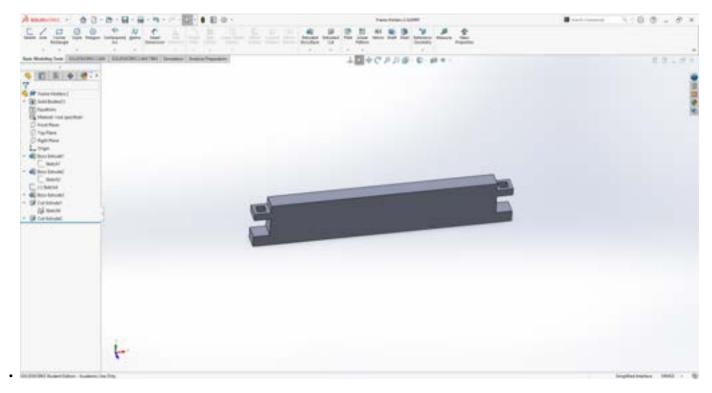
Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal was to create a mockup idea of how the frame would sit on top of the well plate. We are mainly focusing on being able easily move the frame up and down and figuring out how to properly align it to the stamper. I also wanted to work on developing my SolidWorks skills.

Content

- · Able to redesign with updated dimensions
- · Created holes to allow the stamper to go through in order to easily align with the straw better
- added a lip/rim to stop the stamper so it does not go all the way through the straw
- · need to add the holes for the straws
- used centerline and relation in Solidworks which made it easier to defined dimensions



Conclusions/action items:

Overall, I learned how to new features to help me easily design the frame in SolidWorks. I need add holes for the straws in the frame and figure out whether the current dimensions for the side holes are sufficient enough. We need to figure out the design for the stamper and making the design to align with the straws.

Janice Amornthanomchoke - Nov 13, 2025, 1:15 AM CST

Title: Slicer Attachment

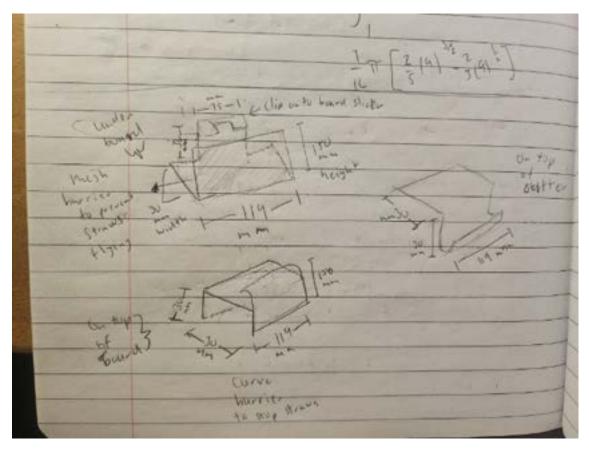
Date: 11/13/2025

Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal is to come up with ideas to attach to the slicer to prevent the straws from flying into the air. I also want to think about the benefits and cons of each design. I will present to the group to get feedback about the ideas.

Content:



Top left

- · difficult to hold mesh vertically
- · might be bulky
- · would prevent the most amount of straw from flying

Bottom left

- smaller and more portable
- difficult to make the curve on top
- could prevent a decent amount of straws from flying

Right

- · difficult to make the curve
- · easier to attach to the cutter board
- · would not be able to catch straws that shoot upwards

Conclusions/action items:

Overall, I thought of three designs that could work to stop the straws from flying. The top and bottom drawings would work the best, but would be the most difficult to produce. The top drawing would be difficult to find materials for with the amount of time we have left. The bottom drawing would be difficult to produce the curve over the cutting board.



Janice Amornthanomchoke - Oct 02, 2025, 12:02 AM CDT

Title: Training Certificates

Date: 10/1/2025

Content by: Janice Amornthanomchoke

Present: Janice Amornthanomchoke

Goals: The goal is to complete certificates that would expand my skill in engineering, research, or other that I would need for my project. The goal would be to learn the safety around certain machining, tool, and research labs. Hopefully, these skills can be transferable for future internships, projects, and other career or academic endeavors.

Content:



This certifies that Janice Amornthanomchoke has completed training for the following course(s):

Expand All

Collapse All

Course	Assignment	Completion 1/19/2025	Expiration No Expiration
Biosafety 105: Biosafety Cabinet Use	Biosafety 105: Biosafety Cabinet Use Quiz		
Biosafety 106: Autoclave Use	Biosafety 106: Autoclave Use: Safety and Efficacy - Verification Quiz	1/19/2025	No Expiration
Biosafety 107: Centrifuge Safety	Biosafety 107: Centrifuge Safety Verification Quiz	1/19/2025	No Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	1/19/2025	1/19/2030
Biosafety Required Training	Biosafety Required Training Quiz 2024-2025	6/28/2025	6/28/2030
Chemical Safety: The OSHA Lab Standard	Final Quiz	6/28/2025	
Chemical Safety: The OSHA Lab Standard	Final Quiz	1/19/2025	
Stem Cell Ethics and Policy Training	Assurance	1/19/2025	1/19/2028

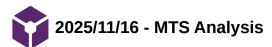
Data Last Imported: 10/01/2025 11:24 PM



My Memberships					
Membership Type	Start Date	Expiry Date	Renew	Card Info	
Machining	Tue, Aug 20 2024	Permanent.	Not Renewable	N/A	
Shop Tools	Tue, Aug 20 2024	Thu, Jan 2 3000	Not Renewable	N/A	
Laser Cutter	Tue, Aug 20 2024	Thu, Jan 2 3000	Not Renewable	N/A	
Lab Orientation	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Renewable	N/A	
Shop Tools - Training Eligible	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Renewable	N/A	
Laser Cutter - Training Eligible	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Renewable	N/A	

Conclusions/action items:

Overall, I have learned about the various machines I can used like 3-D printing, Laser Cutter, Lathe, Mill, and many more. I learned the safety actions and materials in the research labs. In the future, I could learn about the other training in ECB, Wendt, or for the labs in the future.



Janice Amornthanomchoke - Nov 18, 2025, 1:05 PM CST

Title: MTS Analysis

Date: 11/18/2025

Content by: Janice Amornthanomchoke

Present: Janice Amornthanomchoke, Lydia Miller, and Varenya Vegesna

Goals: The goal is to analyze the data collected from the MTS machine. Hopefully, the data will give us a better idea on how much force is needed to push out the content. It will also help us figure out if we need to run more trials or collect different types of force data.

Content:

Initial forces

Test run 1: 0.6493 N Test run 2: 0.7136 N

Test run 3: 0.4774 N

Test run 4: 0.6966 N

Test run 5: 0.4363 N

Average initial force: 0.5946 ± 0.1288 N

```
Code:
```

```
close all;
clear all;

[file, path] = uigetfile({'*'});
fullpath = fullfile(path, file);
data = readtable(fullpath);
disp=data(:,1);
force=data(:,2);
time=data(:,3);
force = table2array(force);
time = table2array(time);

figure;
plot(time,force);
xlabel("time (s)")
ylabel("force (N)")
```

```
mask = time >= 0 & time <= 1;
maxForce = max(force(mask));</pre>
```

Note: this code only finds the max force within the first 1 second of data collection, representing the initial force needed to push the cotton

Max Forces

Test run 1: 2.8296 N

Test run 2: 1.0295 N

Test run 3: 0.7077 N

Test run 4: 0.8492 N

Test run 5: 0.5647 N

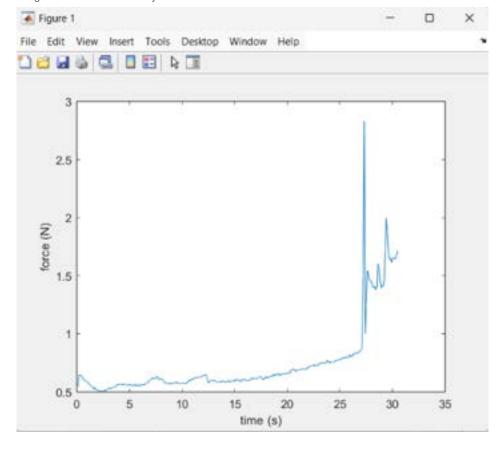
Average max force: 1.1962 ± 0.9292 N

Changes made in code

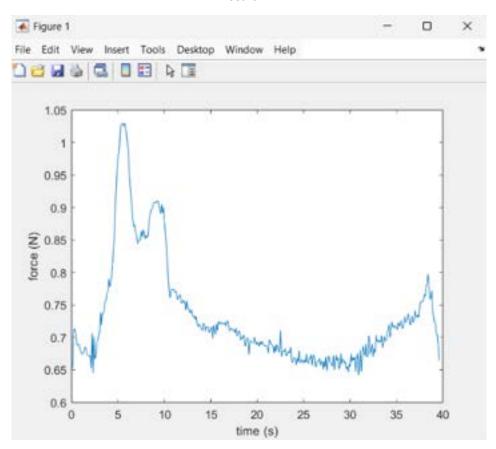
```
mask = time >= 0 & time <= 1;
maxForce = max(force(mask));</pre>
```

Note: this code finds the max force from the entire time the rod pushed the contents of the straw

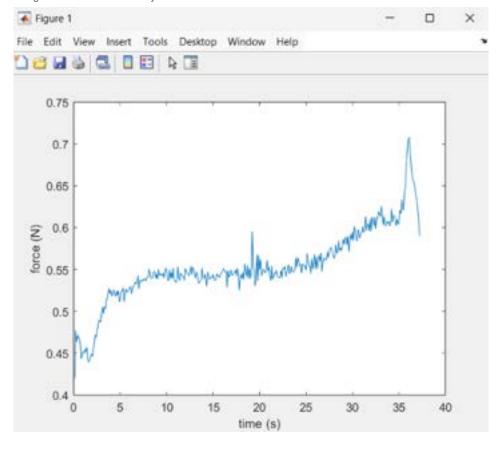
Graphs:



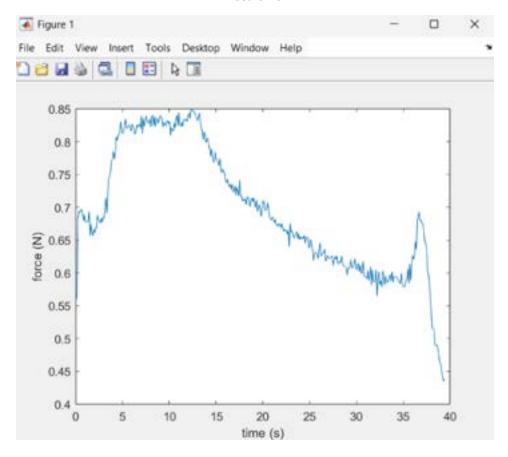
Test run 1



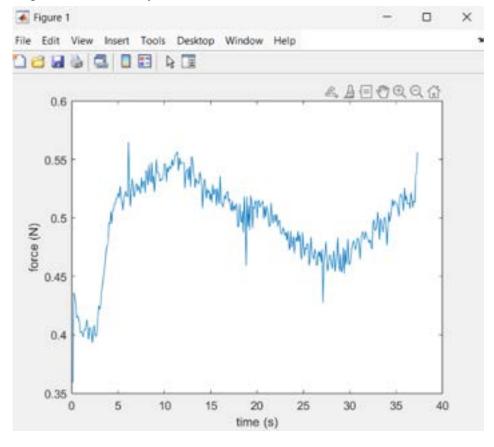
Test run 2



Test run 3



Test run 4



Test run 5

Conclusions/action items:

Overall, we ran five different trials to analyze the initial force and the overall maximum force needed to push the content. The average initial force was 0.5946 N, and the average overall force was 1.1962 N, which indicates that it does not require a lot of force to push out the contents. The next steps would be to report the results to our team and possibly start testing for sanitation and contamination.

Janice Amornthanomchoke - Nov 28, 2025, 6:52 PM CST

Title: Preparation for Contamination testing and Rod bending

Date: 11/22/25

Content by: Janice Amornthanomchoke

Present: Janice Amornthanomchoke, Lydia Miller, Catie King

Goals: The goal is to figure out how to insert the fluorescent dye into the straw in order to simulate the process of pushing out the contents for contamination testing. We also wanted to analyze the max force the rods can withstand before they begin to bend. This would allow use to create a baseline force to compare the force needed to push the semen contents.

Content:

- submerging the straws in the dye did not work
- · Syringe method did work
 - Cut straw and push semen out of straw into a 1 mil microcentrifuge tube
 - Make dye + water (maybe oil) mixture, using a .625 concentration
 - o Mix dye mixture with semen using a 1:1 ratio
 - · Push cotton from the other side to go back up through the straw
 - · Fill syringe with dye mixture and insert back into the tube
 - ensure the needle is long enough as the content will only disperse as long as the needle
 - · repeat process until desire amount of straws is made
- · Rod bending test:
 - Use BME 201 compression test same test we used for force of straw bending
 - Set rate to .02 mm/sec slower to ensure accuracy
 - 5 trials
 - Stop when force plateaus ... and see a visual bend

Code:

```
close all;
clear all;

[file, path] = uigetfile({'*'});

fullpath = fullfile(path, file);

data = readtable(fullpath);

disp=data(:,1);

force=data(:,2);

time=data(:,3);

force = table2array(force);

time = table2array(time);

figure;

plot(time,force);

xlabel("time (s)")
```

ylabel("force (N)")

max_force = max(force)

Max Forces

Test run 1: 6.7424 N

Test run 2: 6.4713 N

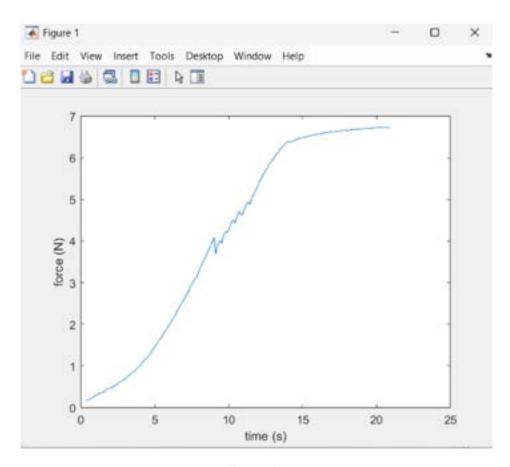
Test run 3: 6.5168 N

Test run 4: 6.4810 N

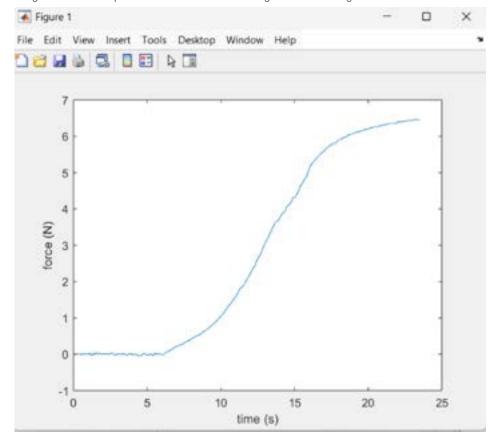
Test run 5: 6.5130 N

Average max force: 6.5449 N

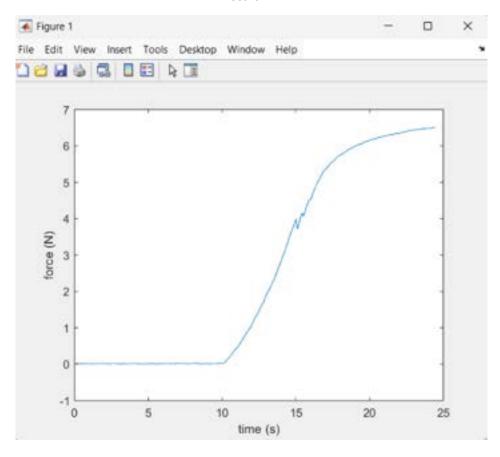
Graphs:



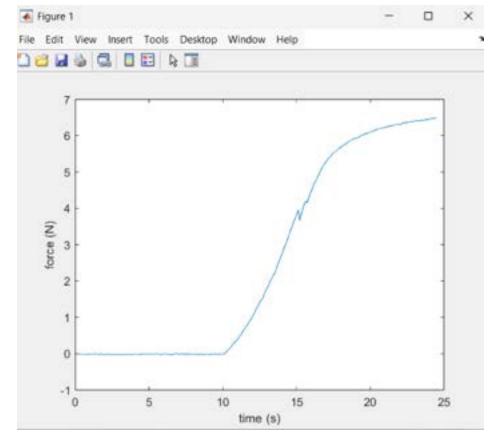
Test run 1



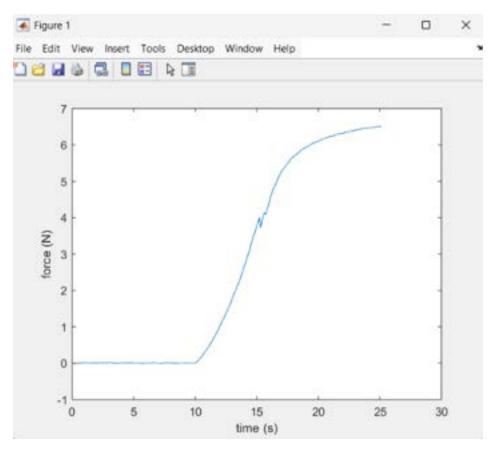
Test run 2



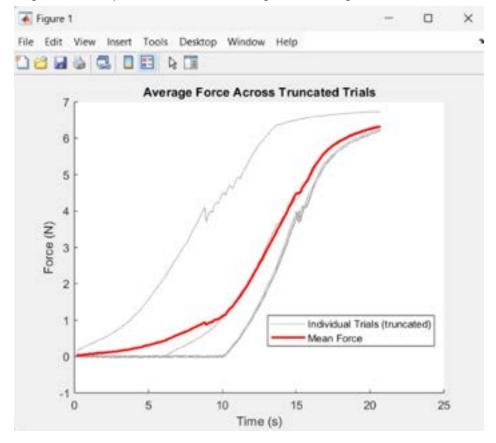
Test run 3



Test run 4



Test run 5



Code to make this graph - used chat

```
close all; clear all;
% Ask user to select multiple trial files
[files, path] = uigetfile({'*'}, 'Select all trial files', 'MultiSelect', 'on');
numTrials = length(files);
all_forces = {};
all_times = {};
% --- Load all force/time vectors ---
min_length = Inf;
for i = 1:numTrials
  fullpath = fullfile(path, files{i});
  data = readtable(fullpath);
  force = table2array(data(:,2));
  time = table2array(data(:,3));
  % store temporarily
  all_forces{i} = force;
  all_times{i} = time;
  % update the minimum length
  min_length = min(min_length, length(force));
```

```
% --- Truncate all trials to the smallest length ---
forces_trunc = zeros(min_length, numTrials);
times_trunc = zeros(min_length, numTrials);
for i = 1:numTrials
  forces_trunc(:,i) = all_forces{i}(1:min_length);
  times_trunc(:,i) = all_times{i}(1:min_length);
end
% --- Use the first trial's truncated time vector as the shared time ---
common_time = times_trunc(:,1);
% --- Compute mean force curve ---
mean_force = mean(forces_trunc, 2);
figure; hold on;
% --- Plot all individual truncated curves and save handle ---
h_trials = plot(common_time, forces_trunc, 'Color', [0.6 0.6 0.6]);
% --- Plot mean force and save handle ---
h_mean = plot(common_time, mean_force, 'r', 'LineWidth', 2);
xlabel("Time (s)")
ylabel("Force (N)")
title("Average Force Across Truncated Trials")
% --- Legend with correct colors ---
legend([h_trials(1), h_mean], ...
      {"Individual Trials (truncated)", "Mean Force"}, ...
      'Location', 'best');
```

Conclusions/action items: Overall, we identified new procedures that would enable us to prepare the straws for contamination testing. We determined that the force (approximately 6.5 N) is greater than the force needed to push the semen out (approximately 2 N). Thus, there will be no bend in the straws, which means the device to hold the straws upward is safe.

Janice Amornthanomchoke - Nov 07, 2025, 12:54 PM CST

Title: Tong Lecture

Date: 11/7/2025

Content by: Janice Amornthanomchoke

Present: N/A

Goals: The goal of the presentation is to learn about Kristin Myers's career journey. The goal is to learn how to build yourself in your career and seizing opportunities in healthcare. She also wants to emphasize how the healthcare industry is broken and what we could do to help improve it.

Content:

- · Chapter 1 foundation
 - Getting experience, show what you can do
- · Chapter 2 climb the growth curve
 - · Combine eq with iq to multiply impact and reach
 - · Working through teams
- · Chapter 3 build and transform
 - Drive system level impact through innovation and scale
 - Hopscotch health
 - Advance primary care for rural communities
 - Blue cross blue shield association
 - Increase access, affordability, outcomes, and experience for ⅓ americans
- Follow hard problems and build skills that allow you to make an impact
- · Quadruple aim
 - Improve provide experience
 - · Improved patients outcomes
 - Lower cost of care
 - Improved patient experience
- 50% would study to be a doctor if they had to go back and do it again
- · US Ranked last on equity, access and outcome
- · Challenges
 - Misaligned incentive
 - Fragmented financing and regulation
 - · Data silos and legacy IT
 - Inequalities, 10-15 gap between zip codes
- · Work hard and build range
 - Take on hardest projects, classes, and experiences

- · Effort and range are your foundation
- Find job for experience and showing you can work in professional setting
- · Seek diverse exposure
 - · Explore different sectors, teams, and geographies
 - o Gain perspective and learn how systems connect, not only how parts works
 - · Keep the things you like and continue search for other experiences
- · Choose your people wisely
 - Surround yourself with curious, driven, high integrity people
- · Know your values and protect them
 - Define what matters most
 - Family friends, health, career impact
 - Make decisions that align with those
- · Embrace challenge and keep growing
- · Improving health
 - Improving primary care and specialist care
 - · Giving people transparency data

Conclusions/action items:

Overall, she emphasizes on gaining as much experience as possible, using those experiences to show off your skills and decisions to take on projects, and utilizing what you learn to take on projects that would make an impact. She also emphasizes how the healthcare industry is facing issues with accessibility, affordability, and patient care. She goes on to talk about how she tries to improve accessibility and possible strategies to be more transparent to patients to improve healthcare.



2025/09/10 - Genomics and Breeding Decisions

CAITLIN KING - Oct 02, 2025, 8:10 PM CDT

Title: An overview of recent technological developments in bovine genomics

Date: 9/9/2025

Content by: Catie

Present: Catie

Goals: Before starting the project, it is important to understand the motivation behind cattle breeding and genomics research. Also, I want to learn more about current technologies in bovine genomics and understand the process of how this research is conducted.

Content:

- · There will be a massive increase in global demand for animal derived food products
 - · Genetically improved livestock may help to decrease the environmental harm likely to be caused
- · Genomic selection and artificial insemination processes have improved the selective breeding process of livestock
- · Genomic selection has simplified and lowered the selection process, especially compared to progeny testing
 - Allows more bulls to be selected and increases diversity and lowers inbreeding trends
- Genetic gain has improved significantly with the new genomic technology and allows better selection and use of cattle with superior genetics

Conclusions/action items: The new research on cattle genomics and genomic selection have greatly improved cattle genetics. With an increasing demand for cattle products, it is important to find ways to produce these in an environmentally conscious way, and genomic selection is the current technology being used. Overall, this helps me understand the motivation for Genetic Visions for their QC procedure, which drives my motivation for the project as well. Next, I want to research more about the actual procedure and a slicer lever mechanism.

Citation:

[1] Navid Ghavi Hossein-Zadeh, "An overview of recent technological developments in bovine genomics," *Veterinary and Animal Science*, vol. 25, pp. 100382–100382, Sep. 2024, doi: https://doi.org/10.1016/j.vas.2024.100382.



2025/09/09 - Bull Semen for Artificial Insemination

CAITLIN KING - Sep 10, 2025, 9:42 PM CDT

Title: Review: Semen handling, time of insemination and insemination technique in cattle

Date: 9/9/2025

Content by: Catie

Present: Catie

Goals: Learn about the different ways that bull semen is stored and the thawing methods used for artificial insemination to get a better idea of the texture of the bull semen and the mechanics necessary to push it out of a straw.

Content:

- Bull semen usually stored in 0.25 or 0.50 mL straws in -196°C in liquid nitrogen
- Important to thaw frozen semen quickly to reduce chances of damage to the sperm by reducing time for ice crystals to form
- Critical temperature zone for ice crystals to form is between -50 and 0 degrees celsius
 - Semen switches from glassy to a liquid state
- · Artificial insemination straws are placed in 35 degree celsius water bath while waiting to be used
- Straws retained at a constant temp of 36 degrees celsius
- · Each place will thaw differently according to the labels on the straws, but the general concept of thawing is the same

Conclusions/action items: The thawing process of these semen straws is extremely important in the quality of the sperm and efficacy of insemination, and I assume Genetic Visions, our client, puts the straws through a similar thawing process to replicate the conditions the sperm will be under. Since the semen will be in a liquid (and ideally not watery form), there will not need to be too much pressure from the plunger system to push it out of the straw. In the meeting with the client watching the procedure, I hope to gain a better understanding of the protocol so I can better understand the design constraints needed for this.

Citation:

[1] M. G. Diskin, "Review: Semen handling, time of insemination and insemination technique in cattle," *animal*, vol. 12, no. s1, pp. s75–s84, May 2018, doi: https://doi.org/10.1017/s1751731118000952.



2025/10/06 - Low-Pass Sequencing for Cattle

CAITLIN KING - Oct 06, 2025, 11:51 PM CDT

Title: Assessment of Imputation from Low-Pass Sequencing to Predict Merit of Beef Steers

Date: 10/6/2025

Content by: Catie

Present: Catie

Goals: GVI uses low-pass sequencing and imputation to identify if sperm is from the bull listed, so the goal is to learn more about this process and purpose.

Content:

- · Genomic selection and breeding value usually done with SNP arrays
- · Low-pass sequencing with imputation to "fill in" genotype calls is a much cheaper alternative to SNP methods
- · Low pass sequencing sequencing genome at a low depth so not every base in the genome is read many times (covered by 0 or 1 read)
- · Imputation uses a reference panel (set of individuals sequenced deeply) to infer likely genotypes
- low-pass sequencing with imputation is a viable alternative to SNP arrays for genotyping
 - imputation accuracy depends on reference panel's representation

Conclusions/action items: Genetic Visions-ST utilizes low-pass sequencing and imputation to ensure that the sperm provided is from the same bull that is listed on the straw. This is a cost-effective way of sequencing data using a reference panel to infer likely genotypes. The verified genotype is provided by the companies getting the sperm tested and sending it to GVI, and then GVI is doing the low-pass sequencing by extracting DNA from straw and seeing if it matches bull semen.

Citation:

[1] W. M. Snelling *et al.*, "Assessment of Imputation from Low-Pass Sequencing to Predict Merit of Beef Steers," *Genes*, vol. 11, no. 11, pp. 1312–1312, Nov. 2020, doi: https://doi.org/10.3390/genes11111312.



2025/10/06 - Sample Contamination in Genotype Calling

CAITLIN KING - Oct 07, 2025, 12:01 AM CDT

Title: Correcting for Sample Contamination in Genotype Calling of DNA Sequence Data

Date: 10/6/2025

Content by: Catie

Present: Catie

Goals: Learn about the practical errors of cross-contamination and why it is bad, how it affects the sperm and sequencing, and ways to prevent it.

Content:

- DNA sample contamination is a common problem in DNA sequencing
- DNA sample contamination can happen during sample collection, any time a sample is put in or taken out of storage, during shipping, and during other steps of preparing for DNA sequencing
- Contamination can result in systematic genotype misclassification
- · Impact of contamination increases with contamination level and decreases with sequencing depth
- If contamination is < 5% then there is considerable improvement in genotype accuracy methods

Conclusions/action items: Contamination in DNA sequencing poses a massive issue for genotyping and accuracy of this process. This can occur during nearly all the steps of sequencing, and even including storage. In our specific project, this can happen during the cutting process, stamping process, and anytime throughout if semen gets onto the hands too. It is extremely important to limit contamination.

Citation:

[1] M. Flickinger, G. Jun, Gonçalo R. Abecasis, M. Boehnke, and H. Kang, "Correcting for Sample Contamination in Genotype Calling of DNA Sequence Data," *American Journal of Human Genetics*, vol. 97, no. 2, pp. 284–290, Aug. 2015, doi: https://doi.org/10.1016/j.ajhg.2015.07.002.

CAITLIN KING - Sep 15, 2025, 5:05 PM CDT

Title: ASTM G31-72(2004) - Standard Practice for Laboratory Immersion Corrosion Testing of Metals and ASTM F1089018 - Standard Test Method for Corrosion of Surgical Instruments

Date: 9/15/2025

Content by: Catie

Present: Catie

Goals: Learn about standards for corrosion testing of metals. The straw stamp and slicer blade that will push the semen out of the artificial insemination straws will likely be metal that is resistant to corrosion, so we must follow corrosion testing protocol if we test our materials.

Content:

ASTM G31-72

- · Corrosion testing procedures are all different, but must follow a general use guideline
- Specific metals can have something called "pitting corrosion" which cannot be measured using weight loss like the other types of corrosion

ASTM F1089-18

- · Specific to stainless steel materials and corrosion is tested using the boil test and copper sulfate test
- · Preparation of specimen
 - Wash instrument with mild soap in (25-50 degrees celsius water)
 - Rinse in distilled water or isopropyl alcohol and then dry (use gloves)
- · Boil test
 - · Immerse in water and bring to a boil --> boil for 30 mins
 - Remove from heat source and let device stand for about 3 hours
 - Let air dry for 2 hours
 - Surfaces should show no signs of corrosion (rust is acceptable)
- · Copper Sulfate test
 - o 250 mL distilled water, 1mL of sulfuric acid, 4g of copper sulfate solution
 - · Apply solution to instrument and keep surface wet for > 6 mins then rinse
 - Surfaces should show no signs of copper plating (copper plating on teeth, locks, etc are okay)

Conclusions/action items: ASTM G31 will not be incredibly useful as we do not have the apparatus it requires to do corrosion testing. However, ASTM F1089-18 guidelines can be used to test the metal we end up using for our slicer and semen straw stamp. This testing will help us identify the device's corrosive properties, as the device we create should not be corrosive from water, especially from bleach and/or ethanol.

Citation:

[1] Standard Practice for Laboratory Immersion Corrosion Testing of Metals. American Society for Testing and Materials International, 2004. Available: https://compass.astm.org/content-access?contentCode=ASTM%7CG0031-72R04%7Cen-US
[1] Standard Test Method for Corrosion of Surgical Instruments. American Society for Testing and Materials International, 2018. Available: https://compass.astm.org/content-access?contentCode=ASTM%7CF1089-18%7Cen-US

CAITLIN KING - Sep 15, 2025, 4:01 PM CDT

Title: ISO 10993-1: Biological Evaluation of Medical Devices

Date: 9/15/2025

Content by: Catie

Present: Catie

Goals: Understand an ISO standard that we must follow when making the device to make sure it is biocompatible with bull semen and not influencing or contaminating the bull semen.

Content:

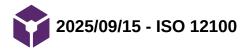
- biocompatibility is "the ability of a medical device or material to perform with an appropriate host response in a specific application"
- Chemicals or materials that are known to have negative effect or harmful biological responses must have an intensive risk assessment and management
- · There must be a complete chemical characterization, toxicological assessment, and biocompatibility testing

Conclusions/action items: Overall, ISO 10993 just makes sure that any material that touches a biological component must not have adverse effects on the body or component. This applies to our project because the metal being used to cut the straws or to push the semen must not cause any harm in the DNA of the semen as this could throw off the sequencing.

Citation:

[1] Biological Evaluation of Medical Devices. International Organization for Standardization. Available:

https://www.iso.org/standard/68936.html



CAITLIN KING - Sep 15, 2025, 4:19 PM CDT

Title: ISO 12100 - Safety of machinery - general principles for design - risk assessment and risk reduction

Date: 9/15/2025

Content by: Catie

Present: Catie

Goals: To know the design considerations and other safety precautions for machinery and things we must consider in our straw slicer.

Content:

- There are three types of standards: type-A, type-B, type-C.
 - Type A is the international standard and it has basic safety standards such as principles for design and other basic concepts
- · Strategy for risk assessment and risk reduction
 - Determine limits of machinery, identify hazards, estimate risk for each hazard, evaluate risk and make decisions about need for risk reduction, eliminate hazard or reduce risk associated with it
- Some protective measures include:
 - o inherently safe design measures
 - o safeguarding and complementary protective measures
 - o information for use

Conclusions/action items: Before creating this semen straw slicer, we must propose design ideas and safety should be the number one priority. There are many ways to mitigate risk, such as implementing safety features in our device and understanding all the risks that come with it and making sure to teach the users exactly how to use it in the best way to reduce the hazards.

Citation:

[1] Safety of machinery - General principles for design - Risk assessment and risk reduction. International Organization for Standardization, 2010. Available: https://www.iso.org/standard/51528.html

CAITLIN KING - Oct 24, 2025, 11:42 AM CDT

Title: TECAN Infinite M1000 User Manual and Software

Date: 10/23/2025
Content by: Catie

Present: Catie

Goals: To figure out how to use the tecan infinite M1000 Plate reader in the ECB 1002 lab for future sanitation and cross contamination tests

Content:

User Manual

- · Fluorescent molecules emit light at specific wavelength when struck by a light
 - · Fluorescent molecule absorbs light with the excitation wavelength and then emits a light at a longer wavelength
 - This can be measured through electrical signal and intensity of each signal as it is directly proportional to the fluorophore concentration
 - Temperature, pH, etc can influence these measurement results
- Absorbance can measure how much light transmits through a sample
 - Measure of optical density (A = log(I0/Isample)
- Software
 - Magellan is great as it has data processing capabilities and after a method is performed, the processed data is immediately output into a file
 - · Safe and easy interface that can be specific to each different Assay
- · How to Use Machine
 - Turn machine on
 - 'Retract/Eject' button allows plates to be inserted or removed
 - Set up temperature time and allow time to reach temp
 - There are shaking modes that can be used (usually for longer reading if contents need to stay mixed)
 - · i-control software goes straight to MS excel

Conclusions/action items: Overall, a plate reader seems like a good option to measure concentration using a fluorophore and reading absorbance and intensity. There is a user manual that can be found on the BME lab website that outlines specifics of how to set parameters and use the machine. It seems like this would be a good call for a sanitation protocol so we can compare with no exposure to fluorophore/semen-like mixture, one where it was exposed and not sanitized, and one with sanitation.

Citation:

[1] "Instructions for Use for infinite M1000." Accessed: Oct. 24, 2025. [Online]. Available: https://sharedlab.bme.wisc.edu/labs/1002A/equipment/Tecan/InfiniteM1000_Manual.pdf

CAITLIN KING - Oct 29, 2025, 11:47 PM CDT

Title: The use of ultrasound for cleaning the surface of stainless steel and nickel-titanium endodontic instruments.

Date: 10/29/2025

Content by: Catie

Present: Catie

Goals: To learn more about the efficacy of ultrasonic cleaners, specifically for stainless steel since the components that will likely make the most contact with the semen are made of stainless steel.

Content:

- · Electron microscopy was used to evaluate different nickel-titatnium and stainless steel instruments
- · All metals right out of the package showed metallic residues before cleaning
- After cleaning, the groups with ultrasound and Hig-Med had cleaner surfaces than the groups with ultrasound and water (not statistically significant)
- Logic: Detergent Hig-Med is soluble in water, so it provides emulsification and dispersion of solid particles --> better cleaning
 - · results did not show this.
- Ultrasonic cleaning recommended because alcohol with gauze has possibility of not cleaning all portions of the device as well as risk of contamination by the operators

Conclusions/action items: Ultrasonic cleaning is a viable option to sterilize the stainless steel and other materials such as the materials used for the compartments frame. This makes material choice a bit easier as constant exposure to alcohol is not viable for some good material options.

Citation:

[1] M. Tanomaru Filho, M. R. Leonardo, K. C. Bonifácio, F. R. Dametto, and L. A. B. Silva, "The use of ultrasound for cleaning the surface of stainless steel and nickel-titanium endodontic instruments," *International Endodontic Journal*, vol. 34, no. 8, pp. 581–585, Dec. 2001, doi: https://doi.org/10.1046/j.1365-2591.2001.00430.x.

CAITLIN KING - Sep 24, 2025, 3:25 PM CDT

Title: Individual design ideas for the straw slicer, stamp, and frame

Date: 9/21/2025

Content by: Catie

Present: Catie

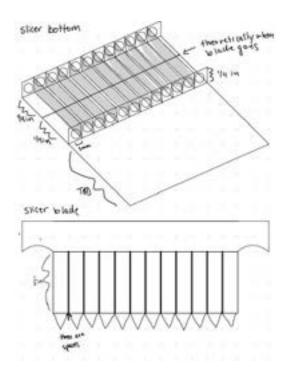
Goals: To come up with one design idea for the slicer, stamp, and frame that work as a cohesive unit and be able to explain to the group how it works for when we do the design matrix.

Content:

PDF seen below

Conclusions/action items: Generally we planned on making a few tweaks to the design and to split up into pairs so each pair worked on diving deeper into one design. We decided to go with a clamp that held the straws that could be set into place on notches on the frame.

CAITLIN KING - Sep 24, 2025, 3:26 PM CDT



Download

Design_idea.pdf (741 kB)

CAITLIN KING - Oct 01, 2025, 10:34 PM CDT

Title: Individual Stamper Idea

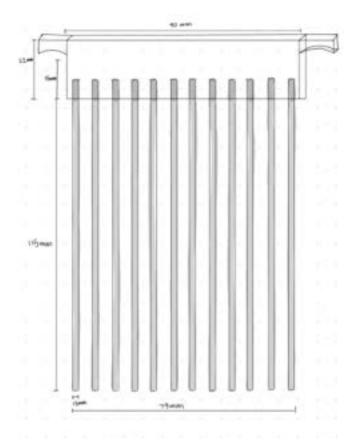
Date: 10/1/2025

Content by: Catie

Present: Catie

Goals: To sketch another polished stamper idea with dimensions so during the group meeting we can share ideas and create a design matrix for the stamper device.

Content:



This stamper has two horizontal handles on the side for gripping with two fingers from each hand to push down. It is a manual stamper that can push 12 straws at a time. The upper box component will have 12 holes that are nearly 1.5mm diameter made with a grippier material where the twelve steel rods can be pushed in and held in place. This allows for the rods to be removable and replaceable if they ever get worn down.

Conclusions/action items: This design was shared with the group, and the part where the rods are removable and replaceable was an idea that lots of team members had in their design so it was incorporated. A design matrix was made and a final design was decided upon as a team. We are thinking about materials and methods of fabrication.



2025/10/29 - SolidWorks Stamper Design

CAITLIN KING - Oct 29, 2025, 11:43 PM CDT

Title: SolidWorks Stamper Design

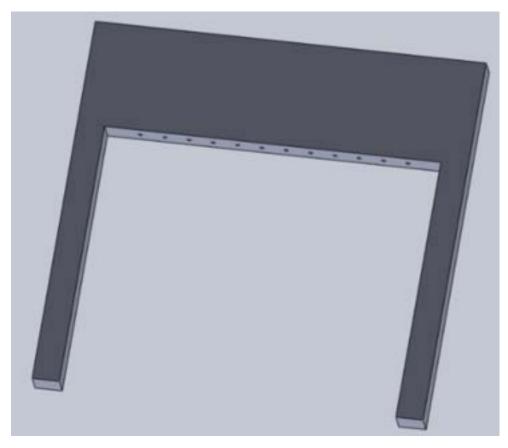
Date: 10/29/25 written, made a week before this

Content by: Catie

Present: Catie

Goals: To make a stamper design that can slide into the compartments frame on the side for better alignment of prongs with the straws.

Content:



Conclusions/action items: Action items are to match up dimensions with the well plate frame as well as the compartments frame to make sure it is all one cohesive device.



2025/10/30 - Human Subjects Research Training

CAITLIN KING - Dec 08, 2025, 10:39 AM CST

Title: Human Subjects Research Training

Date: 10/30/2025 **Content by:** Catie

Present: Catie

Goals: To successfully complete the human subjects research training and obtain the certificate

Content:



Conclusions/action items: Successfully completed.

2025/09/10 - Lecture 1 - BME Career Prep

CAITLIN KING - Sep 10, 2025, 2:02 PM CDT

Title: Lecture 1 Notes - BME Career Prep

Date: 9/10/2025

Content by: Catie

Present: Catie

Goals: Learn how to prepare for the career fair and how to effectively job search.

Content:

Job search tips

- ECS.wisc.edu has a job tracker spreadsheet
- Actual company --> Handshake --> LinkedIn are best places to apply to jobs
- · Make a connection with someone at the company before you are a candidate (foot in the door)
- Apply early!!! Send follow-ups after 2-3 weeks

Resume tips

- · Your resume is always under construction Tailor your resume to the position
 - Only put objective for career fair, not for a specific 1-to-1 job
- Jobs Organization + Location, Position title + Dates
- · Technical skills and coursework is important to add
- Add design projects without years/semesters to list in regard to importance (looks for dates in regard to job)
- · Put technical skills on the resume, but soft skills in your descriptive words and job description

Cover letter

- · Custom to each job and based on job posting
- · Amplify greatest selling points and add clear and concise support
- Demonstrate employer knowledge
- · Address to a person
- Outline (Intro of who you are, applying for, where you found it, and thesis statement, paragraph about A, paragraph about B, why this employer/role)

Career fair advice

- · Identify purpose (more than just an internship)
- · Research the employer
- Develop your "valued added" statement why you?
 - o why do you as a BME (speciality) makes you a better candidate than one of the other 4 engineering pillars

Madison BME acceptors (ge, epic, plexus, abbvie, exact)

Conclusions/action items: Applying to jobs early is extremely important, but your pitch/resume/cover letter matter a lot too. A resume is constantly changing and being altered as you gain more experience and for different positions, so you must update it and tweak it to fit the specific job. Also, do not limit yourself to just places that say they want BME, try to expand your options and still be able to sell yourself as the ideal candidate. When describing BME projects, make sure to state your specific role in it and how you contributed to it rather than making it generic because you want to stand out, even from people that may have been in the same groups as you.

CAITLIN KING - Sep 17, 2025, 2:07 PM CDT

Title: Leadership

Date: 9/17/2025

Content by: Catie

Present: Catie

Goals: To learn how to be an effective leader and how to be a guiding mentor.

Content:

Anatomy of a good leader

- · Self-awareness understanding your strengths and weaknesses
- Vision
- Transparent
- Communication
- · Decision-making
- · Empathy able to understand and connect

Leadership at a variety of levels

- Organizational (CEO, director, etc)
- · Team (facilitate team interaction and empowering others)
- Interpersonal (building on empathy, active listening, building trust, meeting needs)
- Personal (self-awareness and management, competency, goals)

LOOK AT CLIFTON STRENGTHS TEST (already paid for by the college)

- · Executing (process) glue that holds team together
- · Influencing (impact) set bar high and push for excellence
- · Relationship building (people) set pace for team, create systems to be efficient
- Strategic thinking(thought) big picture and future

Styles of leadership

- Power model (leadership = power)
 - someone must take control --> only certain people are born to lead and being in control is the most important thing -->
 hierarchy, authority, command
- Servant (leadership = mutual service)
 - it is about the needs of the followers --> being of service to others, sharing power, listening/understanding --> empathetic, empowering, shared decision-making
- Authentic (leadership = authenticity)
 - Being genuine self is what gains trust --> building self esteem and self-awareness, emotional intelligence, creating authentic relationshios --> transparency, genuineness, honest

Connect

- · Self assess what are your strengths, what drives you?
- · Observe and reflect what are tasks that make you feel accomplished
- Seek out feedback get outside opinion to help you identify blind spots

Goal Setting

- 1. Become more comfortable and the leadership role and gain confidence as a mentor
 - Be more assertive in situations and be the first one to text, or make that document, or start the work

· I think I am a very capable and confident person, but its important to also feel that way in the workspace

2. Procrastinate LESS (personal goal)

- · Try to block out more time in the day to finish assignments or work on stuff
- Try to multitask less and try to go one assignment at a time rather than bouncing from one to the next the second something gets hard because for myself, it has shown to be a less efficient way of going about things and getting things done
- Success would be being able to get to sleep every night by 12 and not have to work on any type of work past 10pm

Conclusions/action items: There are many different leadership styles and ways to be a better leader. For myself, I really want to be a more confident and grounding leader and be that person who my team members can ask questions to and feel confident coming to with ideas. I also want to be able to procrastinate less and lean into the process oriented leader as those tend to be the ones to get stuff done.

CAITLIN KING - Sep 24, 2025, 2:09 PM CDT

Title: Near Peer Mentoring

Date: 09/24/2025

Content by: Catie

Present: Catie

Goals: To learn about some strategies for peer mentoring the BME 200 students and to become a better mentor figure.

Content:

Why are you mentoring BME 200 students?

- So we can relate and help guide them. It is good for the BME 200 students because they can get a taste of the design process with people to turn to and get guided by, and it is also good practice for the BME 300 students to teach and help students.
- · Peer mentors are more approachable and seem less intimidating when it comes to asking questions
- Share experiences we may have had with courses, co-ops, internships, research, etc

Transferrable Skills

· Leadership, communication, active listening, study practices, self awareness, interpersonal skills

General Benefits of Mentoring

· Increased confidence, increased patience, helping identify gaps in our own personal knowledge

What does it mean to be a good mentor?

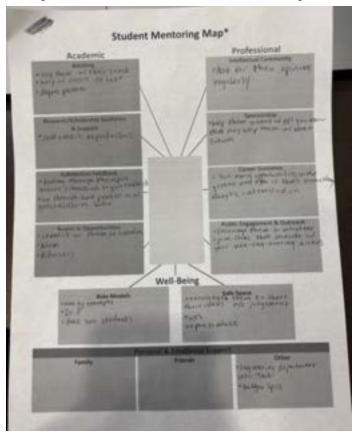
- · Inclusivity, kindness, and genuine interest in the group members as people
- · Organized and communicative
- · building trust, psychological safety, reliability, support/enthusiasm, being available, transparent, humanizing their challenges

Listening effectively

· Get rid of distractions, stop talking, act like you're interested, ask questions, check for understanding, react to ideas and not the person

What do you wish you knew in BME 200?

- It was okay to not know how to do things, because you'll be taught later
- · Ask for more help from the advisor, because they're great resources for more in depth questions
- Knowing what resources you could use (TEAMLab was actually a great resource and they can help you build your ideas)



Conclusions/action items: BME 300/200 mentorship is just as much for the juniors as it is for the sophomores. Yes, as a 300, we provide a lot of advice, mentorship, and help with the design process and class schedules, and even other classes. It is also just as important for the 300 students though because we learn how to be leaders and provide solid advice. We also may learn where our knowledge gaps are.

CAITLIN KING - Oct 01, 2025, 1:59 PM CDT

Title: Lecture 4 - Sustainability in BME

Date: 10/1/2025

Content by: Catie

Present: Catie

Goals: To learn more about sustainability in BME and get a better grasp on it to help with my future mindset in engineering and this specific BME project.

Content:

What is sustainability?

- · Resources and using only as much as you need
- Encompasses social, environmental, and economic decisions and ideas
- · Circular economy how do we keep our resources in the economy?
 - · when is it worth it? when is it not worth it?

Example of life cycle assessment: coffee pot vs keurig coffee pods

- · Most environmental impact comes from agricultural side and electricity side
- · Both have a very similar environmental impact (electricity of pot and grounds/fl oz of coffee is similar to waste of plastic)

Speculums - stainless steel vs acrylic

- · Stainless steel must be washed and autoclaved in order to be re-used
- · Look at breakeven points (at what point does one option make more sense?)
- · Clinic that does fewer exams may go with plastic, while clinic that does lots of exams may go with stainless steel

Team discussion

- Definitely reiterates the idea of making our stamper and slicer reusable since they are performing this procedure upwards of 40 times a
 month
- · Think of grip material and see what requires fewer materials
- · Consider how much energy it will take us to fabricate it and how much of an impact that will actually have on cutting down their labor

Conclusions/action items: Sustainability is one of those things that nearly everyone knows an extremely generalized version of that they think they understand it without knowing all of the different aspects of it. For example, it is not talked about that much in BME curriculum, but it is important to know the applications of sustainability in all types of engineering. One of the main things to keep in mind is all of the different ways that something can have environmental impact (ex. for coffee pods vs coffee pot, they are similar because although theres a ton of plastic in the single use pods, it requires less electricity and requires less coffee ground per fluid ounce of coffee, and the agriculture and electricity is where most of the environmental impact comes from). When thinking about reusable vs single-use devices, one must consider their personal use for it and see where the breakeven point is and then to go from there in the decision.



2025/10/08 - Lecture 5 - WARF, IP, Disclosing and Licensing

CAITLIN KING - Oct 08, 2025, 2:01 PM CDT

Title: Lecture 5 - Introduction to WARF, IP, Disclosing and Licensing

Date: 10/8/2025

Content by: Catie

Present: Catie

Goals: Learn all about intellectual property and resources on campus to go to for help with this and specific inventions.

Content:

WARF

- · Non-profit organization that tries to support UW-Madison research and get it out into the world
- · Helps secure UP rights and commercial licenses (Technology trasfer)
 - · Intellectual property licenses, industry sponsored research, consulting arrangements, fee for service

Intellectual Property Overview

- Four common types of IP: Patents, copyrights, trademarks, trade secrets
- · Other: biomaterials, technique and know how, data

Non-patent IP

- · Copyrights for creative expressions, software close can be included
- · Trademarks protection for names, marks, logos, etc and requires use in commerce
- Trade Secrets can be used to protect anything of value, protection good as long as concept is not known

Patents

- Patent is property right granted by governmental agency (ex. USPTO)
- · Three types
 - Design (15-year term, limited to ornamental features)
 - Plant (new variety, 20-year term, non-tuber)
 - Utility (provisional is a 1-year placeholder, non-provisional is a 20 year term and can claim priority to a provisional)
 - Non-provisional
 - for invention of new and useful process, machine, manufacture, or composition of matter
 - Takes 2-5 years to issue after filing
 - costs about \$30k for attorneys
 - ~90% of patents issued by USPTO are non-provisional utility patents (WARF covers this expense)
- · Requirements for patents
 - 101 eligible; cannot be a product of nature, abstract idea, or natural phenomenon
 - 102 novel: it must be mew
 - 103 nonobvious; cannot be simple modification or combination of existing concepts
 - 112 enabled and described; must provide enough detail to teach others how to make or use invention

Disclosing an Innovation to WARF

- Disclosing
 - describe innovation, identify advantages and potential applications, name contributors, provide funding and public disclosure details
- · Meeting with WARF
 - · discuss innovation in more detail, ask questions about WARF and patenting processes
 - discuss next steps

Marketing and Licensing

- Market Analysis
 - o market status established, emerging, new
 - Size and type large and growing, medium and contracting
- · License Negotiation
 - Type and terms exclusive and field limited, sublicensing, etc.
 - · Consideration upfront payment, royalties, reimbursement

AI and IP

- Patents
 - Can AI invent? (no)
 - inventor is a natural person and conception
 - o limited to US? (no)
 - south africa is the exception
 - o can AI assist in inventing?
 - evolving, but likely yes under pannu factors
- · Copyright
 - o original works of human authorship
 - Al must be incidental to conception and creation
 - o original conception by human mastermind are prompts sufficient? (no)
 - traditional elements of authorship generated by AI? (no)

Conclusions/action items: Protecting intellectual property is an extremely useful tool to know about and utilize, especially during these design projects that we are doing since we are inventing a new product. There are a few requirements to getting a patent: the invention must be novel and not obvious, and it requires a decent amount of money to get attorneys to work with us on patents. There is a long process to getting a patent, but WARF is a great resource on campus to connect with when trying to navigate the patent situations and to schedule a meeting and explain the invention and the steps from there.

2025/10/15 - Lecture 6 - Bioengineer It. Protect It.

CAITLIN KING - Oct 15, 2025, 2:08 PM CDT

Title: Lecture 5 - Bioengineer It. Protect It.

Date: 10/15/2025
Content by: Catie

Present: Catie

Goals: Hear more about Andrea Arndt's journey and to learn more about other careers that might be interesting

Content:

Importance of Intellectual Property for BMEs

- IP protection lets allows research to safely transfer into products, processes, and/or systems
- · IP enables investment, partnerships, and ethical competition

Legal Career Paths for Engineers in IP

· Technical advisor, patent agent, patent engineer, patent attorney, patent litigator, IP license attorney, tech transfer manage, engineer

Skills from Engineering to IP

- · Research determine if invention is truly new
- · Analytical reasoning claim drafting/infringement analysis
- · Technical writing translate complex technical concepts into clear, precise language
- · Communication explaining tech to non-experts and patent examiners
- · Creativity problem solving in patents / creating competitive products
- · Collaboration cooperate with colleagues and external professionals
- · Project Management manage resources, meet deadlines, and organize tasks

IP Ownership in the Biomedical Industry

- University: disclose before publishing, university usually owns IP
- Company: employer typically owns inventions, trademarks, copyrights and other IP
- Startup: you own IP, file early, use NDAs

Timing and Publication

- · Disclose internally
- Publish before filing and offers for sale --> lost patent rights abroad and possible loss of rights in the US
- · Posters or abstracts can count as public disclosures
- · First to file system (not first to invent

Legal and Ethical Duties of Engineers

- · Respect others' IP
- · Keep invention notebooks
- · Understand inventorship vs. authorship
- · Maintain confidentiality agreements

Common Types of Intellectual Property

- Patent
- Trademark
- · Copyright
- Trade Secrets

Patents

- Critical in BME where innovation drives competitive advantage
- · Two types:
 - Utility how product works or is made
 - Design unique visual appearance of a product

Trademark, Copyright, Trade Secret Protection

Conclusions/action items: There were many things I learned from this talk. One was all the different steps it takes to get a patent and protect intellectual property and the requirements of an invention to get a patent. I also learned that it is important to protect your research and if its at a university or company, even if you're doing it on your own, the university or company can be the ones to own the invention not you. Another thing I learned that was the most important to me were all the different career trajectories that one can go down with a BME degree. Specifically in Andrea's case, she went for the intersection of law and BME, and it is good to know that there are many options with this degree and there are infinite opportunities.

2025/10/22 - Lecture 7 - Post Grad Plans

CAITLIN KING - Oct 22, 2025, 2:14 PM CDT

Title: BME Advising - Post Graduate Planning

Date: 10/22/2025

Content by: Catie

Present: Catie

Goals:

Content:

General Pointers

- Get some research
- · Get 3 strong letter writers and references early

Writing your story

- Start with what you do thesis statement, your narrow experience snd how it applies to your broad interest, specific to each position or
 plate
- personal statement show a reasonable idea of what you will achieve at university, what you want to do after, name faculty

Graduate School

- · Masters, MS.
 - o stepping stone, change directions, gain depth, expand credentials for future
 - Way to rewrite story and change directions (bioinstrumentation --> biomechanics, biomechanics --> biomaterials)
 - Fill gaps in your resume instead of getting a job, you can use this time to volunteer in hospital, get experience on campus, etc.
 - Powerful to add in industry (intern during this)
 - · industry focused
 - o generally one year
- · Doctoral, PhD
 - · Desire to be independent researcher
 - Write grants
 - Work in academia
 - · Lead projects in industry, startups, and consulting

Master's Options - 24 credits

- Research (1.5-2 years)
 - · Can be funded (RA/TA/PA) tuition remission and stipend
 - o thesis requires (must have PI identified and willing to support before applying)
- Accelerated Programs (1 year)
 - · Funding (TA only) stipend only (no tuition remission \$1200/credit)
 - Accelerated
 - Coursework only
 - independent study/research is allowed (up to 6 credits)
 - Biomedical Innovation, Design, and Entrepreneurship
 - Project based project required (BME design project continuity)
 - Partnership with business school
 - Applying
 - Apply online
 - Statement of purpose: why you want to pursue further education in BME

- Research only: list the PI who plants to support you
- Don't need letters of rec, you use Janna Pollock and her three email addresses
- Your application is reviewed separately, given special consideration to BME undergraduate students (need at least 3.0 overall and 3.0 in last 60 credits) -> AUTOMATICALLY IN (less than a 3.0 talk to them and you can make it work)

PhD Options

- · Build resume/CV
 - REU summer (grab an REU in the city i want to live in after and make those connections)
- · GRFP for external funding

Med School

- · Two sem of gen chem
- Chem 344 and 345
- 2 sem of physics (ena 201 and 303) + 315 = physics 201 Might need to talk to puccinelli to explain this
- · Two sem of english use liberal studies
- I/A and S/H and Comm B use liberal studies
- · Psych 202 and Soc liberal studies
- · Research required
- Volunteering (clinical setting desired)
- Shadow
- · Patient contact time
- Build relationships = letter writers
- · Requirements vary by degree

Conclusions/action items: It is important to be incredibly prepared for what comes after undergraduate school. A master's program is a great opportunity for people to do if they don't know what their next steps are and if they want to have a year to build their resume, switch paths, or just get more experience. PhD programs are also an option, and pre-health advising is a must if I want to go to dental school.

CAITLIN KING - Oct 29, 2025, 2:09 PM CDT

Title: Lecture 8 - To Regulate, or Not to Regulate... That is the Question

Date: 10/29/25

Content by: Catie

Present: Catie

Goals: To learn about FDA regulation

Content:

Regulatory Pathway

- · Class I, Class II, Class III (classifications of devices based on risk)
 - · Class I (Low Risk)
 - exempt and then clearance to market device
 - · Class II (Moderate/Controlled Risk)
 - 510k and then clearance to market device
 - Testing mostly evaluated based on difference between your device and the one already on the market
 - · Class III (High Risk)
 - PMA and then approval to market device
- · Early feasibility study, feasibility study, pivotal study

"Regulations are Paid for in Blood"

- Dalkon Shield
 - Did not stop pregnancy
 - High risks of complications septic pregnancy, maternal death, etc.

Product Recalls

- · Philips CPAP
- · Abbott neurotism systems and spinal cord stimulators

Conclusions/action items: Regulations are a difficult thing to navigate, and there are many debates about whether or not the FDA should even exist, as well as the efficacy of it today and whether or not it needs to be stricter or if it needs to loosen up. Also, companies should be more open about product recalls, and it should be in the news.

CAITLIN KING - Nov 05, 2025, 2:09 PM CST

Title: Regulatory Strategy: The Framework Guiding Advanced Therapeutic Product Development

Date: 11/5/2025

Content by: Catie

Present: Catie

Goals: To learn about therapeutic product development - FDA/laws/regulations, "quality" mindset, science/engineering career opportunities in regulated industry

Content:

- . Drug (CDER) NDA (new drug application), IND (investigational new drug applications)
- Biologic (CBER) BLA (biologics license application), IND

Advanced Therapeutics

- · Gene editing target precise genome locus and delete, insert, or change existing sequences
- · Gene delivery transfer molecular tools and assembled gene to cells
- Cell therapy use expanded cells to transfer medicinal bio-activity to regenerate damaged tissue or restore health

351 vs 361 Regulation Pathways

- 361 can be done in clinic immediately
 - Taken from a patient and put back into them (autologous/homologous use)
 - homologous use used for the same function, purely mechanical function (not biological)
 - · Minimally manipulated (centrifuge, syringe)
 - · Do not require significant regulation
- 351 takes many years to get through regulatory process
 - Biologic
 - · Not minimal manipulation (culturing)

Target Product Profile (TPP)

- Core
 - Indication and patients, efficacy, route of administration, dosage and dose form
- · Clinical Development Planning
 - · Clinical pathway, regulatory pathway, timelines, cost, risk
- CMC (qTPP: quality TPP)
 - · Product attributes purity, degradents, biocompatibility
 - · storage, stability, container, pharmacopoeial compliance

Quality Management System Implementation

- · System that documents policies, processes, internal rules, procedures, and other records to ensure consistent quality
- Must keep extremely thorough and good records of procedures

Conclusions/action items: In regard to therapeutic product development, there are a few key differences from the device development industry. There are two things called the 351 and 361. 351 regards higher manipulation procedures and requires a much more rigorous regulatory process as it is not homologous, while 361 covers procedures where the procedure is homologous, meaning the thing being moved serves the same function and will not have significant biological functions. One thing that sets people apart is understanding quality system, because that is where the money is in the industry, and is a setback for a lot of people if they don't know it.

CAITLIN KING - Nov 07, 2025, 12:57 PM CST

Title: Building a Career of Impact - Why Healthcare Needs More Engineers - Kristin Myers

Date: 11/7/2025

Content by: Catie

Present: Catie

Goals: Hear and learn more about kristin myers' journey and see how she got to where she is today. Also, to learn more about the healthcare system.

Content:

Myers.hbs@gmail.com

"Run towards the hard problems... they are the ones that change the world"

Chapter I: The Foundation

- Intern/Co-op for Abiomed, Baird, Guidant (for boston scientific), and GAP
- · Worked full-time for medtronic
- Went to Harvard for MBA
- · Worked at Skyline Ventures and Arboretum Ventures

Chapter 2: The Growth Curve - combine EQ with IQ to multiply impact and reach

- · Aetna chief of staff to ceo
- Unified Women's Healthcare president and chief operating officer
 - · worked there, three months later the pandemic hit
 - · Temporarily layoff 50% of staff

Chapter 3: Build and Transform - Drive system-level impact through innovation and scale

- · Hopscotch Health
 - Founder and CEO
 - Focused on advanced primary care for rural communities
- · Blue Cross Blue Shield Association
 - o Chief Operatin Officier
 - · Make healthcare affordable, accessible, successful outcomes, and quality patient experience

"You don't need to know your final destination - just follow hard problems and build skills that allow you to make an impact"

The Healthcare System

- · Important things
 - · Improved provider experience
 - · improved patient outcomes
 - lower cost of care
 - · improved patient experience
- 5.3 trillion dollars and 18% of GDP spent on healthcare
- We spend 2x more on each patient than other countries
- · US ranked last on equity, access, and outcomes
- · Lower life expectancy
- 10% uninsured and 25% don't pursue care do to cost

- · misaligned incentives, fragmented financing and regulation
- Inequities (10-15 year gap between zip codes)
- · Healthcare is broken because it was never designed to be one system
- Integrated System to Enable Health and Wellness for all
 - · Healthcare needs better systems. And systems are what engineers build best.
 - · Aligned Incentives
 - Everyone should be rewarded for outcomes, not activity
 - Performance is transparent and known to all

Advice

- · Work Hard and Build Range
 - take on the hardest projects, classes and experiences you can find. effort and range are your foundation
 - · Look for companies where you can be in the office with people get a sense of personalities and leaders
- · Seek Diverse Exposure
 - Explore different sectors, teams and geographies. gain perspective and learn how systems connect, not just how parts work
 - Meet many different types of people and use your resources at the university
- · Choose Your People Wisely
 - Surround yourself with curious, driven, high-integrity people. they will shape who you become
 - The people you hold close to you influence your perspectives and shape your trajectory
 - Find people who can offset you and balance you out with their differing views
- · Known Your Values and Protect Them
 - Define what matters most family/friends, health, career/impact, values and make decisions that align
- · Embrace Challenge and Keep Growing
 - · Run towards the hard problems. growth lives on the edge of discomfort where big impact starts

Q&A

- To avoid burnout
 - energy flows and specific time of days where we are wired to do certain things. block calendar for yourself and take a break
 - · It is okay to say no to plans you don't want to participate in
 - o exercise, sleep, work, family
- · How to fix broken healthcare system where businesses are built to optimize profit
 - · Build a greater network with data connecting/flowing and a real-time network and a larger database for medical records
 - Proving that good and connected primary care can deliver outcomes at a lower cost
 - Empowering consumers to make good choices and give transparent data
- · Decision she regrets the least career wise
 - Going to business school
 - Fundamentally knew she was interested in business and general management
 - · Loved learning how to deconstruct things and finding solutions to put everything back together
 - · Switch up from going to undergrad where everyone wanted to change the world and do huge things
 - Got to be surrounded by people who also took a pause during their career and thought about how they
 wanted to change the world
 - · Lots of credibility from an engineering/business intersection made her the wildcard candidate

Conclusions/action items: We are in a position in our lives right now where we have a lot of resources and opportunities to explore what we want to do and branch out and reach out to people in fields that we want to be in, so we should take advantage of those resources. On top of this, we need to learn to challenge ourselves and take on the hard tasks as well as learning how to balance other aspects of our life such as family, sleep, friends, etc. Also, the healthcare system is a great field to go into as an engineer because one solution to the healthcare problem is to build a better more cohesive system, and engineers have great perspectives of these systems and can contribute.

2025/11/12 - Lecture 10 - Institutional Review Board

CAITLIN KING - Nov 12, 2025, 2:00 PM CST

Title: Institutional Review Board

Date: 11/12/2025

Content by: Catie

Present: Catie

Goals: To learn about IRB basics, review process, and UW-Madison IRB resources

Content:

· Ethical and scientific rigor go hand in hand

Ethical Research Framework

- · Nuremberg Code, 1947
 - Voluntary Consent
- · Declaration of Helsinki, 1964
 - · Focus on medical research do no harm
- · National Research Act, 1974
 - US response to US public health service untreated syphilis study at tuskegee
 - Publication of Belmont report and creation of Institutional Review Boards

Belmont Principles

- Principles
 - · Respect for persons/autonomy
 - acknowledge autonomy and protect those with diminished autonomy
 - Beneficence
 - Maximize possible benefits and minimize possible harms
 - Justice
 - Who receives the benefits of the research and who bears its burdens
- · Applying principles
 - 1991 DHHS 45 CFR 46
 - criteria for approving research, protections for vulnerable groups
 - 2018 revised common rule

IRB Compositions

- · Diversity of membership required
 - · Race, gender, cultural backgrounds
 - Scientific expertise
 - Non-scientists

Purpose of IRB

- · Protect rights and welfare of people enrolled in research
- IRB review human research according to: ethical principles, federal regulations, state laws, institutional policies

Common Rule Definitions

- Research systematic investigation designed to develop or contribute to generalizable knowledge
- · Human subject living individual about whom an investigator conducting research obtains info or biospecimens through interaction

De-identifying Data

· Directly Identifiable

- · Identifiers included with data
- · Coded/Indirectly Identifiable
 - Identifiers removed from data but linked via study ID code
- · Anonymized/Deidentified
 - · All identifiers removed

IRB Review Process

- · Administrative Review
 - o checks for required training, and basic completeness of application
- IRB Pre-Review
 - Checks for consistency, clarity, completeness
 - Helps researchers achieve review-ready application
- · Committee or Non-Committee Review
 - Determines if criteria for approval are met, requests modifications if needed, approves when criteria are met

Conclusions/action items: For all research, it is extremely important to get approval from the IRB before conducting research. The IRB is in place because of a bunch of historically unethical research studies such as WWII nazi prisoner studies, intentionally infected hep B and syphillis cases that were ethically wrong and did not benefit the participants at all, but rather a different, more privileged group with more resources and access to healthcare. There are different levels of de-identifying data as well as categories for the types of research, and each research study will fall into one of each of these. The review process is rigorous, and it should remain that way.



2025/11/19 - Lecture 11 - Product Development in Industry

CAITLIN KING - Nov 19, 2025, 1:58 PM CST

Title: Product Development in Industry

Date: 11/19/2025

Content by: Catie

Present: Catie

Goals: To understand how new opportunities are selected and prioritized, understanding how projects are managed and resources, etc.

Content:

- NPD is highly regulated (FDA), expensive (clinical testing), resource intensive (sizable teams), and competitive
- Corporate business strategy -> product portfolio review -> project review -> budgeting and resource allocation

Types of NPD Projects - increase in risk/cost down the bullets

- · Line extensions: additional sizes/configurations
- · Product improvements: existing product change due to market feedback
- · New-to-company: product line that is new to company
- · New-to-world: create completely new markets
 - · resource intensive most individuals and teams

Managing NPD: Stage-Gate Process

- · Stage 0: Ideation
- · Stage 1: Exploration
- Stage 2: Concept Development
- · Stage 3: Design Development
- Stage 4: Design Confirmation
- Stage 5: Design Transfer and Commercialization

Case Study: Fluid management solutions for high volume cases existing in 2007

Manual: Suction CanistersAutomated: Stryker Neptune

Automated: ORwell Fluid Management System

- Ideation Choose area of opportunity, review market trends, primary/secondary research, identify customer unmet needs, create highlevel "back of the napkin" ideas
 - Challenge setting up tubing, enzymatic cleaner was not effective cleaning the 20L container
 - · Must make it cleaner/not smelly, easier setup
- Exploration define problem, review/refine list of ideas from stage 0, get down to 8 designs
 - Defining problem: what is problem, how is it be solved today, how is your solution the winning solutions
 - No system existed that maximized productivity and clinician safety
- Concept Definition 1 leading concept, develop robust business case, conduct IP examination
- Design Development move to functional prototype, continue iterative design process with initial testing/reviews, confirm regulatory pathway, begin formal design control documentation
- Design Confirmation extensive verification/validation, finalize product and component drawings, accelerate manufacturing process development (make vs buy), "freeze" design at end of stage, submit regulatory documentation
- Design Transfer and Commercialization complete remaining testing, make final design changes, build molds and assembly/test
 equipment, create instructions for use, develop service plan and resources, finalize go-to-market strategy
- Post Market Surveillance regulatory agencies expect companies to monitor and document customer complaints and field issues post launch, 4-6 month cadence: project teams report out to stakeholders
 - o Stryker launches Neptune 2 shortly after ORwell was introduced

• Stryker reduces price of consumable manifold by 50%

Conclusions/action items: Medical device development is expensive, complex, and a highly collaborative effort. Having limited resources, Stage-Gate process is used to reduce risk and increase chances of success. Good product design and development is needed for commercial success. There are many stages to stage-gate which are ideation, exploration, concept definition, design development, design confirmation, and design transfer and commercialization. Post market surveillance is also important to see how the product is doing financially, how the customers like it, advertising, expansion, etc.

2025/9/11- Advantages to AI in Livestock

Emma Stroshane - Sep 11, 2025, 10:12 AM CDT

Title: Advantages of AI (Artificial Insemination) in Livestock

Date: 9/11/2025

Content by: Emma

Present: Emma

Goals: One goal is to understand the importance of Artificial Insemination in livestock, as well as its advantages.

Content:

- · Increased efficiency
 - Only a certain amount of bull semen is needed to fertilize the egg, so by using AI, they can dilute and extend the amount of
 eggs fertilized with just a single ejaculation
 - · The semen can be stored for long periods of time, and males can reproduce long after their reproductive span has ended
- · Increased genetic selection
 - · Can increase the genetic pool by choosing which animals are mated, which can decrease inbreeding
 - · Can choose the strongest and best animals for better offspring
- · Increased safety
 - · Bulls are large, and it can be unsafe and hard to maintain bulls on farms, so AI allows no bull to reside on the farm
 - · Natural mating can be dangerous for the female (and sometimes the male), depending on the size of the male
- · Reduced disease
 - Again, choosing the animals to mate can reduce the spread of diseases
 - Can choose disease-free males for semen collection
- · Improving productivity
 - · Al can enhance animal productivity, such as producing more milk
- Conservation
 - · Can be used for rare or endangered species

Conclusions/action items: All or artificial insemination in livestock is important for numerous reasons. It can reduce the spread of disease and inbreeding, as well as enhance animal productivity. Those who use All can choose which semen is used, meaning they can usually create offspring that are on the better end of the genetic pool. Another importance is that the semen from a bull can be more efficiently used and inseminate multiple cattle at a time, versus wasting semen on one female in the natural process.

Citation: G. K. Patel, N. Haque, M. Madhavatar, A. K. Chaudhari, D. K. Patel, N. Bhalakiya, N. Jamnesha, P. Patel, and R. Kumar, "Artificial insemination: A tool to improve livestock productivity," *Journal of Pharmacognosy and Phytochemistry*, vol. 6, Special Issue 1, pp. 307-313, 2017. Accessed: Sepetember 11, 2025. Available: https://www.phytojournal.com/archives/2017/vol6issue6S/PartG/SP-6-6-67-515.pdf.



2025/9/16 Potential Material Properties

Emma Stroshane - Sep 18, 2025, 4:34 PM CDT

Title: "Materials for Hostile Chemical Environments" - Potential Material Properties

Date: 9/16/2025

Content by: Emma

Present: Emma

Goals: One goal of this research is to understand which materials might be more favored for our project. Our client detailed that the material will need to be cleaned, whether with soap and water or bleach. The material needs to be durable and withstand harsh conditions.

Content:

- There are many different steel types
 - Steel is commonly used due to its strength and corrosion resistance
- · When exposed to air and moisture, carbon steel may corrode
- · Coating steel with chromium oxide reduces oxygen diffusion towards the surface, which helps prevent corrosion
 - o Cr2O3
- · Many elements can be combined with steel and have different properties
- · Some elements provide resistance to corrosion in seawater
 - Mo
- · Other elements improve the strength
- Table 4.1 provides stainless steel uses in engineering and the properties
 - 400 series has poor corrosion resistance
 - 102 is used for general applications

Conclusions/action items:

When determining which material to use for our tool, we have several factors to consider. We have to think about our budget and how much money we want to spend on materials based on researched properties. Another piece to think about is how hard the material is to work with. There is a steel that is good for welding but has lower corrosion resistance, so we also need to think about how valuable each property is to us. Lastly, if we find a piece of the tool that has already been manufactured, we have to consider what material is used in that and possibly match the rest of our tool to it.

V. Sudarsan, "Chapter 4 - Materials for Hostile Chemical Environments," in *Materials Under Extreme Conditions*, A. K. Tyagi and S. Banerjee, Eds., Amsterdam: Elsevier, 2017, pp. 129–158. doi: 10.1016/B978-0-12-801300-7.00004-8.

Title: Device Max Weight Limits

Date: 9/16/2025-9/18/2025

Content by: Emma

Present: Emma

Goals: The goal of this entry is to understand what our weight limit is based on the intended use of our device. I want to figure out what the maximum weight is for our device, while still allowing

Content:

- The maximum weight limit for the floor to table is no more than 20kg (coming from a table, where it is at a lower point for the work needed)
 - This ensures a safe and efficient move using the legs (vs back) method
- . The weight limit for the forearm to shoulder movement will be less, since this movement is isolated
- 11-14kg is the approximate weight for this isolated movement, and the time between fast-paced reps (approx 15 seconds)
 - o This information was for a female
 - Men for these same categories had higher maximum weights, but do not need only one device for all, and older people
 - o Our weight limit should be on the lower end to capture all these demographics
- · Important factors to weight limit: distance, work needed, age, gender, number of reps, time between reps

Conclusions/action items:

If our device has a separate holder, the maximum weight for this item should be 20kg since it may be moved from the floor to the table. However, this may not happen; if it is later implemented, I ensuring a safe and efficient process. The main movement that will be isolated will be from the forearms and shoulders, and will be fairly quick reps. We also don't want to crush the straws if the

Work Practices Guide for Manual Lifting. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupationa Accessed: Sept. 16, 2025. [Online]. Available: https://books.google.com/books?

 $hl = en\&lr = \&id = uoY3OpylFTwC\&oi = fnd\&pg = PR5\&dq = safe + weight + limit + when + manually + lifting\&ots = Qy9YGo_qXo\&sig = 7fCqhysB6pwQNO2hoMyE6RbFfaw#v = one than the contraction of the contracti$

Emma Stroshane - Oct 02, 2025, 12:48 PM CDT

Title: 3D Printing Consideration + Material Research

Date: 2025/10/1
Content by: Emma

Present: Emma

Goals: Understand some considerations that we need to think about if we 3D print. Learn about which material for 3D printing may be better than others for our goal.

Content:

- -When printing larger parts with lower infill, damage is more likely to occur
- -Higher infill can also increase tensile stress
- -Highly flexible polymers do not follow a straight path
- -Geometry dimensions play a crucial part in strength and stiffness
- -Cavities and voids in low infill parts are more likely to affect strength
- -Can keep infill constant, but strength can vary still based on dimensions

Conclusions/action items:

This was for PLA and TPU, which are not going to be the materials we likely go with. It provided insight about some factors that can impact the strength of the print no matter of what material. We need to be careful about the infill that we choose since there are small cavities. Being that the design is also so small, we will need to make sure surrounding areas are supported, but also that we are able to get these supports out. We won't have much tension/pulling force, but there will likely to compression.

N. Elmrabet and P. Siegkas, "Dimensional considerations on the mechanical properties of 3D printed polymer parts," *Polymer Testing*, vol. 90, p. 106656, 2020. [Online]. Available: https://doi.org/10.1016/j.polymertesting.2020.106656

Emma Stroshane - Oct 16, 2025, 5:42 PM CDT

Title: 3D Printing Filaments

Date: 2025/10/16
Content by: Emma

Present: Emma

Goals: The goal is to understand which material is best for our prototypes and final product. I want to weigh the prices of each and the strengths of each to determine a cost-effective, yet durable, material.

Content:

They tested PLA, ABS, Nylon + carbon fiber using 3D fused deposition modelineg (FDM). Used three geometrical patterns: linear, hexagonal, and tridimensional. Used three infill percentages: 33%, 66%, and 100%. Changed deposition Orientation: 0 degrees/90 degrees and +45 degress/-45 degrees. Used two-layer heights: 0.18mm and 0.14mm. Lastly, the fixed parameters were the printing speed at 35mm/s and contour layer height (0.18mm). UTS means Ultimate Tensile Strength and measures the maximum stress can withstand before breaking.

Results from the study:

- Geometric pattern has little impact on UTS, but material type and infill percentage will greatly affect UTS
- Higher infill = stronger parts but more expensive
- -The 0.18mm layer height was weaker compared to the 0.14mm in relation to UTS
- +45/-45 degree orientation gives greater UTS than 0/90 because of stress distribution is maximized
- UTS maximized when: N + CF with 100% infill, 0.14mm layer height, and +45/-45
 - 85 MPa
- Filament UTS Averages:
 - ABS: 49.7 MPaPLA: 49.0 MPa
 - N + CF: 57.3 MPa

Filament pros:

- ABS
 - Higher infill reduces voids, UTC increases
 - +45/-45 enhances flexing
- N + CF
 - Improved stiffness
 - Layer thickness and deposition angle are more critical and significant with N + CF

Conclusions/action items:

Currently, we have been using ABS for our prototypes. The cost per gram is \$0.05 for PLA and ABS. Compared to PLA, ABS will have increased UTC when setting identical features. The Makerspace has a more expensive ABS for \$2.96 per gram, which may be useful for the final product. PLA is generally weaker and can work for some weaker prototypes, but it will not be used for the final product. By having the +45/-45 degree orientation, we can increase strength without spending more money on infill. Some considerations are that more infill will make it stronger, but cost more money and time to do so. We can play around and possibly get similar strength by changing layer height, which could be cheaper. It would still require more material to do smaller layer heights.

S.L. Rodríguez-Reyna, C. Mata, J.H. Díaz-Aguilera, H.R. Acevedo-Parra, and F. Tapia, "Mechanical properties optimization for PLA, ABS and Nylon + CF manufactured by 3D FDM printing," *Materials Today Communications*, vol. 33, p. 104774, 2022. [Online]. Available: https://doi.org/10.1016/j.mtcomm.2022.104774. Accessed: Oct. 16, 2025.

Emma Stroshane - Oct 16, 2025, 2:45 PM CDT



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3D_Printer_Dimensions_-_Sheet1.pdf (78 kB)



2025/11/6 Ultrasonic Cleaning Considerations

Emma Stroshane - Nov 06, 2025, 6:31 PM CST

Title: Ultrasonic Cleaning Consideration (Small Particles)

Date: 2025/11/6

Content by: Emma

Present: Emma

Goals: One big factor is that our devices need to be sanitized if they touch the straw. However, our parts are so small and are made out of 3D printing material. We aren't sure if they can withstand repeated dipping in ethanol, so we are looking into ultrasonic cleaners.

Content:

The two mechanisms of ultrasonic cleaning: cavitation and acoustic streaming

Cavitation:

- -Creates shock waves to dislodge particles
- -Can create surface damage

Acoustic Streaming:

- -Shear force to remove the particles
- -Less damaging and used for delicate surfaces

Trends:

- -Increasing particle size creates a greater efficiency in cleaning
- -More particles = more efficient (agglomeration)
- -Increasing time gives better removal
- -Faster-moving fluid means great efficiency
- -Temperature is best at 105 degrees F, but declines out of this range

Effective for submicron particle removal, which means 0.3 micrometers or less

Conclusions/action items:

The bull semen sperm is in the micrometer range, but a tad larger. This might be a good option to make sure the material we use isn't breaking down from ethanol. However, some factors that we have to consider are whether this process will still damage the surface of the material, causing more contamination issues later on. Also, if this process even speeds up the time, it might take a little bit to clean and repeat, and ultimately does not solve the efficiency issue.

Kashkoush, A. Busnaina, F. Kern, and R. Kunesh, "Ultrasonic Cleaning of Surfaces: An Overview," in *Particles on Surfaces 3*, K. L. Mittal, Ed. Boston, MA: Springer, 1991, pp. 217–235. doi: 10.1007/978-1-4899-2367-7 17

2025/11/6 Force Reduced Vibrating Knife

Emma Stroshane - Nov 06, 2025, 7:41 PM CST

Title: Vibrating Knife to Reduce Force

Date: 2025/11/6

Content by: Emma

Present: Emma

Goals: We are working on the next part of our project, the slicer. We haven't decided on an option, but one thing mentioned was a vibrating knife. In theory, this would reduce the force needed to cut through the straw while also allowing for a cleaner cut. My goal is to understand to what extent it can improve and how.

Content:

The study was done on frozen sliced horse quadriceps. The knife was vibrating parallel to the direction it was cut in. They tested various thicknesses and vibration frequencies.

Conclusions from the study:

- -Vibration reduced the cutting force by reducing the friction between the blade and the meat
- -No significant difference between vibrating and non-vibrating blades regarding surface cut quality
- -1000 Hz for vibration speed improves the efficiency of cutting.

Conclusions/action items:

The vibration reduces the force needed to cut through something by reducing friction between the object and the blade. In terms of our project, this can allow us to more easily cut through the row of straws without applying more force than could bend the straws. Two potential concerns are safety and fabrication. We don't want the knife to be too unsteady since it could pose a safety hazard. We would also have to get a battery source for the motor, possibly getting in the way of the process.

M. J. King, "Fracture Energy During Slicing of Frozen Meat by a Vibrating Knife," *Meat Science*, vol. 46, no. 4, pp. 387–399, 1997. doi: [10.1016/S0309-1740(97)00033-8] (https://doi.org/10.1016/S0309-1740(97)00033-8)



2025/11/20 Nylon 3D Printing Mechanical Properties

Emma Stroshane - Nov 20, 2025, 11:57 AM CST

Title: 3D Printing Nylon Mechanical Properties

Date: 11/20/2025

Content by: Emma

Present: Emma

Goals: For our final design, we are considering printing out of Nylon. My goal is to understand how printing in this material will affect our model. I know the quality of printing can change between materials, so this would be something we have to consider.

Content:

The study went through 18 different printed parts with different characteristics. They changed: infill density, layer thickness, contours, pattern, width, shells, and orientation. They measured: UTS, TE, UFS, FE, build time, volume, and cost. This was for Nylon 12 parts. They wanted the highest strength-to-cost ratio, so they took UTS/cost.

Conclusions/action items:

The study found that low infill density with high contour count and raster width creates strong parts at low cost. The most important features that determined strength were: raster orientation, infill density, and layer thickness. The raster orientation had a big effect on UTS and UFS, while infill density affected cost and layer thickness affected build time and mechanical strength. Raster width, number of contours, and shells were medium influential, but the least influential was raster pattern. One thing to note with that is that the software limited it to two levels in the study.

G. Mostafa, C. Montemagno, and A. J. Qureshi, "Strength to cost ratio analysis of FDM Nylon 12 3D Printed Parts," *Procedia Manufacturing*, vol. 26, pp. 753–762, 2018, doi: 10.1016/j.promfg.2018.07.086.

2025/9/7- Competing Semen Straw Slicer

Emma Stroshane - Sep 11, 2025, 10:13 AM CDT

Title: Competing Slicer Patent Research

Date: 9/7/2025

Content by: Emma Stroshane

Present:

Goals: A key goal of this research session is to understand the competing features of a semen straw slicer. In addition, I want to grasp why these unique features are important to its functionality and what the overall aim of this project is. Another purpose is to ensure that the technology we develop isn't a copy of a current patent, so we don't run into law/patent issues.

Content:

*Translated from Korean in Google Patents, so some of the translation did not make the most sense.

Slicer should not break the straw or deform the straw in any way since this can damage the semen or cause it to shoot backward into the slicer. The slicer has grooves so the straws are always placed in the same location, allowing for uniformity between various straws.

- . One feature to keep in mind: the slicer should not deform or break the straw in any way
 - · This is important for functionality so multiple straws can be sliced at the same time without contamination or damage
 - The original patent had testing that found that semen was backshooting
 - This is done using a straw insertion hole with a predetermined guide
- The purpose of this tool is to efficiently and safely carry out the preparatory work needed to artificially inseminate cows using precollected semen
 - This allows for breeding of healthier and stronger animals that can better serve their purpose
 - Reduces the chances and amount of diseases that may be passed on by artificially choosing which bulls and cows are involved
- This tool uses scissors or a knife to actually perform the cutting, but uses the above-mentioned hole and tracks to reduce breakage
 - · The straws involved in this project are perforated, making it easier to cut with a knife or scissors
 - Wording in the document makes it sound like a knife is not a part of the tool and is separate, but the diagram shows it as
 one piece
- This tool can only cut "a dozen straws (15)" at a time
 - The diagram only shows three (to my knowledge!*)
- Patent/legal documents began in 2007, and the current status says "Expired."
- The diagram shows the use of one hand to perform the cutting action
 - o A level performs the slicing action according to the diagram

Conclusions/action items:

When designing our slicer, we need to be conscious that the design doesn't cause the semen to backshot. Another point to be careful of is that there is no cross-contamination between samples when slicing, since we are working with multiple straws at a time. The current status of the patent is expired, so not sure how we could use that information, but possibly taking ideas and expanding on them from this design. One question for the client is whether the straws are perforated, because that can determine how much strength is needed to go into cutting the samples. Another piece of information from the client is how wide/dimensions of the straws.

Citation: B. Gwang-su, P. Su-bong, L. Wang-sik, P. Sung-jae, and K. Hyun-seop, "Cow's artificial insemination semen straw cutter," South Korea patent KR200447231Y1, filed Dec. 26, 2007; issued Jan. 7, 2010. Accessed on September 8, 2025. https://patents.google.com/patent/KR200447231Y1/en? q=(cattle+semen+straw+slicer)&oq=cattle+semen+straw+slicer



2025/10/9 Stainless Steel Corrosion Research

Emma Stroshane - Oct 09, 2025, 12:01 PM CDT

Title: Stainless Steel Corrosion Research

Date: 10/9/2025

Content by: Emma

Present: Emma

Goals: Understand the different types of stainless steel and their corrosion-erosion properties. The goal is to figure out which steel to use in the stamper, so we can start purchasing it.

Content:

- · Corrosion-erosion resistance can be negatively affected by the cold
 - o AISI 304, 316L, 301
- 316L Stainless steel with a surface nanocrystalline layer has reduced resistance in a 3.5% NaCl solution
 - Due to increased surface roughness
 - Dislocation density
 - · Increase in grain boundaries
- 316 and 304 are used in food applications, petrochemical, and marine environments
 - Most have a naturally passive chromium oxide film, which provides corrosion resistance
- · The flow stress and tensile strength of AISI 316L are not well understood

Conclusions/action items:

The study did not focus on what temperatures the cold affects the corrosion resistance, but did say that this 316L is used in marine environments, and in food appliances, which can get quite hot or cold. Our client mentioned that this process is usually done at room temperature or from the fridge environment, so above freezing, which should not considerbly affect the corrison resistance.

K Wood, J. C. Walker, T. J. Harvey, S. Wang, and S. S. Rajahram, "Influence of microstructure on the erosion and erosion–corrosion characteristics of 316 stainless steel," *Wear*, vol. 306, no. 1–2, pp. 254–262, 2013, doi: 10.1016/j.wear.2013.08.007

Emma Stroshane - Oct 01, 2025, 11:45 PM CDT

Title: Individual Preliminary Design Sketch

Date: 9/21/2025

Content by: Emma

Present: Emma

Goals: Come up with a possible design idea for the group meeting. One design, but include the three main components: frame, slicer, and stamper

Content:

- Create compartments/containers that would rest on top of the well plate to hold straws
- -Slicer has a "bagel cutter" mechanism
- -Straws stay in the container to be cut and stamped
- -Stamper has a lock function so you can line up everything before stamping

Conclusions/action items:

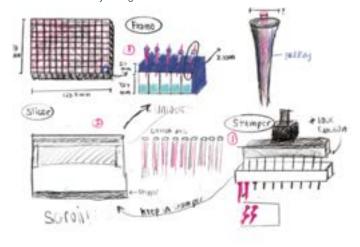
Cons:

- Hard to clean
- -Precise/tiny holes to cut
- -Three separate pieces that don't snap into place

Pros:

- -Compartment to reduce contamination
- -Providing structure to straws to protect from breaking
- -Straws not touching bottom of well plate

Emma Stroshane - Sep 27, 2025, 10:55 PM CDT



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Screenshot_2025-09-27_225457.png (1.4 MB)

2025/9/24- Updated Preliminary Matrix Sketch (Pairs)

Emma Stroshane - Sep 25, 2025, 8:56 PM CDT

Title: Preliminary Matrix Final Draft Sketch

Date: 9/24/2025

Content by: Emma

Present: Catie

Goals: Work in pairs to finalize sketches for three determined ideas (from meeting)

https://drive.google.com/file/d/1bXj-VWY2FaW5T6xzzuM4A8TPG4-dDIMZ/view?usp=sharing

Content:

- -The Clamp design
- -Straws are clamped together with markings for where to place the straws
- -Once loaded, straws are moved to a slicer, which will cut them horizontally
- -Then loaded into the frame and will be stamped
- -Frame has notches for the clamp to fit into, so it fits into the wells

Conclusions/action items:

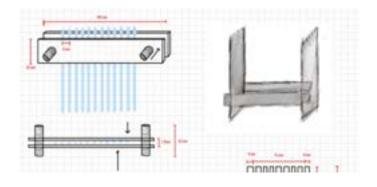
Cons:

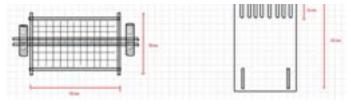
- -Not much divide between straws to reduce/prevent contamination
- -Clamp mechanism?
- -Straws might not have enough force to keep them in the clamp
- -Possibly break/bend straws
- -It may be hard to load into the clamp and get them the same between runs

Pros:

- -Easy to clean
- -Clicks into place
- -Pieces work together
- -Can load and then cut and stamp before cleaning and reloading
- -Can adjust clamp strength

Emma Stroshane - Sep 27, 2025, 10:56 PM CDT





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Screenshot_2025-09-27_225616.png (950 kB)

Emma Stroshane - Oct 01, 2025, 11:55 PM CDT

Title: Individual Stamp Sketch Idea

Date: Officially recorded 2025/10/1

Meeting (9/29/2025)

Content by: Emma

Present: Emma

Goals: Sketch one possible stamp idea that will correspond with "The Compartment" frame. Then present the idea to the team.

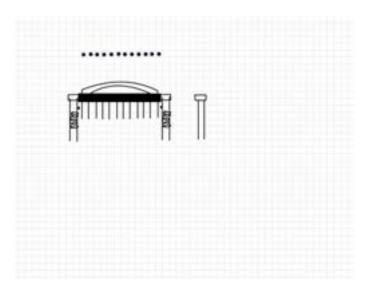
Content:

- -Ergonomic round handle
- -12 removable pins
- -Spring mechanisms that can lock
- -Fits into the track that is part of the frame
- -Pins long enough to push cotton to the bottom, but will stop, so it doesn't keep pushing

Conclusions/action items:

I included an ergonomic handle to reduce muscle strain. I made it rounded and long to help with this. My idea behind the spring mechanism was to counteract some of the force needed to push the contents out. Semi-similar to what they gave us for their idea, but will fit into the track on our frame.

Emma Stroshane - Oct 01, 2025, 11:52 PM CDT



Download

Engineering_Design-2.jpg (548 kB)

2025/10/9 SolidWorks Quick Frame Mockup

Emma Stroshane - Oct 09, 2025, 11:36 AM CDT

Title: Mockup #1 SolidWorks Frame Component

Date: 10/8/2025

Content by: Emma

Present: Emma

Goals: My goal was to get a rough idea of the steps needed to complete this 3D print. I wanted to identify if I saw any changes that could be made during this process.

Content:

The rough steps to model the compartment component:

- · Create a 12mm by 8mm rectangle
- Extrude that rectangle up 109mm
- . Create a hole centered in the middle that is 2mm in diameter
- · Sketch on one of the faces and add a cutout

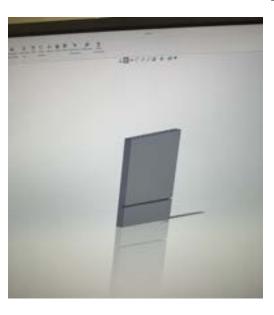
Changes to make:

- · Clip piece on the bottom
- · Funnel for straw
- · Oval vs circle
- · Having ridges in the circular hole
- · No bottom piece for the blade and clippings
- · Possibly having a bottom piece strictly for lining the blade up

Conclusions/action items:

The part is small, which means that we will have to be careful where the weak points are. Additionally, when thinking about the clip at the bottom, it has to be strong enough to withstand multiple clips on and off. When sketching, we included a bottom piece that would hollow to catch the clippings; however, if we clip outside of the well plate, I don't see a need for this. A possible change is to keep a cutout so the user can get a uniform cut. However, make the piece solid vs hollow since it will be small. Figure out how we want cleaning done, since that will be tricky to get in there. Possible change is having top and bottom fully enclose the straw, but the middle piece just has supports, but this might be prone to breakage.

Emma Stroshane - Oct 09, 2025, 11:35 AM CDT





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IMG_0965.jpg (2.75 MB)

Emma Stroshane - Oct 09, 2025, 11:35 AM CDT



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IMG_0968.jpg (2.71 MB)

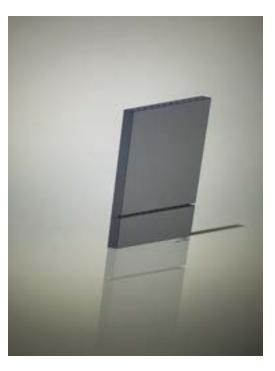
Emma Stroshane - Oct 09, 2025, 11:35 AM CDT



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IMG_0967.jpg (2.44 MB)

Emma Stroshane - Oct 09, 2025, 11:35 AM CDT



Download

IMG_0966.jpg (2.12 MB)



2025/10/16 SolidWorks Frame Well Plate Idea

Emma Stroshane - Oct 16, 2025, 6:09 PM CDT

Title: Well Plate Lip Plate Holder

Date: 10/16/2025

Content by: Emma

Present: Emma

Goals: Model a frame that would allow the well plate to rest on. This would allow the user to line up the compartments with each row and so the plate

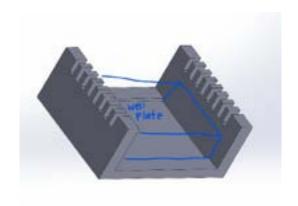
doesn't slip around.

Content:

Conclusions/action items:

Propose an idea to the team. Need updating about notch depth and how we plan to attach the stamper to compartments. The plan would be to have the stamper also attach somehow so it is an attachment versus completely separate pieces.

Emma Stroshane - Oct 16, 2025, 6:10 PM CDT



Download

WellPlate_Frame_Notebook.pdf (126 kB)



2025/10/23 SolidWorks Frame Well Plate + Compartments

Emma Stroshane - Oct 23, 2025, 6:48 PM CDT

Title: Frame Well Plate + Compartment Assembly

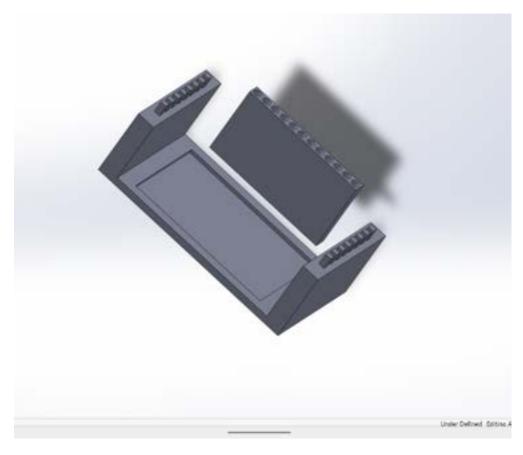
Date: 10/23/2025

Content by: Emma

Present: Emma

Goals: Make an assembly to model the compartment and frame together. From this I hope to accomplish changes that need to be brought up to the team to decide our next steps.

Content:



Conclusions/action items:

I think that it would be helpful to ask the client where they order the well plates or if they have a 3D model. In the frame part, I used construction lines to determine the center of each row, accounting that the edges have a thicker plastic. However, from the assembly, it is difficult to tell if the compartments would be landing in the well plate holes. We should print the frame to see if the well plate fits, but overall, I think that the side walls could be brought in to increase the strength of the pieces by making them shorter. We have to determine the height of the walls and notches as to make it so that the straws release into the individual holes, but are strong enough since we are in mm right now.



2025/10/27 SolidWorks Frame Well Plate Updates (post meeting)

Emma Stroshane - Oct 30, 2025, 11:07 AM CDT

Title: Frame Well Plate Updates Post Meeting

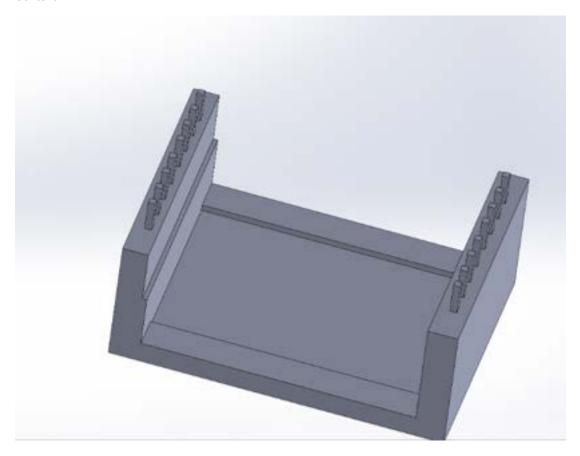
Date: 10/27/2025

Content by: Emma

Present: Emma

Goals: Update the assembly based on what we discussed in our team meeting and new caliper measurements. Once I had access to a caliper and the well plate, I measured the lip at the bottom of the well plate. The plan is to get the dimensions of this frame nailed down so then we can work our other pieces together.

Content:



Conclusions/action items:

In our team meeting, we discussed having the pegs come up rather than be holes coming down. With this, we also said I should bring the walls closer together because these pieces are in mm and a lot smaller than they seem. I left a small cutout because of the way I made it in SolidWorks, so we could make it larger if needed. I also changed the height of the walls based on measurements we took of the straws in the well plate while someone held it. I was able to print it, but upon testing, it was too small to fit the well plate. I measured the well plate and created a mock one using construction lines, so I wonder if when I made it smaller, it didn't keep the construction lines the same, and so I assumed that it would work. Another issue could have been my tolerance. My next action item is to possibly model the well plate quickly and then fit it together on an assembly for our show and tell. I need to physically measure how big I need to increase my dimensions and see which dimensions work.



2025/11/13 SolidWorks Frame Compartment Cutting Holder

Emma Stroshane - Nov 13, 2025, 6:16 PM CST

Title: Compartment Cutting Holder

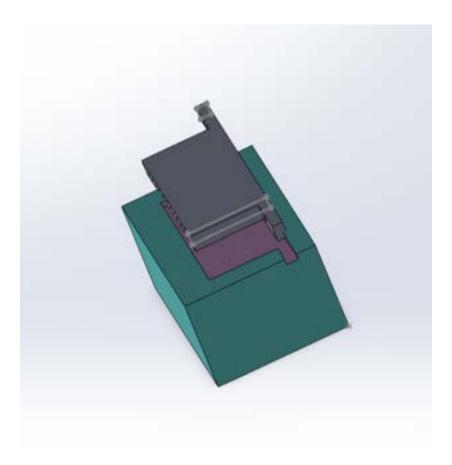
Date: 11/13/2025

Content by: Emma

Present: Emma

Goals: GVI emailed us back, wondering if the cutting process would be a two-person job since we had someone cutting and another holding the straws. However, the idea was just to show them that it cuts the straws and that we would make adjustments to allow for one person to do the whole process. The purpose of this model is to show GVI an initial idea of how the straws will be held during cutting. I think that it will take two hands to get the clean cut, so the design needs to be able to stand by itself and not move.

Content:



Conclusions/action items:

This is a very simple design, but it just shows the concept. The compartments will fit snugly into the top of the box. I just have the cutout deep enough so the straws rest on the top and get some support that way. One trouble we have had with the cutter is that the tips go flying. I have such a simple box, so we can integrate something with this to make it one piece. We have to make it so the clipping tool can fit between the straws and the gutter, but not get in the way. Being that two hands are needed to cut, the box should not slide around too much. To fix this, we could place a sticky cloth piece on the backside.

Emma Stroshane - Nov 06, 2025, 2:27 PM CST

Title: Training Documentation

Date: 10/31/2025 (updated 11/6/2025 with biosafety training in the system)

Content by: Emma

Present:

Goals:

Content:

OLD: The Biosafety Training one is not yet in the system, so I screenshotted the page showing my quiz score and that I completed the course. There are two photos for one training, but once updated, I will fix it.

Conclusions/action items:

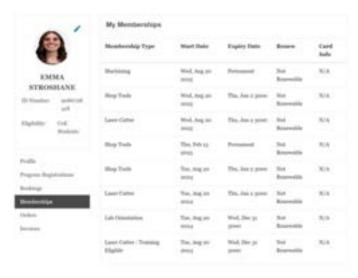
Emma Stroshane - Oct 31, 2025, 6:32 PM CDT



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Screenshot_2025-10-31_183147.png (113 kB)

Emma Stroshane - Oct 31, 2025, 6:29 PM CDT



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Screenshot_2025-10-31_182857.png (217 kB)

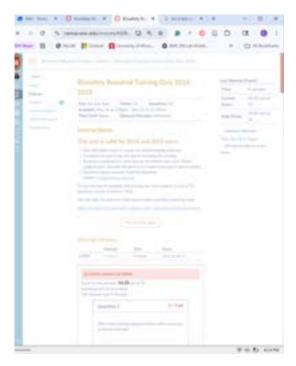
Emma Stroshane - Oct 31, 2025, 6:29 PM CDT



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Screenshot_2025-10-31_181526.png (116 kB)

Emma Stroshane - Oct 31, 2025, 6:29 PM CDT



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Screenshot_2025-10-31_181503.png (370 kB)

Emma Stroshane - Nov 06, 2025, 2:26 PM CST



Download

training_2.pdf (163 kB)

Title:

Emma Stroshane - Nov 07, 2025, 12:58 PM CST

Date:
Content by:
Present:
Goals:
Content:
"Run towards the hard problemsthey are the ones that change the world"
Chapter 1: The foundation

Being a good engineer and learn skills

Be a high achiever and high perfromance in tech

- · Abiomed: interned for a company that made artificial hearts
- · Guidant: now part of BostonSci
- · Medtronic: worked full-time
- · Worked for a firm in venture capital that invested in biomed companies

Chapter 2: The growth curve

- · Went to business school and worked at Aetna as chief of staff, then president of Student Health and Great Lakes Region
- · Became president of Unified Women's Healthcare and faced challenges from the pandemic
- · First part of her career was about her, and the second chapter was about how to work through teams and make a much bigger impact
- IQ with EQ

Chapter 3: Build and Transform

- · Drive system-level impact through innovation & scale
- Founder and CEO, Advanced Primary Care for Rural Communities
- Now Chief Operating Officer for Blue Cross Blue Shield Association
- · Enable access, affordability
- "You don't need to know your final destination-just follow hard problems and build skills that allow you to make an impact

Health:

- Improved provider experience
- · Improved patient outcomes
- · Lower cost of care
- · Improved patient experience

How much do we spend on healthcare in the US?: \$5.3 trillion

How much do we spend per person compared to other countries? 2x

US ranked last on equity, access, and outcomes

The archaic system is factoring into this

- · Misaligned incentives
- IT
- · Fragmented financing
- Inequities

"Every broken system is an invitation for someone brave to fix it"

Rural areas are hard to get wif, so hardwired that telehealth could be helpful

What do you need to build a better healthcare system?

- System
- Design
- · Human-centered design
- · Connected care and delivery platform
- Aligned incentives and measurements (rewarded for outcomes, not activity and performance are transparent all known to all)
 - · No primary care doctors graduated because they make a lot less than specialists. People running after money to a degree
- 1. Work hard and build range: take on the hardest projects, classes, and experiences you can find. Effort and range are your foundation
 - · Companies with offices and people allow for pulling people in for questions more easily
- 2. Seek diverse exposure: explore different sectors, teams, and geographies. Gain perspective and learn how systems connect, not just how parts work
- 3. Choose your people wisely: surround yourself with curious, driven, high-integrity people. They will shape who you become
- 4. Know your values and protect them: define what matters most- family/friends, health, career/impact, values- and make decisions that align
- 5. Embrace challenge and keep growing: run towards hard problems. Growth lives on the edge of discomfort- where big impact starts

Questions:

Greatest piece of advice to avoid burnout:

- · Energy flows where we have certain times of the day with different activities
- · Prime time working, then a break for lunch, then a little bit, then activities with less focus
- · Say no: if you wouldn't do it the next day, don't say yes
- · sleeping, exercise, family, work

System broken, but companies are profiting from it being broken:

- Incentives
- · Data connecting and data flowing

Experience: regret the least (career)

- · Going to business school
- Knew was interested in general management
- Could have learned online, but was able to physically go and interact

Conclusions/action items:



2025/09/09- Artificial Insemination Straws

VARENYA VEGESNA - Sep 09, 2025, 7:23 PM CDT

Title: Artificial Insemination Straws

Date: 09/09/2025

Content by: Varenya Vegesna

Present:

Goals: By doing this research, I want to understand more about artificial insemination straws. I hope to understand this process and the use of the straws better. That way, I can contribute ideas to make this process easier and more effective with a straw slicer.

Content:

- These straws were first introduced in Denmark in 1940.
- In Europe in the 1970s, most of the inseminations were done by professionals, while in the US, they were done by people of varied skill levels.
- A smaller straw saves costs, but a larger straw is easier to use.
- A smaller, 1/4 cc straw has a 0.9 improvement in conception rates compared to a 1/2 cc straw.
- The difference is small enough that there is no need for a change in the US.

Citation:

[1] J. Stevenson, "Straws, straws, and more on A.I. Straws," Hoard's Dairyman, https://hoards.com/article-24721-straws-straws-and-more-on-ai-straws.html (accessed Sep. 9, 2025).

Conclusions/action items: In conclusion, I was able to learn more about the history of artificial insemination straws. I learned that the US mainly uses a 1/2 cc straw, as they are easier to handle for people of varied skill levels. Although there is a minor difference in the effectiveness between a 1/4 cc straw and a 1/2 cc straw, it is not big enough for the US to switch over.



2025/09/16- Artificial insemination of cattle

VARENYA VEGESNA - Sep 16, 2025, 7:46 PM CDT

Title: Artificial insemination of cattle

Date: 2025/09/16

Content by: Varenya Vegesna

Present:

Goals: After working on the PDS, I was curious about how artificial insemination of cattle works. By doing this research, I hope to understand more about the artificial insemination process and why a straw slicer is necessary. This way, I can contribute ideas to make the product successful.

Content:

- Lactating cows have a conception rate of 40%.
- · You have to do the insemination in an area that the cow is familiar with to reduce stress on the cow.
- You do not want to use your hands to touch the frozen semen straw, as this might thaw the semen; it will warm up when placed in the
 warm bath.
- You use a breeding gun to insert the semen into the cattle.
- · It is important that the semen is at the correct temperature.

References:

[1] "Artificial insemination of cattle," *extension.umn.edu*. https://extension.umn.edu/dairy-milking-cows/artificial-insemination-cattle#preparing-the-breeding-gun-2130361. (Accessed Sep. 16, 2025)

Conclusions/Action Items: In conclusion, this research helped me learn more about the artificial insemination process. It also allowed me to learn more about why this process is important and that the semen straws need to be handled with care. Using this information, I can apply this to my project by focusing on reducing cross contamination so that the artificial insemination can happen with minimal complications.



2025/09/09- Competing Design: Ultrasonic Cutting

VARENYA VEGESNA - Sep 09, 2025, 7:04 PM CDT

Title: Competing Design: Ultrasonic Cutting

Date: 09/09/2025

Content by: Varenya Vegesna

Present: Varenya Vegesna

Goals: By doing this research, I wanted to see what other products were already out there. That way, I could understand more about our project. Additionally, this research could also help me think of ways to make our design better than other designs already out there.

Content:

The goal of this design was to optimize the bovine semen by getting as many IVF uses from a single straw.

Materials and Methods:

- · This experiment used ovaries from Korean Hanwoo cows and frozen semen from Jersey breeding bulls.
- Used 1/2, 1/3, and 1/4 straw segments.

Results:

- The motility between the control differed in the top 1/2, top 1/3, and middle 1/3 portions of the straws.
- The top portions of the 1/2 and 1/3 straws had fewer spermatozoa than the lower portions.
- · The ultrasonic vibration does damage the spermatozoa slightly, but not significantly.
- One frozen semen sample can be used for four IVF trials.
- Can be cost-effective, but people might not have access to the materials.

Citation:

[1] S. W. Kim et al., "Ultrasonic cutting of frozen semen straws to optimize the use of spermatozoa for in vitro fertilization," MDPI, https://www.mdpi.com/2076-2615/10/11/2152 (accessed Sep. 9, 2025).

Conclusions/action items: In this research, I found out an effective way to slice straws is ultrasonic cutting. This method allows one straw to be used for four IVF trials, reducing costs and stops waste. However, this method utilizes a lot of tools a lot of people may not have. Also, this method was seen to cause some damage to the samples. In the future I want to research more competing designs.

VARENYA VEGESNA - Oct 24, 202

Title: Fluorescent Particles

Date: 10/16/2025

Content by: Varenya Vegesna

Present:

Goals: After meeting with Professor Williams on Friday, our team discussed using fluorescent dyes to test the contamination. However, with fluorescent particles, we would be able to quantify the than we could with fluorescent dye. I wanted to do research to help me better understand the particles.

Content:

- · The particles absorb light at one specific wavelength/color
- · Then emit light at another color
- · Valuable tools in flow cytometry, fluorescence micrscopy, fluid dynamics, and cell labling
- · Advantages:
 - Broad size range
 - · Lots of surface availability
 - · High fluorescence intensity

References

[1] "Bioparticles-Abvigen Inc," *Abvigen.com*, 2022. https://www.abvigen.com/content.asp?

55633&gad_source=1&gad_campaignid=20203860372&gbraid=0AAAAACtxfmeoInQQBV9n4tuaFWdWyTIG5&gclid=CjwKCAjwr8LHBhBKEiwAy47uUmipoqlj6FFbxb9eZWwC

2LZIZuDd-TnBuzTjwt8IURoC9dwQAvD_BwE (accessed Oct. 16, 2025).

Conclusions: Overall, I believe that using fluorescence beads could be a valuable tool to test contamination. There are a lot of advantages to using this method, such as being able data. Over the next week I want to continue researching more testing methods.

Action items:

2025-10-23- Sanitation Research

VARENYA VEGESNA - Oct 24, 2025, 9:26 AM CDT

Title: Sanitation Research

Date: 10-23-2025

Content by: Varenya Vegesna

Present:

Goals: The clients have stressed the importance of sanitation with this project. The material we are currently using is ABS. I wanted to do some research on how different cleaning materials react with ABS to make sure the clients could clean the product without it corroding or dissolving.

Content:

- Each chemical is rated on a scale from A to D on how it affects ABS
 - · A being excellent, D being a severe effect/ do not use
- Common cleaning materials include Acetone, Alcohols (general), Ethanol
- Acetone was rated a D, so we can not use that to clean it
- Alcohols (general) were also rated a D, so they can not be used as well
- · Ethyl alcohol was rated a B, good but not excellent
- Synthetic detergents were rated an A; however, it is unclear what the site considers synthetic materials, and if those are suitable to completely clean the product.

Refrences:

[1] "ABS Chemical Compatibility: Full Guide for Safe Usage," *Calpaclab.com*, 2025. https://www.calpaclab.com/abs-chemical-compatibility/?srsltid=AfmBOoqlvXE4sr18UJ6XfMvicLTuYg8vYlGbu1EX2jJefQDefBpogZWE (accessed Oct. 23, 2025).

Conclusions/action items: Using this data, we might want to consider using a different material. The common cleaning materials do not react well with the ABS. In the future, I want to research different materials that we can use to print.

VARENYA VEGESNA - Oct 02, 2025, 1:25 PM CDT

Title: Preliminary Designs

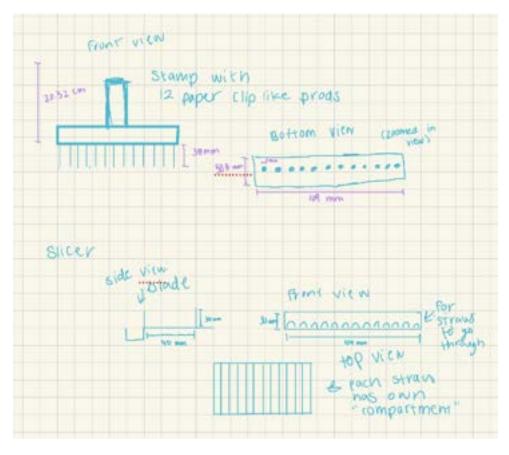
Date: 09/21/2025

Content by: Varenya Vegesna

Present:

Goals: My goal is to draw very preliminary designs. Then I can show these designs to my team and discuss our possible design ideas. These ideas are just rough sketches to share with the team.

Content:



Conclusions/action items:

After meeting with the team, chose three design ideas. Then, work with a partner to finalize one of the three design choices. Later this week, work on the design matrix and choose our top design.

2025-09-28 Preliminary Stamper Idea

VARENYA VEGESNA - Oct 02, 2025, 1:23 PM CDT

VARENYA VEGESNA - Oct 02, 2025, 1:44 PM CDT

Title: Preliminary Design Stamper

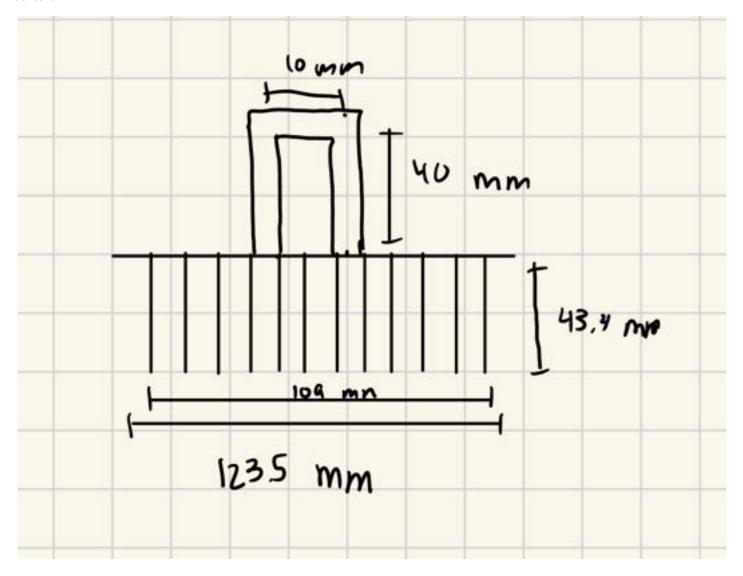
Date: 09/28/2025

Content by: Varenya Vegesna

Present:

Goals: My goal is to draw very preliminary designs. Then I can show these designs to my team and discuss our possible design ideas. These ideas are just rough sketches to share with the team.

Content:



Conclusions/action items:

On Monday, I will share these ideas with my team. We will then discuss our favorite designs. Finally, we will construct a design matrix to include in our presentation on Friday.

VARENYA VEGESNA - Oct 09, 2025, 11:10 AM CDT

Title: Bambu 3D Printer

Date: 10/09/25

Content by: Varenya Vegesna

Present:

Goals: After having a design consultation, the Bambu 3D printer was recommended to us. I wanted to conduct more research about this printer to better understand it and how it works. This way, we can understand our options and decide on our final material soon.

Content:

Key features:

- · Closed body for high-temperature filament printing
- Up to 20000 mm/s^2
- · Well polished hardware and software
- · Multi color capability



Refrences:

[1] "Bambu Lab P1S 3D Printer," *Bambu Lab US Store*, 2025. https://us.store.bambulab.com/products/p1s? gad_source=1&gad_campaignid=20326984537&gbraid=0AAAAAo9so7N-2NSPNZAOhksKGX9UaCPtm&gclid=CjwKCAjwup3HBhAAEiwA7euZurYFhUFigQJd-yilVCjYjzuxHMzmE7K4MYW-_UliZFkwyxgGe_vS3xoCVZwQAvD_BwE (accessed Oct. 09, 2025).

Conclusions/action items: This 3D printer would be a good 3D printer to use. It is very fast and can choose between multiple colors. I should also research other 3D printers the makerspace has and compare them to the Bambu 3D printer.

VARENYA VEGESNA - Oct 30, 2025, 9:44 AM CDT

Title: Nylon Printer Research

Date: 10/30/25

Content by: Varenya Vegesna

Goals: For our final product, we were thinking about using a nylon printer. I wanted to do more research about how durable nylon is, as well as how small it can print becuase our product dimensions are small. Overall, I wanted to learn more about the SLS Nylon printer.

Content:

- An unsupported vertical wall can be 0.6 mm thick, and a horizontal one can be 0.3mm thick.
 - Same goes for the supported walls
- Tolerance is 0.2-0.4 mm.
- If you are printing two things at once, you must have them at least 1 mm apart, but preferably 5 mm.
- The minimum hole diameter is 1 mm.
- · The build volume depends on what type of nylon you are using.

References:

[1] "Formlabs Customer Support," *Formlabs Customer Support*, 2025. https://support.formlabs.com/s/article/Design-specifications-for-3D-models-Fuse-1?language=en_US (accessed Oct. 30, 2025).

Conclusions/action items:

Overall, I believe this material would work as all of our dimensions are bigger than the minimum. This research was very useful as we were nervous that the nylon would not be able to print things as small as we needed. Next, I want to research how durable the nylon is, and if it will corrode in ethanol.

Title: Slicer Ideas

Date: 11/06

Content by: Varenya Vegesna

Present:

Goals: After our show and tell, we received multiple ideas on what to use for our slicer. However, there are pros and cons to all of the ideas. I wanted to take time to list these pros i

Content:

Bagel cutter/ Pizza cutter idea



Pros:

- Easy to use
- Stable
- Easy to clean
- Relatively cheap

Cons:

- Would be difficult to find one in the necessary size
- Rocking motion might cause cross contamination

Veggie Cutter Scissors



Pros:

- Very easy to use
- Smaller chance of cross contamination
- Can cut multiple very fast
- Size is closer to the size of our design

Cons:

- Might be hard to take apart and clean
- Unsure if blade is replaceable

Electric Knife



Pros:

- · Would be very fast
- Very little effort is necessary

Cons:

· Would be difficult to clean

- · High risk of cross-contamination
- Might be dangerous to have vibrating knife in lab setting

Refrences

[1]

"Choice 20" Rocking Pizza Cutter with Plastic Handles," WebstaurantStore, 2022. https://www.webstaurantstore.com/choice-20-rocking-pizza-cutter-with-plastic-handles/407PZZRCKR.html?srs

[2]

"Electric Knife with Ergonomic," Cusinart. https://www.cuisinart.com/electric-knife-with-ergonomic/CEK-30.html?

utm_source=google&utm_medium=paid_search&utm_campaign=MB~CUR_PT~GOOG_CC~DTC_IMP~N_KC~GEN_KMT~GEN_CN~CSNRT_Feed_Only_PMAX_PR~ALL_PK~TROAS&utm_
30&nb_ppi=&nb_placement=&nb_li_ms=&nb_lp_ms=&nb_fii=&nb_ap=&nb_mt=&gad_source=1&gad_campaignid=21480652252&gbraid=0AAAAADFjouLyAWePP9-tqkwQiwZp3GRuM&gclid=(

[3]

"2-in-1 Kitchen Scissors and Cutting Board, Multifunctional Food Chopper, Stainless Steel Blade, Ergonomic Handle," Walmart. https://www.walmart.com/ip/2-in-1-Kitchen-Scissors-and-Cutting-wmlspartner=wlpa&selectedSellerId=102845351&sourceid=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn&wmlspartner=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn_ad_34ba2672-106a-484b-a996-41cf96423ae3&veh=dsn_ad_34ba26

Conclusions/action items: This research was very helpful to help narrow down our slicer ideas. I believe that the Veggie cutter is our best option as it has the least risk of corss cou

VARENYA VEGESNA - Oct 29, 2025, 8:03 PM CDT

Title: Training documentation

Date: 10/29/25

Content by: Varenya Vegesna

Present:

Goals: Doing all these trainings helps me become better prepared to fabricate our project.

Content:

Sort Prignit Q





My Memberships					
Membership Type	Start Date	Explry Date	Renew	Card Info	
Machining	Wed, Ang 20 2025	Permanent	Not Renewable	N/A	
Shop Tools	Wed, Aug to 2025	Thu, Jan 2 3000	Not Reservable	N/A	
Laser Cutter	Wed, Aug no nous	Thu, Jan 2 3000	Not Renewable	N/A	
Shep Tools	Tue, Aug 20 2024	Thu, Jan 2 3000	Not Resemble	N/A	
Laser Cutter	Tor, Aug 20 2024	Thu, Jan 2 3000	Not Renewable	N/A	
Lab Orientation	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Reservable	N/A	
Shop Tools - Training Eligible	Tue, Aug per person	Wed, Dec 31 3000	Not Renewable	N/A	
Laser Cutter - Toxining (Digible	Tion, Aug 20 2024	Wed, Dec 31 3000	Not Reservable	N/A	

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This certifies that Varenya Vegesna has completed training for the following course(s):

Course	Assignment	Completion	Expiration
2024-2025 HIPAA Privacy & Security Training	2024-2025 HIPAA Privacy & Security Training	9/4/2025	
Biosafety 102: Bloodborne Pathogens for Laboratory and Research			8/1/2026
Biosafety 105: Biosafety Cabinet Use	Biosafety 105: Biosafety Cabinet Use Quiz	8/19/2025	No Expiration
Biosafety 106: Autoclave Use	Biosafety 106: Autoclave Use: Safety and Efficacy - Verification Quiz	8/19/2025	No Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024-2025	7/31/2025	7/31/2030
Chemical Safety: Cryogen Safety Training	Part 1 Final Quiz	8/19/2025	8/19/2030
Chemical Safety: Cryogen Safety Training	Part 2 Final Quiz	8/19/2025	8/19/2030
Chemical Safety: The OSHA Lab Standard	Final Quiz	8/11/2025	

Data Last Imported: 10/29/2025 07:54 PM

VARENYA VEGESNA - Nov 07, 2025, 12:58 PM CST

Title: Tong Lecture

Date: 11/07/2025

Content by: Varenya Vegesna

Present:

Goals:

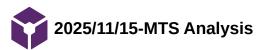
Content:

- Chapter 1: The Foundation
 - o Solve tangible problems, work hard, add value
- Chapter 2: Climb the growth curve
 - · Combine EQ with IQ to multiply impact and reach
 - · Atena: Chief of staff to the CEO
 - · Unified Women's Healthcare: President and Chief Operating Officer
- · Chapter 3: Build and Transform
 - · Drive system-level impact through innovation and scale
 - · Hopscotch Health: founder and CEO
 - o Blue Cross Blue Shield Association: Chief Operating Officer
 - Make healthcare affordable and accessible
- How much do we spend on healthcare in the US- 18% of GDP or 5.3 trillion dollars
- How much do we spend per person on healthcare vs OED countries- 2x
- 60% clinician burnout
- Underlying Challenges
 - · Misaligned incentives
 - Inequities (10-15 yr gap between zip codes)
 - Data silos and legacy IT
 - · Fragmented financing and regulation
- 1. Work hard and build range
 - · Take on hard projects, classes, and experiences
 - This helps build your foundation
 - · Look at companies where you can be in the office most of the time
- 2. Seek diverse exposure
 - Explore different sectors, teams, and geographies
 - · This will help gain perspective and learn how systems connect, not just how parts work
- · 3. Choose your people wisely
 - Surround yourself with curious, driven, and high-integrity people
 - This shapes who you become
- · 4. Know your values and protect them
 - o Define what matters most-family/friends, health, career/impact, values
 - Make decisions that align
- 5. Embrace challenge and keep growing
 - · Run towards hard problems
 - Growth lives on the edge of discomfort
 - This is where big impact starts

Questions:

- · Advice for burnout: Energy flows, at certain times in the day, you are built to do different things
 - o If it was tomorrow and you would say no, don't say yes to it when it is in 3 weeks

Conclusions/action items:



VARENYA VEGESNA - Nov 20, 2025, 12:51 PM CST

Title: MTS Analysis

Date: 11/16/2025

Content by: Lydia

Present: Varenya, Janice, Lydia

Goals: The three of us met up to go over our MTS testing and analyze the data. From the data we wanted to gather the max force it takes to push the content out of the straw. We also wanted to see if our data was good or if we needed to run more trials.

Content:

Initial forces

Test run 1: 0.6493 N Test run 2: 0.7136 N Test run 3: 0.4774 N Test run 4: 0.6966 N Test run 5: 0.4363 N

Average initial force: 0.5946 ± 0.1288 N

```
Code:
```

```
close all;
clear all;

[file, path] = uigetfile({'*'});
fullpath = fullfile(path, file);
data = readtable(fullpath);
disp=data(:,1);
force=data(:,2);
time=data(:,3);
force = table2array(force);
time = table2array(time);

figure;
plot(time,force);
xlabel("time (s)")
ylabel("force (N)")
```

```
mask = time >= 0 & time <= 1;
maxForce = max(force(mask));</pre>
```

Note: this code only finds the max force within the first 1 second of data collection, representing the initial force needed to push the cotton

Max Forces

Test run 1: 2.8296 N

Test run 2: 1.0295 N

Test run 3: 0.7077 N

Test run 4: 0.8492 N

Test run 5: 0.5647 N

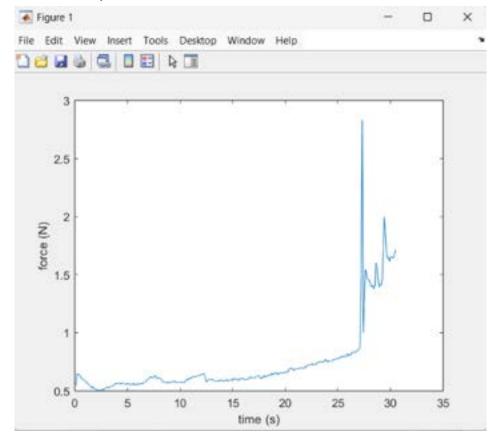
Average max force: 1.1962 ± 0.9292 N

Changes made in code

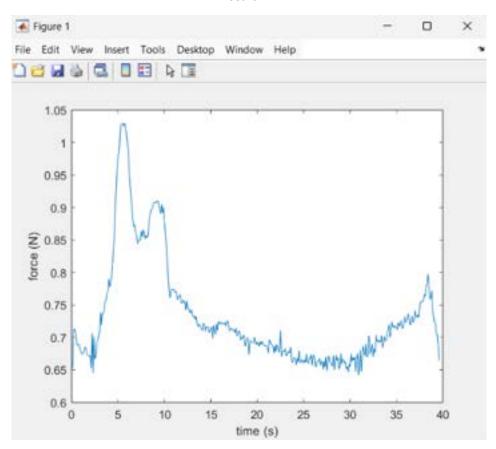
```
mask = time >= 0 & time <= 1;
maxForce = max(force(mask));</pre>
```

Note: this code finds the max force from the entire time the rod pushed the contents of the straw

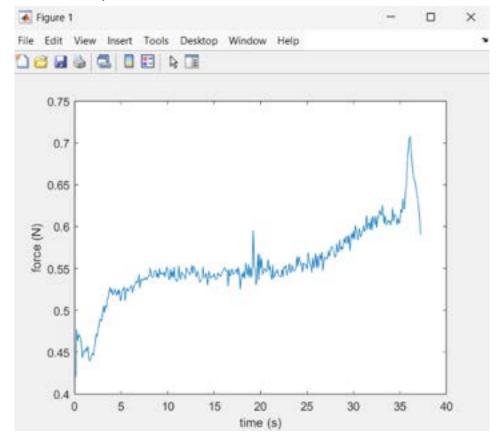
Graphs:



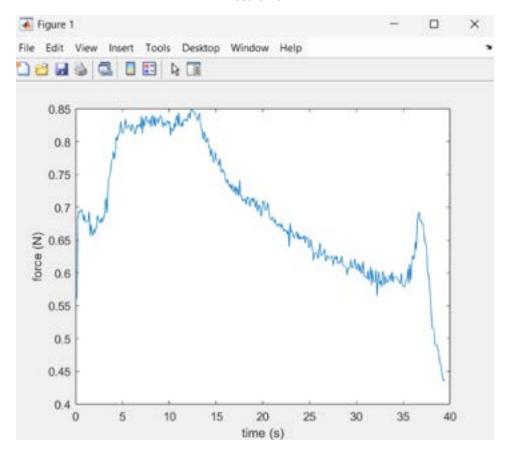
Test run 1



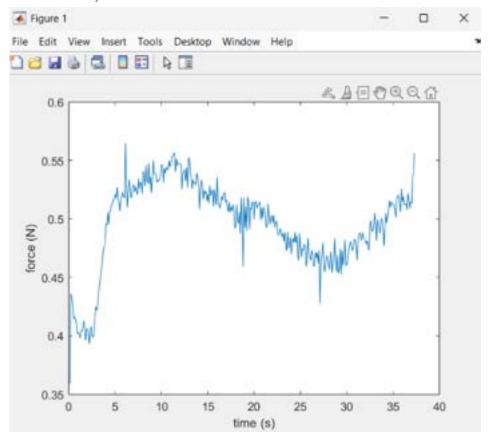
Test run 2



Test run 3



Test run 4



Test run 5

Conclusions/action items: The data we gathered was unusual, likely due to the setup or other noise from the MTS machine. The overall average force was 0.5946 N. In the future, we should report this data to our other teammates and clients. We should also start our contamination and sanitation testing.

9/10/2025 Artificial Insemination Straw

MEGAN LEE - Sep 10, 2025, 6:34 PM CDT

Title: Artificial Insemination Straw

Date: 9/10/2025

Content by: Megan

Present: Megan

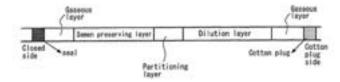
Goals: To understand how an insemination straw works and how it's designed.

Link: https://patents.google.com/patent/US9339360B2/en

Citation: K. Uchiyama and Y. Minato, "Artificial insemination straw." https://patents.google.com/patent/US9339360B2/en

Content:

- There is a partitioning layer in the straw to separate layers
- The volume ratio of the dilution layer to the semen preserving layer is 3:2 to 1:4
- The dilution layer and semen preserving layers are frozen
- There's one semen storage layer containing an anti-freeze agent on one side and a dilution layer with no anti-freeze agent on the other



- This invention is used to improve conventional straws for artificial insemination to improve conception rate

Conclusions/action items:

This shows an example of the possible insemination straw currently used at GVI. It has different components to separate parts of the sperm, and is closed on one side and plugged with cotton on the other. It will be important to know if the straws will be frozen in the procedure to know what the force to cut it should be.

MEGAN LEE - Sep 10, 2025, 7:06 PM CDT

Title: Bull Semen Quality

Date: 9/10/2025

Content by: Megan

Present: Megan

Goals: To understand what qualities make bull semen the most ideal for artificial insemination.

Citation: C. S. Silva *et al.*, "Semen quality of Nellore and Angus bulls classified by fertility indices and relations with field fertility in fixed-time artificial insemination," *Theriogenology*, vol. 212, pp. 148–156, Dec. 2023, doi: https://doi.org/10.1016/j.theriogenology.2023.09.001.

Content:

- The categories used to assess the quality of frozen semens include ejaculate volume, sperm concentration, sperm morphology, number of viable spermatozoa per volume unit, progressive motility after thawing, and motility after a heat resistance test
- Additional parameters include fluorescent markers for assaying the integrity of sperm membranes, the hypoosmotic test, and evaluation of chromatin integrity
- In vitro tests are representative only if they correlate with observed fertility rates in vivo
- Determination of acrosomal status via flow cytometry is also useful in evaluating sperm quality
- Can be measured using fluorescetly labeled plant lectins
- In the test, the semen samples were analyzed for subjective motility, CASA, FC, rapid thermoresistance test, and morphology
- To analyze the sperm, the samples had to be thawed in a water bath at 37 degrees C for a minimum of 60s

Conclusions/action items: There are many different parameters used to identify bull sperm quality. These include the ejaculate volume, sperm concentration and morphology, etc. In order to test the sperm quality, the samples must also be thawed.

MEGAN LEE - Sep 15, 2025, 4:27 PM CDT

Title: Wet Lab Conditions

Date: 9/15/2025

Content by: Megan

Present: Megan

Citation: "Laboratory Temperature and Humidity Requirements & Compliance | Primex," *OneVue Sense*, 2020. https://onevuesense.primexinc.com/blogs/onevue-sense-blog/laboratory-temperature-humidity-requirements

Goals: To find the conditions of the wet lab at GVI to understand the environment where the device will be used.

Content:

- In the US the FDA recommends labs to be 68 °F and 77 °F (20°C and 25 °C) with humidity levels somewhere between 30% and 50%
- Humidity and temp are the most vital conditions
- Improper temp and humidity can lead to contamination of specimens, poor bacteria growth, and other problems with lab equipment

Conclusions/action items: The operating environment and storage place of the device will be a wet lab condition. If GVI's lab is within regulatory standards, it will be 68-77 degrees F and between 30-50% humidity levels. This will be important when determining what materials we should use.



9/15/2025 Finding Force Using Pressure

MEGAN LEE - Sep 15, 2025, 4:33 PM CDT

Title: Finding Force Using Pressure

Date: 9/15/2025

Content by: Megan

Present: Megan

Citation: Looh Augustine Ngiejungbwen, Hind Hamdaoui, and M.-Y. Chen, "Polymer optical fiber and fiber Bragg grating sensors for biomedical engineering Applications: A comprehensive review," *Optics & laser technology/Optics and Laser Technology*, vol. 170, pp. 110187–110187, Mar. 2024, doi: https://doi.org/10.1016/j.optlastec.2023.110187.

Goals: To find an equation to determine the force needed to push through the straw's vacuum seal.

Content:

- Pressure is defined as force exerted per unit area on a system boundary
- Measured in N/m^2 or Pascal
- Atmospheric pressure is 1.013bar (101,300 Pascal)

Conclusions/action items:

In order to find the force needed to push the contents of the straw, the pressure equation can be rearranged to F = PA. We can use the atmospheric pressure for P and then use the area of the straw for A.

9/15/2025 Livestock Semen Storage Conditions

MEGAN LEE - Sep 15, 2025, 4:39 PM CDT

Title: Livestock Semen Storage Conditions

Date: 9/15/2025

Content by: Megan

Present: Megan

Citation: M. Wiebke, B. Hensel, E. Nitsche-Melkus, M. Jung, and M. Schulze, "Cooled storage of semen from livestock animals (part I): boar, bull, and stallion," *Animal Reproduction Science*, vol. 246, p. 106822, Nov. 2022, doi: https://doi.org/10.1016/j.anireprosci.2021.106822.

Goals: To understand the optimal conditions the insemination straws will be stored at.

Content:

- For bulls, the storage temperature should be 4-18 °C
- Storage time should be 1-3 days
- For bulls, a buffered medium is needed to secure a stable pH value
- Simple sugars such as glucose can be added as an energy source for spermatozoa

Conclusions/action items:

Bull sperm is typically stored at 4-18 °C for around 1-3 days. This will be important to know as our device will be constantly interacting with it, and should be able to withstand the temperature fluctiations of refridgerated semen to room temperature.



10/2/2025 3D Printing Material Chemical Resistance

MEGAN LEE - Oct 02, 2025, 11:13 PM CDT

Title: 3D Printing Material Chemical Resistance

Date: 10/2/2025

Content by: Megan

Present: Megan

Goals: To understand which 3D printing materials would be best to utilize in our design and won't corrode when cleaned with ethanol or bleach.

Citation: E. Ara, "Chemical resistance: The ultimate 3D printing materials corrosion test," *BCN3D Technologies*, Feb. 26, 2020. https://www.bcn3d.com/3d-printing-materials-corrosion-test/

Content:

- An experiment was conducted where different 3D printed materials were set into Nitro-P: an organic solvent used to dilute paints

PLA:

- The geometry of the piece had completely changed, with fractures and separation of layers
- The material resisted chemical corrosion

PET-G:

- The surface finish lost some of its brightness
- The piece significantly increased in flexibility
- The thickness of the sample increased by 10%

ABS:

- The solvent drastically affected the material
- The solvent reduced its thickness by 15%

TPU:

- Increase in volume; thickness increased by 150%

PA:

- The sample increased in flexibility, and the thickness increased by 10%

PP

- Did not show dimensional or aesthetic variations

PP GF30

- The sample did not show dimensional or aesthetic variations

Conclusions/action items:

After experimenting with different materials, it was shown that neither PP nor PP GF30 had been affected by the solvent and are ideal materials for our 3D printed parts.

MEGAN LEE - Oct 16, 2025, 10:18 PM CDT

Title: Fluorescent Microspheres

Date: 10/16/2025

Citations: Y. Lipovetskaya, "Fluorescent Microspheres - Properties and Applications," Cospheric.com, Feb. 05, 2015.

https://www.cospheric.com/fluorescent_microspheres_microparticles/fluorescent_spherical_powder.htm (accessed Oct. 17, 2025).

Content by: Megan

Present: Megan

Goals: To understand how to use fluorescent microspheres to quantify contamination testing

Content:

- Fluorescent microspheres are round particles that emit bright colors when illuminated UV light
- Fluorescent spheres offer extra sensitivity and detectability for analytical methods
- They are often used to trace spread of viruses
- Fluorescent spheres appear clear under ordinary light but are able to emit visible color when shone with UV light
- Fluorescent microspheres come in a variety of excitation wavelengths and emission wavelengths
- UV fluorescent microbeads vary based on size: submicron, 1-5 micron, 10-15 micron and 20 micron 1000 micron (1mm)
- Microspheres that are heavily loaded with fluorescent colorants are the most highly visible with the strongest fluorescent response
- Product can be stored at room temp and dispersed in water or air

Conclusions/action items:

Fluorescent microspheres are good options to use when testing the contamination rate. They only shine when emitted with UV light and are commonly used in liquid media. Next steps will be to learn how to use the UV microscope to detect them and also look at buying these beads.



10/23/2025 Calibration Protocol for Plate Reader Measurments

MEGAN LEE - Oct 23, 2025, 10:41 PM CDT

Title: Calibration Protocol for Plate Reader Measurements

Date: 10/23/2025

Content by: Megan

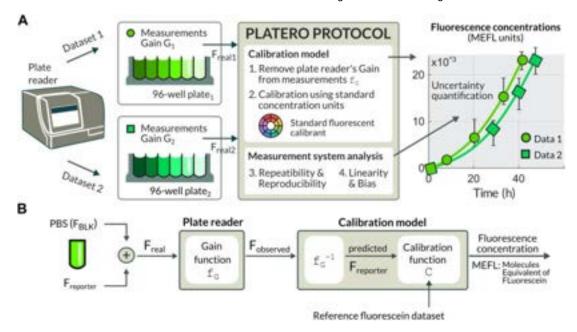
Present: Megan

Goals: To understand how a plate reader would work to detect contamination.

Citation: A. González-Cebrián, J. Borràs-Ferrís, Y. Boada, A. Vignoni, A. Ferrer, and Jesús Picó, "PLATERO: A calibration protocol for plate reader green fluorescence measurements," Frontiers in Bioengineering and Biotechnology, vol. 11, Jan. 2023, doi: https://doi.org/10.3389/fbioe.2023.1104445.

Content:

- Plate readers provide a measure of the light emitted by a certain fluorescent molecule
- These measurements are generally expressed in arbitrary units and affected by the measurement device gain this limits range of measurements in a single experiment
- PLATERO: a calibration protocol to remove the gain effect of the measurement device
- The fluorescent intensity values are transformed into units of concentration using a Fluorescein calibration model
- Two main classes of devices are used to measure fluorescence: flow cytometers and plate readers
- The amount of Green Fluorescent Protein can be estimated using a measure of the light emitted a certain fluorescent molecule



Conclusions/action items:

We can use a well plate reader to detect the amount of fluorescence in a sample. This can be useful to quantify the amount of contamination between different straws. This article shows how to calibrate the plate reader in order to get accurate results.



10/31/2025 Protocol to Quantify Samples Using Plate Reader

MEGAN LEE - Oct 31, 2025, 5:17 PM CDT

Title: Protocol to Quantify Samples Using Plate Reader

Date: 10/31/2025
Content by: Megan

Present: Megan

Goals: To understand how to use a plate reader to quantify contamination

Citation: L. Anconelli et al., "Protocol to quantify total intracellular magnesium in small samples using a fluorescent plate reader and fluorescent dye," STAR Protocols, vol. 6, no. 3, p. 103956, Jul. 2025, doi: https://doi.org/10.1016/j.xpro.2025.103956.

Content:

- If using an Ensight plate-reader, it uses Kaleido software, which can be exported into Excel
- From the data derived from the reading, you can determine the average fluorescence with each concentration a calibration curve is drawn
- The curve will be described from a typical equation of a line
 - Fluorescence Intensity (F) = a + b[Mg]
 - [Mg] = (F-a)/b where F = average fluorescene
 - Total Mg content (nmol/10^6 cells) = ([Mg] x V x 10^6)/n where n = number of cells per well and V = total volume per well

Conclusions/action items:

Depending on what plate reader we use, we can quantify the fluorescence intensity as well as other data points using the corresponding equations.

9/25/2025 The Compartments Design Idea

MEGAN LEE - Sep 25, 2025, 10:17 PM CDT

Title: The Compartments Design Idea

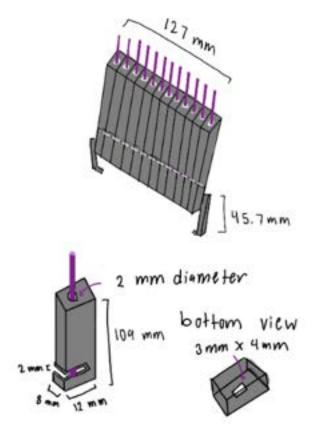
Date: 9/25/2025

Content by: Megan

Present: Megan

Goals: To create a design idea for the frame of the stamp and slicer device.

Content:



- For this design, each straw will have a little compartment where the top part is held snug so it won't move when being stamped and sliced. There is a little divit in each section where a large rectangular blade will go through and slice the part of the straw for each row. On the bottom part of the compartment, there is a larger hole where the leftover straw can be easily removed.

Conclusions/action items:

The compartment design idea is a feasible idea for the frame of our device. We will use this design in the preliminary matrix and compare the ideas to see which one we should try to pursue.

9/30/2025 Retractable Stamper Design

MEGAN LEE - Sep 30, 2025, 11:59 PM CDT

Title: Retractable Stamper Design

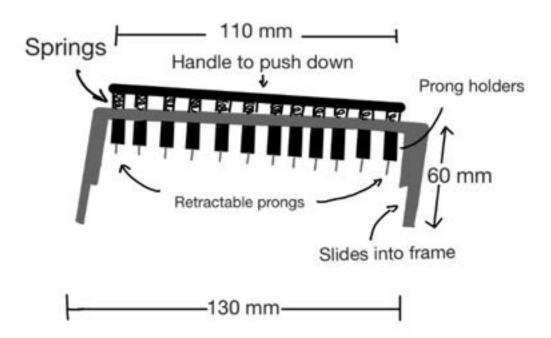
Date: 9/30/2025

Content by: Megan

Present: Megan

Goals: To create a stamper design

Content:



- Handles are compatible with the compartment design; easily slides into grooves on the frame
- Mechanism is similar to a mechanical pencil; when you push down, the prongs slowly protrude
- Uses a spring mechanism to push out prongs
- Prongs are able to be taken out completely and easy to replace

Conclusions/action items:

This stamper idea is compatible with our chosen frame idea and has compartments for the prongs which make it easy to be placed over the straws. It has a design similar to a mechanical pencil, where you can push out/retract the prongs. The only con is that this might be harder to fabricate and there are many moving parts.

MEGAN LEE - Oct 09, 2025, 1:04 PM CDT

Title: CAD Frame Idea

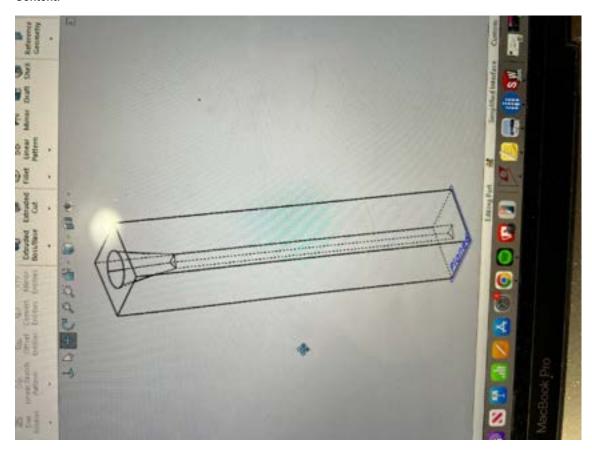
Date: 10/9/2025

Content by: Megan

Present: Megan

Goals: To create our frame idea on SolidWorks

Content:



- This design features a funnel opening, which makes it easier for the straw to be placed through
- The funnel tapers into a triangular opening, which will hopefully help to keep the straw in place
- The whole thing is enclosed in a square box that is the same dimensions of the well plate, to make it easier to duplicate across the entire row

Conclusions/action items:

This design is modeled from the ideas given in the consultation meeting. Our next steps will be to 3D print it and make any further changes after that.



10/16/2025 Updated CAD Frame with Dimensions

MEGAN LEE - Oct 16, 2025, 10:44 PM CDT

Title: Updated CAD Frame with Dimensions

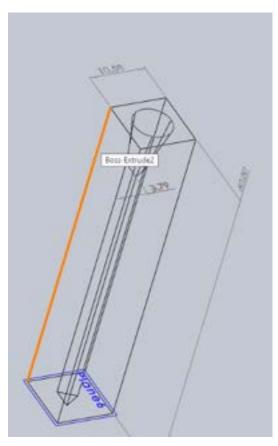
Date: 10/16/2025

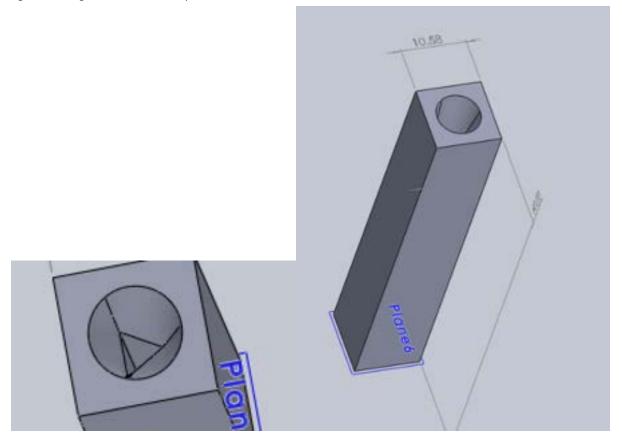
Content by: Megan

Present: Megan

Goals: To create a 3D design of the frame component

Content:





Conclusions/action items:

These are the updated dimensions with a 3 mm triangle height to fit the straws better. Next steps will be to merge 12 of them and figure out how to attach it to the stamper and well plate.

MEGAN LEE - Oct 23, 2025, 10:31 PM CDT

Title: CAD Full Frame

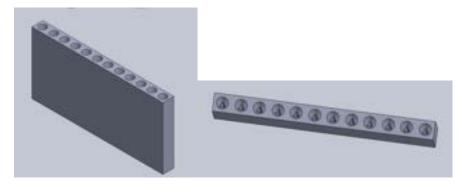
Date: 10/23/2025

Content by: Megan

Present: Megan

Goals: To create the compartments for all 12 straws

Content:



- This design is a little different from the previous ones as the triangles are rounded instead of having sharp edges. This will hopefully reduce any gaps when the stamper goes in
- The compartment was mirrored to create 12 identical holders

Conclusions/action items:

This frame spans 127 mm. Our next steps will be to see if this dimension works with the well plate. We will also start to plan out the dimensions for the corresponding stamper and well plate to ensure they all fit well together.

11/6/2025 Updated CAD Full Frame

MEGAN LEE - Nov 06, 2025, 9:28 PM CST

Title: Updated CAD Full Frame

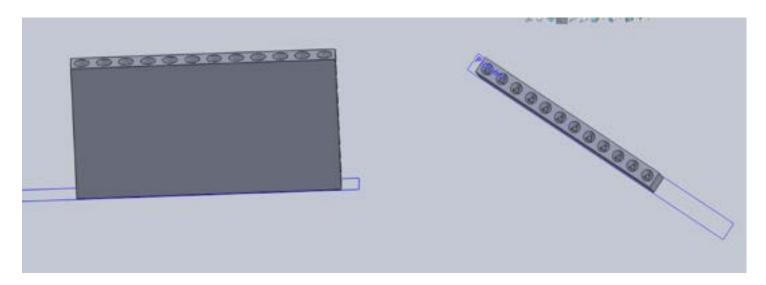
Date: 11/6/2025

Content by: Megan

Present: Megan

Goals: To create an updated SolidWorks drawing of the compartments for the full 12 straws

Content:



- height of the triangles are now 2.75 mm and are filleted in hopes that it reduces gaps between the straws
- The whole frame dimension is smaller than original to hopefully align the straws better
- Next steps will be to add the slots on the sides to insert the stamper and well plate frame

Conclusions/action items:

This new design is smaller overall and has a smaller triangle height than the previous full-frame. This will hopefully reduce any gaps in the straws and make them more aligned.

MEGAN LEE - Nov 12, 2025, 8:57 PM CST

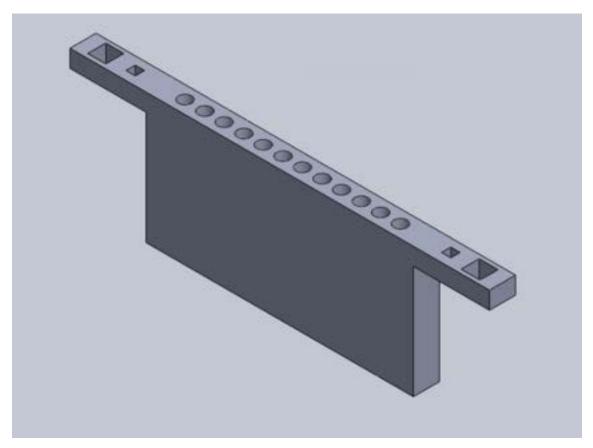
Title: CAD Frame with Handles

Date: 11/12/2025
Content by: Megan

Present: Megan

Goals: To add a handle with holes on the compartments so well plate and stamper can align.

Content:



Conclusions/action items:

This new design added a handle that is spaced out to align with the stamp and well plate frame. The next step will be to make the holes a little bigger and also change dimensions of the compartments themselves.

MEGAN LEE - Nov 20, 2025, 11:32 PM CST

Title: New Compartment Dimensions

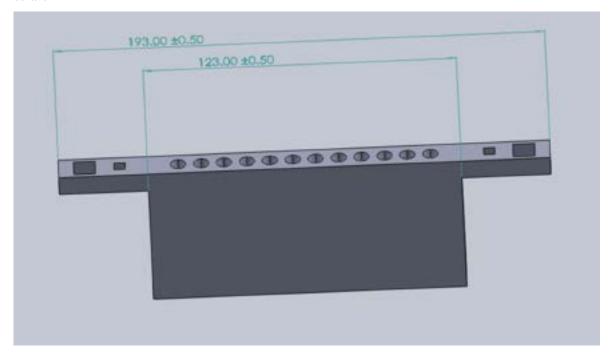
Date: 11/20/2025

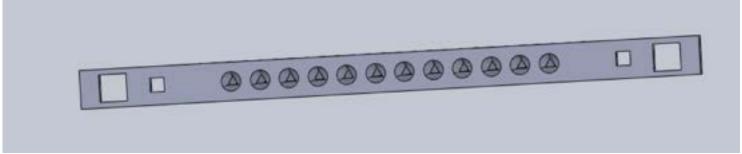
Content by: Megan

Present: Megan

Goals: To make the compartment holes smaller so they fit snug to the straws

Content:





- Side holes were changed to be bigger
- Triangles were changed to be 2.8 mm and were unrounded

Conclusions/action items:

This print turned out to fit the well plate holder and stamper better. However, the triangular holes are too tight and need to be increased to 2.9 mm. We also need to reprint this in Nylon for our final design.



12/6/2025 Updated Compartments and Stamper without Handles

MEGAN LEE - Dec 06, 2025, 5:32 PM CST

Title: Updated Compartments and Stamper without Handles

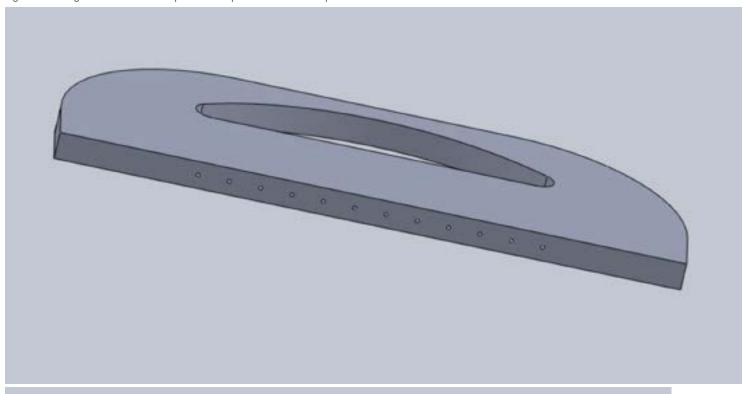
Date: 12/6/2025

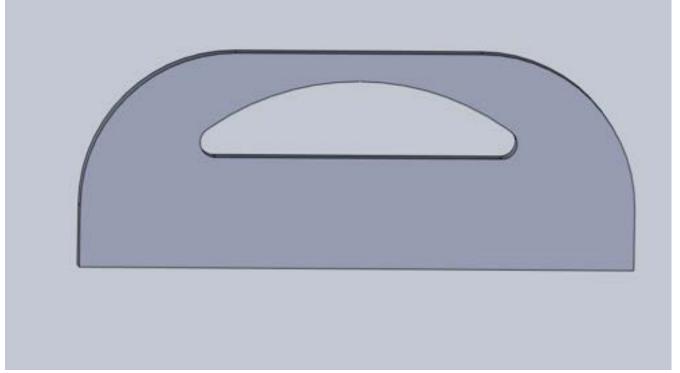
Content by: Megan

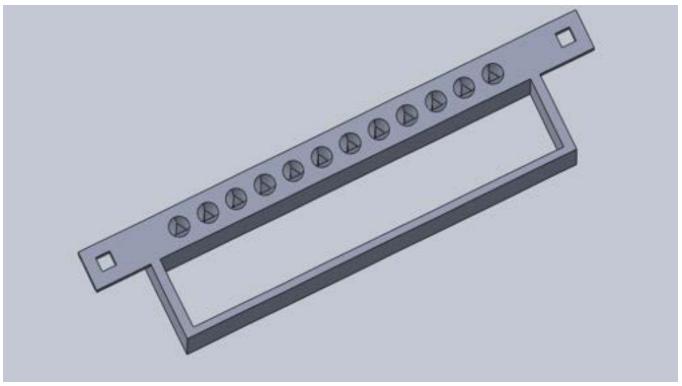
Present: Megan

Goals: To create a new stamper without handles and corresponding compartments.

Content:







- This new stamper has the same hole design for the prongs, but doesn't have a handle that slips into the compartments
- This was due to problems aligning the prongs with the straws while the handle was originally designed to help with alignment, it just seemed to impede the user instead
- The new stamper has an ergonomic handle and is made of resin which can resist ethanol and other cleaning materials
- Compartments stayed the same except that the height of the triangle is increased to 2.95 mm and doesn't have the slits for the stamper
- This new compartment will also be made with resin

Conclusions/action items:

The biggest change was in the stamper, where the handles were taken off and replaced with an upper ergonomic handle instead which allows flexibility for how the user stamps the straws. Both of these prints will be printed in resin.

MEGAN LEE - Oct 30, 2025, 12:18 PM CDT



Download

Human_Subject_Certificate.pdf (77.9 kB)

MEGAN LEE - Sep 10, 2025, 2:07 PM CDT

Title: BME 300 Lecture 1 - BME Career Prep

Date: 9/10/2025

Content by: Megan

Present: Megan

Goals: To get career advice and prepare for the BME Career Fair

Content:

Job Search Tips:

- Keep track of what you do
- Quality of source matters: Handshake, LinkedIn, etc...
- Connect before you are a candidate (gain connections!)
- Make sure to follow about 2-3 weeks
- Find a person to connect with
- Experience is better than no experience

Resume Tips:

- Tailor your resume to the position
- Try to integrate key words
- Your resume is always under construction
- You don't need to put dates on projects

Cover Letters:

- Always based on the job posting
- Custom to each job
- If it doesn't ask for a cover letter, don't put one in
- Only put if it's required or if it'll help your application

Intro: who you are, applying for, where you found it, and "thesis" statement:

Thesis: Based on my experience in A and B, I believe I would be able to make a difference in the X role at Y company

Paragraph all about A

Paragraph all about B

Why this employer/role + closing/next steps

Career Fair Advice for BME:

- Identify your purpose
- Looking beyond the obvious
- Research the employer
- Develop your "valued added" statement
- Write objective on resume for career fairs

- In skills section, add technical ones not soft ones

Elevator pitch: introduction, research, ask a question

Conclusions/action items:

There are several things to do to prepare for the Engineering Career Fair next week. Make sure your resume is updated and for the career fair, add an objective. At the fair, make sure to do research of the employer before and look beyond the obvious. For applying in general, make sure to try to find a contact person and reach out to them if you haven't heard in 2-3 weeks.

MEGAN LEE - Sep 17, 2025, 2:02 PM CDT

Title: Lecture 2 - Leadership

Date: 9/17/2025

Content by: Megan

Present: Megan

Goals: To understand qualities to make an effective leader

Content:

- Important qualities of an effective leader: communication and listening; people skills
- Anatomy of a good leader:
 - Self-awareness: understand your strengths and weaknesses
 - Vision: provide direction and purpose, set goal
 - Transparent: clear processes and open to feedback
 - Communication, decision-making

You can practice leadership at a variety of levels: organizational - team - interpersonal - personal

- Styles of leadership
 - Power model
 - Servant: mutual service
 - Authentic

Servant leadership: being of service to others, sharing power, listening and understanding

Authentic leadership: building self esteem and self-awareness, emotional intelligence, creating authentic relationships

- Leadership in industry: managers and mentors show servant and authentic leadership as they provide feedback and give guidance
- Leadership in camp: servant as they are very empathetic and understanding
- Leadership in discussions/classes: some show power and dominate the conversation; not very helpful
- I see myself as a process-oriented and thought-oriented leader
- Leadership doesn't require a particular job title
- Exploring how you want to lead: self-assess, observe and reflect, seek out feedback
- Goal setting: My goal for this semester/year is to become better at communicating my ideas and also making sure to check in other people to hear their opinions. In the past, I felt like I hide my opinions and wasn't open to speaking out. This time, I want to be open with what I'm thinking, regardless if my ideas are fesible or not. I also want to make sure that I am actively trying to mentor the sophomores and getting their opinions. Sometimes, it seems daunting to share ideas in front of the juniors, so I want to make sure they feel like they are in a comfortable space to openly share their thoughts and ideas. Some ways which I can track my progress is by getting feedback from my other group mates. I can make sure that they see that I am sharing my ideas and also that I'm inclusive to others' ideas as well.

Conclusions/action items:

There are different types of leadership: power, servant, and authentic. Overall, servant and authentic leadership is what I see most often and are the most effective. Additionally, looking at my strengths, I feel like I fit in as a process-oriented and though-oriented leader. My goal for this semester is to become better at communicating and be a helpful mentor to the sophomores. I can do this by simply being aware of what I'm saying/how I'm interacting with the group.

MEGAN LEE - Sep 24, 2025, 2:08 PM CDT

Title: Lecture 3 - Peer Mentoring

Date: 9/24/2025

Content by: Megan

Present: Megan

Goals: To understand how to become a better peer mentor to the 200 students

Content:

- Why are you mentoring BME 200 students?
 - To teach them what we've learned so far and advise that we wish we knew when we were in their shoes
 - It's an experience to become a better leader and mentor
 - Peer mentors are more approachable, mentees are more willing to ask questions
 - Share experiences
 - Increases belonging
 - Mutual benefits
 - Transferable Skills: leadership, communication, active listening, study practices, self-awareness, interpersonal skills

General benefits of mentoring

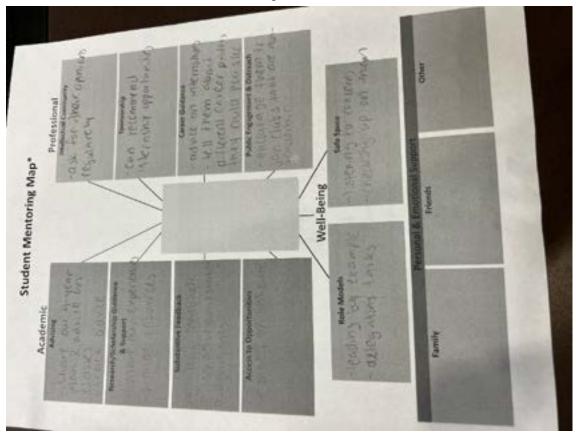
- Increased self-esteem/confidence
- Increased patience
- Build positive habits
- Foster personal growth
- Help identify gaps in your knowledge

What does it mean to be a good mentor?

- Having people get to know you as a person; having them ask about your career goals, hobbies, etc. helps to make them more approachable and open up more
- Building trust, psychological safety, reliability, support, being available, and transparency
- Listen effectively, get rid of distractions
- React to ideas, not to the person

What do you wish you knew in BME 200?

- That I didn't need to know everything right away I would learn it later
- Using advisors for advice
- Knowing what resources are available
- Understanding that what I did in the project could be potentially put on a resume and transferable for internships



Conclusions/action items:

I learned a lot about becoming a better mentor. I learned that there are many categories that you can provide mentorship to: academic, professional, and well-being. I will take what I learned today to put it into action and effectively mentor our sophomores.

10/1/2025 Lecture 4 - Sustainability in BME

MEGAN LEE - Oct 01, 2025, 2:17 PM CDT

Title: Lecture 4- Sustainability in BME

Date: 10/1/2025

Content by: Megan

Present: Professor Hicks and BME 300 Lecture

Goals: To understand what sustainability in BME looks like

Content:

- Circular economy: Keeping resources circulated in the economy instead of going to waste
- Lifecycle assessment: able to track carbon footprint
- There can be environmental choices that are also economic
- There are many environmental impact criteria: ecotoxicity, respiratory effects, and electricity
- Coffee debate: is it more sustainable to use ground coffee or disposable coffee cups?
 - They have the equal amount of carbon footprint
 - Ground coffee needs labor, transportation, electricity cost, etc
- What are ways to make our design more sustainable?
 - Disposable vs reusable
 - How much energy to clean things
 - Lifetime of devices
 - Substitutability
- Brainstorming ways to make our design more sustainable:
 - Reusable prongs; look at materials
 - Look into durability of our components
 - Look into 3d print materials to see which is most sustainable; easier to be cleaner
 - Which 3d printing machine would take less time

Conclusions/action items:

MEGAN LEE - Oct 01, 2025, 3:34 PM CDT

Conclusion: Sustainability is an important factor to consider when thinking about BME design. We can factor lifecycle assessment when thinking about our project design.

MEGAN LEE - Oct 08, 2025, 2:08 PM CDT

Title: Lecture 5 - WARF

Date: 10/8/2025

Content by: Megan

Present: BME 300 Lecture

Goals: To learn about WARF and how to patent our designs

Content:

- WARF facilitates IP rights and commercial licenses
- Examples of technology transfer include: intellectual property licenses, industry sponsored research, consulting arrangements, fee for service
- Four common types of IP: patents, copyrights, trademarks, trade secrets
- CopyrightsL protection for creative works that are expressed in a tangible medium, a wide range of subject matter, including software code
- Trademarks: protection for names, marks, logos, dress, etc
- Trade secrets: can be used to protect anything of value, protection is good so long as the concept is not generally known
- A patent is a property right, granted by a governmental agency ex. US Patent and trademark office
- Patent holder has right to exclude others from making, using, selling, or importing the claimed invention

There are 3 different types of US patents:

- Design: 15-year term, limited to ornamental features
- Plant: new variety, 20-year term
- Utility: provisional 1-year placeholder, non-provisional: 20-year term

Utility (non-provisional) patents:

- Issued for the invention of a new and useful process, machine, manufacture, or composition of matter
- A quid pro quo with the USPTO and the public
- Often takes 2-5 years to issue after filing (patent examination)
- Costs, on average, \$30k mostly attorneys' fees

Requirements for patenting:

101: eligible; cannot be a product of nature, an abstract idea, or a natural phenomenon

102: novel; it must be new

103: non-obvious; it can't be a simple modification or combination of existing concepts

112: enabled and described; must provide enough detail to teach others how to make or use the invention

WARF bases its decision on accepting an innovation into our portfolio on:

IP Considerations

Licensing Considerations

Licensing the IP is the next step in transferring the technology

- Values of licensing to the company:
- · Reduces R&D costs, improves time to market, opportunity to enter new markets and expand the company quickly
- New features or products provide additional revenue opportunities
- Determining the Value:
- Technology application, key selling points/features/benefits
- · Technology trends
- Market size, trend, competition
- Industry standards/historical deals

Can Al invent? No

Conclusions/action items:

WARF helps students/faculty members patent their inventions. There are different types of patents and many necessary steps in order to go through the patent process.



10/15/2025 Lecture 6 - Bioengineer It. Protect It.

MEGAN LEE - Oct 15, 2025, 2:09 PM CDT

Title: Lecture 6 - Bioengineer It. Protect It.

Date: 10/15/2025

Content by: Megan

Present: Megan

Goals: To understand patents and the importance of them

Content:

- Legal Career Paths for Engineers in IP

Technical Advisor - STEM degree

Patent Agent - STEM degree + patent bar

Patent Examiner - STEM degree

Patent Attorney - Law degree + patent bar

Patent Litigator - Law degree (STEM degree + Patent Bar optional)

IP License Attorney - Law degree

Tech Transfer Manager - STEM degree preferred

Engineer - STEM degree

- Skills from Engineering to IP

Research - determine if an invention is truly new

Analytical reasoning - claim drafting/infringement analysis

Technical writing - translate complex technical concepts into clear, precise language

Communication - explaining tech to non-experts and Patent Examiners

Creativity - problem - solving in patents/creating competitive products

Collaboration - cooperate with colleagues and external professionals

 $\label{project Management - manage resources, meet deadlines, and organize tasks \\$

IP Ownership in the Biomedical Industry:

University: disclose before publishing; university usually owns IP; possible license opportunities

Company: employer typically owns inventions, trademarks, copyrights and other IP

Startup: you own IP; file early, use NDAs, documental development

- Disclose internally first
- Publishing before filing and offers for sale = lost patent rights abroad and possible loss of rights in the US
- Posters or abstracts can count as public disclosures
- First to file system

Legal and Ethical Duties of Engineers

- Respect others' IP
- Keep invention notebooks

- Understand inventorship vs. authorship

Main types of IP: Patent, Trademark, Copyright, Trade Secret

What Makes an Invention Patentable

Novelty - must be new

Non-obviousness

Utility

Enablement - must describe how to make and use

Trademark: words, devices, symbols or composite of both

Conclusions/action items:

After creating a design, you need to protect it. A way to do this is to get it patented. There are many steps to take in order to make sure your invention is patentable. If you want to pursue a career in this field, there are many different opportunities, and is especially achievable with a STEM degree.



10/22/2025 Lecture 7 - Fall Post Graduate Planning

MEGAN LEE - Oct 22, 2025, 2:01 PM CDT

Title: Lecture 7 - Fall Post Graduate Planning

Date: 10/22/2025

Content by: Megan

Present: BME 300 Lecture

Goals: To understand what options there are post grad.

Content:

- · Masters, MS
 - · Stepping stone/change directions/gain depth
 - · Industry focused
 - · Generally one year
 - Reasons: Rewrite your story, MD: Need time to prep for MCAT or apply for Med schools
 - Will fill in gaps in resume, higher level of skills
 - · More experiences
- · Doctoral, PhD
 - Desire to be an independent researcher
 - · Write research grants
 - · Work in academia
 - · Lead projects in industry, startups, and consulting

3 MS options within BME:

- Research (typically 1.5-2 years)
- Accelerated programs (1 year)
 - Special for UW BME BS students: don't need letters of rec, no transcripts

Follow your passion

- Network!
- · Conferences!
- Utilize your lab PI here
- Build your resume REU
- Honors in research look into this

Conclusions/action items:

There are many options to go into post grad. There are PhD and Master programs avaliable depending on what you want in your career path. Get involved but also learn how to balance!

MEGAN LEE - Oct 29, 2025, 2:10 PM CDT

Title: Lecture 8 - Regulation

Date: 10/29/2025

Content by: Megan

Present: Lecture BME 300 and Dr. Kip Ludwig

Goals: To understand how the FDA regulates medical devices

Content:

- FDA determines that the benefits outweigh the risks
- · Class I: Low Risk
 - o doesn't require FDA
- Class II: Moderate/Controlled Risk
- · Class III: High risk
- · FDA didn't start regulating medical devices until 1976
- · Recent FDA recalls:
 - Phillips PDAP
 - · Abbott's neurostim systems
- FDA found that from spinal cord simulators, 200k implanted throughout all companies 107k medical device reported
 - 500 associated with a patient death
 - o 78k associated with a patient injury
 - o 29k associated with device malfunction
 - Growth hormones derived from cadavers who had Alzheimer's caused Alzheimer's in the children who were implanted with the hormones

Conclusions/action items:

There are many regulations in place before a device can go into the market. The regulations are very dependent on the Class of the medical device as well as the product itself and its uses. Although there have been many regulations, there have been multiple medical device recalls, which have caused multiple patient deaths and injuries.

11/5/2025 Lecture 9 - Regulation Strategy

MEGAN LEE - Nov 05, 2025, 2:10 PM CST

Title: Lecture 9 - Regulation Strategy

Date: 11/5/2025

Content by: Megan

Present: BME Lecture 300

Goals: Understand the overall structure of FDA, how these regulations guide product development, and learn what a quality mindset is

Content:

- · Genome Editing, Gene Delivery, Cell Therapy
- 351 Products: biologic product class, homologous use (taken from patient and put back in), FDA approval required for marketing, assured bioactivity and purity, novel design, high barrier to entry, 12 year marketing exclusivity
- 361 Products: HCT/P product class, FDA approval not required, no clinical claims for labeling claims, bioactivity and purity not tested, low barrier to entry
- · A target product profile is your product vision
 - o Core: indication and patients, efficacy, safety, dose and regimen, route of administration
 - Clinical development planning: clinical pathway, regulatory pathway, timelines, cost, risk
 - o CMC: product attributes, purity, degradants, biocompatibility, storage, stability, container
 - · Is it medically and commercially compelling?
- · Considerations when developing a 351-regulated CGT: nonclinical, quality, clinical, regulatory
- · Quality: a system that documents policies, processes, internal rules, procedures, and other records to ensure consistent quality
- · Career options within a regulated environment: chemistry, manufacturing, controls
 - · Process development, manufacturing development

Conclusions/action items:

Having a quality mindset is very important for a job in industry, especially one in biotech. Quality is a system of documenting policies, processes, internal rules, and other records to ensure that there is consistent quality.



11/12/2025 Lecture 10 - An Introduction to Research the IRB

MEGAN LEE - Nov 12, 2025, 1:58 PM CST

Title: Lecture 10 - An Introduction to Research the IRB

Date: 11/12/2025

Content by: Megan

Present: Megan + BME 300 Lecture

Goals: Learn about IRB history/basics and resources from Madison IRB

Content:

- · Ethical rigor and scientific rigor go hand in hand
- · Ethical Research Frameworks:
 - Nuremberg Code, 1947: Emphasis on voluntary consent
 - o Declaration of Helsinki, 1964: focus on medical research
 - · National Research Act, 1974: US response to US Public Health Service Untreated Syphilis Study
- · Belmont Report:
 - · Respect for persons/autonomy
 - Beneficence: maximize possible benefits and minimize possible harms
 - Justice
 - · Research should be voluntary
 - · Applying the Belmont principles:
 - 1991 Department of Health and Human Services 45 CFR 46
 - Common Rule: criteria for approving research, protections for vulnerable groups, requirements for IRB operations
 - 2018 Revised Common Rule
 - Modifications to reduce administrative burden
- IRB Composition
 - Diversity of membership required:
 - race, gender, cultural backgrounds
 - Scientific expertise
 - Non-scientists
- IRB Purpose
 - Protect rights and welfare of people enrolled in research
 - · IRBs review human research according to:
 - Ethical principles
 - Belmont Report
 - Federal regulations
 - Common Rule, HIPAA, FERPA
- IRB Review Requirements:
 - · Requires IRB review IRB review of all research involving human subjects, including exempt human subject research
- · Benefits need to be reasonable compared to the risk
- Research: a systematic investigation, designed to develop or contribute to generalizable knowledge
- · UW-Madison IRB Resources:
 - IRB website
 - Arrow

Conclusions/action items:

The IRB is very important when submitting a review. The IRB is designed to protect rights and welfare of people enrolled in research and is made of a diverse group of members. A big factor that the IRB considers when reviewing a research is that the benefits need to be reasonable compared to the risks. There are many UW-Madison IRB resources for further information.



11/19/2025 Lecture 11 - Medical Devices Into Industry

MEGAN LEE - Nov 19, 2025, 1:55 PM CST

Title: Lecture 11 - Medical Devices Into Industry

Date: 11/19/2025

Content by: Megan

Present: BME 300 Lecture

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

Content:

- · NDP in the medical device industry is:
 - · Highly regulated, expensive, resource intense, competitive
- Selecting and prioritizing projects
 - · Corporate Business Strategy Product portfolio review project review budgeting and resource allocation
- · Types of NPD Projects:
 - · Line extensions: addition of additional sizes and configurations
 - · Produce improvements: existing product change due to market feedback and/or new customer needs
 - · New-to-company: product line that is not new to market but is new for the company
 - New-to-world: innovative products that create completely new markets
- · Managing NPD: Stage-Gate Process
 - Stage 0: ideation
 - Stage 1: exploration
 - · Stage 2: concept development
 - · Gate review: Go/no-go decision
 - Stage 3: design development
 - · Stage 4: design confirmation
 - Gate review: design freeze
 - Stage 5: design transfer and commercialization
 - · Gate review: launch
 - Post-market surveillance
- · Case study: fluid management solutions for high volume cases existing in 2007
 - Stage 0: choose area of opportunity, review market trends, conduct primary and secondary market research, identify customer unmet needs, create high-level ideas
 - Stage 1: define problems to be solved and customer requirements, review, refine, and screen list of ideas from Stage 0 to exploration, create concepts for 8-10 ideas
 - Stage 2: Based on customer interviews and use-case assessments, down-select to 1 leading concept, develop robust business case including market opportunity, initial forecast, and projected expenses
 - Stage 3: Design Development: move to functional prototype, continue iterative design process, including initial testing and reviews with customers, begin formal Design Control documentation (Prototype, evaluation, test)
 - Design control: mandatory for FDA class 2 & 3 and almost all EMA devices
 - Stage 4: conduct extensive verification and validation testing, finalize products and component drawings/models,
 accelerate manufacturing process development, along with plans for quality control
 - Stage 5: complete any remaining testing, make final design changes, build molds, assembly/test equipment, create
 Instructions for Use and user manuals, develop service plan and resources, finalize go-to-market strategy and start limited
 release
 - Post Market Surveillance: on a 4-6 month cadence, project teams report out to stakeholders: account sales, business and regulatory issues observed, complaints, product and process improvement opportunities

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Medical device development is an expensive, complex, and highly collaborative effort. Having limited resources, most businesses have instituted processes like Stage-Gate to reduce risk and increase the probability of success. Good product design and development is necessary for commercial success but not sufficient!

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John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity, subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

Title: Descriptive title (i.e. Client Meeting)

Date: 9/5/2016

Content by: The one person who wrote the content

Present: Names of those present if more than just you (not necessary for individual work)

Goals: Establish clear goals for all text entries (meetings, individual work, etc.).

Content:

Contains clear and organized notes (also includes any references used)

Conclusions/action items:

Recap only the most significant findings and/or action items resulting from the entry.

2014/11/03-Template 329 of 329

John Puccinelli - Nov 03, 2014, 3:20 PM CST

Title:	
Date:	
Content by:	
Present:	
Goals:	
Content:	
Conclusions/action items:	