BME Design-Fall 2025-Biopsy Press
Complete Notebook

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Simon Nam

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Simon Nam - Sep 12, 2025, 11:25 AM CDT

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Project description

RUHI NAGARKATTE - Sep 08, 2025, 11:25 AM CDT

Course Number: BME 400

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

Short Name: Biopsy Badgers

Project description/problem statement:

Project Objective

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

Project Description

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

Materials and Supplies Available

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

Relevant Journal Articles and Websites

Related Literature:

Gou, S. et al. (2023) 'Development of an ex vivo porcine skin model for the preclinical evaluation of subcutaneously injected biomacromolecules', International Journal of Pharmaceutics, 648, p. 123562. doi:10.1016/j.ijpharm.2023.123562.

Gou et al. (2023) explained the development of an ex vivo porcine skin model that retains viability in extended periods of tissue culture. The paper initially discussed existing explant models of approximately 1mm thickness, containing only the epidermis and dermis, lacking the hypodermis which is responsible for subcutaneous investigation. Looking to solidify a "full thickness" tissue model with extended viability was the goal of this investigation.

Dame, M. K., Spahlinger, D. M., DaSilva, M., Perone, P., Dunstan, R., & Varani, J. (2008). Establishment and characteristics of Gottingen minipig skin in organ culture and monolayer cell culture: relevance to drug safety testing. In vitro cellular & developmental biology. Animal, 44(7), 245–252. https://doi.org/10.1007/s11626-008-9091-3

Dame et al. (2008) describes an optimized culture process for ex vivo minipig tissue culture with potential to be used as a surrogate for human skin in similar studies. The authors describe many similarities found in the physiological and pathophysiological responses of pigs and humans, allowing translatability between the two models.

Ching-Yan C. Yeung, PhD1 ; David F. Holmes, PhD 2; Helen A. Thomason, PhD 1;Christian Stephenson, BSc Hons 3; Brian Derby, PhD 4; Matthew J. Hardman, PhD, (2016). An ex vivo porcine skin model to evaluate pressure-reducing devices of different mechanical properties used for pressure ulcer prevention. Wound repair and regeneration, DOI:10.1111/wrr.12481.

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

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

About the client:

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Alternate Contact

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Problem Statement

ELLA LANG - Sep 12, 2025, 10:36 AM CDT

Title: Problem Statement

Date: 9/11/2025

Content by: Ella Lang

Content:

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

Conclusions/action items:

- Utilize this problem statement in all future reports, updating as necessary

9/8/25- Client Meeting 1 - Intro & Questions

SARAH RAUBENSTINE - Sep 12, 2025, 11:17 AM CDT

Title: Client meeting notes

Date: 9/8/25

Content by: BME Badgers

Present: BME Badgers, Bailey, Dr. Gibson

Goals: Meet client and identify main goals for this semester.

Content:

Continual Meetings

Would you like to meet biweekly or monthly?

- Same place and time would work for us
- Monthly good, this time slot is good too :)

Does this time (1-1:30) work for you for future meetings?

- Preferably online? - virtual is good too

Where or how would you like to meet?

- virtual

Can you reexplain your project description? - this is chaotic, apologies

- Specific dimensions / process
- Lab studies burns, uses pig skin as a model
- endogenous fluorescent molecule to analyze burn depth and healing process, pig skin is easier to work with for this
- when they get the skin they have to remove the fat
- After fat removal, create burns on the epidermis layer and punch out the burns with the biopsy punch, centering the burn in the biopsy punch
- any fat left, effects the nutrients needed to perform analysis on the tissue
    - Pig skin has a harder texture, more difficult to remove the fat layer
    - Don’t want to damage surface of the skin, can be difficult to hold it and use a scalpel to cut off the fat layer on each individual biopsy
    - They’re circular, if you pinch them they roll, can become uneven
    - Inefficient process
    - Tested if complete fat removal leads to better results
- pig skin can be hard to work with
- Second or third day, everything is dead on the sample
- 2mm from skin surface
- LDH stain to look at viability of a sample
    - Top layer of keratinocytes
    - Dermis with the fiberglass and collagen - does most of the work in wound healing

    - Skin appendages throughout

- Tissues typically in a fresh media dish (image)
- For doing sectioning we need uniform perpendicular cuts
- Biopsies with the fat still on sample reduces viability of entire sample by day 7, cannot heal and is not viable
- When wounds heal, the keratinocytes need something to crawl over (proliferate over to close the wound)
- 4mm diameter to go down for a partial
- Temp, time, pressure = burn
- Hair follicle goes down all the way to the fat in pig skin, not totally representative of humans, still some healing viability in the fat

Current model!! - 3D printed guillotine

Cheese grater

Function/Clients' Main Objective:

What is the primary function of the device in need? Is it more for standardizing thickness, improving speed, reducing variability? Or all of them at once?

- Standardization!!
- Want to be gentle with the samples

How big of skin samples will the device be used on? Is it uniform or does it vary?

- 12 mm diameter
- 4-5 mm thick - cut it down to 2-3mm

Is the device intended for only professional surgeons/researchers or for all lab affiliates with minimal training?

- Lab affiliates with minimal training

How many cuts would you like from a sample? How close should the cuts be?

- Potentially be able to cut both the fat off and also cut in half, multi-use tool
    - For imaging, want to cut directly down the center of the burn
    - On the last day of the culture, they cut them and then preserve for the time being
    - Cut in half would be after the fat removal, potentially days later
    - For now focus on cutting the 2mm thickness, wound suggestion would be more of a next semester process
- Method for an excisional wound in the biopsy, want to be able to have a precise depth (right now fairly variable for at what depth the cut is made), want to standardize

Performance Requirements:

What is the desired thickness range (consistently leave ~2mm)?

- Doesn't have to be 2mm but would prefer (less than 3)

How precise should the cut be? (tolerance/margin range?)

- Needs to be a flat surface / perpendicular to the epidermis

How many samples per session should the device handle without any replacement or adjustment?

- Current idea has 2, 1 or 2 works just fine, goal is to increase efficiency so if the method is fast (1 is not too little for an easy to use device)
- Max of 3 or 4 samples per device

How much time per sample should the device aim for trimming?

- Under a minute

Blade

- If we could use a regular razor blade, very reproducible
- The biopsy blades themselves, they swap out every ten or so just because they dull

Safety:

What kind of safety concerns are priority? (minimizing user injury, preventing tissue contamination, avoiding mechanical damage to tissue, etc)

- Make sure blade is covered ideally

Should the blade part be fully enclosed or open to exposure in a surgical lab environment?

- Razor blade
- Whatever works it sounds like…big picture maybe think about safety covering for more widespread use

Accuracy & Reliability:

Do you expect the tool to achieve the same cut quality every time despite who is the user?

- yes

Is it better to maximize consistency or throughput?

- both

Life in Service/Durability/Sterilization

Do you intend to use this device as a single-use disposable type or long-term reusable?

- Should live in the biosafety cabinet
- Will probably have to replace the blades after a few samples just due to dulling

If re-usable, should it be up to 40 samples before replacement or permanent?

- Punch = 10 punches before dulling

Will the tool need to be sterilized between uses? (autoclave/ethanol)

- Ethanol or autoclave

Operating Conditions:

Will the cutting take place in a sterile hood, surgical site, or general benchtop station?

- In the hood, sterilize with ethanol before going under the hood

Any environmental conditions (humidity, temperature, exposure to liquid forms) to consider for tool design?

- Liquid from medium

Size & Weight:

Should the device be only hand held, or mounted by clamp or benchtop?

- Able to be moved
- Suction cup?

Device size specs

- Small as it needs to be as long as we can just work with it
- Clear would be awesome if we could see the sample and device etc, also for cleaning

Products & Cost:

What is the expected budget (semester/year)?

- Its fine lmao, 500 dollar range within reason

How many units do you need?

- 1, with changeable blade

What is the target cost per device for lab use?

Standards/Regulations

Does the device need to comply with FDA, ISO, or ASTM standards (if eventually going to be applied for human biopsies?)

- It will not be for human biopsies

Competition?

Please explain more about existing tools you tried that partially meet your needs? What factors were the main drawbacks?

- Circular pinching with biopsy punches, but they roll in afterwards
- Use of scalpel

Testing

Would we be able to come in for device testing on porcine skin? (or get our own?...)

Would we be able to hand off the device to you guys for satisfaction testing later in the semester?

- yes

Conclusions/action items: Continue monthly client meetings and move forward with identifying product design specifications based on client info.

10/8/25- Client Meeting 2 - Design

SARAH RAUBENSTINE - Oct 08, 2025, 2:40 PM CDT

Title: Client meeting notes

Date: 10/8/25

Content by: BME Badgers

Present: BME Badgers, Bailey, Grace, Dr. Gibson

Goals: Talk to client about the current trajectory of the project, look at out current design, discuss possibilities of testing.

Content:

- Introduce MedTECH, Grace, to Dr. Gibson!
- Catch up Dr. Gibson on where we are at
    - Preliminary presentation
    - Printed the biopsy press
    - Currently working on our preliminary report
    - There are dimensions we want to change about device, integrate any suggests and reprint next week
- Notes about the current model from Dr. Gibson
    - Understand the general purpose
    - If the biopsies aren't exactly the same thickness, when we put the lego piece on there, it will push down different amounts so different levels of compression
    - Slit for the blade is too long
    - Decrease the size? maybe just two indent samples cut down the size and maybe that would be easier for the blade
        - Gianna comment, this one particularly is dimensioned for using a 22 surgical blade on a handle - she likes this!! definetly have the ability to get these, but she was envisioning something to be less expensive
            - These are gonna be used very often so from a budget standpoint, we would want something fairly inexpensive, can check into the pricing of these.
            - She could maybe pick on up easily from the OR! - never mind - can't get them through shopUW, but they're not within the hospital system, maybe a little too hard to come by?
        - For a surgical blade, the actual cutting surface of the blade is that longer part, think about where the sharper part of the blade is
        - Ella comment - if we were to use the razor blade, provide more of a handle
        - Is it out of question to use the regular razor blade? they have razor blades in the lab, can give us some plain razor blades
        - Razor blades definitely secured
    - Surface area of the larger base may help with stabilization, but maybe look into sizing
        - Bailey said maybe take away two of the indents and
        - Might be hard to continuously go through all four samples at once
        - Try to use stryofoam or playdoh or something until we have a sample we could try it with, she will give us a 12 mm biopsy punch
    - Diameter of the circles should be a little larger than the biopsy, maybe set to 13 mm, the indents looked a little small on the prototype
    - How deep do you think they hole should be? right now its 5-6mm, Bailey says a decent amount more than that, maybe it's better to be deeper, more lego piece action with a longer hole
        - 10 mm holes potentially, just to ensure that the hole plug system really works
    - Fix the compression issue with the lego piece, take away two of the holes, less samples to make the pressure uneven, don't have to worry about the ones in the middle decreasing the number
        - just due to the samples being a little unpredictable
- Bailey says that we can get 22s but don't have the handles
    - gave us a 10 and 11, those they use more frequently and they're easier to get
    - They have a ton of full razor blades
- If we wanted to try and design a handle for the razor blades, go ahead and do that too!
- Paper cutter device feedback - this one actually does use a razor blade!

    - Dr. Gibson thinks that this would more compress and squish than slice
    - The skin is too dense, needs the actual cutting action rather than the guillotine
- Material pick up
    - Friday or next week any day!
    - maybe ask about the different types of razor blades that they had available
- Grace can get us some 22 blades from anatomy lab! Thank you Grace!

Conclusions/action items: Move forward with revisions to the biopsy press, pick up some materials some Bailey this coming week!

11/5/25- Client Meeting 3 - Design Modifications

SARAH RAUBENSTINE - Nov 05, 2025, 2:20 PM CST

Title: Client meeting notes

Date: 11/5/25

Content by: BME Badgers

Present: BME Badgers and Bailey

Goals: Talk with Bailey about design progress and where we are headed for testing

Content:

- Ordered the rubber slab
  - No formal tracking service on ShopUW
  - Expected to arrive on the 13th
- Design modifications
  - Likes the size
  - longer might be easier
- Base Design
- Addition of weight for the base
  - metal to add heft?
- Pressing mechanism
  - Additional handle for the user to grasp it and press on it
  - "Door knob handle"
  - Handle in line of where the biopsies are for better force distribution
- Handle for the razor blade
  - Gianna is on it!
  - Hoping to print soon
- Can order on amazon if there's not anything else on shopUW, still just have them buy it :)
  - just let her know and she can order with her card
- Any suggestions?
  - Project in a good place
  - Likes the base design with the rubber
- Cleaning testing
  - Stuff getting caught in the little holes
  - Buy glowderm from amazone
  - Some 3D printed material can't be UVed for sterilizing, is this degradable from UV
    - We are thinking of nylon for final material and can look into chemical properties
    - Its okay if they can't they just need to know so they keep it in or take it out of the hood
    - Let them know
- Skin for testing
  - Potentially going to have some pig skin the week after thanksgiving, would be free and easy to get
  - We are testing with styrofoam with the other kids
  - We would love to have them use it, works for Bailey!
  - Preferably before thanksgiving
  - We can join in if we want to!
  - She can reach out to the swine center to see if they can get
- We could do a mini experiment just to see the viability, that would be awesome!
  - another level of testing to show the difference before and after using the device, maybe something to look further into for next semester :)

Conclusions/action items: Move forward with revisions to the biopsy press, pick up some materials some Bailey this coming week!

11/26/25 - Client Meeting 4 - Device Usability Testing

Simon Nam - Dec 06, 2025, 12:20 PM CST

Title: Client meeting notes

Date: 11/26/2025

Content by: Simon

Present: Simon and Bailey

Goals: Let the client (Bailey) try out the latest modified design for usability testing and receive feedbacks

Content:

After the Swine center delivered the porcine sample readily available for biopsy analysis, the client (Bailey) scheduled a session for testing the usability of the device.

Figure 1: Porcine skin layer sample in the BSC

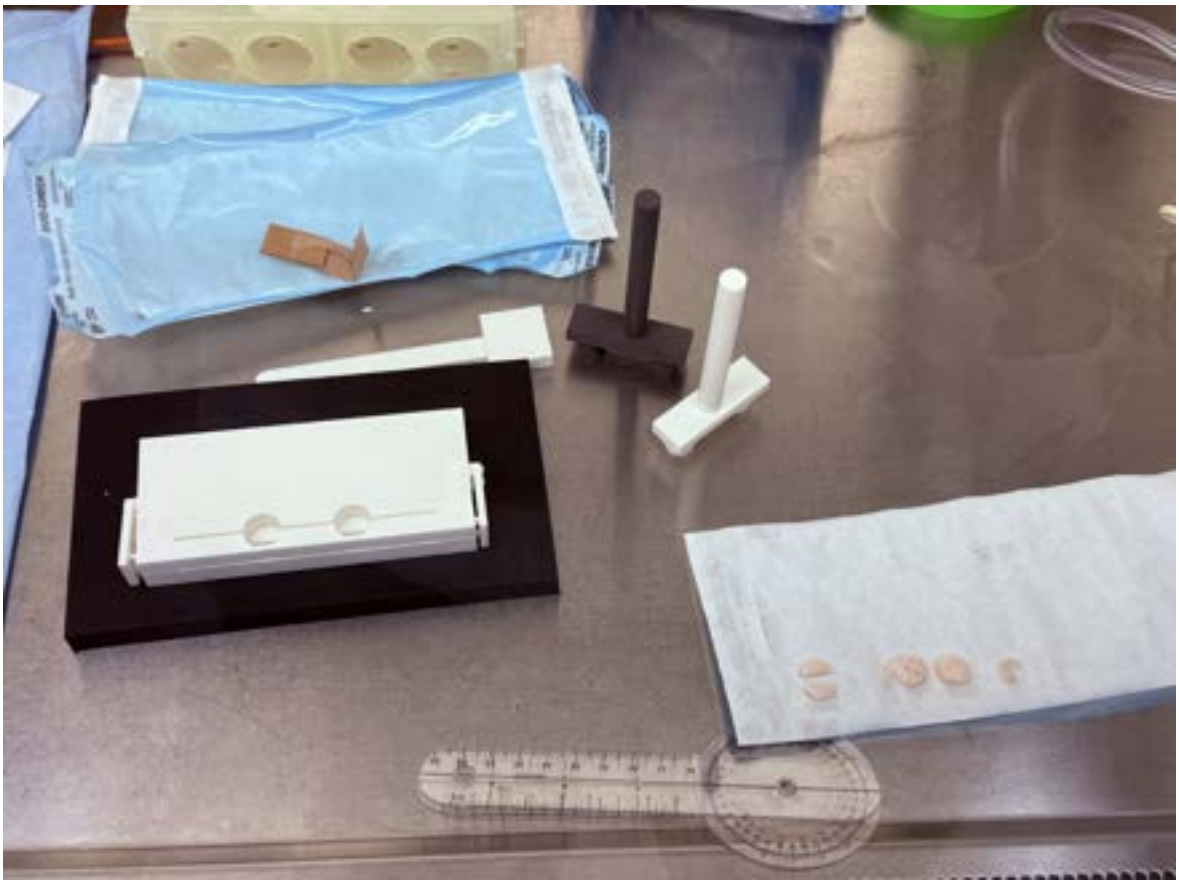


Figure 2: Biopsy Press latest design stationed at the BSC and ready for testing

Figure 3: Testing with precision cutting with the design

Figure 4: 1st trial of porcine samples after processing horizontal cutting

Figure 5: The ones with whiter surface area is the cut samples required for further studies with 2-3mm of thickness, the ones with red spots is the fat layer that needs to be removed

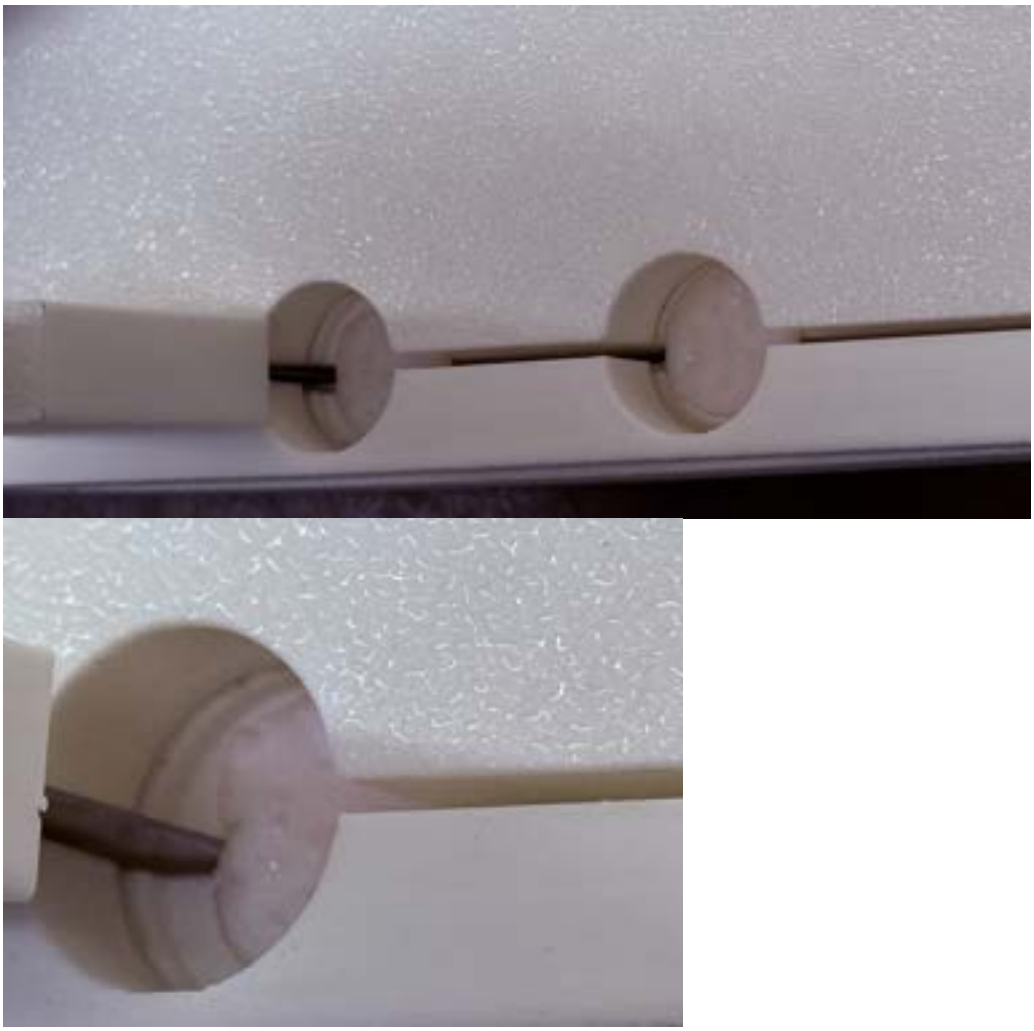


Figure 6: Issue identified with vertical cutting procedure; the horizontal cut sample tend to be shifted towards side while attempting to cut with the blade which is not desired for outcome

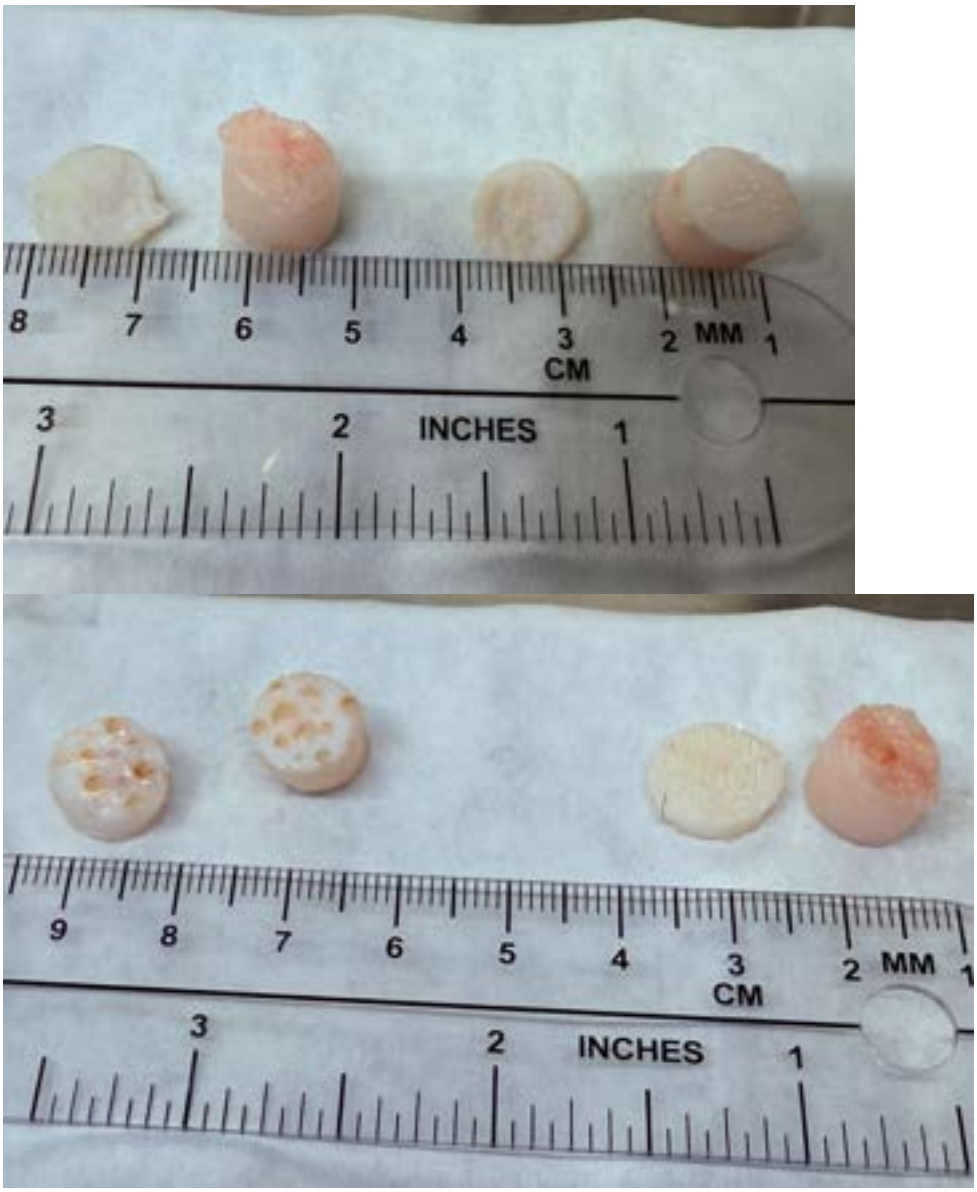


Figure 7: Second & third trial with more porcine samples

Figure 8: Additional testing with scalpels #10 and #11 to compare the effects of precision cutting to the one with razor blades

- Feedback/Improvements for the design:

    Increase the dimensions of internal connector pegs to make them stronger

    Reduce the depth (height) of the applicator (for pressing down mechanism) so that it does not obstruct the horizontal pathway

    Possibly shift the vertical cutting station to a new seperate space with reduced depth of sample well down to 2-4 mm to better acommodate the process of vertical cut afterwards

    Include threaded bolts onto the system for providing further stabilization for the samples to contained inside wells while cutting procedure occurs

More testing on the device can be done outside the WIMR lab with using the artificial skin from 'suturing kit' or through obtaining actual pig skins from the local butcher's store

Conclusions/action items: Move forward with revisions to the biopsy press, retrieve the latest design from her again next week after Thanksgiving break for further modification

12/01/25 - Client Meeting 5 - Planning for spring semester

Simon Nam - Dec 06, 2025, 12:29 PM CST

Title: Client meeting notes

Date: 12/01/2025

Content by: Simon

Present: Simon, Ruhi, Sarah, and Bailey

Goals: Discuss the future direction and goals for continuing the project and decision making on type of blade to implement on the design

Content:

-Design retrieved back from the client*

-Bailey is now strongly towards the idea of replacing razor blades with scalpels (surgical blades) for better precision in cutting

-Their research group needs to further discuss about deciding on the specific type of blade for biopsy usage

-Bailey also proposed another alternate cutting option, 'Microtome blade' (see figure below for reference)

Figure 1: DURAEDGE PTFE COATED MICROTOME BLADES

-The clients are expected to attend Final Poster Presentation Day

-The clients may need another re-modified design to conduct further testing on usability over the break; therefore the team would have to hand-off another printed design to them before the break

Conclusions/action items: Await for their final decision on deciding which type of blade will be used for the cutting (razor blade is no longer likely the option*)

9/12/25- Team Meeting 1 / Prelim Research & PDS

RUHI NAGARKATTE - Sep 14, 2025, 1:30 PM CDT

Title: Team Meeting 1 / Prelim Research & PDS

Date: 9/12/2025

Content by: Ruhi Nagarkatte

Present: Whole Team

Goals: To discuss research and divide up the PDS among team members

Content:

- Each teammate has research entries on tissue biopsy methods, porcine skin samples, and competing designs used commercially to cut through pig skin
- The Product Design Specifications (PDS) is divided evenly among teammates
    - First draft is due 9/17, one day before actual deadline - to re-read and edit
    - Next team meeting scheduled for 9/17, to discuss preliminary ideas and design specs
- Progress report 1 was successfully sent out
    - Clients Dr. Gibson, Bailey are receptive to update
- Prepare progress report 2 for next week
- Start thinking of design ideas as matrix and preliminary deliverable deadlines are coming up
- Expand research areas on competing designs, methods, and client presentations

Conclusions/action items:

- Everything is going smoothly so far. Progress report 1 was sent out this past week -- the content looks good to the client. Next week, the team is scheduled to meet to discuss prelim design ideas and revise the PDS before the due date.

9/17/25- Team Meeting 2 / Design Brainstorm

SARAH RAUBENSTINE - Sep 18, 2025, 9:36 PM CDT

Title: Team Meeting 2 / Design Brainstorm

Date: 9/17/2025

Content by: Ruhi Nagarkatte

Present: Whole Team

Goals: To discuss research and divide up the PDS among team members

Content:

- Each teammate brought 1-2 preliminary design ideas to the table
  - Reference each team member's design idea folder for preliminary sketches
- The team discussed our top design options out of those brought to the meeting
- For the design matrix, ideas were narrowed down to the top three
  - Paper cutter
  - Guillotine box
  - Modified biopsy pen
- Each teammate has research entries on tissue biopsy methods, porcine skin samples, and competing designs used commercially to cut through pig skin
- The Product Design Specifications (PDS) is divided evenly among teammates
  - First draft is due 9/17, one day before actual deadline - to re-read and edit
  - Next team meeting scheduled for 9/17, to discuss preliminary ideas and design specs

Conclusions/action items:

- Progress report 2 was just sent out and the first draft of the PDS was completed. Using the prelim design ideas, a design matrix will be used to assess each of them and will be sent out in the next progress report
- Start modeling the designs on CAD! Hope to get a few prints in before presentations on 10/3

RUHI NAGARKATTE - Sep 18, 2025, 3:11 PM CDT

Download

Prelim_designs_400.pdf (198 kB)

9/24/25 - Team Meeting 3 / Design Matrix

RUHI NAGARKATTE - Sep 25, 2025, 8:49 PM CDT

Title: Team Meeting 3 - Evaluating Preliminary Designs

Date: 9/24/25

Content by: Ruhi Nagarkatte

Present: Simon, Gianna, Sarah, Ella, Grace

Goals: To evaluate the 3 preliminary ideas in a design matrix

Content:

- All of the 3 designs were drafted on CAD (OnShape) - they look great
- Design matrix was created - check design process folder
- We quickly discussed the scoring for each category
- We split up the writing portions for each category and justification
- We will send it out to the client and discuss with Dr. TJP on Friday during advising meeting
- Try to get started on 3d printing on Friday (9/26) to get a head start on prototyping
- We will plan to meet with Jesse at the TeamLab in the upcoming weeks to talk about prototyping and fabrication

Conclusions/action items:

- We are in a great spot going into the preliminary presentations
- continue to iterate on the designs based on feedback
- start 3D printing!

10/15/25 - Team Meeting 4 / Design Revamp

Gianna Inga - Oct 15, 2025, 2:41 PM CDT

Title: Design Revamp

Date: 10/15/25

Content by: Biopsy Badgers

Present: Biopsy Badgers

Goals: Make goals and actionable changes for the designs based on the comments from the client.

Content:

- Sarah getting supplies today
    - ask where they would set up the device and what it looks like
- Reprint tomorrow
- Make sure print based on the design now
- Attach to the table
    - clamps
    - suction cup
    - weighted rubber bottom
    - stone slab bottom
    - sliding tract
- testing
    - styrofoam
    - writing out a protocol
    - MTS
    - pig skin
        - caliper variation of cut accuracy
        - angle deviation
    - cadaver
    - ask Tracy what is good quantitative testing

Conclusions/action items: Sarah to ask where and what constraints the device will be in the lab. Gianna to finalize the onshape drawing for Ruhi to print tomorrow with the updates from client. Team will meet with Tracy Friday to address how to improve testing plans for more quantitative data.

10/29/25 - Team Meeting 5

Gianna Inga - Oct 29, 2025, 2:52 PM CDT

Title: Team Meeting 5

Date: 10/29/25

Content by: Gianna

Present: Biopsy Baddies

Goals: Update each other on the progress of each aspect of the project.

Content:

- IRB
  - application almost finished
  - subjects
    - hopefully will be medical students
    - need to reach out to TECH org leaders / our TECH student
  - create consent form
  - finalize survey
  - create diagram of experiment
- Block holder
  - rubber is very hard to find
  - might change to a metal and put material on bottom to improve grip
- biopsy press
  - all updates have been made
  - need to add
- razor handle
  - finish other side?
  - clip on?
  - add cap with protector
- Testing sterilization
  - need to order glo germ kit
  - protocol will be written
  - research has been done

Conclusions/action items: We have made progress in all parts of the project. We are finalizing the deliverables to submit to the IRB, finish the CAD drawings for the press and handle, creating protocols for testing, and deciding on the material for the base.

11/21/25 - Team meeting 6 with Grace!

SARAH RAUBENSTINE - Nov 21, 2025, 12:14 PM CST

Title: Team meeting with MedTech

Date: 11/21/25

Content by: Sarah Raubenstine

Present: BME Badgers and Grace!

Goals: Get feedback on design so far and update what we have done

Content:

- Show final design and intended modifications
    - Looks great
- Just got IRB exemption! --> Testing is next step
    - We were hoping the techs could be our test subjects as the target population
    - Run testing with styrofoam samples
    - Hand out usability survey
    - Grace is really open post thanksgiving!
    - Week we come back from thanksgiving, Monday or Tuesday
    - Grace is not really in contact with the other techs, we will have to find that contact info
    - Grace is clear Monday and Tuesday next week (11/24-25)
    - Want to do the testing in the teaching lab at ECB
    - Research symposium on Monday, Grace can network - as many as she can wrangle
    - Maybe Wednesday morning too?
    - Simon will be here for all of these dates!
    - Tuesday Dec. 2nd works nice too
- Poster presentation is Dec. 5th!
- Grace will be our TECH next semester too!
- Using the skin samples - reserved for the client, they have their own way to recruit pig skin and IRB approval, for the TECHs we will just use styrofoam samples

Conclusions/action items: Continue to check in with Grace about testing logistics next week!

12/3/25- Team meeting 7

Simon Nam - Dec 06, 2025, 1:03 PM CST

Title: Team meeting 7

Date: 12/3/25

Content by: Simon

Present: BME Badgers

Goals: Wrap up on final deliverables and prepare for poster day

Content:

- Finalized the poster on contents and imaging
- Assigned each member to address specific sections of the poster
- Sarah prepared additional title labels for the props to be displayed in front of poster
- Reviewed the requirements of the poster and final report deliverables

Conclusions/action items: Rehearse for the final poster presentation and begin working on the final report

9/12/2025 - Week 2

SARAH RAUBENSTINE - Sep 12, 2025, 1:06 PM CDT

Title: Advisor meeting Week 1

Date: 9/12/25

Content by: Sarah Raubenstine

Present: BME Badgers and TJP

Goals: Introduce advisor to project and discuss initial research and client meeting

Content:

- Recap of client meeting
- Showed the client's rough draft box
  - we got a lot of info all at once, need to try and produce ideas away from the black box for preliminary drafting
- Research recap
  - background research about client's lab
  - materials research for sterilizable and smooth surface for device
  - staining research
  - current biopsy research
  - competing design discussion
- Outreach seminar next week
- Meetings 15 minutes next week, ours will probably be around 1:45
- Getting pig skin... at the grocery store?
- What part of the skin? I think the thick back skin
  - try bucky's butchery
  - storage in the teaching lab fridge, as long as not too big and label really well
- Would be worthwhile to get a biopsy punch from them
- PDS due on the 18th

Conclusions/action items: Work on PDS!!!

9/19/2025 - Week 3

SARAH RAUBENSTINE - Sep 19, 2025, 2:40 PM CDT

Title: Advisor meeting Week 3

Date: 9/19/25

Content by: Sarah Raubenstine

Present: BME Badgers and TJP

Goals: Show current designs to TJP and get advice on design matrix

Content:

- Finished up PDS and worked on preliminary designs
- Asked clients for props for presentation
- TECH med student today
- 3D printing with the clear resin
    - fails often
    - find someone who knows alot about 3D printing with the resin, reach out and specifically ask if they are very familiar with working with the resin
- Matrix criteria
    - criteria good
    - consider ease of use, maybe efficiency, through put instead? are you focusing on speed?
    - accuracy, cut accuracy/precision
    - safety always important
- Kitchen blades, enclosed mandolin
- Combined down the design
    - one matrix is okay, designs are so different hard to split it up
- Biopsy punches not available here

Conclusions/action items: Doing good! Keep it up and work on design matrix this week.

9/26/2025 - Week 4

SARAH RAUBENSTINE - Oct 17, 2025, 12:26 PM CDT

Title: Advisor meeting Week 4

Date: 9/26/25

Content by: Sarah Raubenstine

Present: BME Badgers and TJP

Goals: Discuss design matrix and plans for preliminary presentation

Content:

- Pulled up preliminary designs in OnShape
  - Biopsy punch design
  - Paper cutter design
  - Biopsy press
- Biopsy press
  - print in PLA with low fill just to see
  - maybe final in resin, biomedical resin
  - nylon can be autoclaved, but not transparent, but strong, less microgrooves
- Design Matrix
  - Sterilizability category depends on more the material less the design
    - description is really good, just sterilizability might be the wrong term
    - Cleanibility? lmao
    - Manual Cleaning
  - Maybe try to rename in a way that conveys more easily wipeable less ability of material to be sanitized
  - Consideration of throughput?
- Side note - use of styrofoam in testing if it really is that close in texture
- Gianna record video, test it!! anyone with link can view, have a backup plan
- Will try to get feedback on the PDS too before we have to turn it in on report
- Discussed past design project drama

Conclusions/action items: Work on presentation, PDS feedback should be here soon!

10/17/2025 - Week 7

SARAH RAUBENSTINE - Oct 22, 2025, 1:22 PM CDT

Title: Advisor meeting Week 7

Date: 10/17/25

Content by: Sarah Raubenstine

Present: BME Badgers and TJP

Goals: Discuss preliminary report, design progress and possible testing protocols.

Content:

- Weekly updates
- Update on the new design and the client input
- Check Bucky's Butchery for pig skin slabs (varsity meats?)
    - normally only open once a week, try to get them on a day where they are butchering, they're good about giving students animal parts
    - occasionally they need a letter, ask if needed

Conclusions/action items: Continue with testing plans

10/24/2025 - Week 8

SARAH RAUBENSTINE - Oct 24, 2025, 1:11 PM CDT

Title: Advisor meeting Week 7

Date: 10/24/25

Content by: Sarah Raubenstine

Present: BME Badgers and TJP

Goals: Go over testing and our updated design

Content:

- Updated design
- Handles for razorblades are already availible
    - modify a handle for holding on just one side
    - a lot of 3D printed handles available
    - modify the CAD file
    - Would need to attach the handle without removing the gaurd and then need a way to revome the blade from the handle without using your fingers
    - Gianna paper guard idea?
- Base of the device
    - Material - rubber?
    - Very expensive
    - Vacuum cup - the kind where you pull down a lever and it suctions down
- Testing and data collection
    - Functionality and performance survey
    - Want someone outside of the team to a survey
    - Significant risk with a razor blade involved
        - need a handle before we do testing
    - NEED to do the CITI training
    - Have to go through IRB? There needs to be a way to contain the blade there is risk involved
- Sterilizability testing?
    - usually you clean before you sterilize
    - wash it with soap
    - cleaned first and then sterilized
    - have some steps where you clean with soap and water
- FEA analysis on OnShape comparable to the forces that they are using
    - look up the numbers and cite sources that validate the usage of styrofoam
    - this might not be super practical
- Other testing that we could do that would be more practical, we're trying to validate our product over the other method
    - The actual physical survey testing is where we're gonna get our best results
- Shift gears away from design and move towards getting IRB approval?
- Next steps with IRB
    - Go to arrow irb.arrow.wisc.edu
    - will send out an example that got approved
    - we need to have everything done in order to get approval
        - surveys completed, once we have a draft of a survey send it over and get feedback
    - Need clear testing protocols and clear safety protocols
    - Target people who are familiar with using razorblades to limit risk
    - Consent form so that the data can be collected and published
    - They take about a month to approve something
    - Need to put Tracy on it as the PI, she can help with the language
- Do need notes in the notebook for show and tell!!!!
    - Simon has to yell at people and tell them its time to switch

    - One minute for the elevator pitch including the ask
    - Then we have four minutes to receive feedback and we switch
    - Need to be really quick, concise and clear to describe project
    - SIMON SAYS SWITCH
- No formal meeting setup for next week but we can meet to work on IRB
- Notebook, she's gonna try and give us feedback on the last weekly one there's no mid semester

Conclusions/action items: IRB!!!!!!!!!!!

11/07/2025 - Week 9

SARAH RAUBENSTINE - Nov 14, 2025, 11:59 AM CST

Title: Advisor meeting Week 9

Date: 11/14/25

Content by: Sarah Raubenstine

Present: BME Badgers and TJP

Goals: Go over survey and IRB

Content:

- Printed blade handle - thank you Gianna!!
  - looks great
  - OSHA standards ??
    - handling something sharp
    - just got prints back, we need to check if they work
    - I think you're gonna get some pushback from IRB becuase of this
    - Better to submit it and address the issues, allowed to submit multiple times for reapproval
- IRB
  - target audience is group MedTECHs
  - keep on the screening question
- Reading over email and editing
  - refer to lab blade as razor blade
  - In order to participate, you must have some experience
    - Comfort level question should just be a yes or no
  - She think this is okay
  - Blurb about the results of this test will remain anonymous
  - The results will be presented and or published in aggregate form with no identifying information
  - Google form survey
    - for IRB explain what a medtech is (just call them medical students that are currently serving as advisors to BME design students
- Survey protocols
  - This is fine
  - Video demo for how to use
    - submit the video to IRB
    - Nevermind, for IRB purposes, don't mention the video at all, but just for clarity have this video for how to use it
  - Clearer scaling for 1-5
    - SHOW WHAT EACH NUMBER IS
    - copy and paste this for each question and fill in/check a box
    - Quick table with one row and a check box symbol for each question
  - Questions themselves
    - Have the testers attach the razor blade?
  - Add a comment box, any suggestions to improve the device? - specifically WHAT COULD BE IMPROVED instead of just comments
- Consent form
  - Try for porcine skin with the MedTechs too anyways, can try and place orders for the skins once approved
  - Include part about: your answers to the survey will remain anonymous and the data collected will be presented in aggregate form with no identifying information
- We can still get data from the client before IRB
  - we just can't publish
  - We can present on poster
  - Journal article cannot include any graphs or data from the client testing before IRB

        - Can refer to it as just preliminary data
- Client testing
    - have pig tissue for them
    - They want us to come in!
    - Possibility of staining and imaging the samples
- TRY TO USE PIGSKIN UNLESS IRB SAYS NO? skip out on styrofoam
    - we could get really good data in a couple weeks from your client
    - put styrofoam for the medical students and porcine skin for the client
    - I'm a little confused isn't that what we had originally planned
    - Okay never mind everything, use styrofoam for the med techs
- TWO DIFFERENT CONSENT FORMS, ONE FOR THE STUDENTS AND ONE FOR THE CLIENT AND THEIR GROUP!!!!!!
- Does the client already have an IRB?
    - to publish data in future, especially using something that is potentially dangerous
- Could we publish client data? seems like we don't know
- Already did the work for it, just submit for styrofoam and whoever gets the case for it we can ask further questions about what we can and can't publish

Conclusions/action items: SUBMIT IRB!!!!!

11/14/2025 - Week 10

SARAH RAUBENSTINE - Nov 14, 2025, 12:53 PM CST

Title: Advisor meeting Week 10

Date: 11/14/25

Content by: Sarah Raubenstine

Present: BME Badgers and TJP

Goals: Go over IRB review and new materials

Content:

- Got the goo and rubber slab! picked those up today
- IRB Comments
  - Expired PI CITI training
    - Tracy will look into this and fix it! It's annual now
  - Status relationship with the participants
    - Respond and say no, not sure where that question is coming from
  - Exemption process
  - Need to include more information before the activity
  - Can't share in google drive...
    - Not identifiable photos
    - Will have to address the possibility of tattoos on hands, have to blur out tattoos?
    - THEY WILL BE WEARING GLOVES
    - "The people will not be in the image except for gloved hands."
  - IRB just for the styrofoam, client has own IRB for own lab, don't need to include them in this
  - Quick edits on procedure
- Will get these fixe up quick and submit second rendition of application
- Fabrication this coming week
- Cleaning testing
  - got the materials!
- Simon will do testing with the lab before Thanksgiving
- Draft/outline of poster to look at during meeting next week
  - We will be in person in Tong next week
- BME 400 in Vegas!
  - Stay safe!!
  - Take pictures!

Conclusions/action items: Race to the finish line these next couple weeks! Get to work on poster draft

11/21/2025 - Week 11

SARAH RAUBENSTINE - Nov 21, 2025, 12:59 PM CST

Title: Advisor meeting Week 10

Date: 11/21/25

Content by: Sarah Raubenstine

Present: BME Badgers and TJP

Goals: Go over poster, testing, and final design

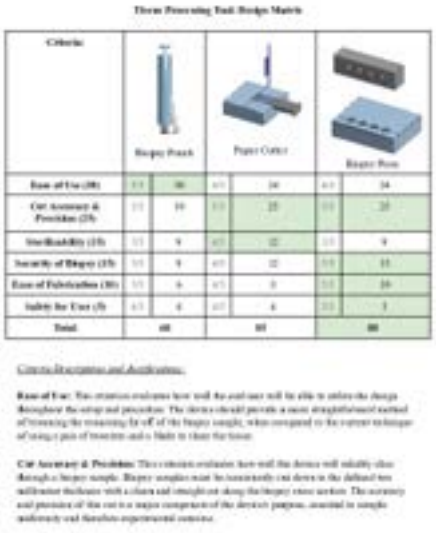
Content:

- We got exempt!! aka no risk whatsoever
- Show off new design
- Safety for razor blade - add to instructions
    - push the razor blade into the cover instead of the cover into the razor blade to reduce risk
    - include these safety measures in the instructions for the techs
- Base design - adds stability
- Make sure we save all our iterations and label them for the poster presentation
- Awards
    - we could do Tong?
    - could potentially identify a big enough market
- Glo germ testing - the two different cleaning tests
    - gets caught in sharp edges and intrusions
    - future work to reduce those
- Next week - Simon meeting with tech student and other med students as well as the lab to do usability testing
- Poster overall design
    - label label label
    - maybe have a hand holding the blade
    - Sterilizability pictures - is there a way to remove backgrounds
    - Rename to disinfecting testing, cleaning doesn't sound fancy enough?
    - Cleansing testing?
    - Sanitizing!!!!!! - this ones good :)
    - Usability testing looks good, like that format and coloring to show answers
- Force testing
    - does it make sense to run an FEA simulation on the snap ins or the blade handle?
        - Maybe? if its simple enough to do
    - Mentioned FBD previously
        - lack of concrete values for grip strength etc. how to model
        - Maybe do FEA instead to show areas of stress
        - Compare force taken to use device vs. what it would take for normal procedure
    - Tracy: identifying weak points might be useful in informing the design
    - Don't do it just to do it, but if you think that it would inform the design and make valid points, add it in
    - If we know a range of mech properties of pig skin, we know our material and the infill, go for it
    - Might be interesting to look at different infills, can we input that for the FEA test? i think yes?
    - Maybe focus on the handle first, then if we have time and think its still important to do the hinges
    - See how it does in nylon, might be a little more brittle? hmm
- We can do a quick meeting after thanksgiving for feedback on the poster before we print it!!
- Client test - need at least THREE people
- Simon - Dr. P's Thanksgiving Thursday at 2:00 PM

Conclusions/action items: Email next week at some point to try and figure out a time to meet before posters!!!

9/25/25- Design Matrix v1

RUHI NAGARKATTE - Sep 25, 2025, 8:41 PM CDT



Download

Design_Matrix_biopsy_badgers.pdf (893 kB)

9/25/25 - Updating Biopsy Press

Gianna Inga - Sep 26, 2025, 9:34 AM CDT

Title: Updating Biopsy Press

Date: 9/25/25

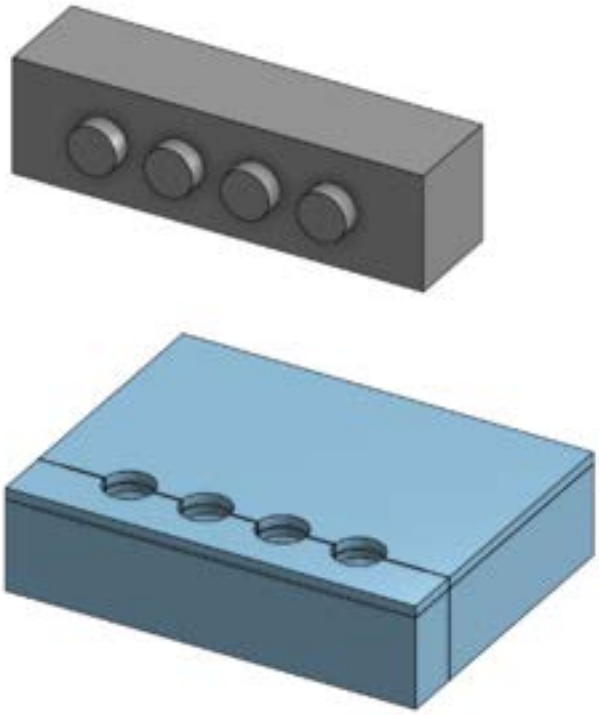
Content by: Gianna Inga

Present: Gianna Inga

Goals: Document the changes I made to Ella's original CAD drawing.

Content:

I edited Ella's design to better fit the dimensions of a #22 surgical scalpel by changing the depths of the cutting crevices and bringing the sample indents closer the the edge. I also made edits to make the based be able toe break apart into 4 parts to be able to grab the samples once they have been cut easier also well as be able to clean and sterilize between uses. The design uses a pressing part to secure the samples and then slots to accomodate a surgical blade to slice both parallel and perpendicular to the epidermis. The only downside to the design is that the user cannot see the sample and thus may be more prone to making a mistake.



Conclusions/action items: This design is ready to be printed. We will see how it performs initially and then make edits. Hopefully we also can obtain a scalpel and blade from our client to ensure that the blade will go deep enough to cut the sample, won't get caught on the device, and will run smoothly as intended. Ruhi will print on 9/26 with the formlabs fuse (sls) using nylon.

10/1/25 - Comments on Biopsy Press Print

Gianna Inga - Oct 01, 2025, 11:22 AM CDT

Title: Comments on Biopsy Press Print

Date: 10/1/25

Content by: Gianna Inga

Present: Gianna Inga

Goals: Document what works and doesn't work with the Biopsy Press 3D print and what changes need to be made.

Content:

- The prints did not go together
    - the extruded parts needed to be a smaller diameter
    - research what allowance it should have based on the accuracy of the printer
- the 2mm extrudes were too thin and snapped
    - the only extrudes that can fit on the top pieces are the 4mm diameter that go into the bottom 2 parts
- the top part of the slots seemed to be easily deformable
    - calculate the deformation force for pla and nylon

All this considering, we did print in pla for ease, time, and cost, however, ideally we would print using nylon. This will be stronger and more accurate than the standard pla and thus some of these issues may resolve itself.

Conclusions/action items: I will change the extrudes to all be 4mm and only located on the bottom parts. I will also change their dimensions to allow for easy assembly.

10/16/25 - Updated Biopsy Press

Gianna Inga - Oct 22, 2025, 10:57 AM CDT

Title: Updated Biopsy Press

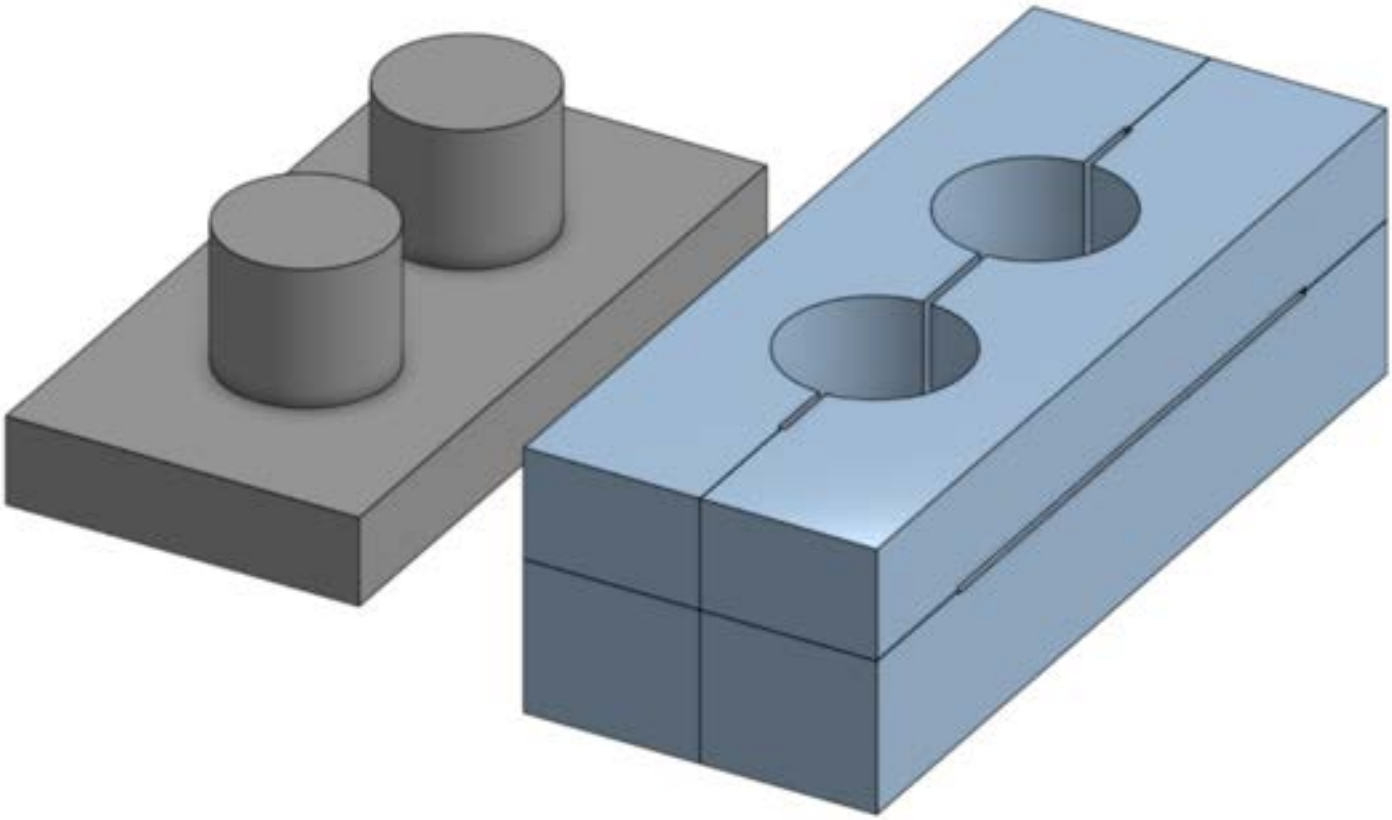
Date: 10/16/25

Content by: Gianna

Present: Gianna

Goals: Document the Updated Biopsy Press CAD drawings and how it addresses the comments from the client.

Content:



- The sample holder was reduced from holding 4 samples at a time to 2
- the overall dimensions went from 3x4" to 1x2.5" as the client wanted a smaller device that reduced excess material waste
- the 4 parts of the sample holder still utilize pegs and holes to stay together however:
  - the holes were changed to be 4.4mm in diameter to have enough allowance for compatibility
  - the pegs remained 4mm in diameter and the ideal height was .75", however, two pegs had to extrude into 1 part because there wasn't enough material for it to utilize the top two pieces as holes, and to ensure they didn't run into each other they had to have a length of .5"
- the sample well diameters were changed to 13mm

Conclusions/action items: The team will print the design tomorrow and then we will access how it has improved from the first print. This design should be easier to take apart and put together. We will also be getting the blades from the client to dimension and then we will update the design to accommodate them.

10/21/25 - Blade Dimensions

Gianna Inga - Oct 22, 2025, 11:11 AM CDT

Title: Blade Dimensions

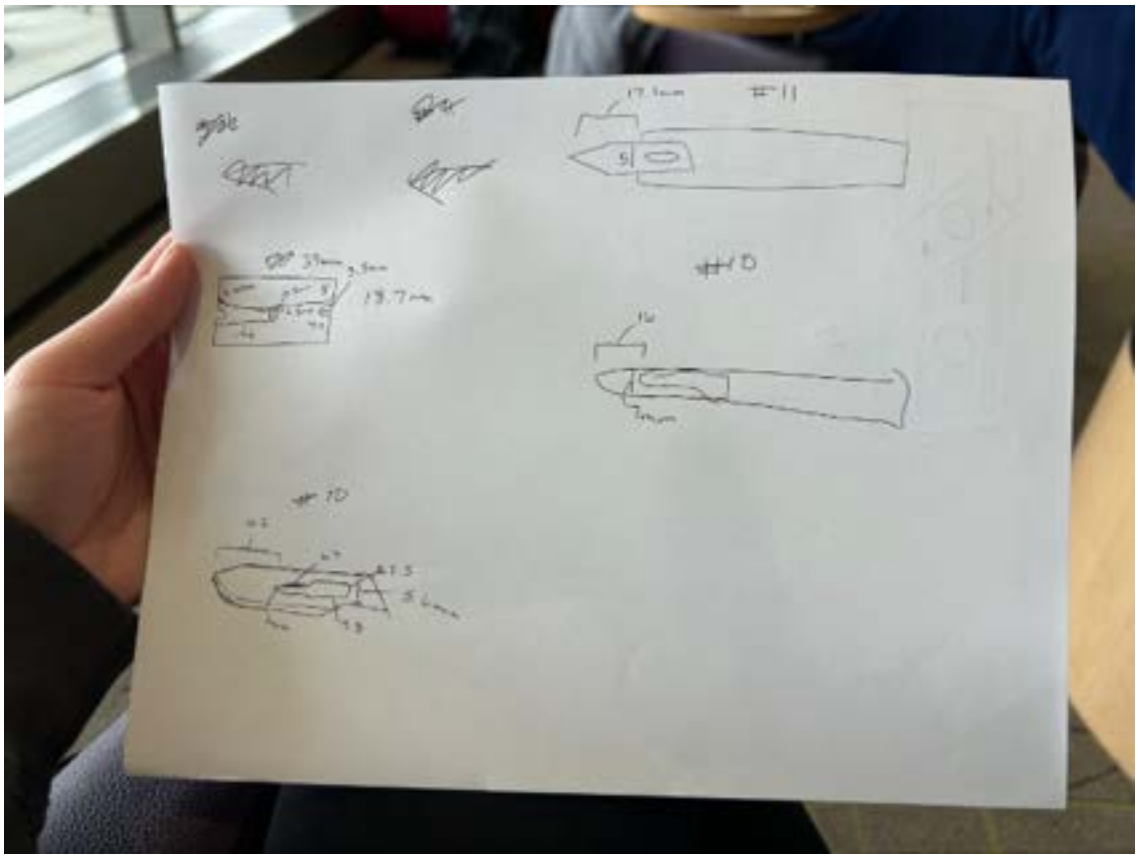
Date: 10/21/25

Content by: Gianna

Present: Gianna

Goals: Dimension the relevant measurements of the blades received from the client to implement into the design.

Content:



- We were given the following blades:
  - razor
    - documented the holes and the thicker handle
    - barely had enough thin area to cut through 12 mm from the blade to the thick handle
  - #11 on handle
    - 17.1mm from blade tip to thick handle attachment
    - 5mm wide
    - a good potential in the design, could work with the biopsy press as is
    - pointy tip & thin blade area
  - #10 on handle
    - 16mm from blade tip to key hole handle attachment
    - 7mm wide
    - a good potential in the design, a little shorter than the #11
    - curved tip & wider blade area
  - #10 surgical blade

        - documented keyhole dimensions to attach the blade in the design if we wanted to utilize the blade without its handle
    - #20 surgical blade
        - stupid
        - didn't even dimension because the blade to keyhole attachment was so short
        - no potential

Conclusions/action items: Take these dimensions of the blade to the team meeting and share my findings. Decide if we should implement a surgical blade alone into the design or if we should utilize the ones that already come on a handle. The potential problems with using just the surgical blade is user safety when changing it and having a secure attachment that will last.

10/31/25 - Notes for Biopsy Updates

Gianna Inga - Nov 14, 2025, 12:40 PM CST

Title: Notes for Biopsy Updates

Date: 10/31/25

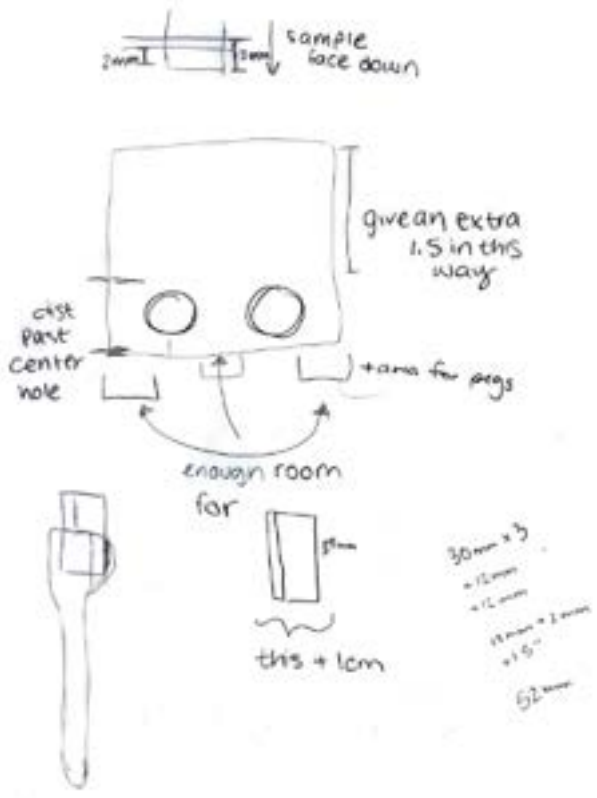
Content by: Gianna

Present: Gianna

Goals: Document the notes for the biopsy press changes

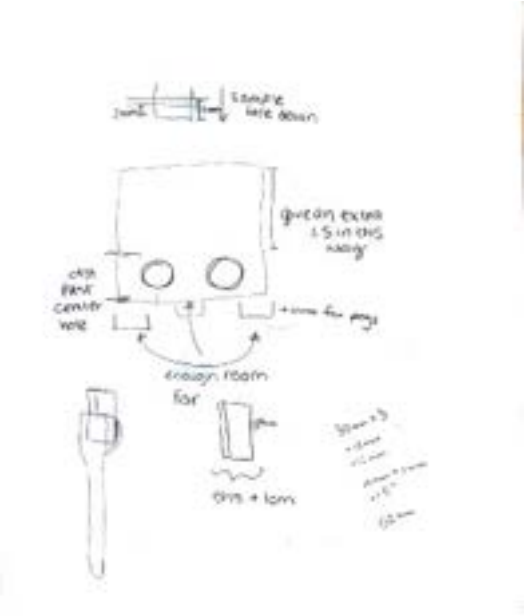
Content:

- The main changes
  - longer and wider
  - make sure the entire blade can pause between and past samples
  - the handle for the blade should look like the handles for the scapel blades
    - make sure the bottom of the blades is covered
  - make a blade cover to increase safety
  - search for over razor blade handles
  - try to make the a clickable lego pieces
  - add a handle for the part pressing down on the samples



Conclusions/action items: Make these changes, print the device, and see if the handle secures the blade, the clickable parts join, and blade fits in the biopsy press. Afterwards, I will show the team the prints and get their opinions on changes I should do.

Gianna Inga - Nov 14, 2025, 12:24 PM CST



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11/7/25 - Updated Biopsy Press & blade handle

Gianna Inga - Nov 14, 2025

Title: Updated Biopsy Press & Blade Handle

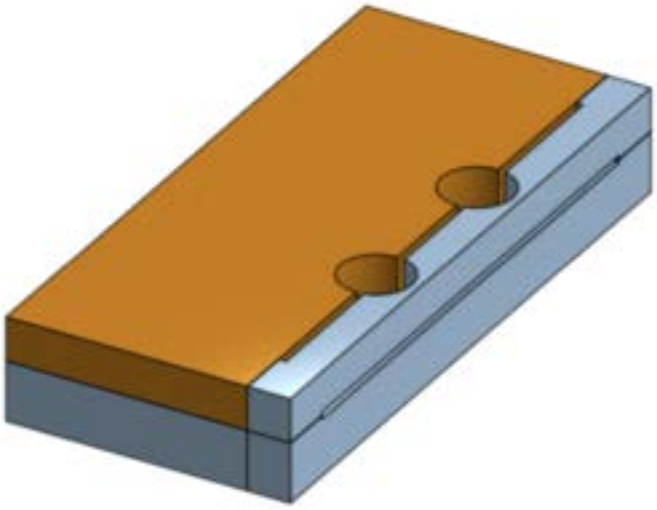
Date: 11/7/25

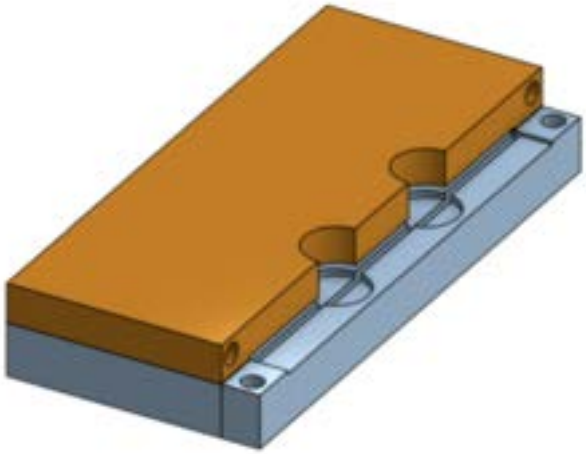
Content by: Gianna

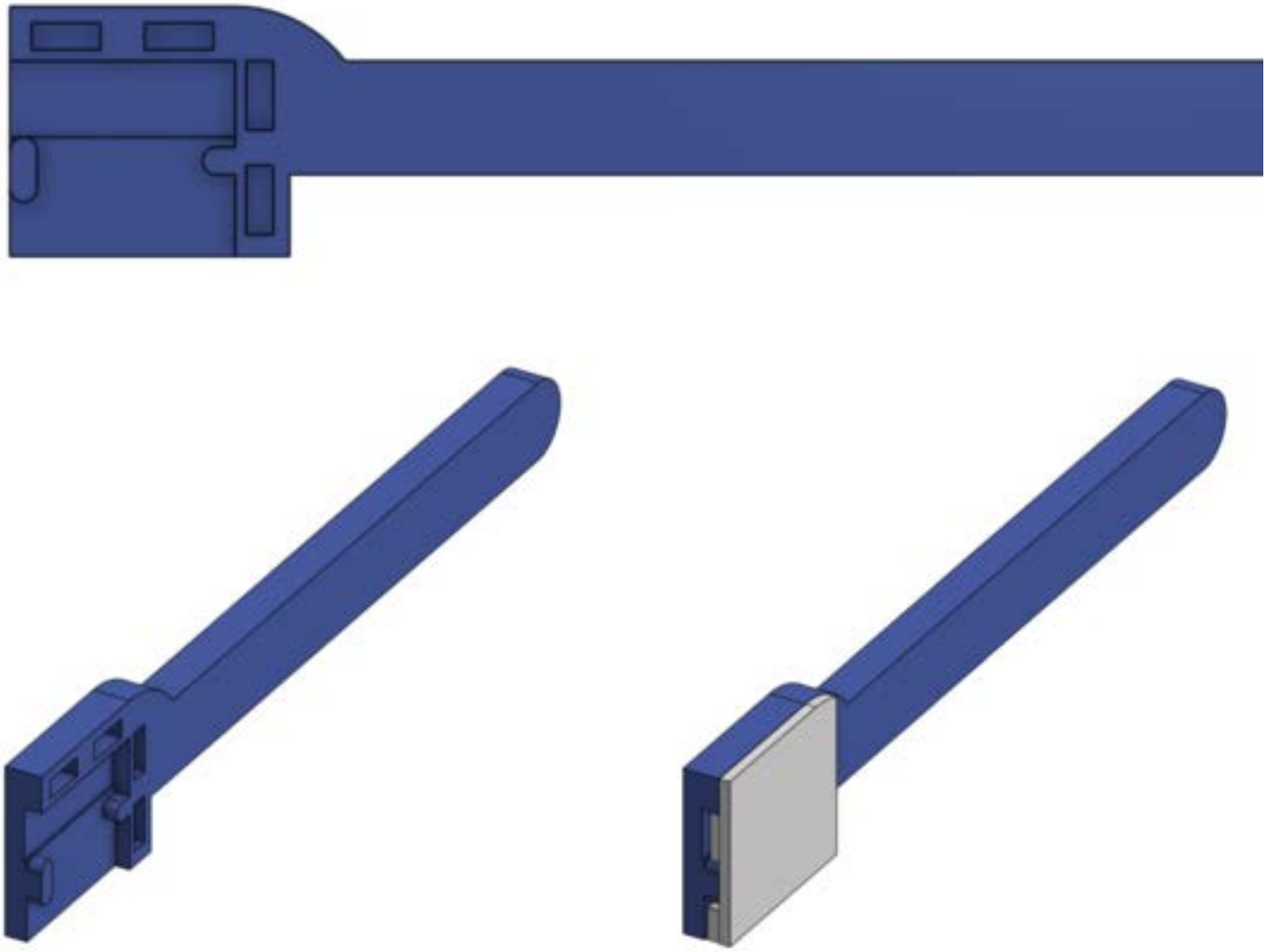
Present: Gianna

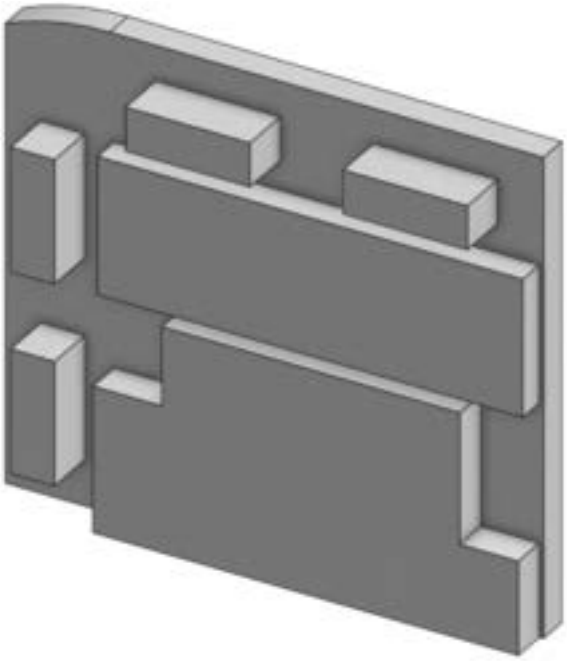
Goals: Document the updated design and print

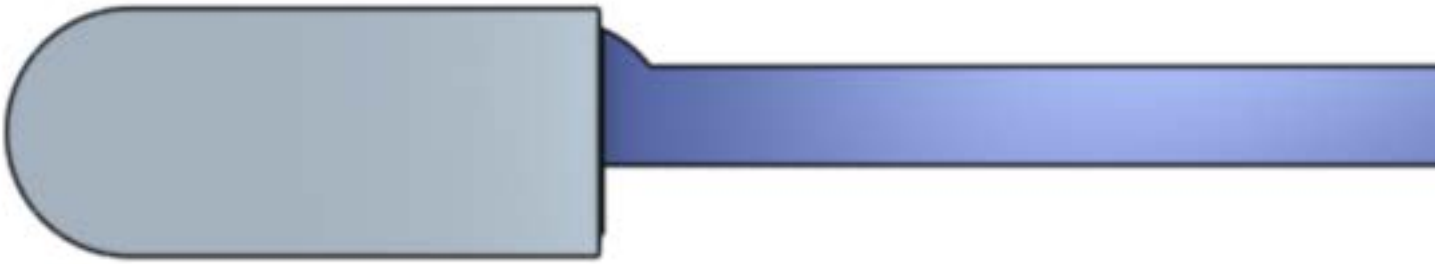
Content:











Conclusions/action items: This design has all the changes addressed in the last note. This is the first version of the razor blade handle. I will print this in PLA and see what problems they have

11/14/25 - Changes for the CAD drawings

Gianna Inga - Nov 14, 2025, 12:48 PM CST

Title: Changes for the CAD drawings

Date: 11/14/25

Content by: Gianna

Present: Gianna

Goals: Document the changes to make on the CAD drawing based on the print limitations.

Content:

- change width of pressing device to have no overhang
- locking mechanism did not work
    - the flanges were too wide and would not go into the hole
    - supports in the hole were stuck and could not come out
    - need to utilize a different design
- the locking mechanism also needs to be implemented for the razor blade handle
- reduce the center hole extrude length to better fit the razor blade
- 30% was a good infill
- the bottom part of the handle needs to encase the blade
- change the side hole extrude dimensions to better fit the razor blade
- razor blade cover is good as is
- change the slot dimensions to be smaller
    - the blade can rotate a little up and down right now
- make the pusher handle length shorter

Conclusions/action items: I will implement these changes to the CAD drawing and reprint once more in PLA. After we make these changes and ensure that the locking mechanism works, the design will be printed on the final material. We will then utilize that print in the testing.

12/1/25 CAD Design with Wings

ELLA LANG - Dec 07, 2025, 1:08 PM CST

Title: CAD Design with Wings

Date: 12/1/25

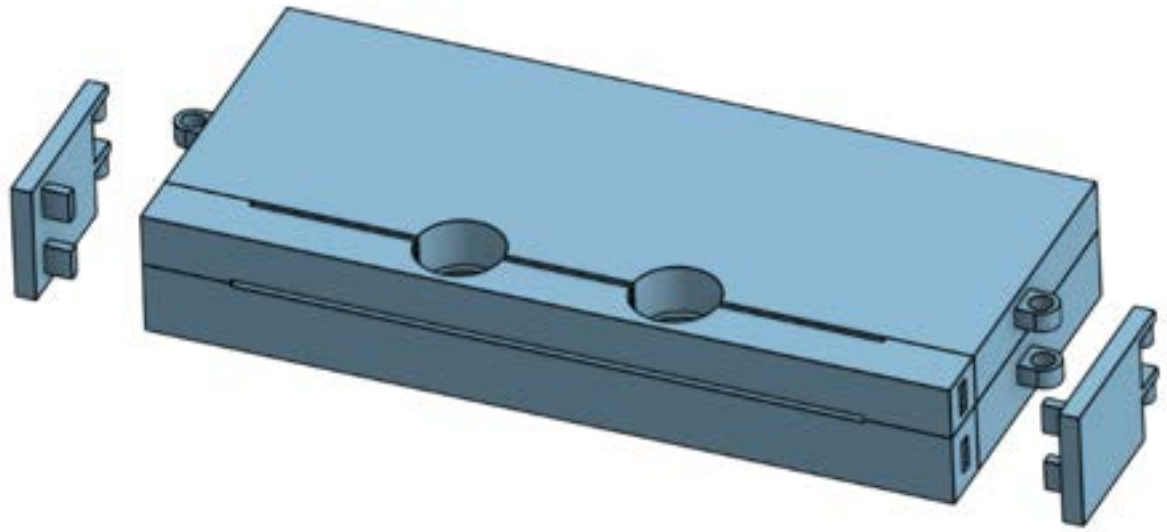
Content by: Ella Lang and Gianna Inga

Present: Ella lang

Goals:

- Depict and explain the new design with hinged wings

Content:



Design by Gianna inga

The updated design utilizes snap-in hinged wings to securely hold all the base components together. The wing pegs attach to loops on the side of the base and can be swung closed, snapping in place. This holds all the device components steady while the user is cutting samples.

Additionally, the wings can be easily swung back open to take the device apart or remove the samples.

Conclusions/action items:

- Print this design version in PLA

- Test this design version with tissue samples and blade insertion into the cut lines

12/1/25 CAD Design with Pegs

ELLA LANG - Dec 07, 2025, 1:13 PM CST

Title: CAD Design with Pegs

Date: 12/1/25

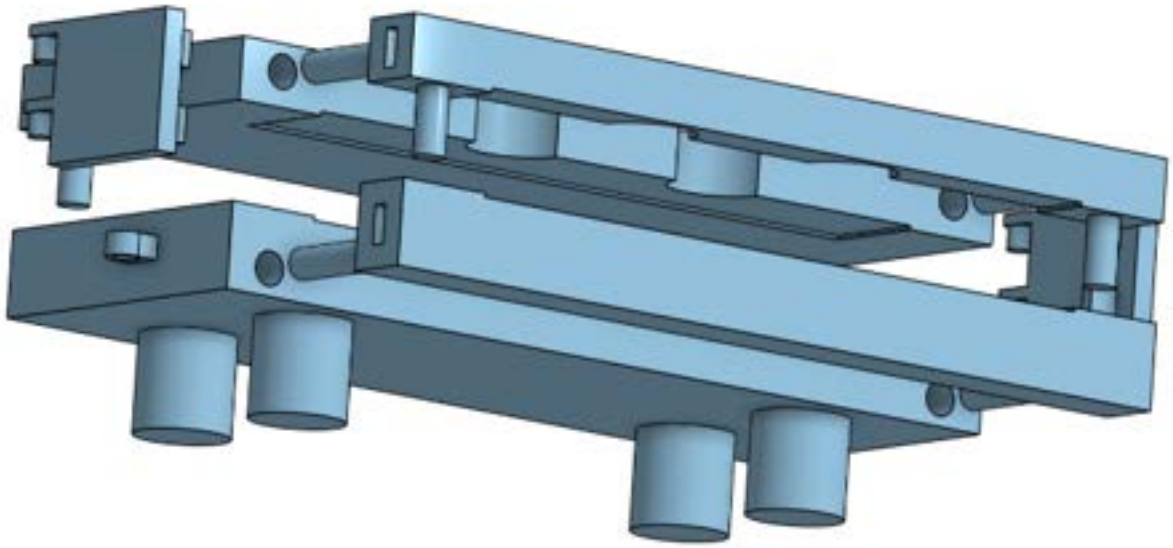
Content by: Ella Lang

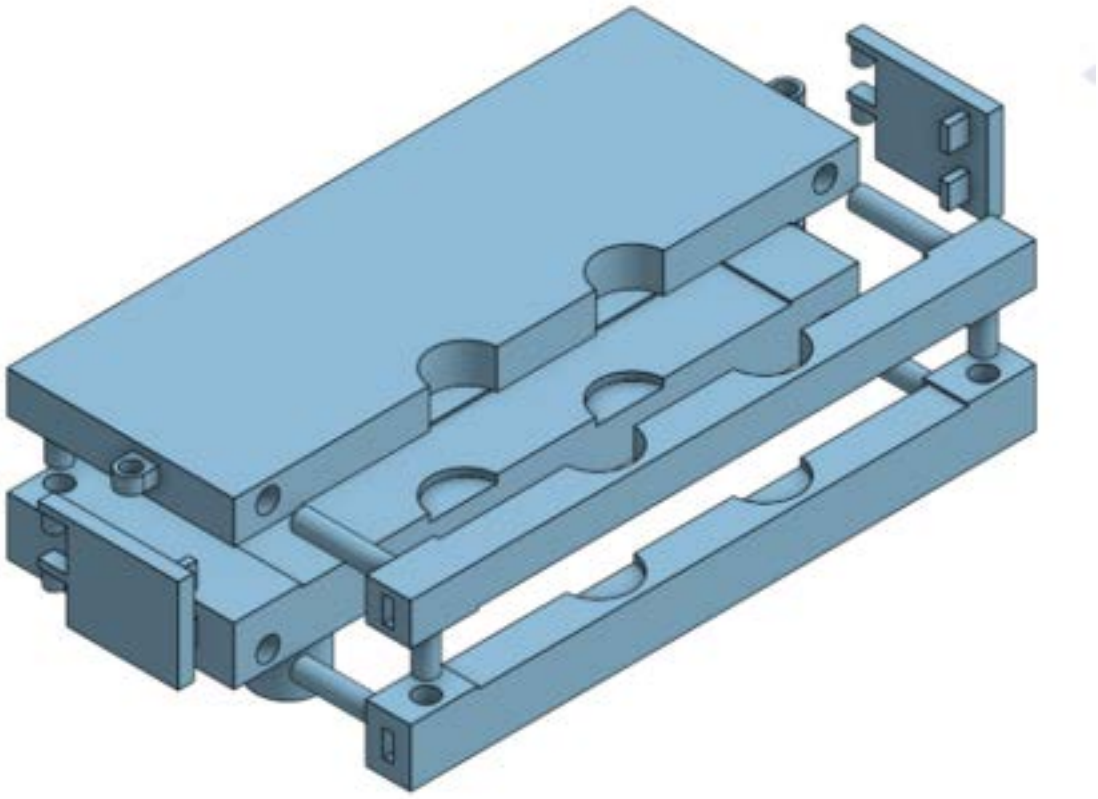
Present: Ella Lang

Goals:

- Create a CAD design with extruding pegs coming off of the base design that fit into the neoprene mat

Content:





Peg design by Ella Lang

- This design incorporates pegs on the bottom that slide into the machined neoprene base

- This holds the design to the mat, holding it in place while cutting, preventing sliding or movement

- This aids in keeping the user safe

Conclusions/action items:

- Print this final design in PLA and Nylon 12

- Test the design with the neoprene mat and cutting motions

09/26/2025 - BPAG Info Meeting Notes

SARAH RAUBENSTINE - Sep 26, 2025, 12:40 PM CDT

Title: BPAG Informational Meeting Notes

Date: 9/26/25

Content by: Sarah Raubenstine

Present: BME Design BPAGs

Goals: Get info on purchasing processes and responsibilities.

Content:

- SHOULD get your client to buy stuff for you! - if not you pay and get reimbursed
  - Either way, have all expenses approved by the client prior to purchase
- Any purchase over $1000 must have departmental approval as well as client approval
- Keep good track of all of your purchases
  - All original details should be in the notebook
  - Recorded in a table of expenses - in the notebook, progress report, and final report
- We have a client with a UW Affiliation but not with BME
  - Are they using UW funds, I need to check this
  - If the answer is yes, we need to follow certain rules, if the answer is no, it's pretty much fair game (amazon all good)
- Using UW funds, need to go through Shop UW+ for distributers, system of contracted vendors
  - if it is in the system, have to buy through shop UW, if not, client can buy from anywhere
  - can't reimburse you for tax...
  - Client will use some kind of funding string to buy things with, more for them to figure out
  - Certain timeframe of reimbursement
- BPAG is the only one who should be making purchases and seeking reimbursement, client should be refunding just one person
- Contracted venders on ShopUW+, need to make sure it's not available there before buying on amazon etc.
  - Can't actually shop UW, need to go to each individual vendor seperately
- Makerspace items, 3D printing and mini-mart
  - $50 budget per team to use at the Makerspace, use the design account BMEDesign
  - Everyone's name should be on that
  - Exceeding $50 budget, talk to Dr. P, client can set up own funding string account for payment with Makerspace
- Free stockroom inventory and tools downstairs at ECB, can only use these downstairs, talk to them nicely :)
- Only the BPAG will be reimbursed, don't seek individual reimbursement
  - using UW funds, use eReimbursement, takes a while, need to start this process before the poster session
  - Original receipts must be provided with date, purchaser name, vendor details, itemized items, cost
  - This is a last resort, these suck and take too long, try to make sure that the client buys things, clients don't like this paperwork either
  - For support, work with MD and support staff
- Non-reimbursable expenses
  - Team notebook (we already paid for)
  - Team Poster
  - Not bad at all basically
  - Don't ask client to pay for these things, not their obligation
- Purchasing template, make this repeatable, someone should be able to use this to make what you made
- Should be a nice looking table in your progress reports, keep it updated
  - Manufacturer part number and vendor part number may differ, find on the vendor list and on the manufacturer site
  - end your link on sheets so it looks nicer
  - progress report should not be a screenshot of this, should be able to copy and paste links
- In general, have your client buy things basically, and have them approve things
- BME design request for funding form, we probably won't need, not an independent/special client.
  - proposals will be discussed Wednesday mornings at design faculty meetings, time the request well
- Gifted something or finding materials in the free closet, stock materials, try to see if the piece works, try before you buy

- should still track this on the table, can put in free, whole point of the table is to be repeatable, need to figure out where the free stuff came from and how to buy it again

Conclusions/action items: Have the client buy things! Try not to have to be reimbursed!

2025/12/10 - Final Expense Sheet

SARAH RAUBENSTINE - Dec 10, 2025, 1:35 PM CST

Title: Final Expense Sheet

Date: 12/10/25

Content by: Sarah Raubenstine

Goals: Identify all material expenses from this semester of design

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

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

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

11/20/25 - Fabrication of neoprene rubber base plate

Simon Nam - Dec 06, 2025, 11:35 PM CST

Title: Design Iterations Overview

Date: 11/20/2025

Content by: Simon Nam

Goals: To fabricate the neoprene rubber base plate to attach it with base assembly of the finalized design

Content:

As a team, we agreed on additionally making this component to provide more weight and stability for the entire device to not move when in contact with smooth surface of BSC

This would allow the user to safely and properly handle the precision cutting with the device stabilized on top of the neoprene rubber base plate

Figure 1: Fabrication of neoprene rubber base plate using waterjet cutting machine from D.I. Lab

Figure 2: Finalized base design of neoprene rubber

Conclusion/Action Items: Integrate the neoprene base plate with the biopsy press prototype. Ensure that the 4 newly created pegs at the bottom side of the main base assembly fit perfectly with the rubber sheet.

11/25/25 - Nylon printed design

Simon Nam - Dec 06, 2025, 2:17 PM CST

Title: Nylon printed design

Date: 11/25/2025

Content by: Simon Nam

Goals: To fabricate the neoprene rubber base plate to attach it with base assembly of the finalized design

Content:

Figure 1: Removing residues of nylon dust from in-fill holes/depths of the design components

Conclusion/Action Items:

Overview of Cons with using Nylon material:

-Cost ~$20 which is very high compared to PLA print cost ~$2

-Longer duration of printing by D.I. Lab

-Loosened/elongation in certain parts of the base assembly, that unexpectedly differed from the original dimensions from the SLT file

-After printing was done, it required further procedure to remove all the remnants of nylon dust from the internal parts (ex. holes) and more cleaning to prepare sanitized condition before interaction with samples

12/05/25 - Design Iterations Overview

Simon Nam - Dec 06, 2025, 1:04 PM CST

Title: Design Iterations Overview

Date: 12/05/2025

Content by: Simon Nam

Goals: To showcase all the design iterations at once

Content:

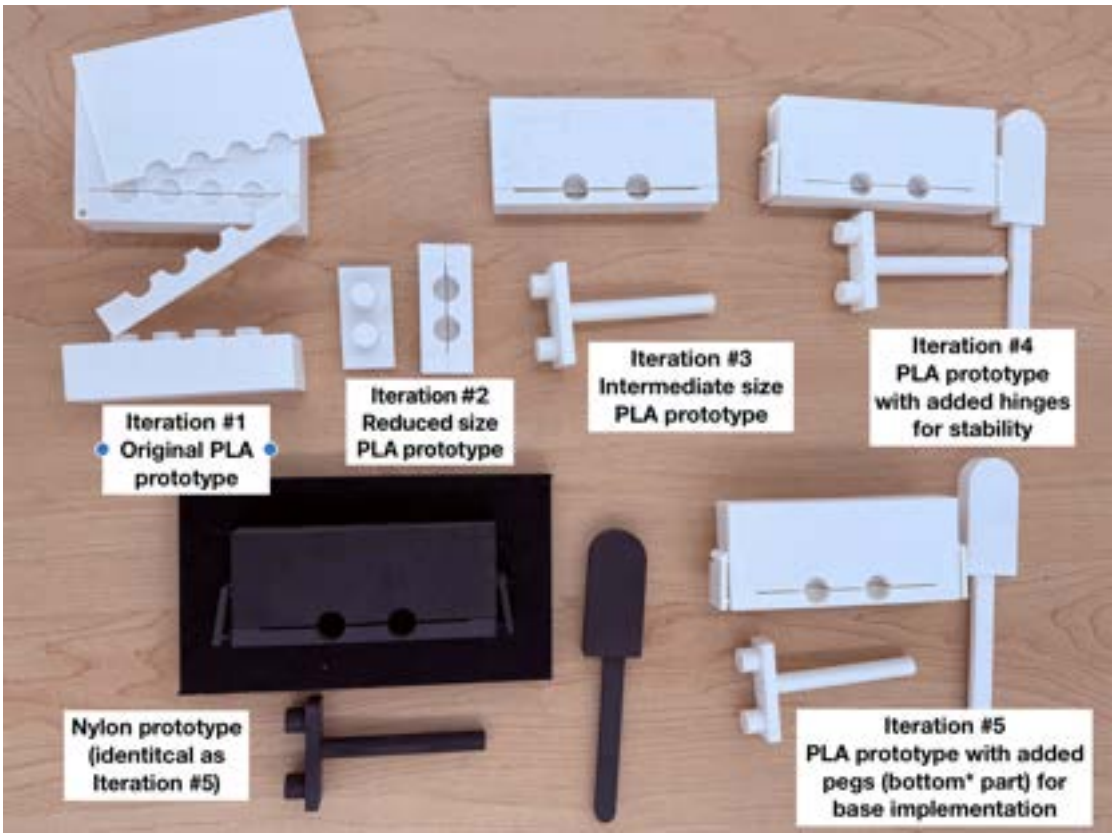


Figure 1: Design Iterations overview

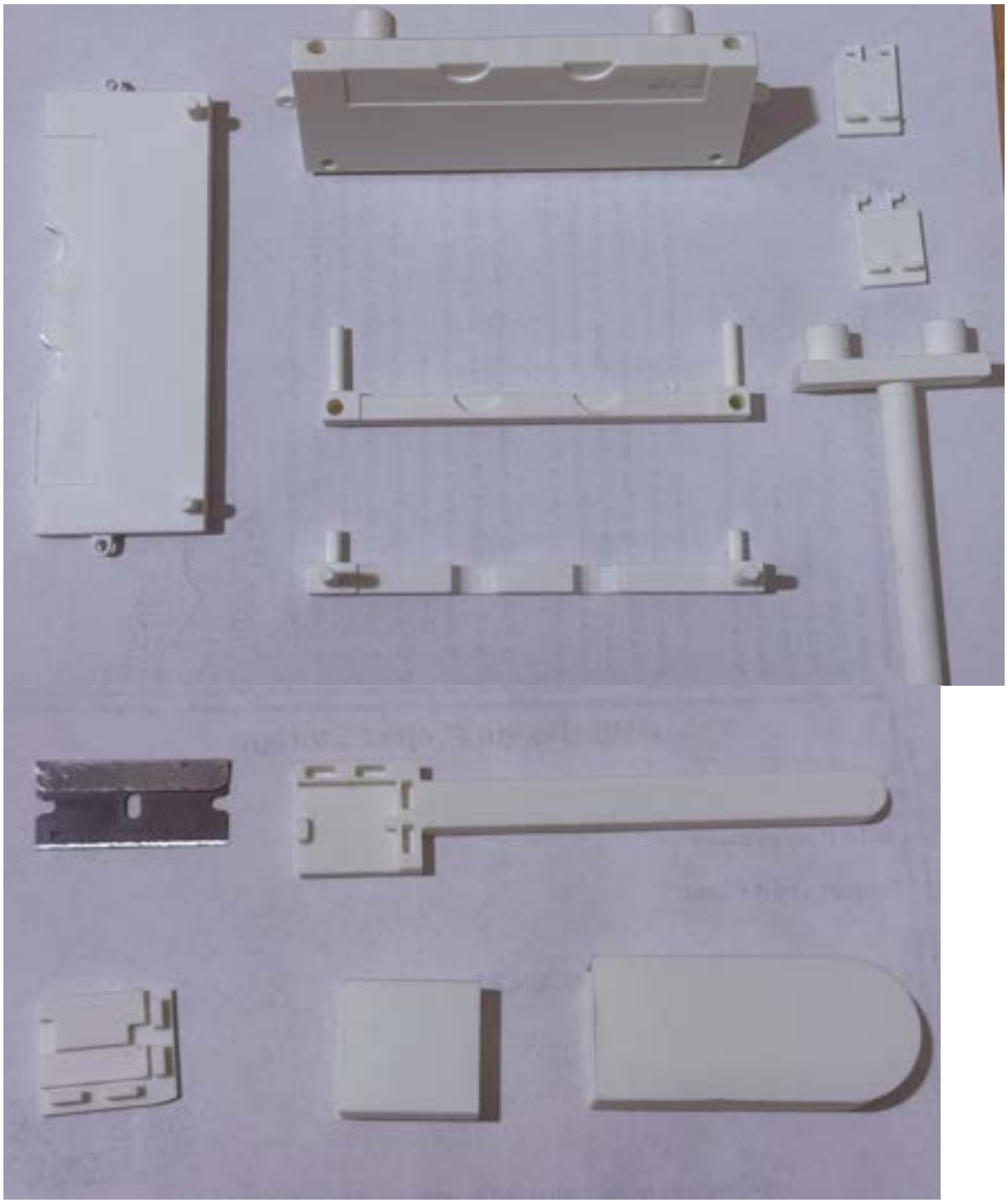


Figure 2: Latest prototype (in PLA) exploded view

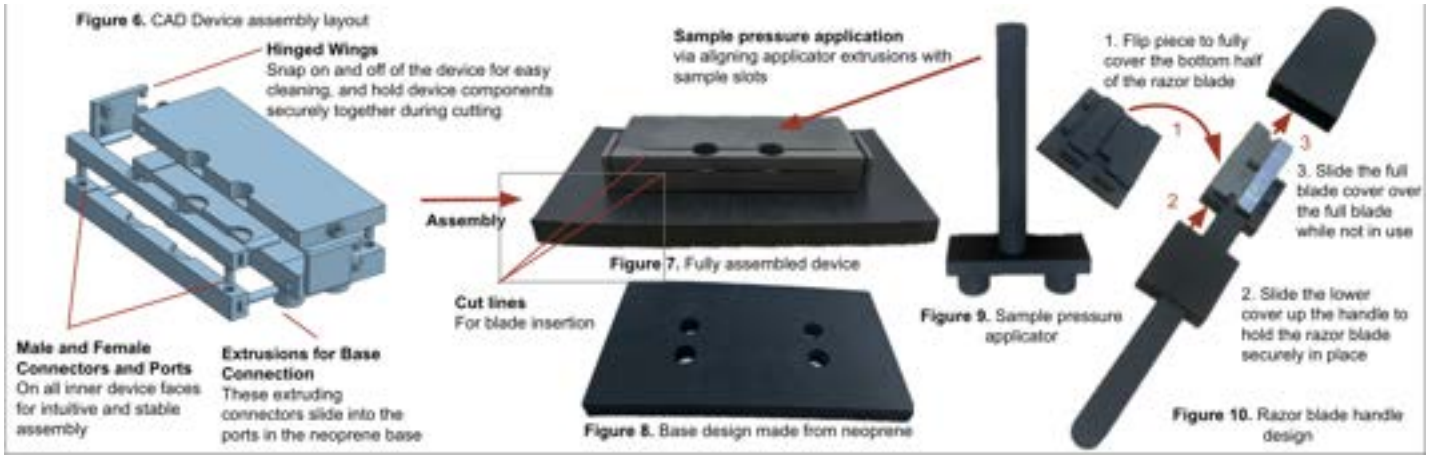


Figure 3: Latest Prototype with detailed explanation on parts & mechanism (made by Ella Lang*)

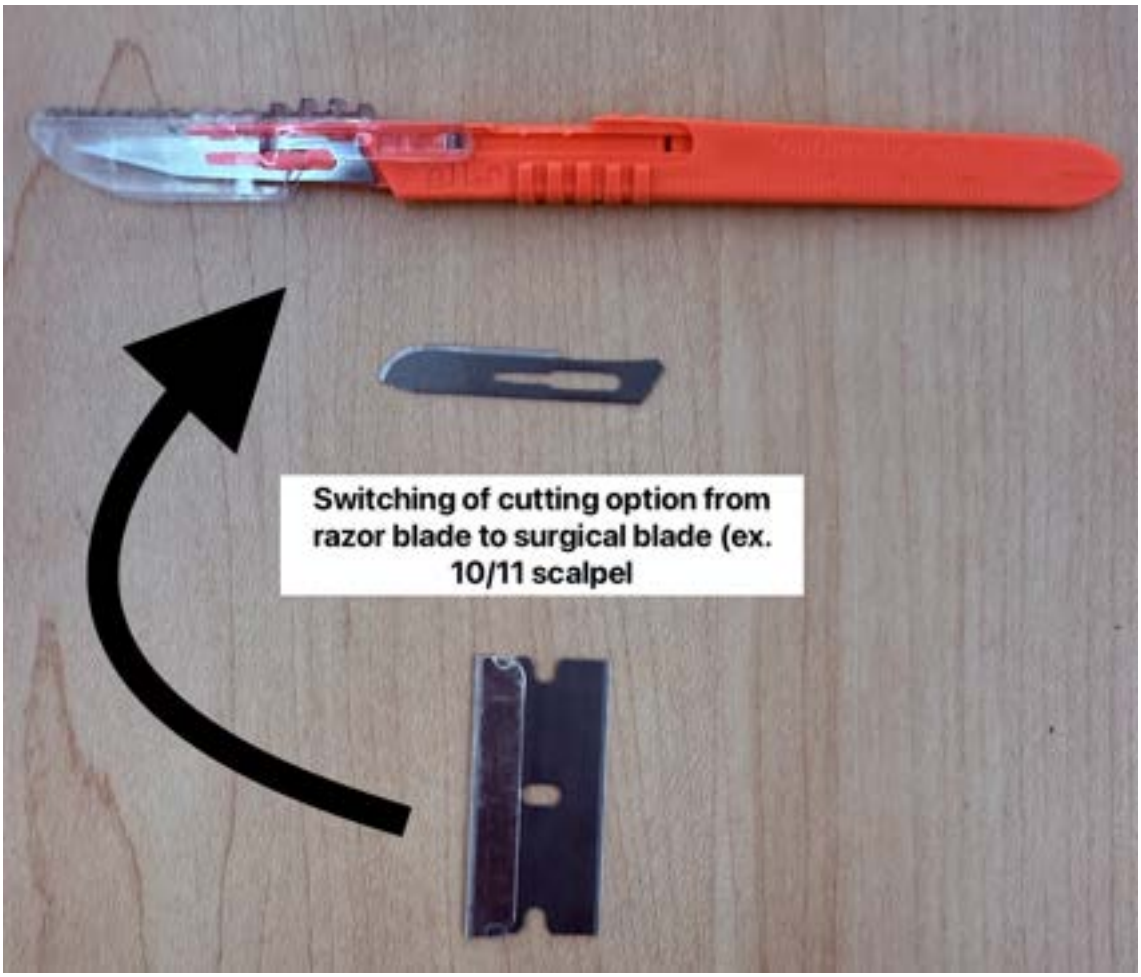


Figure 3: Blade type changing

Conclusions/action items:

-Keep and refer to this entry for making further adjustments/modifications of the design in the future semester

12/05/25 - Solidworks/OnShape Files

Simon Nam - Dec 06, 2025, 1:00 PM CST

Download

Biopsy_Press.stl (338 kB)

Simon Nam - Dec 06, 2025, 1:02 PM CST

Download

Biopsy_Press_v.4_w-_base_pegs.stl (417 kB)

Simon Nam - Dec 06, 2025, 1:02 PM CST

Download

Biopsy_Press_v.3.stl (406 kB)

Simon Nam - Dec 06, 2025, 1:02 PM CST

Download

Biopsy_Press_v.2_trial_snap.stl (303 kB)

11/17/25 - Sanitization Testing Protocol

Simon Nam - Dec 06, 2025, 11:34 PM CST

Title: Sanitization Testing Protocol

Date: 11/17/2025

Content by: Ella Lang

Goals: Use GloGerm and UV light to estimate the effectiveness of 2 sterilization methods at removing porcine tissue residue from the device after use

Content:

Attached below

Conclusions/action items:

- Utilize these images in the final report and expand on ways to improve the design for cleaning

ELLA LANG - Nov 19, 2025, 11:02 AM CST

Download

Sterilizability_Testing_Protocol.pdf (175 kB)

11/19/25 - Survey Testing Protocols

Simon Nam - Dec 04, 2025, 9:26 PM CST

Title: Survey Testing Protocols

Date: 11/19/2025

Content by: Simon Nam

Goals: Use the created Survey Testing Protocols for conducting usability testing on the finalized design and collect scores & feedbacks

Content:

Attached below

Conclusions/action items:

- Utilize these scores & feedbacks to further modify the design as needed

Simon Nam - Dec 04, 2025, 9:26 PM CST

Download

Survey_Testing_Protocols.pdf (100 kB)

11/25/25 - Biopsy Processing Device Testing Consent Form

Simon Nam - Dec 04, 2025, 9:29 PM CST

Title: Biopsy Processing Device Testing Consent Form

Date: 11/25/2025

Content by: Simon Nam

Goals: Use this consent form to conduct testing with authorization for the medical students and clients who are capable with handling sharp blades along with the design

Content:

Attached below

Conclusions/action items:

-Keep physical record of these consent forms for IRB and future reference as needed

Simon Nam - Dec 04, 2025, 9:29 PM CST

Download

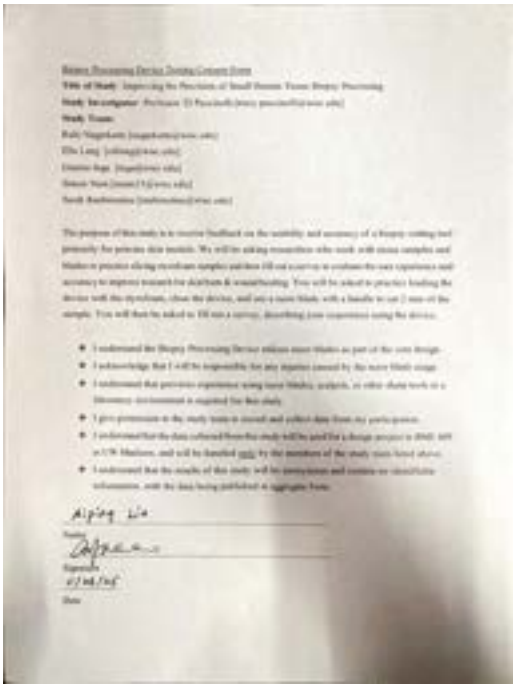
Testing_Consent_form.pdf (2.72 MB)

Simon Nam - Dec 06, 2025, 11:37 PM CST

Download

processed-B12FCBD2-5C7C-4BC0-AAAD-679296EBE127.jpeg (3.4 MB)

Simon Nam - Dec 06, 2025, 11:37 PM CST



Download

processed-C543C824-3A25-4146-85D3-82FBEA126650.jpeg (4 MB)

11/30/25 - FEA Analysis Testing Protocol

RUHI NAGARKATTE - Dec 09, 2025, 3:10 PM CST

Title: FEA Analysis Testing Protocol

Date: 12/9/25

Content by: Ruhi Nagarkatte

Present: NA

Goals: Develop a thorough FEA testing protocol

Content:

Refer to the pdf below.

Conclusions/action items:

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

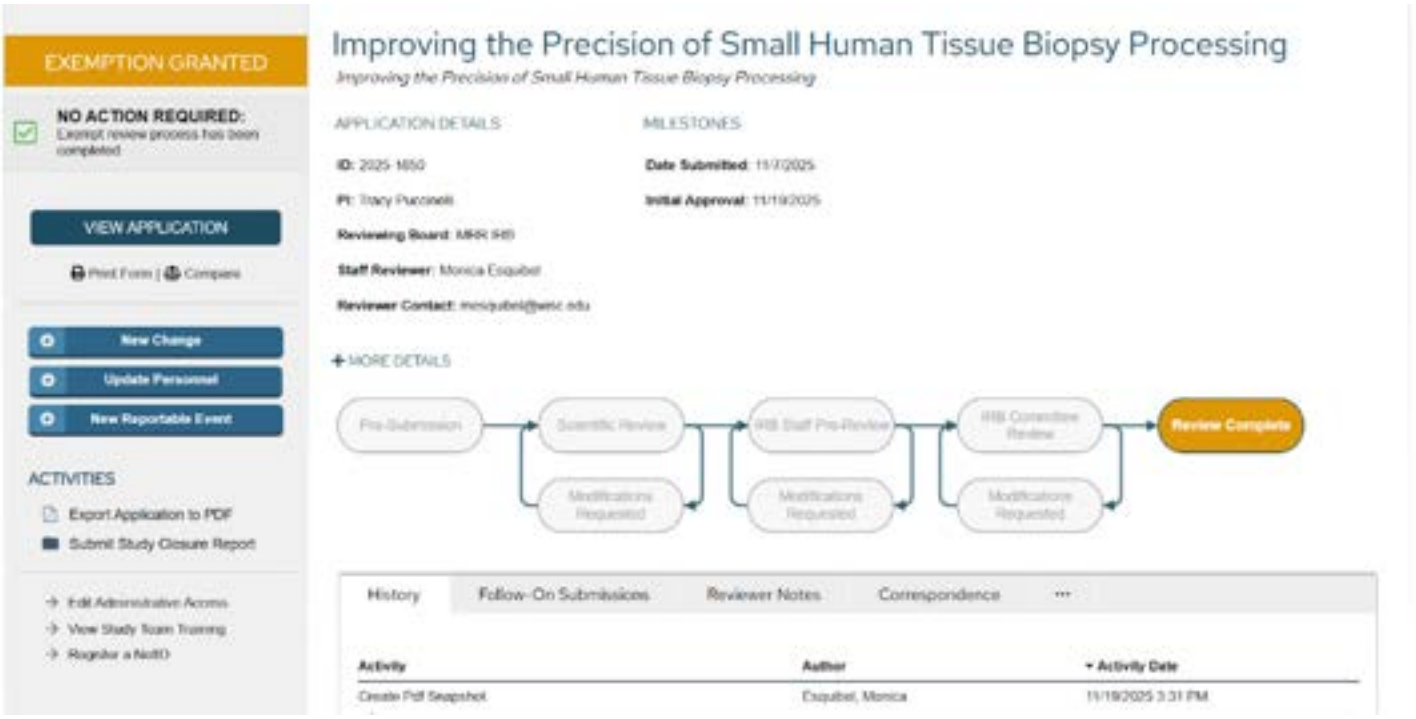
RUHI NAGARKATTE - Dec 09, 2025, 3:10 PM CST

Download

FEA_Protocol.pdf (33.2 kB)

11/19/25 - IRB Application & Approval

RUHI NAGARKATTE - Dec 10, 2025, 7:54 AM CST



RUHI NAGARKATTE - Dec 10, 2025, 7:55 AM CST

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2025-1650.pdf (185 kB)

11/26/25 - Scores & Feedback responses

Simon Nam - Dec 04, 2025, 10:21 PM CST

Title: Scores & Feedback response (actual)

Date: 11/26/2025

Content by: Simon Nam

Goals: To gather and organize all the feedbacks received from the medical students and clients that conducted usability testing of device.

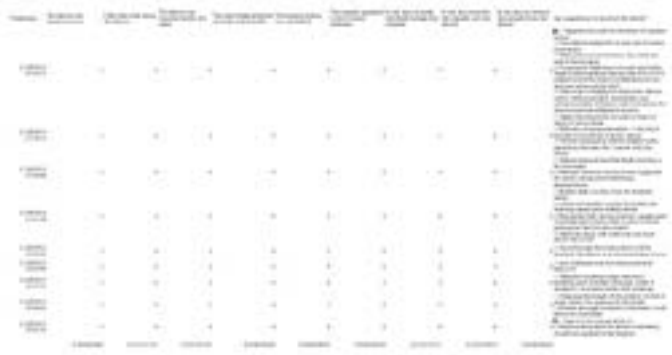
Content:

Spreadsheet Attached below

Conclusions/action items:

-Keep and continuously refer to this summary for making further adjustments/modifications of the design

Simon Nam - Dec 04, 2025, 10:21 PM CST



Download

Survey_Testing_Protocols_Responses_1_.xlsx (9.11 kB)

11/26/25 - Summary of Feedbacks

Simon Nam - Dec 04, 2025, 9:37 PM CST

Title: Summary of Feedbacks from Device Testings

Date: 11/26/2025

Content by: Simon Nam

Goals: To gather and organize all the feedbacks received from the medical students and clients that conducted usability testing of device.

Content:

Attached below

Conclusions/action items:

-Keep and continuously refer to this summary for making further adjustments/modifications of the design

Simon Nam - Dec 04, 2025, 9:36 PM CST

Download

Feedback_summary.docx.pdf (68.5 kB)

11/26/25 - Visual Depictions of Device Usability Testing

Simon Nam - Dec 04, 2025, 10:24 PM CST

Title: Visual Depictions of Device Usability Testing

Date: 11/26/2025

Content by: Simon Nam

Goals: To depict all the procedure and results of the device testing on sample cuttings; styrofoam with medical students, porcine skin with client(s)

Content:

To be updated*

Conclusions/action items:

Refer to the images and captions above for final deliverables and recorded for future work

11/27/25 Results of Sanitization Testing

ELLA LANG - Dec 07, 2025, 1:28 PM CST

Title: Results of Sanitization Testing

Date: 11/27/2025

Content by: Ella Lang

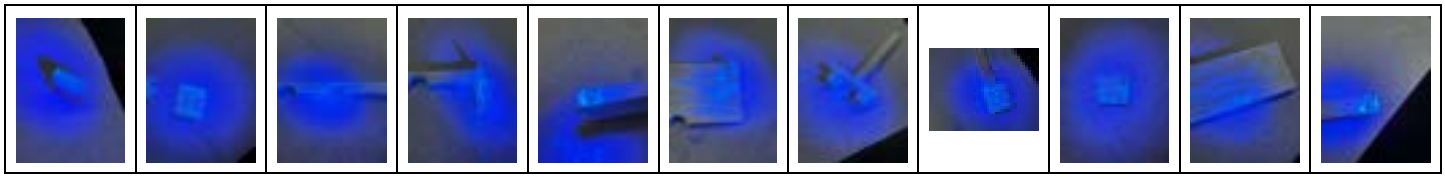
Present: Ella Lang

Goals:

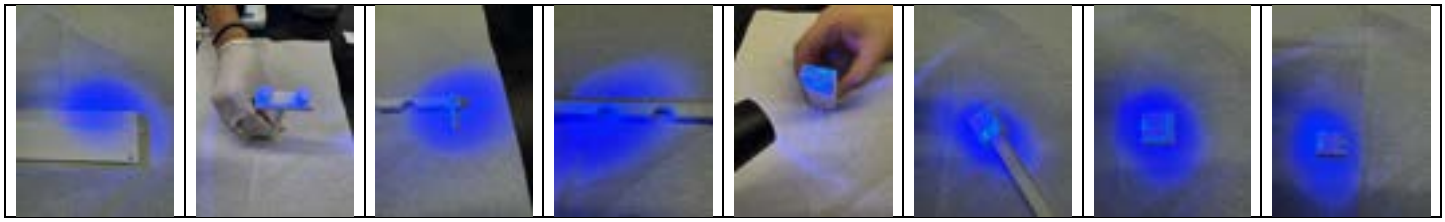
- Show the results of sanitization testing

Content:

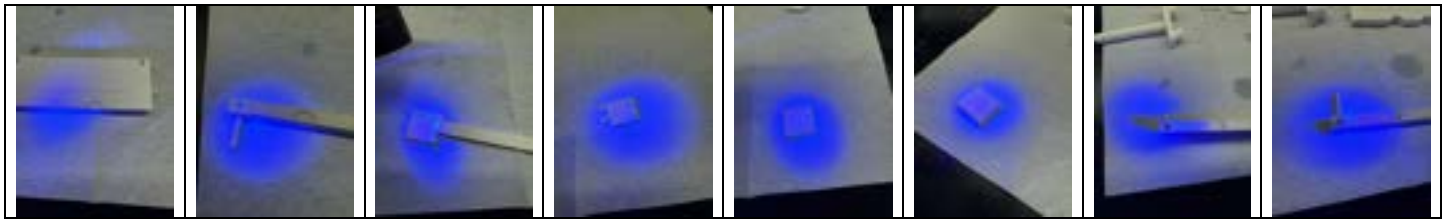
1. Images of components coated in GloGerm



2. Images of components after wiping down with spray ethanol



3. Images of components after washing with soap and water



Takeaways:

- Wiping down with spray ethanol is not effective in removing the GloGerm solution from intrusions or sharp edges

- Cleaning with soap and water is mostly effective in removing the GloGerm solution, however, there is some small buildup in intrusions and at sharp edges

- Recommendation is to clean the device out with soap and water at the end of each day, however, after about a week of use, the device should be reprinted

Conclusions/action items:

- In future semesters, we should redesign the base to have less intrusions and sharp edges

11/30/25 - FEA Analysis Testing Results

RUHI NAGARKATTE - Dec 09, 2025, 3:13 PM CST

Title: FEA Analysis Testing Results

Date: 11/30/25

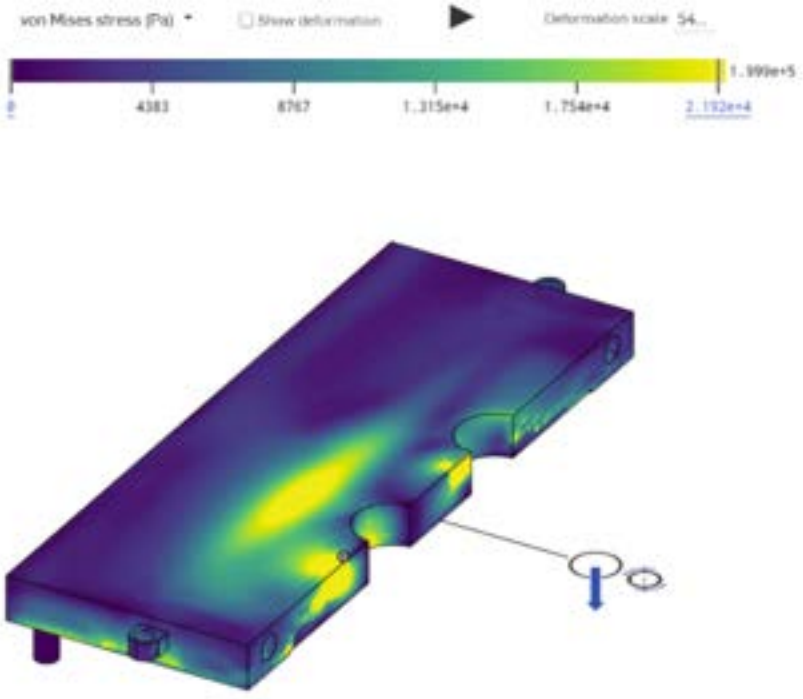
Content by: Ruhi Nagarkatte

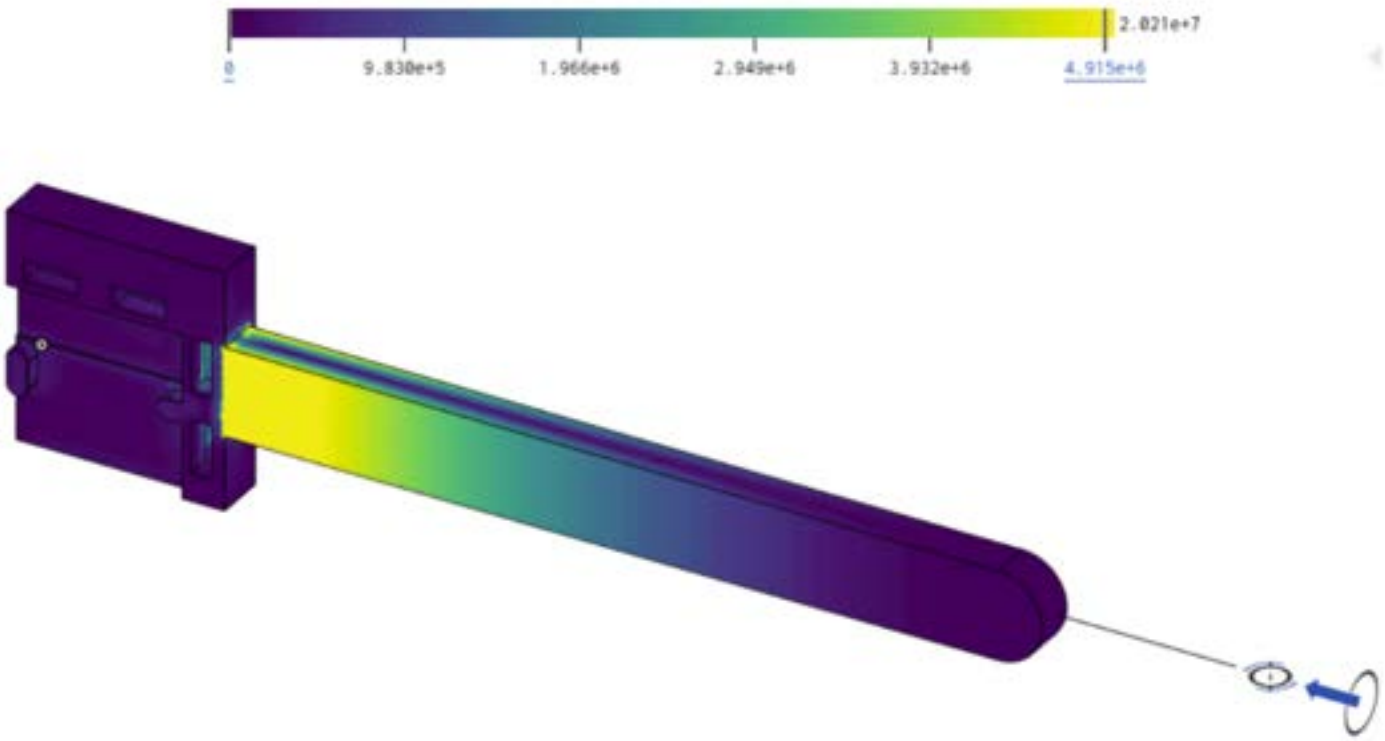
Present: NA

Goals: Interpret results for the FEA simulationn

Content:

A finite element analysis test was performed to identify potential weak points of the design. Both the surface and pegs of the body of the biopsy press and handle of the razor blade are subjected to varying forces, ranging from grip strength to shearing force required to slice the biopsy samples. A range of force from 10-20 Newtons for the biopsy press body and 1-5 Newtons for the razor blade handle was considered and used in the simulation . A von Mises stress analysis, as compared to a max principal stress analysis, simulation was implemented as nylon exhibits predominantly ductile properties. The results are shown in Figures 22 and 23 below.





A 22 N force was applied to the surface of the biopsy press; this value was slightly above the considered range, accounting for additional impact forces that could potentially be exerted by the user. Despite this force exaggeration, the biopsy press was able to withstand upwards of 22 kPa without the critical risk of deformation, reinforcing its structural integrity. Similarly, a 9 N force was directed at the rear end of the handle, which was able to absorb substantial amounts of force. There was a minimal risk around the point of connection between the handle and the shield, but generally could support up to 5 MPa while providing stability for the user to cut the tissue samples. Overall, both of these components emphasized the device's durability and strength, being able withstand the user's applied forces, allowing successful processing of tissue biopsy samples.

Conclusions/action items:

These results show the structural integrity of the design. With exaggerated forces, the components are able withstand high amounts of stress before the critical risk of plastic deformation.

9/18/25 - PDS

Simon Nam - Sep 18, 2025, 8:25 PM CDT

Download

biopsy_badgers_PDS_v1.pdf (455 kB)

9/24/25 - Design Matrix (In Progress)

Simon Nam - Sep 25, 2025, 7:55 PM CDT

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Design_Matrix_biopsy_badgers.docx (741 kB)

10/03/25 - Preliminary Presentation

RUHI NAGARKATTE - Oct 09, 2025, 8:28 AM CDT

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biopsy_badgers_Prelim_Presentation.pptx (12.3 MB)

10/08/25 - Preliminary Report

Simon Nam - Dec 06, 2025, 9:22 AM CST

BME Design

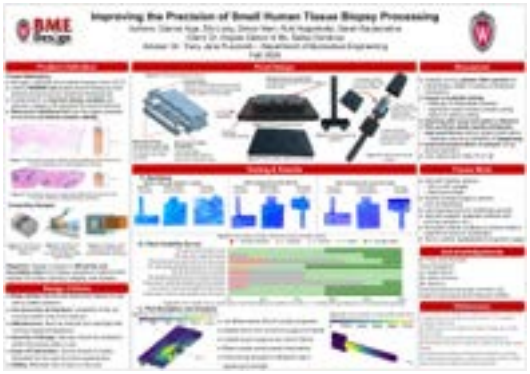
Improving the Precision of Small Human Tissue Biopsy Processing

Download

biopsy_badgers-Preliminary_report.pdf (10.3 MB)

12/05/25 - Final Poster Presentation

Simon Nam - Dec 06, 2025, 9:23 AM CST



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biopsy_badgers_final_poster.pptx.pdf (3.59 MB)

12/10/25 - Final Report

Simon Nam - Dec 10, 2025, 8:54 PM CST

Improving the Precision of Small Human Tissue Biopsy Processing

Download

FINAL_report_biopsy_badgers.pdf (5.2 MB)

10/31/25 - Show & Tell Notes/Feedbacks

SARAH RAUBENSTINE - Nov 05, 2025, 2:35 PM CST

Title: Show & Tell Notes

Date: 10/31/25

Present: Biopsy Badgers Team

Goals: Get feedback from peers about our design and any obstacles

Content:

Quick Pitch (1 min)

-
- We are creating a cutting device for the porcine/pig tissue biopsy samples for our client on wound-healing studies
- Our current prototype, Biopsy Press is in 3D printed assembly form of 5 pieces and consists of 2 wells for the samples to be inserted, pressed down, and cut the cylindrical sample.
- The razor blades will make perpendicular cuts through the samples with this device
- The fat layer of the tissue sample will be cut & removed from the procedure, 2-3 mm
    - Cut 12 mm biopsy samples to 2–3 mm thickness

Other questions to ask:

- Good materials for layers that have high surface friction and are resistant to fumehood surfaces that are to be attached to a heavy, base component?
- Cutting technique with razor blades? Handle compatibility?
- Ask if anyone has past experience with handling porcine skin?

Notes / Feedback from other teams:

-grippy sock material - those little dots on the bottom

-suction cups on the bottom

–suction cups

-with a little knob on top to snap into the base

-silicone base

-force it would take to slice

-heavier infill

-Centered Nylon 3D print

–material on the corners, maybe rubber

-keep grocery bags in place

-bottom on the chairs

-rubber shower rug

-bottom on computer

-**thin slice of rubber, throw it down and put the thing on top of it**

-suction cup separator, something to push up against

-rubber and ethanol don’t mix good

-rubber mesh keeping utensils on the the kitchen epoxy to bottom

-cork

-search scalpel razor blade handle on grab cad

-Testing ideas

- Force plates on the ground for pressing

  Precision analysis through microscope, more insight scale

  Solid-works simulation

-Additional modifications:

Include a like a door knob or handle attached for the press/upper part onto the samples for easier pressing & control x4

--> needs to fit along with the hand formation

Have more variation of test samples besides hard stryofoam

Make it more like a box cutter considering safety factor

Inclusion of more wells in a different arrangement with considering uniformity of pressure

Including clamps instead of pegs to hold them together for assembly

Pushing the reverse buttons for snapping, releasing for detachment

Clip inside that works along with pressure? to hold & release them

Include small magnetic components at the edges for easier assembly/disassembly

Conclusions/action items: Think over how to include some of these ideas into our design.

9/11/2025 - Progress Report #1

ELLA LANG - Sep 12, 2025, 12:18 PM CDT

Improving the precision of small human tissue biopsy processing

Problem Statement

Brief Status Update

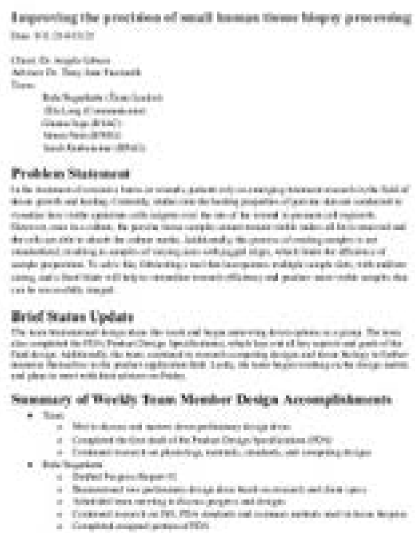
Summary of Weekly Team Member Design Accomplishments

Download

Progress_Report_1.pdf (180 kB)

9/18/2025 - Progress Report #2

Simon Nam - Sep 18, 2025, 8:25 PM CDT



Improving the precision of small human tissue biopsy processing

Problem Statement

Brief Status Update

Summary of Weekly Team Member Design Accomplishments

Download

Progress_Report_2.pdf (183 kB)

9/25/2025 - Progress Report #3

ELLA LANG - Sep 26, 2025, 10:53 AM CDT

Improving the precision of small human tissue biopsy processing

Problem Statement

Brief Status Update

Summary of Weekly Team Member Design Accomplishments

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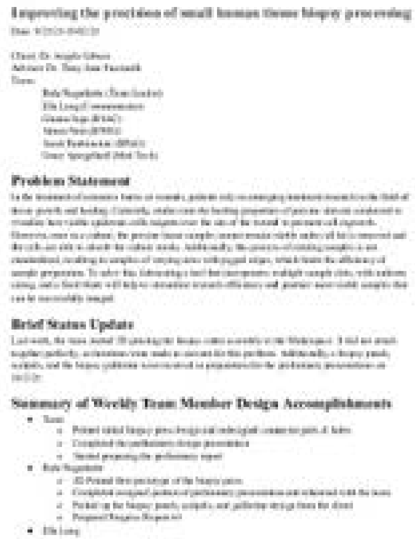
Progress_Report_3.pdf (1.02 MB)

10/2/2025 - Progress Report #4

ELLA LANG - Oct 24, 2025, 1:13 PM CDT


Improving the precision of small human tissue biopsy processing

Problem Statement

Brief Status Update

Summary of Weekly Team Member Design Accomplishments

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Progress_Report_4.pdf (192 kB)

10/9/2025 - Progress Report #5

ELLA LANG - Oct 24, 2025, 1:13 PM CDT

Improving the precision of small human tissue biopsy processing

Date: 09/25/2025

Client: Dr. Angela Gibson
Advisor: Dr. Tony Ann Fawcett
Team:
Bob Napoleon (Team Leader)
Ella Long (Communicator)
Gianna Inga (BSAC)
Simon Peter (BSAC)
Jacob Parkinson (BPAG)
Grace Springfield (Mod Tech)

Problem Statement

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

Brief Status Update

We met with the client, Dr. Gibson and Grace from MedTECH virtually to discuss the final chosen design and received feedback from them about the design. Attributes were made the 3D printing of the final design to account for the adjustments provided by the client. We also completed the preliminary report with all the relevant background details and design specifications for updating all the progress we have achieved so far. Fabrication and further testing will be continued starting next week after we obtain more materials and samples directly from our client.

Most Issues on the meeting with client:
During the meeting, we shared our preliminary presentation and the 3D printed prototype of the Biopsy Press design in which the client notes the need on adjusting specific dimensions, especially the slot length for the blade and the diameter of supplied the biopsy tools. Dr. Gibson stated that if biopsies vary in thickness, the "Loop piece" gives compressed may cause uneven compression across samples. Therefore she suggested to reduce the number of tools from 6 to 4 to improve uniform pressure. The she has the blade was also considered too long, and shortening it would likely enhance precision along with safety factor.

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10/16/2025 - Progress Report #6

ELLA LANG - Oct 24, 2025, 1:13 PM CDT

Improving the precision of small human tissue biopsy processing

Problem Statement

Brief Status Update

Summary of Weekly Team Member Design Accomplishments

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Progress_Report_6.pdf (192 kB)

10/23/2025 - Progress Report #7

ELLA LANG - Oct 24, 2025, 1:13 PM CDT


Improving the precision of small human tissue biopsy processing

Problem Statement

Brief Status Update

Summary of Weekly Team Member Design Accomplishments

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Progress_Report_7.pdf (194 kB)

10/30/2025 - Progress Report #8

Simon Nam - Dec 06, 2025, 9:16 AM CST

Improving the precision of small human tissue biopsy processing

Problem Statement

Brief Status Update

Summary of Weekly Team Member Design Accomplishments

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Progress_Report_8.pdf (182 kB)

11/06/2025 - Progress Report #9

Simon Nam - Dec 06, 2025, 9:16 AM CST

Improving the precision of small human tissue biopsy processing

Problem Statement

Brief Status Update

Summary of Weekly Team Member Design Accomplishments

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Progress_Report_9.pdf (209 kB)

11/13/2025 - Progress Report #10

Simon Nam - Dec 06, 2025, 9:17 AM CST

Improving the precision of small human tissue biopsy processing

Problem Statement

Brief Status Update

Summary of Weekly Team Member Design Accomplishments

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Progress_Report_10.pdf (221 kB)

11/20/2025 - Progress Report #11

Simon Nam - Dec 06, 2025, 9:18 AM CST

Improving the precision of small human tissue biopsy processing

Problem Statement

Brief Status Update

Summary of Weekly Team Member Design Accomplishments

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Progress_Report_11.pdf (227 kB)

12/04/2025 - Progress Report #12

Simon Nam - Dec 06, 2025, 9:19 AM CST


Improving the precision of small human tissue biopsy processing

Problem Statement

Brief Status Update

Summary of Weekly Team Member Design Accomplishments

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Progress_Report_12.pdf (230 kB)

12/10/2025 - Progress Report #13

Simon Nam - Dec 10, 2025, 8:54 PM CST

Improving the precision of small human tissue biopsy processing

Date: 12/4/25 – 12/10/25

Client: Dr. Angela Gibson
Advisor: Dr. Tony Ann Fassbank
Team:

- Rishi Nagubadi (Team Leader)
- Elle Long (Communicator)
- Gianna Inga (BSAC)
- Simon Nam (BSBE)
- Sarah Rubenacker (BPhil)
- Grace Springfield (Mod Tech)

Problem Statement

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

Brief Status Update

The team has successfully completed all final iterations of the devices and deliverables for the semester. The team will meet with the client one additional time, on 12/11/25, to present the final poster and wrap up the last parts of the design.

Summary of Weekly Team Member Design Accomplishments

- Team
  - Scheduled final meeting with client to discuss further feedback of the latest design and next semester future work
  - Received PLA 3D print from the 3-Lab with new modifications
  - Completed the final report with all the necessary updates and progress made on project
- Rishi Nagubadi
  - Divided up and completed assigned portions final report and poster presentation

Download

Progress_Report_13.pdf (246 kB)

9/11/25 -Development of ex-vivo porcine skin models for research

RUHI NAGARKATTE - Sep 11, 2025, 9:49 PM CDT

Title: Development of ex-vivo porcine skin models for research

Date: 9/11/25

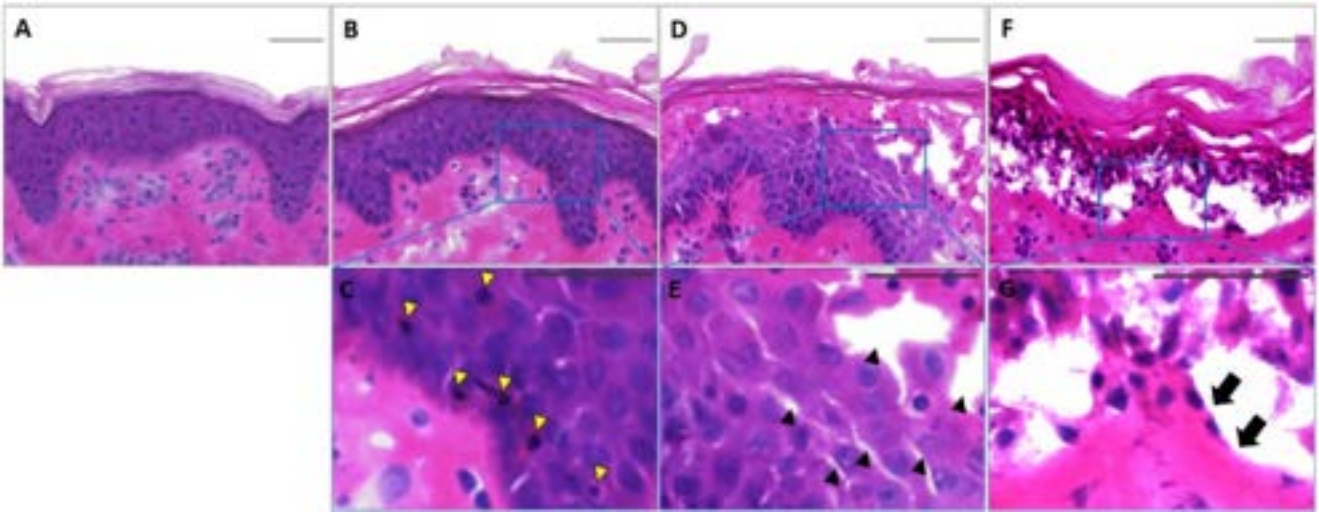
Content by: Ruhi N

Present: NA

Goals: To understand how ex-vivo porcine skin models are developed for clinical evaluation

Content:

- Subcutaneous injection is the main method to administer monoclonal antibodies, peptides, and proteins
    - Less invasive, can self-administer
- In-vivo animal models are costly, time-consuming, and morally questionable, but the connective tissue (less rigid, fibrous) can accommodate a larger volume of injected volume of a biopharmaceutical
- Ex-vivo skin explants have been used to assess skin regeneration following microneedle stimuli
    - With relation to this project, it is assessing burn spots on the model skin
- Porcine skin is a reliable replacement because of the thickness of the epidermis and dermis, lipid composition, and keratinous proteins, and vascularization network & lymph architecture
- Immunohistology: our client uses a method of immunofluorescent staining to help study burns. In the study, the skin was injected and incubated
- Through injection of hyaluronic acid-based formulations, ex vivo porcine skin was determined to be viable during an extended period of culture but also has the potential to be used as a preclinical platform for the evaluation of other subcutaneously injected biomacromolecules



- This image shows the different parameters that were used to histologically analyze the porcine model.
    - A: Hyperkeratosis
- A challenge of maintaining the models is exposure to the air-liquid interface and an inconsistent supply of nutrients

https://www.sciencedirect.com/science/article/pii/S0378517323009833?via%3Dihub

S. Gou *et al.*, “Development of an ex vivo porcine skin model for the preclinical evaluation of subcutaneously injected biomacromolecules,” *International Journal of Pharmaceutics*, vol. 648, pp. 123562–123562, Oct. 2023, doi: https://doi.org/10.1016/j.ijpharm.2023.123562.

Conclusions/action items:

This article was helpful to reference how ex vivo porcine skin models can potentially be used for pre-clinical evaluations. More specifically to our project, our client(s) use porcine models frequently to carry our their burn trauma research. They also use a histological dye to stain the tissues that are relevant to their research. This article helped clarify some methods that go into those methods, as well as a look into subcutaneous injections.

9/11/25 - Porcine Skin Model used to evaluate pressure

RUHI NAGARKATTE - Sep 11, 2025, 10:08 PM CDT

Title: Porcine Skin Model used to evaluate pressure

Date: 9/11/25

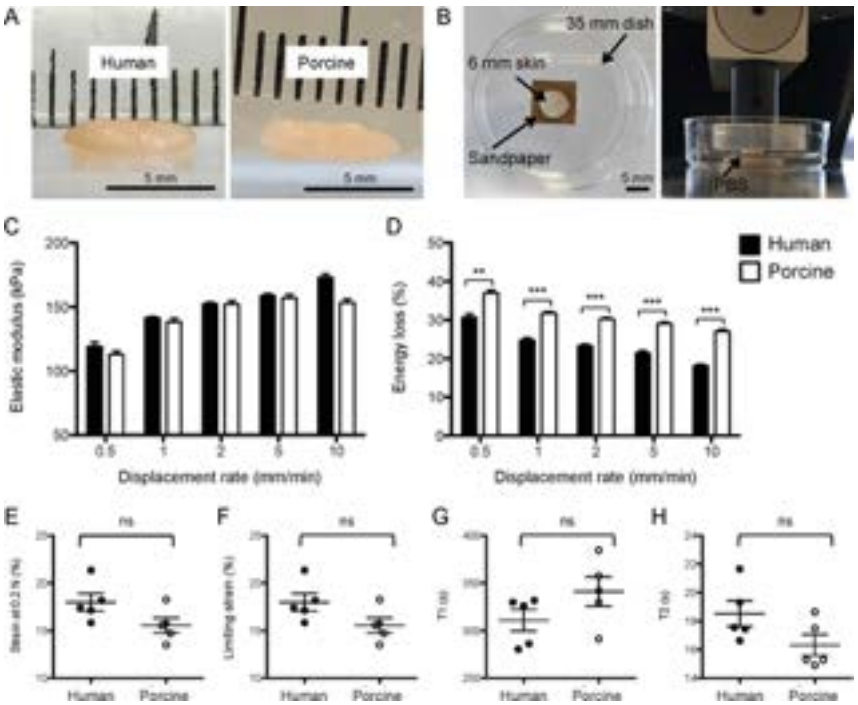
Content by: Ruhi N

Present: NA

Goals: To understand how ex-vivo porcine skin models are to understand pressure-reducing devices to prevent ulcers

Content:

- Pressure ulcers are caused by pressure, shear induced trauma to skin and other tissues
    - Burns can potentially cause this trauma
- Devices like dressings reduce incidence, but there is variability in energy dissipation under compressive loading, and different materials have different mechanical properties which can clinically affect efficacy
- Ex vivo porcine skin model has elastic moduli that closely match human skin (within 6 kPa)
- An ongoing problem to treat the 2.5+ million American people who develop pressure ulcers is the scarcity of appropriate biological experimental models to measure mechanical properties
    - Current treatments costs already exceed $11 billion per year
- Porcine skin survival ex vivo was measured, among other metrics to test viability with mechanical loading
- Mechanical properties and structural properties are closely related in porcine and human skin



- This image shows a comparison of compressive properties of human and porcine skin models. There are no significant differences between the elastic moduli for both skin models
- Pressure induced cell death can happen because of tissue ischemia

- As low as 4kPa reducing vascular blood flow
- Pressure also physically distorts tissue creating tensile, shear, and compression stresses
    - Can cause immediate cell death, whereas hypoxia lasts hours

https://onlinelibrary.wiley.com/doi/10.1111/wrr.12481

C.-Y. C. Yeung, D. F. Holmes, H. A. Thomason, C. Stephenson, B. Derby, and M. J. Hardman, “An ex vivo porcine skin model to evaluate pressure-reducing devices of different mechanical properties used for pressure ulcer prevention,” *Wound Repair and Regeneration*, vol. 24, no. 6, pp. 1089–1096, Oct. 2016, doi: https://doi.org/10.1111/wrr.12481.

Conclusions/action items:

This article was really helpful in clarifying mechanical properties of the porcine and human skin models. It also alluded to some of the detrimental effects of pressure-induced trauma to the skin, which could be a result of a burn. In the future, this will be helpful to use as a metric when designing test protocols that need to meet a certain amount of force to use.

9/11/25 - Burned Porcine Skin Wound to Screen Topical Antimicrobial Agents

RUHI NAGARKATTE - Sep 11, 2025, 10:27 PM CDT

Title: Development of an Ex Vivo-Burned Porcine Skin Wound to Screen Topical Antimicrobial Agents

Date: 9/11/25

Content by: Ruhi

Present: NA

Goals: to understand how burned skin models contribute to topical agent screenings

Content:

- There is a need to screen drugs for repurposing and to develop new antibiotics for controlling infections
- would infection is highly correlated to mortality and morbidity in burn patients and can cause up to 50% of burn-related deaths
- infected burn patients treated with various antimicrobial regimens can develop more serious infections from drug-resistant organisms
- in precinical drug development, in vitro screening is commonly used in drug repurposing and discovery
    - low cost, tightly controlled, high throughput, fewer ethical questions
- animal models can address major shortcomings and have become the standard for experimental studies
- ex vivo models retain the tissue heterogeneity, architecture, and wound bed treatments, providing a realistic matrix to work with
    - drawbacks: small burn size and disinfection of the surface before the induction of burns
- there is a stringent ex vivo model without using skin disinfection to take into consideration the commensals
- this can be an excellent model, it lacks blood circulation and immune system to recapitulate the host environment fully
    - not representative of chronic wounds or biofilm-mediated wound infections
- this model bridges the gap between in vitro and in vivo models for analyzing antimicrobial activity
- Antibiotics 13 01159 g003
- this study shows the treatment effects that were observed in our stringent ex vivo burn wound infection model (in comparison to in vivo studies).

https://www.mdpi.com/2079-6382/13/12/1159

P. Chen, E. A. Sebastian, R. Karna, and K. P. Leung, “Development of a Stringent Ex Vivo-Burned Porcine Skin Wound Model to Screen Topical Antimicrobial Agents,” *Antibiotics*, vol. 13, no. 12, pp. 1159–1159, Dec. 2024, doi: https://doi.org/10.3390/antibiotics13121159.

Conclusions/action items:

This article closely followed effects of burn wounds on ex vivo porcine skin models. This is helpful in context of our project to see how our client's research models help them, while realizing there are some drawbacks to their model. This emphasizes the need to develop an effective tool to cut the fat off so they have a consistent piece of tissue to work with.

9/14/25 - Techniques Used in Skin Biopsies

RUHI NAGARKATTE - Sep 14, 2025, 2:26 PM CDT

Title: Mini review on skin biopsy: traditional and modern techniques

Date: 9/14/25

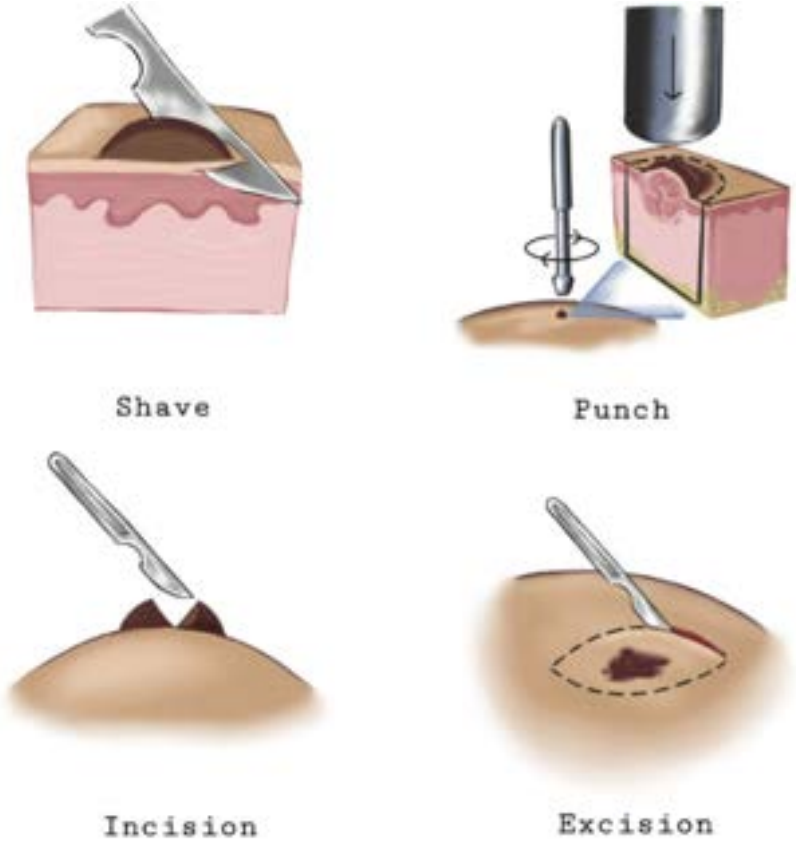
Content by: Ruhi Nagarkatte

Present: NA

Goals: To learn about traditional techniques for biopsy sampling, for the pds

Content:

- Skin biopsy is an important diagnostic tool in dermatology and pathology
    - Handling is important to provide accurate histopathological assessment (even immunofluorescent imaging)
- The future of skin biopsy relies on minimally invasive techniques and integrated pharmacogenomics for personally developed medicine
- Vertical and horizontal sectioning are used to evaluate different layers of skin structure and associated pathologies
- Usually the procedure involvs taking a small tissue sample from the skin and examining it under a microscope to identify abnormalities and diagnose different skin conditions
    - Might vary with tissue structure or pathological changes
- Hematoxylin and eosin details views of cellular architecture
- The skin sample is then cleaned with antiseptic solution
- Punch biopsy: circular blade remove a cylindrical core of skin including the epidermis, dermis, and superficial subcutis (for inflammatory and neoplastic conditions)
- Shave biopsy: scalpel or razor blade used to shave off a superficial layer of skin (for lesions contained in the epidermis: warts and basal cell carcinomas)



- These are the different techniques compared in the article
- AI - direct image analysis

Source:
https://pmc.ncbi.nlm.nih.gov/articles/PMC11919677/#:~:text=Several%20techniques%20are%20used%20to,a%20margin%20of%20normal%20skin.

Nasar Alwahaibi and M. Alwahaibi, “Mini review on skin biopsy: traditional and modern techniques,” *Frontiers in Medicine*, vol. 12, Mar. 2025, doi: https://doi.org/10.3389/fmed.2025.1476685.

Conclusions/action items:

- This article holistically reviewed some of the techniques used for skin biopsies for decades. There are various instruments used along with an AI screening method. This will be helpful to compile into the PDS.

9/15/25- Standards/Specs for Biopsy cutting Tools

RUHI NAGARKATTE - Sep 15, 2025, 6:13 PM CDT

Title: Standards/Specs for Biopsy cutting Tools

Date: 9/15/25

Content by: Ruhi Nagarkatte

Present: NA

Goals: To understand the standards and specifications for surgical cutting tools/blades, for the PDS

Content:

- Scalpels and blades required for general surgical procedures are considered a Class I medical devices which are subject to general controls, but exempt from 501k, premarket notification requirements
    - General controls: good manufacturing practices (quality system regulation), establishment registration and device listing, labeling requirements
- 
- FDA relies on manufacturers and suppliers to meet established standards from ISO to ensure safety
- International Standards:
    - ISO 13485: quality management for medical devices. Scalpels and blades must be manufactured in facilities certified to this ISO standard
    - ISO 7153-1:2016: Covers metallic materials for surgical instruments, more specifically naming the grade of stainless steel that can be used. Most surgical blades are made out of high-carbon stainless steel
    - ISO 13402:2025: determines the resistance of surgical instruments to corrosion, heat, and autoclaving
        - This will be the most applicable to our client's setting and requirements
- General safety: must have features that protect against accidental sharp injuries during use, passing, and disposal
- Biopsy processing:
    - Biocompatibility, sterilization: all components must be sterile, and eventually biocompatible for human subjects

- Mechanism, design: how deep blade can penetrate

Sources:

https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpcd/classification.cfm?id=GES

https://www.iso.org/standard/85618.html

[1] “Product Classification,” *Fda.gov*, 2025. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpcd/classification.cfm?id=GES (accessed Sep. 15, 2025).

[2]]O. for, “ISO 13402:2025,” *ISO*, 2025. https://www.iso.org/standard/85618.html (accessed Sep. 15, 2025).

Conclusions/action items:

- These articles outline some of the most applicable FDA and ISO standards and specifications relevant to surgical cutting blades/scalpels/tools. These parameters describe everything from the materials used to certain design considerations. This information will be added to the PDS.

9/25/25- Biopsy Devices Market: Growth, Size, Share, and Trends

RUHI NAGARKATTE - Sep 25, 2025, 8:16 PM CDT

Title: Biopsy Devices Market: Growth, Size, Share, and Trends

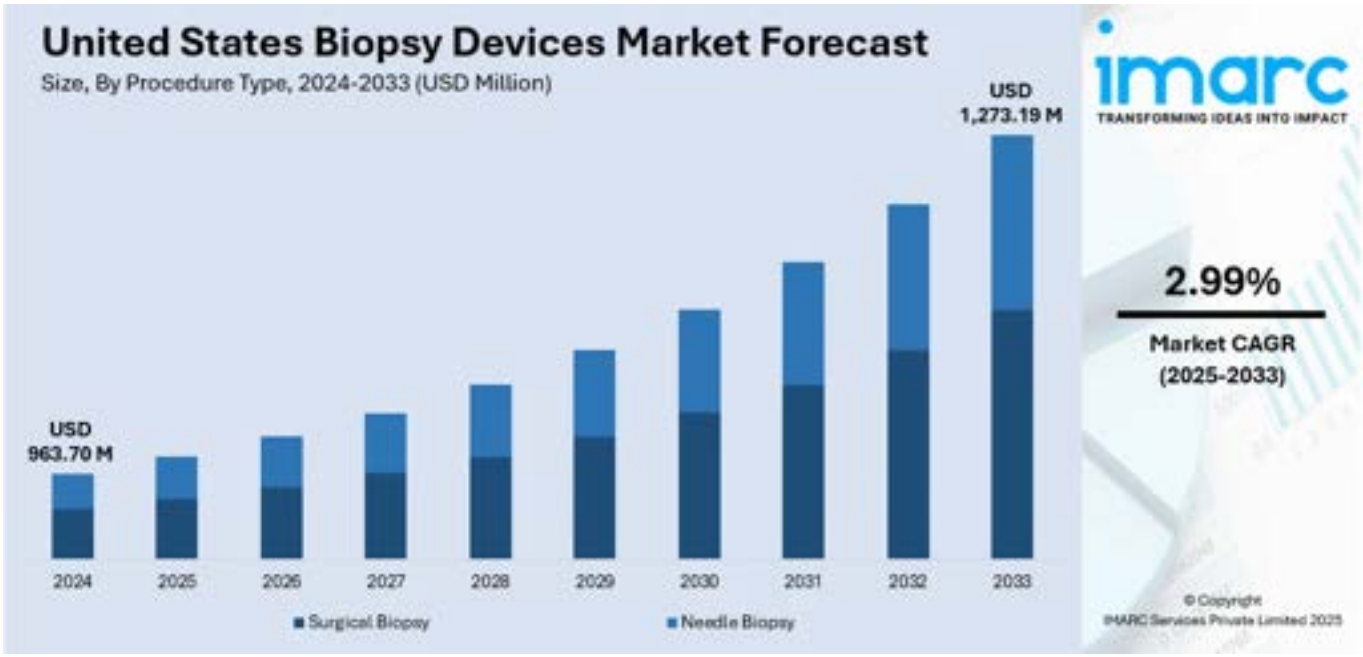
Date: 9/25/25

Content by: Ruhi Nagarkatte

Present: NA

Goals: To understand the national and global economic need for biopsy devices

Content:

- The global biopsy market is valued at $6.86B in 2023
- In 2024, market stood at $7.25 billion and is projected to grow at a CAGR (compound annual growth rate) of 7.2% until 2030
    - In 2030, the market will culminate to a predicted valuation of $11.01 billion
    - The rising prevalence of cancer, preference for minimally invasive surgeries, and improvement in (insured) reimbursement policies will promote the growth for this market
- Opportunities in the Biopsy Device Market
    - Asia Pacific: lifestyle changes leading to increased prevalence of cancer and other chronic diseases. Initiatives undertaken by the government to manage early detection will increase the demand for these devices
- The biopsy device market ecosystem involves manufacturers, healthcare providers, regulatory bodies (FDA), and end-users (researchers).
- Key players include: Becton Dickinson (BD), Medtronic, Cardinal Health, and Olympus Co [1]
- US: in 2024, the market size was valued at $963.70 Million
    - By 2033, expected to reach $1.27B, with a CAGR of 3%
- Market trends: minimally invasive, image guided biopsies
    - Increased demand for precise and easy-to-use devices that enhance diagnosis speed and clinical patient outcomes
- 

    - [2]

[1]"Biopsy Devices Market Size, Share, Trends and Revenue Forecast [Latest]," MarketsandMarkets. https://www.marketsandmarkets.com/Market-Reports/biopsy-device-market-132886515.html

[2]"United States Biopsy Devices Market Size & Share 2033," *Imarcgroup.com*, 2024. https://www.imarcgroup.com/united-states-biopsy-devices-market (accessed Sep. 26, 2025).

Conclusions/action items:

- The US and global market for biopsy processing devices is growing and there's an increasing demand for these tools due to higher incidences of cancer and other chronic diseases, as well as a largely innovative healthcare technology ecosystem
- This info will be helpful in describing the global impact for our design

9/25/25- Materials for 3D Printing

RUHI NAGARKATTE - Sep 25, 2025, 8:38 PM CDT

Title: Materials for 3D Printing

Date: 9/25/25

Content by: Ruhi Nagarkatte

Present: NA

Goals: To find materials that we can use in our prototyping phase

Content:

- For biopsy processing, the material needs to be biocompatible, rigid, and can withstand sterilization methods (autoclave, ethanol) without deformation
- To meet these criteria, certain plastics and metal alloys can be used for industrial-grade applications
- Medical Grade 3-D Plastics
    - Polyetherimide thermoplastic (PEI): offers strong resistance to heat and chemicals
        - Can be used with steam autoclaves and is commonly used for surgical guides
    - Nylon (PA12)
        - Lightweight, durable, corrosion resistant plastic which can withstand autoclaving, ethylene oxide, and plasma gas
        - Need selective laser sintering and multi jet fusion processes
    - Polycarbonate
        - Strong, heat resistant, biocompatible thermoplastic used for surgical guides
- Resins
    - Formlabs BioMed Resins
- Titanium: strength, lightweight, high biocompatibility; resistant to corrosion
- Stainless steel: same properties as titanium; used frequently in surgical tools

[1]“What You Need to Know About 3D Printing in the Medical Field,” RapidMade. https://rapidmade.com/3d-printing/in-the-medical-industry/

[2] M. Walleser, “Sterile 3D Printing for Medical Applications and Sterile Outcomes,” *Technical Articles by Production Automation Corporation*, May 22, 2017. https://blog.gotopac.com/2017/05/22/sterile-materials-and-outcomes-for-3d-printing-sterile-parts/

[3]“3D Printing Materials for the Medical Industry | Xometry Pro,” *Xometry Pro*, Dec. 15, 2023. https://xometry.pro/en/articles/3d-printing-medical-industry/

Conclusions/action items:

All of these materials are biocompatible and easily sterilizable, two important factors in our design specs. This will be useful knowledge when we go into the makerspace to print our preliminary designs.

10/9/25 - Planar type micro-biopsy tool: mechanical design and analysis

RUHI NAGARKATTE - Oct 10, 2025, 7:57 AM CDT

Title: Planar type micro-biopsy tool: mechanical design and analysis

Date: 10/9/25

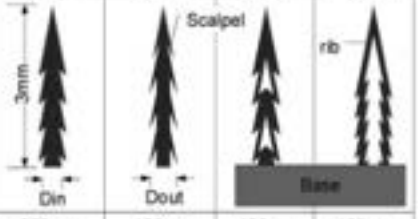
Content by: Ruhi Nagarkatte

Present: NA

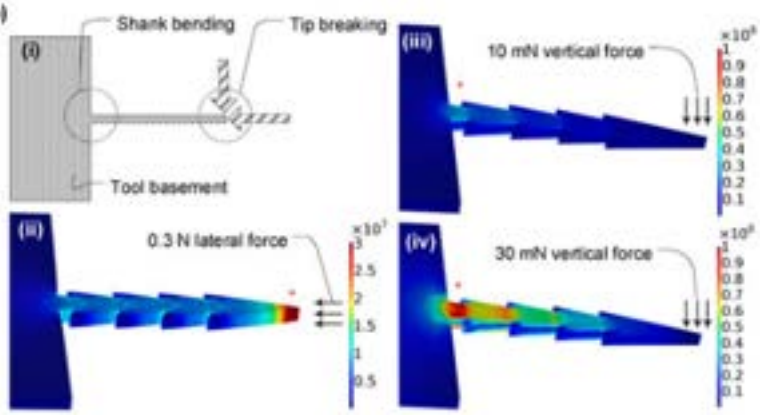
Goals: To understand the mechanical properties used in tissue cutting mechanics to design testing protocols

Content:

- A planar-type micro-biopsy tool was subjected to mechanical tests; it analyzed key parameters like taper angles, tool geometries, and number of cutting knives that have been utilized for tissue extraction in clinical settings
- The failure modes of the micro-biopsy tools include buckling by lateral force during dissection and bending by vertical force, which occurs when the center line of the razor is not normal to the surface of the tissue
- To investigate buckling, factors such as Young's modulus and yield strength of the material were analyzed
- (a)

Tool types	Type 1	Type 2	Type 3	Type 4
Scalpel and shank shape				
Inner shank diameter (Din)	200um	100um	100um	100um
Outer shank diameter (Dout)	400um	200um	200um	275um
Number of scalpels	4EA	10EA		
Thickness of scalpels (rib)	none		57um	75um
Basement demension	3mm x 5mm			

- (b)



- This tool has 4 different side scalpel shapes, shank diameters, and lengths, which were subjected to different stress analysis tests on COMSOL multiphysics software
- Based on this study, we can apply similar principles to mechanically test our device
- Once an average value is found on force exertion on biopsy tools, we can use those values to ensure our design is structurally sound
- Through this found value, we can perform an online FEA on OnShape and perform a mechanical stress test via MTS machine

[1]S. Moon, “A Planar-Type Micro-Biopsy Tool for a Capsule-Type Endoscope Using a One-Step Nickel Electroplating Process,” *Micromachines*, vol. 14, no. 10, pp. 1900–1900, Oct. 2023, doi: https://doi.org/10.3390/mi14101900.

Conclusions/action items:

- Different modes of failure are present in biopsy tools involving blades/shanks
- These failures can range from lateral force buckling and vertical force bending

9/14/25 - Tissue Biopsy Puncher

RUHI NAGARKATTE - Sep 14, 2025, 4:40 PM CDT

Title: Surgical Tools and Accessories: Biopsy Punches

Date: 9/14/25

Content by: Ruhi Nagarkatte

Present: NA

Goals: To learn about a specific tool that is used to collect biopsy samples

Content:

- A biopsy punch is used to take minimally invasive, small samples quickly
- It is a lightweight, pencil-shaped handheld device that utilizes a hollow, circular, steel cutting tip
- Punches have a variety of uses: dermatology, therapeutics, cosmetic procedures, diagnostic procedures for the treatment of various medical conditions
    - they play a vital role in research and are used in:
        - electrophysiology
        - bio-pharmacology
        - regenerative medicine
        - microfluidics
- They come in different sizes to fit the range of applications
- Here are some products offered by World Precision Instruments (WPI):

    - This image is the rapid punch tool

-
- This is the limited reusable puncher
- Some biopsy punches cost over $150
    - This can present a hurdle to the research studies and volume of samples they can analyze

Source: https://www.wpiinc.com/products/surgical/surgical-accessories/biopsy-punches#:~:text=When%20you%20need%20to%20take,molded%20of%20PDMS%20(polydimethylsiloxane).

“Biopsy Punches | Punch Biopsy Instruments,” Wpiinc.com, 2024. https://www.wpiinc.com/products/surgical/surgical-accessories/biopsy-punches (accessed Sep. 14, 2025).

Conclusions/action items:

This is one of the tools that was mentioned by our client in our first meeting; this is a tool they frequently use to quickly gather samples. The biopsy punch tool is helpful to understand the market of competing devices for the PDS. These tools are roughly $150 per unit, which could be an obstacle to our client’s research or data analysis.

9/18/25- Microtome Blades

RUHI NAGARKATTE - Sep 19, 2025, 8:37 AM CDT

Title: High Profile Microtome Blades

Date: 9/18/25

Content by: Ruhi Nagarkatte

Present: NA

Goals: To learn more about a competing device for the PDS and resource that the client uses frequently

Content:

- These FDA Class I tools are designed for high profile blade holders and have sharp

edges at a 35 degree angle to deliver high quality performance and durability.

- Each soft tissue blade is coated in a PTFE resin to reduce

friction when sectioning, either in microtomy and/or cryotomy

- These blades are available in a set of 50 for $190.65

Sample image of two types of blades used for microtomy.

[1]“IMEB, Inc Sakura Accu-Edge High Profile Microtome Blades, Disposable, 50 per Pack,” Fishersci.com, 2025. https://www.fishersci.com/shop/products/accu-edge-bld-high-pro-50pk/NC9733209 (accessed Sep. 18, 2025).

Conclusions/action items:

- These blades are the exact devices our client uses in the lab to slice the tissue samples
- They don’t have the guaranteed accuracy and precision to cut the cylindrical samples consistently
- Add to the PDS → Competing designs

9/17/25- Preliminary Design Sketches (Rough)

RUHI NAGARKATTE - Sep 19, 2025, 1:37 PM CDT

Title: Preliminary Design Sketches (Rough)

Date: 9/17/25

Content by: Ruhi Nagarkatte

Present: NA

Goals: To sketch out some preliminary design ideas based on client specs

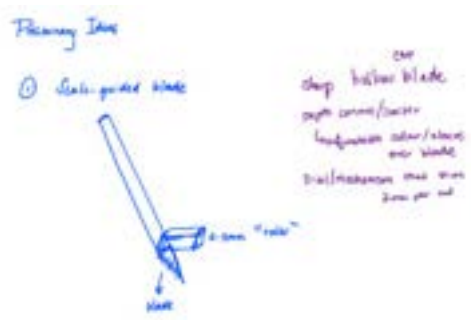
Content:

Check attachment below

Conclusions/action items:

- Refine drawing sketches
- Discuss ideas and components with team
- Continue to brainstorm based on client requirements and background research

RUHI NAGARKATTE - Sep 19, 2025, 1:37 PM CDT



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10/23/25 - Bloodborne Pathogens Research Training

RUHI NAGARKATTE - Dec 10, 2025, 7:57 AM CST

Download

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

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

RUHI NAGARKATTE - Dec 10, 2025, 8:00 AM CST

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citiCompletionCertificate_15019030_73199427.pdf (78.1 kB)

11/7/25 - Tong Lecture

RUHI NAGARKATTE - Nov 07, 2025, 12:46 PM CST

Title: Building a Career of Impact: While Healthcare Needs More Engineers

Date: 11/7/25

Content by: Ruhi Nagarkatte

Present: NA

Goals: To hear from Kristin Myers, COO of BCBS

Content:

- Run towards the hard problems...they are the ones that change the world
- Career journey: Foundation, Growth Curve, Build & Transform
- Foundation: Jobs throughout college, Business, Engineering, Investment, Harvard MBA
- Growth: Combine EQ with IQ to multiply impact and reach
- Aetna: She was willing to take on a challenge that made her a leader of a billion dollar business
- United Women's Healthcare: president and chief operating officer
- Build and Transform: Drive system level impact through innovation and scale
    - Founder, CEO Hopscotch Health, BCBS COO
- The Healthcare system challenges
    - quadruple aim: having good outcomes and patient experience, provider experience, lower cost of care
    - 18% of US GDP
- US ranked last on equity, access, and outcomes, lower life expectancy
- 10% uninsured
- Complications: 900 insurers, 1.2 Trillion in waste
- Steps
    - Work hard and build range
        - take on the hardest projects, classes, and experiences
    - Seek diverse exposure
        - explore different sectors, teams, and geographies
    - Choose your people wisely
        - surround yourself with curious, driven, high-integrity people
    - Know your values and protect them
        - define what matters most
    - Embrace challenge and keep growing

Effort and character compound over time.

Conclusions/action items:

I enjoyed this lecture by Kristin Myers. Her engineering and business background really resonates with me as I was hoping to gain experience in R&D or systems/clincal engineering before going into an MBA at some point in my career. Additionally, being in venture capital was a really interesting path I am thinking of going into. Also, I find it inspiring she lived and adapted to many cities; I've been open to trying different jobs (engineering, business, venture) in places like Chicago, Boston, San Francisco, etc, and it was nice to hear about her experiences being in that position.

9/10/2025 Porcine Materials in Wound Healing

ELLA LANG - Sep 12, 2025, 10:23 AM CDT

Title: Porcine Materials in Wound Healing

Date: 9/10/2025

Content by: Ella Lang

Goals:

- Understand how porcine and human tissue are similar

- Learn more about porcine skin applications

Content:

Challenges of wound healing:

- For serious wounds or burns, grafts are used to increase the healing rate and minimize scarring

- allografts(tissue grafts where donor and recipient are the same species) are in short supply and very expensive

Benefits of porcine tissue:

- Very similar to human tissue:

- has the same 3 layers: epidermis, dermis, hypodermis

- similar thickness

- Collagen and elastin are similar biochemicals

- similar blood flow patterns

- epidermal turnover rate is comparable

Use of Xenografts:

- Def: xenografts (tissue grafts where donor and recipient are of different species)

- Porcine xenografts are now being genetically modified in order to reduce the chance of rejection by the recipient

Use of porcine ECMs:

- Porcine ECMs (extracellular matrix) can be used with xenografts or as a gel to accelerate tissue regeneration

- The use of pig co-products helps to eliminate waste when slaughtering pigs for food

R. Robers, “Porcine Materials in Wound Healing - SSR Solutions,” SSR Solutions, Nov. 10, 2022. https://ssr-solutions.com/porcine/porcine-materials-in-wound-healing/

Conclusions/action items:

- Research the mechanical properties of pig skin

- Utilize the allograft/xenograft terminology I learned from this article

9/12/2025 Micromechanical Comparison of Human and Porcine Skin before and after Freezing

ELLA LANG - Sep 12, 2025, 11:10 AM CDT

Title: A micromechanical comparison of human and porcine skin before and after preservation by freezing for medical device development

Date: 9/12/2025

Content by: Ella Lang

Goals:

- Understand the mechanical properties of pig skin

- Get a sense of how difficult it will be to work with

Content:

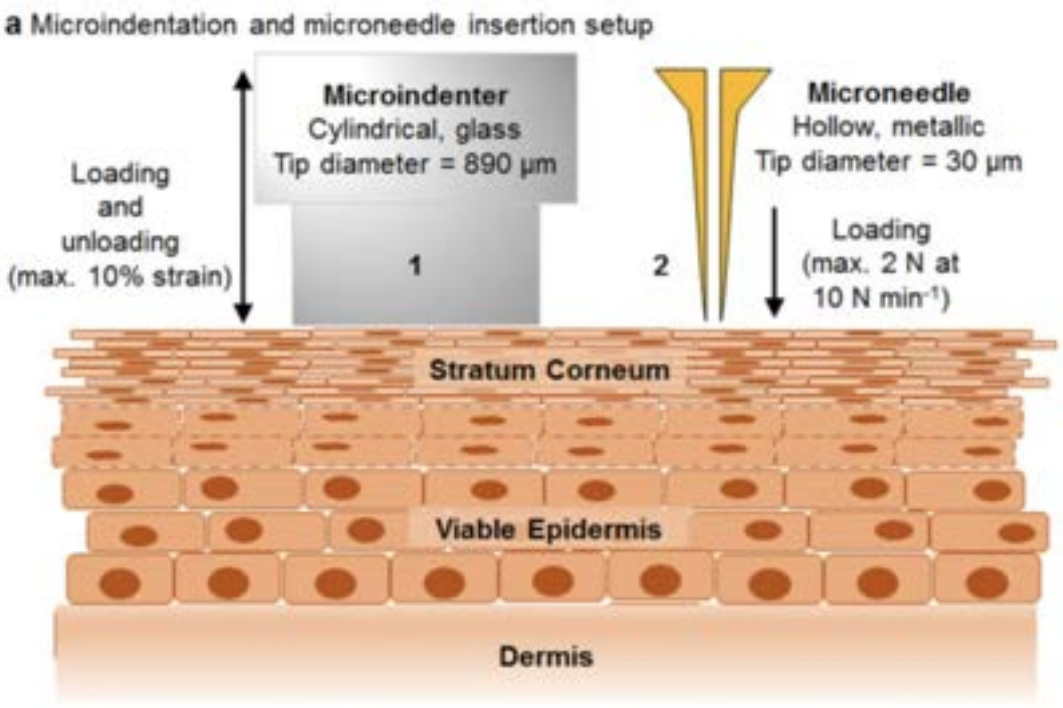
Study goal: To study how the mechanical properties of human vs. porcine skin compare, and how they are changed by one freeze–thaw cycle (−80 °C, 48 h)

Setup:

- Utilized 4 human and 4 pig donors

- Conditions tested at 35% RH and 100% RH

- Additional microindentation tests on layers: stratum corneum (SC), epidermis/dermis (ED), and full-thickness (FT) and microneedle insertion profiling tests looking at: stiffness , insertion force, displacement, and computed work



Key conclusions:

- Porcine epidermis and dermis are generally stiffer than those of humans
- Humidity softens human skin but doesn’t affect pig skin much (in terms of SC)
    - For FT: Human (fresh): 1.69 MPa at 35% RH and 0.93 MPa at 100% RH
    - For FT: Porcine (fresh): 2.11 MPa at 35% RH and 1.37 MPa at 100% RH

- Freezing makes human skin softer at the SC but stiffer overall, while pig skin does the reverse
    - In pigs, the full thickness softens, as damage spreads differently through the pig dermis

S. A. Ranamukhaarachchi *et al.*, “A micromechanical comparison of human and porcine skin before and after preservation by freezing for medical device development,” *Scientific Reports*, vol. 6, no. 1, Aug. 2016, doi: https://doi.org/10.1038/srep32074.

Conclusions/action items:

- Utilize these findings to compare and contrast porcine skin preparation to that of human skin

- Look into ways to cut through stiffer skin

9/12/2025 Skin Biopsy Technique

ELLA LANG - Sep 12, 2025, 12:10 PM CDT

Title: Skin Biopsy Technique

Date: 9/12/2025

Content by: Ella Lang

Goals:

- Understand the punch biopsy technique and best practices

- Understand what preliminary samples look like prior to our job of processing them

Content:

General:

- Punch biopsies range from 2 mm to 8 mm in thickness

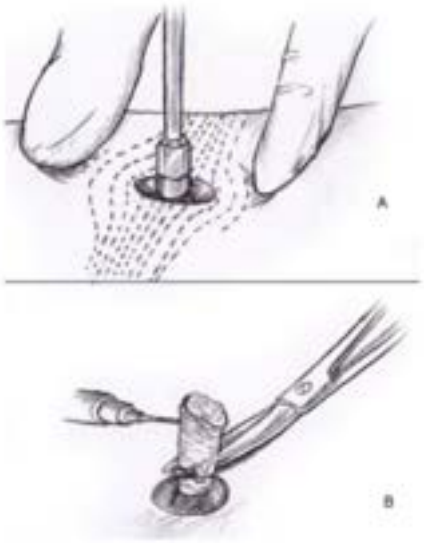
- Gives ability to evaluate into the subcutaneous fat layer

Process:

1. The skin is stretched perpendicular to the lines of least skin tension, the wound should form an oval

2. While holding the stretched skin in place, the puncher is inserted vertically using a smooth twisting motion

3. When the instrument goes to its max depth, the punch can be removed, avoiding crushing the sample by using fine single-toothed forceps



Results:

- a cylindrical sample

- The bottom edge can become jagged since the cut with the fine-toothed forceps is variable

“Skin Biopsy Technique: Approach Considerations, Punch Biopsy, Shave Approach,” *emedicine.medscape.com*. https://emedicine.medscape.com/article/1997709-technique#c2

Conclusions/action items:

- Look into ways to handle the variable uneven bottom that results from taking a punch biopsy

9/18/2025 Slideshow Notes

ELLA LANG - Sep 19, 2025, 9:22 AM CDT

Title: Project Background

Date: 9/18/2025

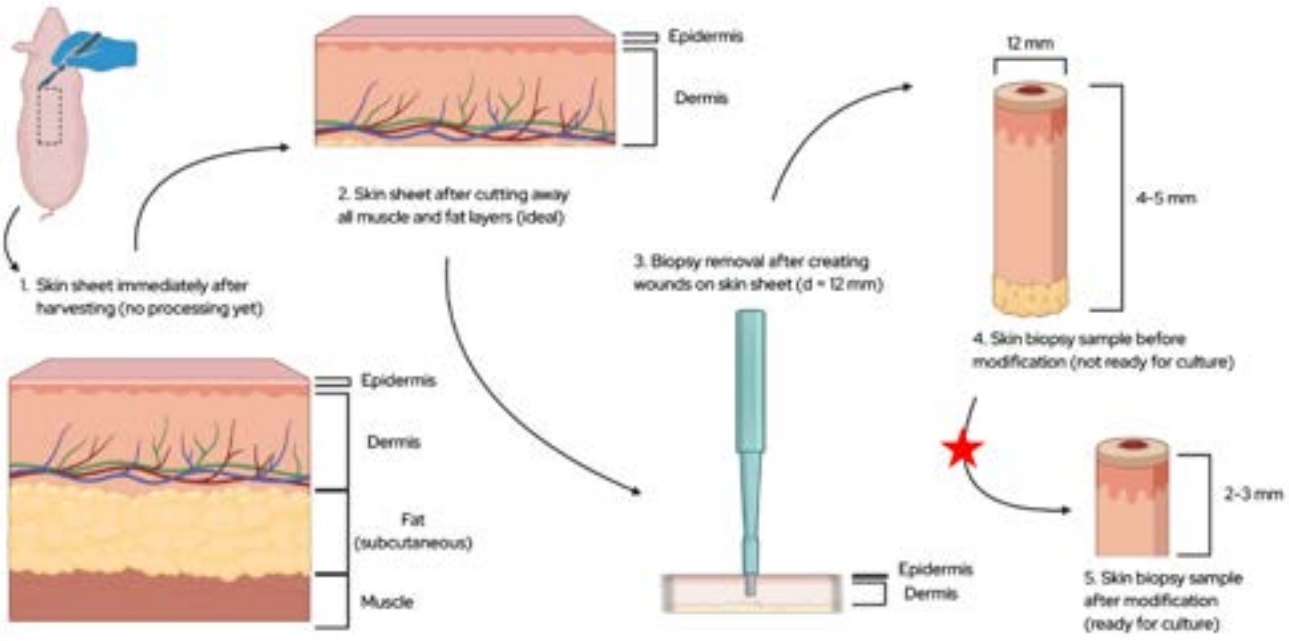
Content by: Ella Lang

Goals:

- Understand the client's research and needs

Content:

Skin biopsy procedure:



After biopsy:

1. 12 mm biopsy samples are placed into culture media

2. Burns are created on the surface of 12 mm biopsies with the burn tool, burns are 4 mm in diameter

3. In each experiment, there is usually n=1 nonburn sample and n=3 burn samples per dish . As many as 12 dishes in an experiment, n=48 biopsies.

Histology:

- An easy way to view healing is with the LDH stain

- Apply the LDH stain to the frozen, halved samples, then image

- If the sample has blue spots- that is viable tissue, if the sample does not, the tissue is dead

- Cannot remain viable in culture without the removal of the entire lower layer of fat, with fat removal, could live for 2 weeks

Available blades and biopsy punches:

- Tissue-tek Accu-Edge high profile blades: PTFE coated, 0.31 (T) x 14 (H) x 75.7 (L) mm

- Standard razor blades with: High carbon steel design, length: 1.5 inches, width: 2.0 inches, height: 1.1 inches

- Acu-punch: 12 mm diameter for biopsy samples

- Acu-punch: 4 mm diameter for wound excision

Sterility methods needed:

- Heat – Autoclave (temperatures higher than 100°C)

- Irradiation – UV Light (included in Biosafety Cabinet)

- Chemical – Alcohol (spray and wipe down every surface before use)

Donahue, Bailey, "BME Design Project – Fall 2025", Sept. 2025

Conclusions/action items:

- Use all considerations mentioned above in the design of our final product

- Try to incorporate existing blades in designs

9/18/2025 3D Printing and Sterilization

ELLA LANG - Sep 19, 2025, 10:14 AM CDT

Title: 3D Printing and Sterilization

Date: 9/18/2025

Content by: Ella Lang

Goals:

- Look into resin options for 3D printing

- Understand how resins can be sterilized

Content:

Resin types available and Makerspace: all made with formlabs

Clear- color-neutral, balance of fast print speed, high accuracy, transparency, and strong mechanical properties. It is ideal for fluidics, mold making, optics, lighting, and showcasing internal features.

Elastic 50A Resin- soft and stretchy material that is semi-translucent. ideal for prototyping parts normally produced with silicone.

Flexible 80A Resin- is a more stiff soft-touch material, also semi-translucent. It is ideal for mimicking the flexibility of rubber or TPU.

Biomed clear resin- medical grade for rigid, non-brittle, biocompatible parts that require long-term skin contact

Sterilization options:

Biomed clear resin- autoclave, ebeam, gamma ray, or ethylene oxide

- Heat deflection temp at 1.8 MPa = 54 degrees Celsius

- Can rinse with 100% isopropyl alcohol to achieve complete transparency after printing

“Formlabs Customer Support,” *Formlabs Customer Support*. https://support.formlabs.com/s/article/Using-BioMed-Clear-Resin?language=en_US

Guide, “Guide to Transparent 3D Printing,” *Formlabs*, 2025. https://formlabs.com/blog/3d-printing-transparent-parts-techniques-for-finishing-clear-resin/?srsltid=AfmBOoq4aCuQQfPWPSpKilxJbL121xCcc6KT_jePH_sa_Y5xexGevJEv (accessed Sep. 19, 2025).

“3D Printer Cost Calculator,” *UW Makerspace*. https://making.engr.wisc.edu/3dprint-cost/

Conclusions/action items:

- Use biomed clear resin in the makerspace to print our design

- Specify that it is autoclavable- mentioned in their requirements

9/25/2025 Guide to Transparent 3D Printing

ELLA LANG - Sep 26, 2025, 10:50 AM CDT

Title: Guide to Transparent 3D Printing

Date: 9/25/2025

Content by: Ella Lang

Goals:

- Understand ways that resin can be manipulated to be clearer after printing

Link: https://formlabs.com/blog/3d-printing-transparent-parts-techniques-for-finishing-clear-resin/?srsltid=AfmBOoqTrtfVvdr2Jqx7Tt5sHOMK7nrWijxiZGaT1PHydyHCk12DLB_U

Citation:

FormLabs, “Guide to Transparent 3D Printing,” *Formlabs*, 2025. https://formlabs.com/blog/3d-printing-transparent-parts-techniques-for-finishing-clear-resin/?srsltid=AfmBOoqTrtfVvdr2Jqx7Tt5sHOMK7nrWijxiZGaT1PHydyHCk12DLB_U (accessed Sep. 26, 2025)

Content:

Manual sanding and polishing:

- process: use a range of fine sandpaper grits to smooth, then polish the part with acrylic cleaner and a microfiber cloth

- At 3000 grit- parts become glossy and smooth

- 12000 grit- parts are reflective

- Try grits from 400 to 12000 in increments of 200, slowly cleaning parts between levels

- Eliminate scratches before moving onto the next grit

- If you only want semi-transparency, use mineral oil

Spray coating:

- fast way to improve clarity without reduction in detail

- clear coating improves layer lines and protects parts from UV exposure, which can yellow them

- for a smooth, glass-like finish, sand and then coat

- General-purpose clear coat spray paints: Use a 2k clear coat

- automotive sprays: high-solids acrylic urethane clearcoats offer high gloss and air dry. Spray guns and base coats are required.

- Process: start with a clear dry part, washed with IPA. Do not post cure. Let the part air dry. Once completely dry, apply 2-3 spray coats in a dust-free environment.

Resin coating:

- Only works on flat or nearly flat surfaces

- Process: apply clear resin to the part with drops from a syringe, or by dipping the part. The resin fills layers and scratches, creating a smooth surface.

- The resin layer should be as thin as possible

- Pull off any bubbles with a syringe

- Completely post-cure the part

- Repeat the process on each side

Conclusions/action items:

- Potentially utilize these methods in the creation of the Press Biopsy Design

10/10/2025 Burn Wound Anatomy

ELLA LANG - Oct 10, 2025, 12:46 PM CDT

Title: Burn Wound Anatomy

Date: 10/10/2025

Content by: Ella Lang

Goals:

- Learn more about burn wound terminology to use in future reports or discussion

Content:

Types of burns:

- Thermal burns: due to heat sources, and can cause tissue cell death or charring. Hot metals, scalding liquids, steam, and flames can cause thermal burns.
- Radiation burns: due to prolonged exposure to ultraviolet rays of the sun, or to other sources like X-rays.
- Chemical burns: due to strong acids, alkalies, detergents, or solvents.
- Electrical burns: from electrical current, AC or DC.

Skin Layers:

- Epidermis
    - Stratum corneum: made up of cells containing keratin. It keeps body fluid in while keeping external substances out. This continuously flakes off.
    - Keratinocytes (squamous cells): made up of cells that are maturing and moving toward the surface to become the stratum corneum.
    - Basal layer: where new skin cells divide to replace the old cells that are shed.
    - The epidermis also contains melanocytes.
- Dermis
    - Blood vessels, lymph vessels, hair follicles, sweat glands, collagen bundles, fibroblasts and nerves
    - Held together by collagen, made by fibroblasts.
    - Conducts pain and touch signals.
- Subcutis
    - network of collagen and fat cells
    - conserves body heat

Burn classes:

1. First-degree (superficial) burns
affects only the epidermis, or outer layer of skin. The burn site is red, painful, dry, and with no blisters. Mild sunburn is an example. Long-term tissue damage is rare.

2. Second-degree (partial thickness) burns
involve the epidermis and part of the dermis layer of skin. The burn site appears red, blistered, and may be swollen and painful.

3. Third-degree (full-thickness) burns
destroys the epidermis and dermis and may also damage the underlying bones, muscles, and tendons. When bones, muscles, or tendons are also burned, this may be referred to as a fourth-degree burn. The burn site is white or charred, with no feeling in the area.

Conclusions/action items:

Utilize this terminology in design descriptions

11/7/2025 Tong Lecture

ELLA LANG - Nov 07, 2025, 12:43 PM CST

Simon Nam - Sep 18, 2025, 8:28 PM CDT

Title: Tong Lecture- Building a Career of Impact (Why Healthcare Needs More Engineers)

Date: 11/7/2025

Content by: Ella Lang

Goals:

- Learn from professionals about career and entrepreneurship opportunities

- Get life advice!

Content:

Kristin Myers- BME undergrad and MBA, COO Blue Cross Blue Shield

- Run towards the hard problems!

- Took on big roles- worked as Chief of Staff for Aetna while also building a family, then took a role leading OBGYNs for Unified Women's Healthcare

- Faced challenges during COVID, required furloughs of close to half of the staff

- First chapter of her career was proving herself and what she could do, second half was taking on big challenges, third chapter focused on implementing systematic changes

- Now, it focuses on how healthcare can be affordable and accessible while maintaining a good patient experience

  - Great looks like: improved provider experience, patient outcomes, patient experience, and lower cost of patient care

  - Not many doctors say they would do medical school again

  - How much does the US spend on healthcare? 5.3 trillion, we spend 2x the amount than other countries; however, we don't have better stats

  - Fee-for-service healthcare system- but the doctor isn't incentivized to focus on one patient; they want to fit in as many as possible

    - For the doctor to have a full picture and deliver care appropriately, they need to make changes to the system

  - Clinicians need to be rewarded for outcomes- for example, primary care physicians make a fraction of what other doctors make but do incredibly important work, often referring to specialists

5 things to focus on:

1. Work hard and build range- willing to work long and hard to get stuff done, you will be the person people look to

2. Seek diverse exposure- look for rewarding jobs that give you a large base of experience

3. Choose your people wisely- you are defined by the people you spend the most time with

4. Know your values and protect them- define what matters most

5. Embrace challenge and keep going- don't operate from a place of fear or self-criticism, you have made it far

Conclusions/action items:

My biggest takeaway is to go after what I want and be flexible with my goals, because you will end up where you are meant to be. Also, of course, work hard and show your worth, especially in the coming years when I am starting my career.

9/17/2025 Tissue Coring Press

ELLA LANG - Sep 17, 2025, 1:53 PM CDT

Title: Tissue Coring Press

Date: 9/17/2025

Content by: Ella Lang

Goals:

- Understand more about current tissue processing/cutting techniques

Content:

Tissue coring Alabama Research and Development:

- Tissue coring presses are used on slabs of tissue to make cylindrical samples

- Alabama research and development has made one that is small and portable: 6" x 6" base, 12" high and 8" deep

- Uses a DC motor and gear head

- To use:

Flip the on switch

Push down the lever-controlled handle

- Eliminates the need for an experienced operator to make tissue samples and makes cores easily reproducible

“Tissue Coring Press - Alabama Research & Development,” *Alspi.com*, 2025. https://www.alspi.com/coring-press.htm (accessed Sep. 17, 2025).

Conclusions/action items:

- Implement the standardized mechanisms of cutting into our project and ensure that we can also make reproducible samples.

9/17/2025 Medical Blades

ELLA LANG - Sep 18, 2025, 11:39 PM CDT

Title: Medical Blades

Date: 9/17/2025

Content by: Ella Lang

Goals:

- Learn more about blade sizing options and vendors

- Learn more about common straight-edge blade types and geometries

Content:

Supplier: the Razor Blade Company

- Offers a variety of models, including double-edged razor blades, single-edged blades, long blades, and scalpels of various sizes. Additionally they have handles and blade removal accessories

- All blades are ISO compliant

- Blades made from stainless steel that is corrosion-resistant and has fewer impurities than standard 400-level steel

- Blades are also available in a dispenser instead of being wrapped to reduce contamination

A standard that discusses the medical blade allowed materials: ISO 7153-1

- Stainless steel and titanium are the primary metals allowed for use in medical blades. The grade is variable, but most blades on the market fall into these categories.

Guide to choosing the right blade:

1. Surgical blade size meanings

- #10 Blade: curved blade, large incisions in skin and muscle.
- #11 Blade: pointed tip, precise, stab-like incisions.
- #15 Blade: small, curved blade for short, delicate cuts.
- #20 Blade: used for long incisions in procedures like orthopedic and general surgeries. longer than #10

2. Blade shapes

- Curved Blades: #10 and #15. excellent for smooth, sweeping cuts, commonly used in general surgeries.
- Straight Blades: #11 blade is straight and pointed.
- Hooked Blades: used for specialized procedures, the #12 blade is also popular for dental and veterinary procedures.

3. Blade materials

- Carbon Steel: Known for sharpness and durability, need careful maintenance to prevent rust.
- Stainless Steel: resist corrosion and maintain their sharpness well
- Ceramic Blades: extreme sharpness and biocompatibility, useful when metal allergies are a concern.

cscorp, “Your Guide to Surgical Blade Sizes, Shapes, and Materials - CS Corp,” *CS Corp*, Jun. 05, 2024. https://cincinnatisurgical.com/2024/06/05/your-guide-to-surgical-blade-sizes-shapes-and-materials/. ISO 7153-1:2016, International

Organization for Standardization, Geneva, Switzerland, 2016. “The Razor Blade Co: About Us | Razor Blade Company,” *Razorbladeco.com*, 2025. https://www.razorbladeco.com/aboutus.

Conclusions/action items:

- Utilize the ISO standard in future reports

- Once design dimensions are decided upon, look into accredited blade companies and varying sizes/types of blades

9/25/2025 Razor Blade Dimensions

ELLA LANG - Sep 26, 2025, 11:26 AM CDT

Title: Common Blade Dimensions

Date: 9/25/2025

Content by: Ella Lang

Goals:

- Understand blade dimensions to further mold design around

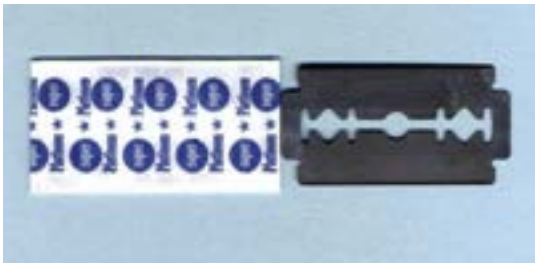
Content:

Double-edge razor blade:

42.96 mm (1.69") L

21.95 mm (0.865") W

0.10 mm (0.004") Thickness



Single-edge razor blade:

Thickness: .012"

Length x Height: 1.50" × .75

This has a thicker upper edge

https://www.razorbladeco.com/heavy-duty-carbon-steel-single-edge-blade?srsltid=AfmBOorxlcrqGCzH3Gy1E2xjEklB3WgZ34aiE7b6easgoQAks-psQinc

https://www.emsdiasum.com/h-double-edge-razor-blade-platinum-coated?srsltid=AfmBOor-gRDEjrhn0N_210uRlErMCNEqFOprsxTBZY4SsgW4_MhWGI3a

Conclusions/action items:

- Utilize these dimensions in design and determine which blade is best for each application

10/10/2025 Base Options

ELLA LANG - Oct 10, 2025, 12

Title: Base Options

Date: 10/10/2025

Content by: Ella lang

Goals:

Look into ways to mount the device to a lab bench

Content:

Bench clamp:

-

- Easily sourced, sold at most hardware stores

- Foam can be added to reduce surface scratches

- lightweight and autoclavable

- Variety of dimensions

Suction cups or mats:

- double-sided suction cups or adhesive suction mats

- would need to be replaced often, as they are not autoclavable

- small and wouldn't get in the way of use

Heavy bases:

- Expensive $80-$100

- Would need to attach the device to the base

- Slabs are larger than we need often 12" x 9"

https://www.mscdirect.com/product/details/00150003?cid=ppc-google-&mkwid=|dc&pcrid=&rd=k&product_id=00150003&gclsrc=aw.ds&gad_source=1&gad_campaignid=22774929511&gbraid=0AAAADPhDjGU6dtETnrVgq9mydp4ZylbJ&gclid=Cj0KCQjw3aLHBhY2WtR6lfGlSGnz83JlzM11GWGffFZ93j95-GuMYhPS_u-P8hGd78aAlwGEALw_wcB

https://www.phywe.com/equipment-accessories/support-material-magnetic-boards/general-support-material/bench-clamp_16911_18864/

Conclusions/action items:

- Discuss options with group members and see if they have a preference or another idea

- Utilize idea in final design to increase stability of design on bench

9/18/2025 Part Holder and Thickness Cutter

ELLA LANG - Sep 19, 2025, 11:29 AM CDT

Title: Part Holder and Thickness Cutter

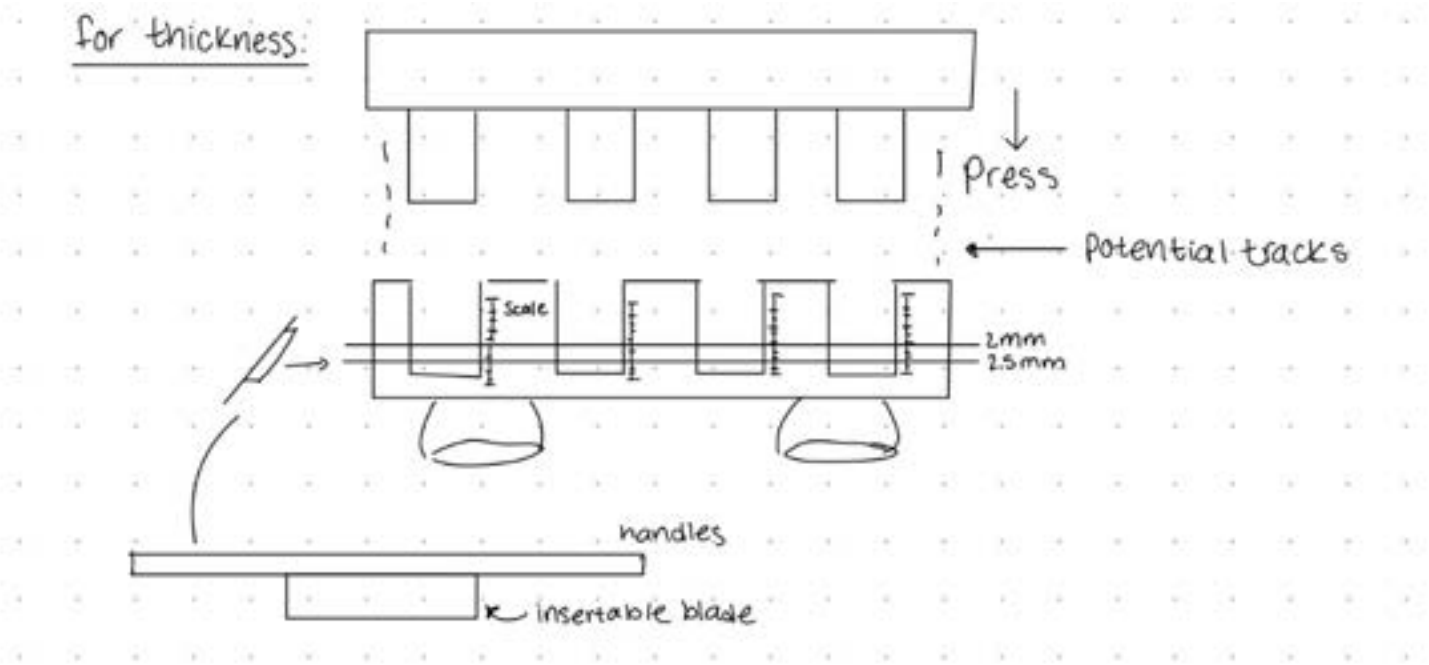
Date: 9/18/2025

Content by: Ella Lang

Goals:

- Propose a design that cuts samples to a desired thickness of 2-3 mm

Content:



The design would have 4 slots with a 12 mm diameter to hold each sample. The bottom half of the device would have a slot where the blade runs on a track horizontally and is pushed by the user with a handle. The blade should also be able to be taken out in order to replace it. The holder will suction to the table, staying stable when used. Small scales can be added to the sides of the tissue sample holders in order to visually measure while cutting. Lastly, a sample pressure applier top piece will be added in order to hold samples still while cutting; this could also potentially go on a track.

Conclusions/action items:

- Begin CAD modeling this design

- Begin writing about this design in the design matrix

9/18/2025 Vertical Cutting Mechanism

ELLA LANG - Sep 19, 2025, 11:29 AM CDT

Title: Vertical Cutting Mechanism

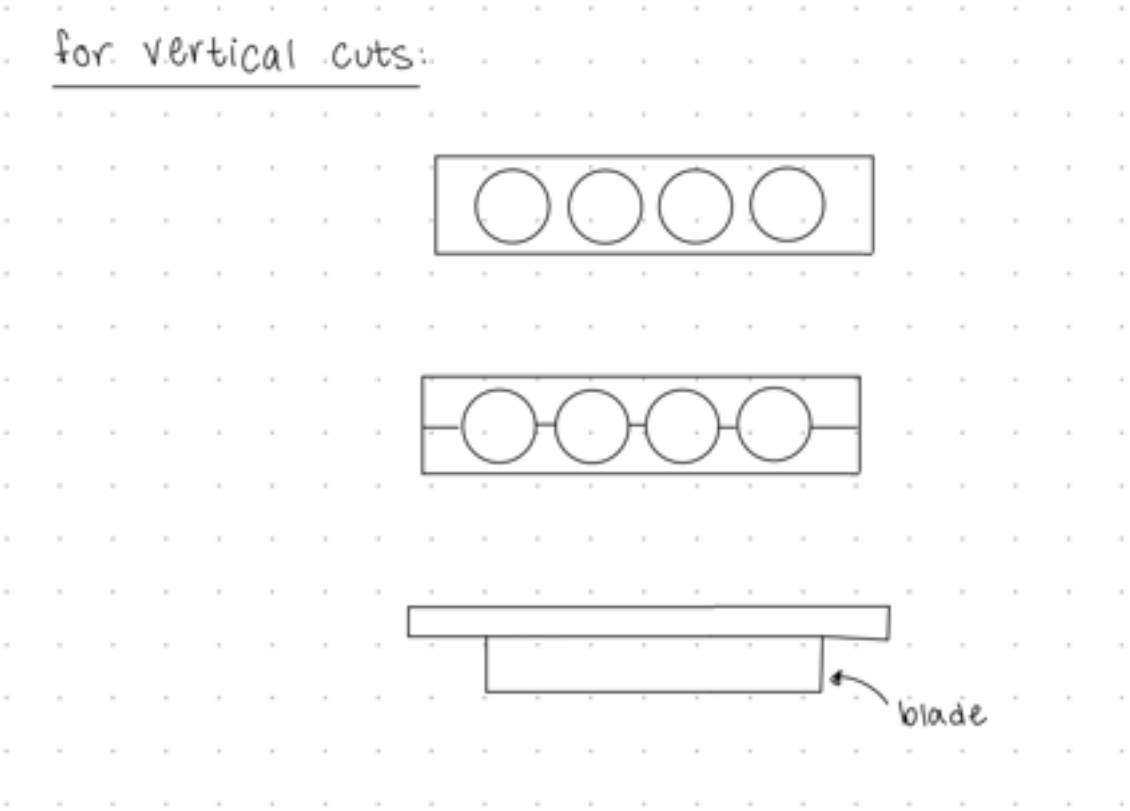
Date: 9/18/2025

Content by: Ella Lang

Goals:

- Propose a design that cuts a tissue sample vertically down the center for imaging

Content:



The design utilizes the tray mentioned in the thickness cutting design, having 4 slots for each sample. The slots have a cut track down the middle. The long blade would have a handle, resembling a table scraper. You would align the blade with the cutting slot and press down, cutting down the center of the cylindrical samples. To remove the samples from the tray, you would flip the tray upside down.

Conclusions/action items:

- Propose this design to the group and use it in our design matrix

9/25/2025 Initial Biopsy Press CAD Design

ELLA LANG - Sep 26, 2025, 11:02 AM CDT

Title: CAD Design of Biopsy Press

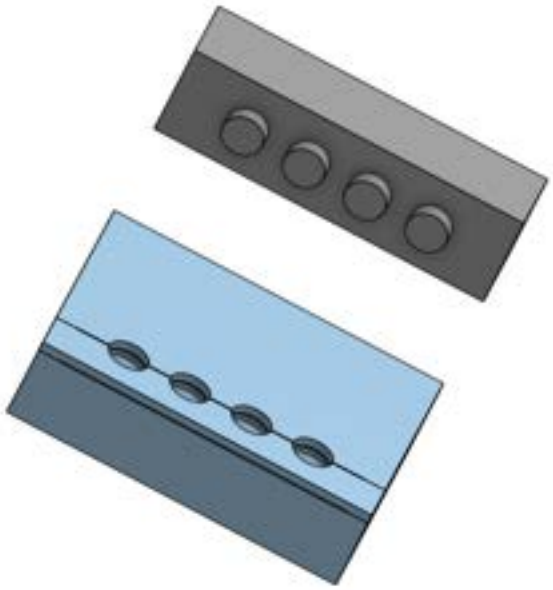
Date: 9/25/2025

Content by: Ella Lang

Goals:

- Begin modeling design and refining dimensions

Content:



Big box dimensions:

- 4in x 3in x 1 in

- Circular holes are 12 mm in diameter and 5 mm in height

- Blade entrance lines are 1in deep into the part and 1 mm wide (adjustable)

Press dimensions:

1 in x 1.5 in x 3.5 in (adjustable)

Protruding cylinders are spaced to match the big box, 12 mm diameter and 5 mm height

Blades:

- Can work with a razor or scalpel blades

Updates needed:

- If razor blades are used: add handles

- Gianna- split box to make blade tracks sterilizable

- add suction cups on the bottom to stabilize

- Update dimensions as needed

Conclusions/action items:

- Pass design off to gianna to update

- 3D print design and assess dimensions

- Order suction cups if moving forward

1/1/2023 TeamLab Machining Certification

ELLA LANG - Apr 30, 2025, 2:02 PM CDT

Download

Machining_Permit_1__1_.pdf (583 kB)

1/26/2024 Bio and Chemical Safety Certification

ELLA LANG - Apr 30, 2025, 2:02 PM CDT

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Certifications_1_.pdf (60.3 kB)

9/8/2025 RECR Training

ELLA LANG - Oct 24, 2025, 2:47 PM CDT

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Screenshot_2025-10-24_at_2.46.39_PM.png (171 kB)

10/24/2025 IRB Training Documentation

ELLA LANG - Oct 24, 2025, 2:45 PM CDT

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citiCompletionCertificate_15016513_73178835.pdf (77.9 kB)

9/12/25 - Gibson Research

Gianna Inga - Sep 12, 2025, 10:19 AM CDT

Title: Gibson Research

Date: 9/12/25

Content by: Gianna Inga

Present: Gianna Inga

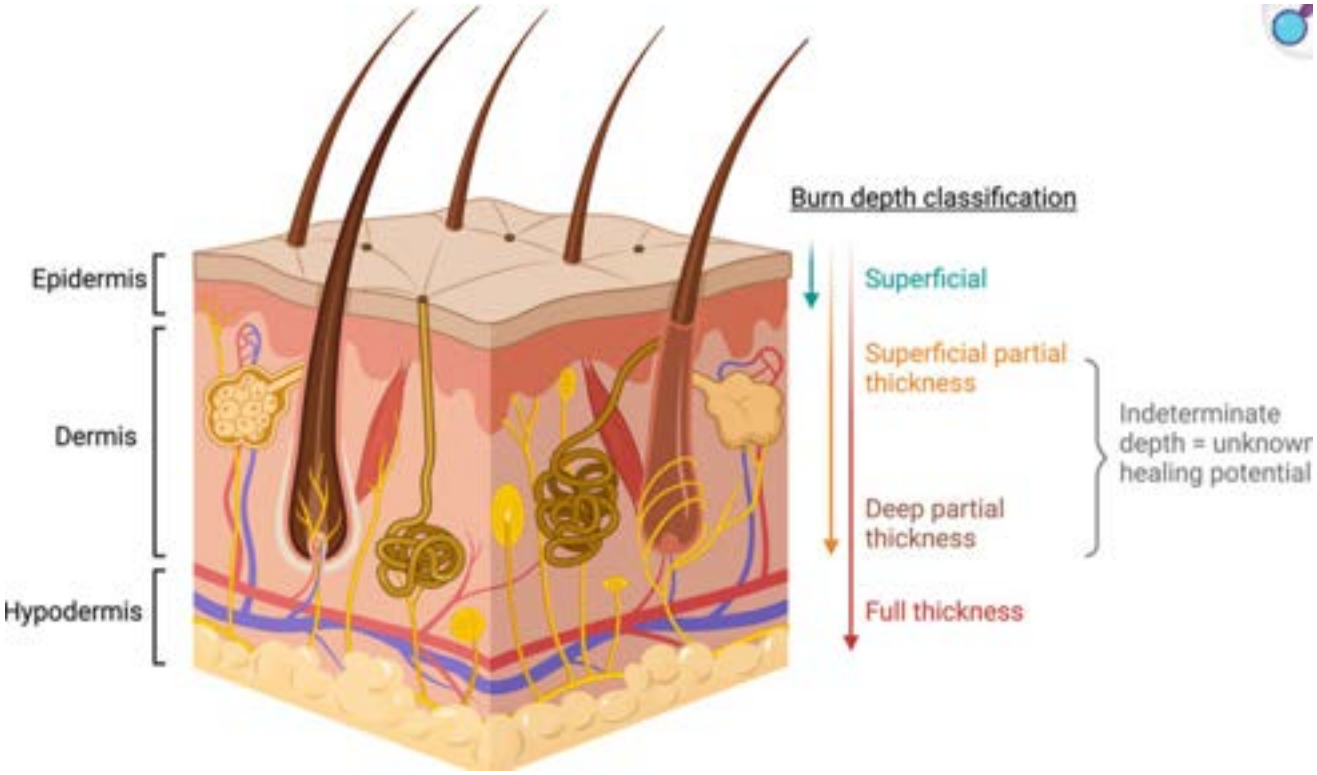
Goals: Understand the research our client is conducting more thoroughly.

Citation:

H. A. García *et al.*, “Indocyanine green angiography processing and analysis pipeline for the assessment of indeterminate burn wounds,” *J Biomed Opt*, vol. 30, no. 6, p. 065002, June 2025, doi: 10.1117/1.JBO.30.6.065002.

Content:

- want to know how deep a burn is
- burns can be:
  - superficial
  - partial-thickness
  - full-thickness
- diagnosing the degree of the burn changes what is the best treatment option
  - full-thickness: excision & grafting
  - superficial: local wound care
  - partial-thickness burns: depends
- accuracy of clinical burn assessment is 50-75%
- biopsies are the gold standard
  - but they are invasive, painful, long
- proposed solutions to diagnose burn severity
  - nuclear medicine imaging - less reliable
  - thermography - less reliable
  - laser speckle imaging
  - hyperspectral imaging
  - optical coherence tomography
  - photoacoustic imaging
  - **indocyanine green angiography (ICGA)**
- **indocyanine green angiography (ICGA)**
  - ICG molecules are injected into the patients circulatory system
  - damaged tissue is illuminated at the appropriate wavelength (NIR ~800 nm)
  - done with video imaging
  - diseased tissues show perfusion and permeability issues and will affect the shape of the kinetics curve



Conclusions/action items: This information is a good reference for understand Dr. Gibson's research and why it is needed in the medical field. It provides background information on how the research is applicable and what methods they use. Next I will research porcine skin mechanical properties to investigate the material they utilize in their lab.

9/12/25 - Sterilizing 3D Printed Materials

Gianna Inga - Sep 12, 2025, 10:47 AM CDT

Title: Sterilizing 3D Printed Materials

Date: 9/12/25

Content by: Gianna Inga

Present: Gianna Inga

Goals: Understand the effects of sterilizing 3D printed materials and which reacted the most favorably.

Citations:

[1] P. Rynio *et al.*, “Effects of Sterilization Methods on Different 3D Printable Materials for Templates of Physician-Modified Aortic Stent Grafts Used in Vascular Surgery-A Preliminary Study,” *Int J Mol Sci*, vol. 23, no. 7, p. 3539, Mar. 2022, doi: 10.3390/ijms23073539.

[2] “3D Printers,” Grainger Engineering Design Innovation Lab. Accessed: Sept. 12, 2025. [Online]. Available: https://making.engr.wisc.edu/equipment/3d-printers/

Content:

[1]

- aortic templates to modify stent grafts
- PLA
- Nylon
- PP
- PETG
- FDM
- SLA
- all models were contaminated with Geobacillus stearothermophilus and Bacillus atrophaeus
- sterilization
    - steam sterilization in the autoclave - 121 degrees Celsius and 132 degrees Celsius
    - Ethylene Oxide 37-63 degrees Celsius
    - Hydrogen peroxide in the plasma
- Autoclave significantly deformed
    - PLA
    - PETG
    - PP
- HPP and ETO did not distort any material

[2]

Nylon

- Heat Deflection Temp @1.8 MPa: 87 degrees Celsius
- Heat Deflection Temp @ .45 MPa: 171 degrees Celsius
- Salt Water 24 hr weight gain: .2%
- Isopropyl Alcohol 24 hr weight gain: .2%

SLA

- Heat Deflection Temp @1.8 MPa: 43 degrees Celsius
- Heat Deflection Temp @ .45 MPa: 50 degrees Celsius
- Salt Water 24 hr weight gain: <1%
- Isopropyl Alcohol 24 hr weight gain: <1%

Conclusions/action items: This information is useful when picking a material to use for our design. We want the sterilization of the device to be effective and easy for the user. They can either autoclave or wipe the device down with ethanol.

9/17/25 - Ways to sterilize 3d printed materials

Gianna Inga - Sep 18, 2025, 3:40 PM CDT

Title: Ways to Sterilize 3D Printed Materials

Date: 9/17/25

Content by: Gianna Inga

Present: Gianna Inga

Goals: Document how to sterilize 3D printed materials to see which can be cleaned in the most ways.

Content:

Nylon - SLS: Autoclave, EtO, Plasma, Chemical, Gamma

- Considerations: moisture, absorption, matte surface

ABS - FDM: Gamma, EtO

- micro-gaps

ULTEM - FDM: steam autoclave

- microgaps

Conclusions/action items: Overall, nylon had the most ways to sterilize itself. It also has a better surface to promote cleanliness as it is not fabricated by layer but rather by a laser. Although it leaves a rough surface, there are no micro grooves like abs or ultemaker. For the body of the device, we will use nylon as the client has recommended we fabricate using a 3D printer as they have access to one.

9/17/25 - Materials of surgical blades

Gianna Inga - Sep 18, 2025, 3:52 PM CDT

Title: Materials of Surgical Blades

Date: 9/17/25

Content by: Gianna Inga

Present: Gianna Inga

Goals: Document the materials of surgical blades and what their advantages are.

Content:

- carbon steel (alloy, 1075, 1095, 1.1%, 1.2%) - sharpness and hardness
  - 1095 most commonly used in razor blades
- stainless steel (301, 420, 440A, 440C) - sharpness and corrosion resistance
  - most commonly used in surgical blades
- high-speed steel (M2, M42, Powered metals) - toughness and strength in high impact
- bi-metal - strength and durability of high speed steel with low cost and ductility of carbon steel
- tungsten carbide - lasts longer
- zirconia ceramics - harder and more resistant to heat
- coatings - lubricity and strength
  - TiN
  - TiALN
  - TiC
  - Ceramic
  - Teflon

Conclusions/action items: Based on the requirements of the client to ensure that the blade can be replaceable due to dulling and to keep the cost minimal, carbon steel or stainless steel will be utilized. The client requires the blade to remain sharp to minimize tissue damage from a dull blade that may alter the affect of the biopsy. We will use carbon steel if we utilize a razor blade in the design and stainless steel if a surgical blade is used.

9/18/25 - Surgical Blade Guide

Gianna Inga - Sep 18, 2025, 4:08 PM CDT

Title: Surgical Blade Guide

Date: 9/18/25

Content by: Gianna Inga

Present: Gianna Inga

Goals: Determine the best surgical blade size to utilize for the device design.

Content:

- #10 - large incisions in skin & muscle
- #11 - pointed tip, precise, stab-like incisions
- #15 - short delicate cuts
- #20 - long incisions
- curved blade - smooth, sweeping cuts
- straight blade - precise puncture incisions
- hooked blade - vein harvesting
- material
    - carbon steel - sharpness & durability
    - stainless steel - corrosion resistant & sharpness
    - ceramic - extreme sharpness and biocompatibility

Conclusions/action items: In terms of the cut that is required of the device, #10 or #15 would be serve as the best blade. The next step will be to document the measurements of both blades and ask the client if the have a preference. If the blade is chosen for the design it's length and thickness will have to be accommodated.

9/18/25 - Surgical Blade Dimensions

Gianna Inga - Sep 19, 2025, 11:40 AM CDT

Title: Blade Dimensions

Date: 9/18/25

Content by: Gianna Inga

Present: Gianna Inga

Goals: Document the dimensions of the possible blades (#15, #10, razor)

Content:

- Surgical size 10
  - blade length: 41.7 mm
  - blade width: 7.2 mm
  - thickness: .4 mm
- Surgical size 15
  - blade length: 37.1 mm
  - blade width: 6.2 mm
  - thickness: .4 mm
- Razor blade
  - blade length: 38.1 mm
  - blade width: 19.05 mm
  - thickness: .3048 mm

Conclusions/action items: The dimensions of the chosen blade will be incorporated into the design. The surgical blade size 15 & 10 are very similar, 15 is just a smaller version of the 10. The razor blade is good if we want a straight blade as both the surgical blades are curved.

9/26/25 - Market Blades

Gianna Inga - Sep 26, 2025, 10:04 AM CDT

Title: Market Blades

Date: 9/26/25

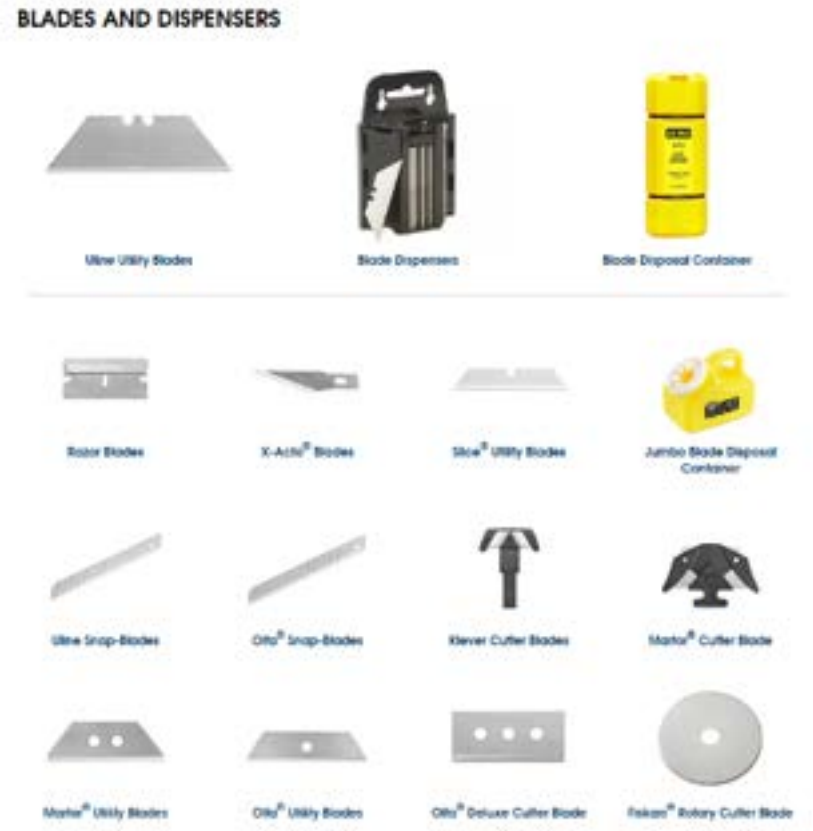
Content by: Gianna Inga

Present: Gianna Inga

Goals: Document blade options on the market to revisit for redesign of the paper cutter design.

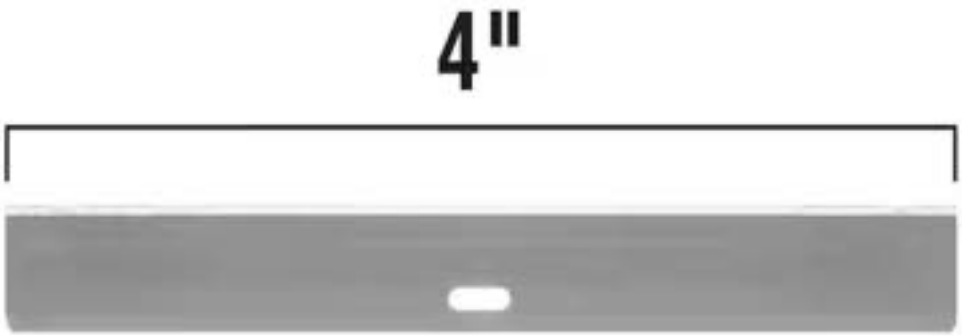
Content:

These are the utility blades on the market. The utility blade would need both securement on the top and bottom. The razor blade needs at least the two side securements and ideally also the middle hole. The X-Acto Blade would only allow for 1 sample to be used at a time. However, the martor utility blades may be an option as the 2 holes could secure the blade and then the sides could go through the samples. [1]



This is another option small razor blade. It is 1.5" long and 5/16" wide, however, it may have enough space in the center to pass through the sample

This is an option of a long blade. It is 4" long and approx. .5" wide. It is a good option for the paper cutter, but it is more expensive.



This is a disposable scalpel handle, it can be incorporated into the design if we use the surgical blade as the blade. This ensures that it the attachment mechanism ever breaks, it can easily be replaced.

References:

[1] “Blades and Dispensers in Stock - ULINE.” Accessed: Sept. 26, 2025. [Online]. Available: https://www.uline.com/Grp_628/Blades-and-Dispensers

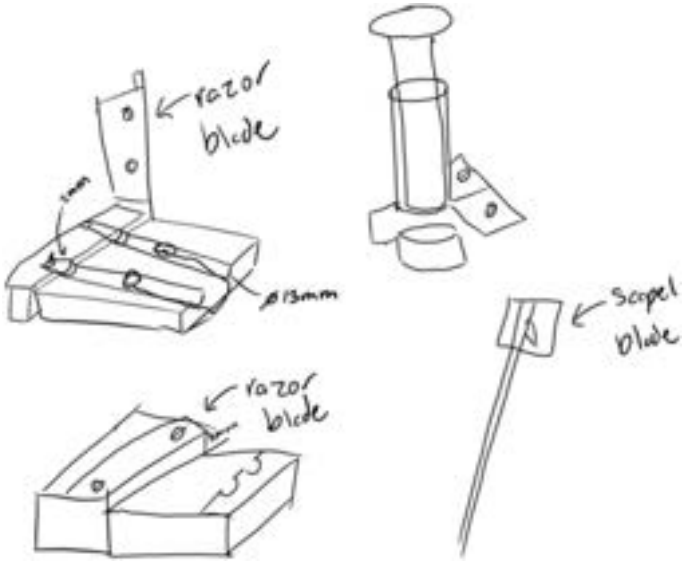
[2] “Replacement Blades for Stretch Wrap Cutter H-175B - Uline.” Accessed: Sept. 26, 2025. [Online]. Available: https://www.uline.com/Product/Detail/H-175B/Stretch-Wrap-Cutters/Replacement-Blades-for-Stretch-Wrap-Cutte

[3] “Disposable Scalpels with Plastic Handles.” Accessed: Sept. 26, 2025. [Online]. Available: https://www.harvardapparatus.com/disposable-scalpels-with-plastic-handles.html

Conclusions/action items: I will refer back to these notes as I update the paper cutter design. Having the blade on a rotating arm ensures that there is precision on every cut, thus, if possible, the design should retain that ability. Utilizing one of these blades may make it easier to accomodate the arm in design. I will discuss these options with my teammates as well as the client to get feedback on what I should do moving forward.

9/17/25 - Brainstorm Ideas

Gianna Inga - Sep 19, 2025, 10:30 AM CDT



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Ideas.png (367 kB)

9/24/25 - Paper Cutter CAD Drawing V.1

Gianna Inga - Sep 26, 2025, 8:29 AM CDT

Title: Paper Cutter CAD Drawing v.1

Date: 9/24/25

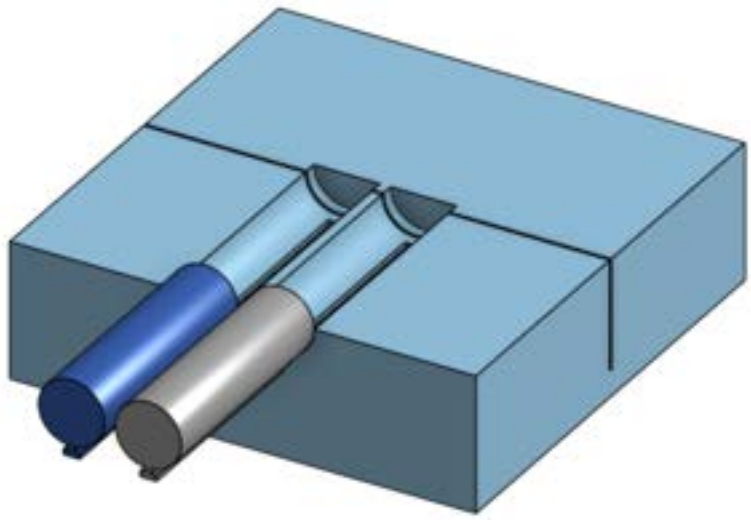
Content by: Gianna Inga

Present: Gianna Inga

Goals: Document my design progress on CAD.

Content:

This is the initial design. The samples are placed into the semi circle indent and then a razor blade on an arm will swing down and slice the 2 mm like a paper cutter. I have the other 2 parts to slide in and apply pressure to the flat edge of the sample and ensure they do not move when being cut. Some problems I have run into in this design is it will be hard to clean if there are multiple little crevices, tissue, media, and bacteria may get stuck and thus affect the samples. I also need to add the arm, hinge, and securement of the razor blade in the design.



Conclusions/action items: Going forward, to improve this design, I will connect the two cylindrical securements together so the user does not have to move and hold that many parts. I will also make the design break into parts on the planes of the cervices to make it more sanitary and able to be sterilized and cleaned. I will work on looking into the dimensions of razor blades and adding the arm to cut the samples.

9/25/25 - Updated Paper Cutter v. 2

Gianna Inga - Sep 26, 2025, 9:34 AM CDT

Title: Updated Paper Cutter v.2

Date: 9/25/25

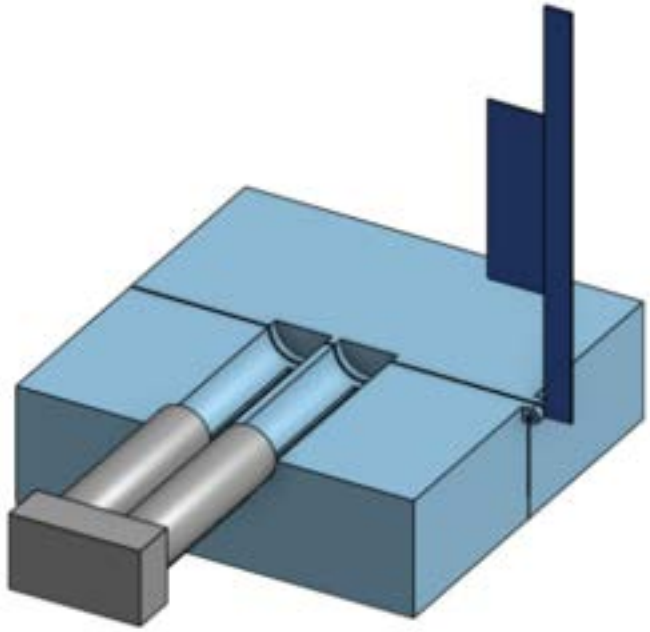
Content by: Gianna Inga

Present: Gianna Inga

Goals: To make changes to the current paper cutter CAD drawing for more efficient use and optimal performance.

Content:

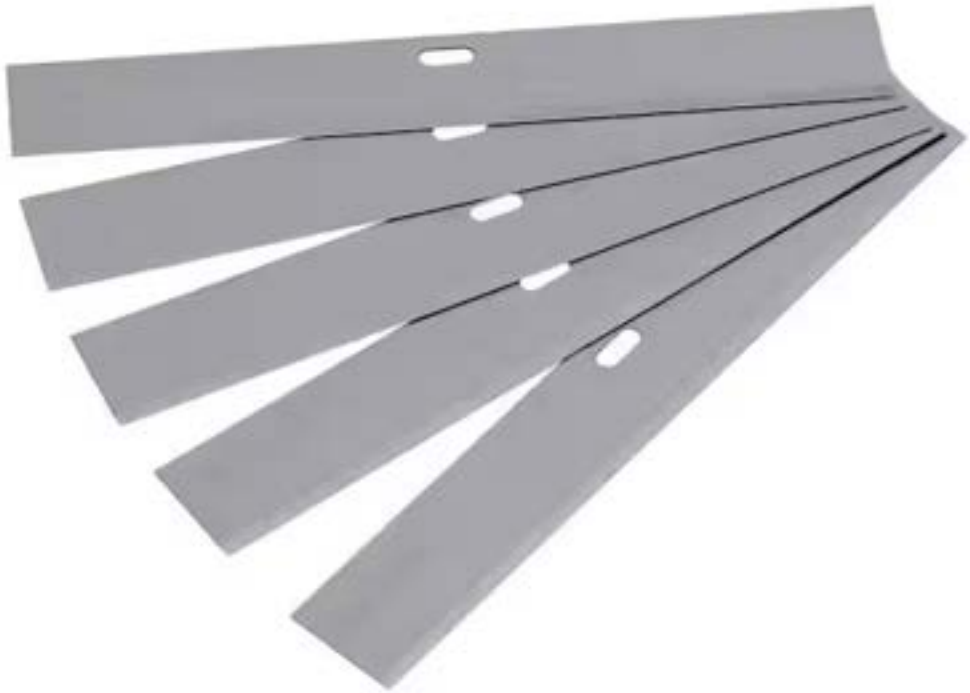
This is the updated paper cutter CAD drawing. The following changes have been made: connected the two cylindrical attachments, adding a hinge, arm, and simplified razor blade. The problems I have encountered thus far have now been that there is no standardized dimensions of the razor blade. Also, there is no descriptive dimensions of a razor blade on the market. Either a .09 or a .12" thick single edge razor will work. Another problem is that from the dimensions I have deduced, the distance from the blade to the flared base is just about 12 mm. Also, how it attaches is 3 points, including a hold in the center, thus to secure it, it would 1. get in the way of cutting and 2. make the cutting distance less than 12 mm. I could use a longer



Some options to solve this problem are as follow:

Use longer single edge blades. These are 4" long and .5" wide, thus, I could attach the center to the hinge part. However, I would have to make the design longer to conceal the blade to ensure safety and the blades would be more expensive. However, when dull, the user could flip it and it would

still have the precise cut.



Another option is using a scalpel blade. This would involve almost making the arm of the device like the handle of a scalpel. However, a scalpel blade utilizes and key slot that initially puts shear stress on the handle. This would mean that nylon may not be strong enough to deal with multiple changes of the blade. Having a scalpel would also mean that only 1 sample could be cut at a time, this may be easier for the user to control, however, it decreases throughput. Also, the edge of the scalpel would be open and thus makes the device more unsafe.

Furthermore, with the scalpel idea, we could use a plastic disposable scalpel holder, thus if it does break the user can easily obtain and replace the arm of the device rather than waiting for it to reprint. This would solve the issue of the shear stress possibly breaking the key slot. However, that also adds another thing the lab must supply themselves with to utilize the device.

Finally, a utility knife blade could be used, however, securing it would be an issue. How this blade is secured in a knife is that it has notches that get secured on the top and and slot that secures it on the bottom. It needs both the forces to not move, however, we could clamp it into the arm. It is a

cheaper option than the ones above.

Conclusions/action items: Overall, changes have been made to the paper cutter design to print for proof of concept. However, future changes may need to be done to the original design to have the best performance. I will discuss these problems and solutions with both my group and the client to get their input.

10/30/25 - CITI Training

Gianna Inga - Oct 30, 2025, 3:16 PM CDT

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11/7/25 - Tong Distinguished Lecture

Gianna Inga - Nov 07, 2025, 12:46 PM CST

Title: Building a Career of Impact

Date: 11/7/25

Content by: Gianna Inga

Present: BME

Goals: Understand the story of the lecturer to see how she used her BME degree and changed the industry.

Content:

- chapter 1: the foundation - solve tangible problems, work hard, add value

  - uw madison bme - 4 internship -> Medtronic's - engineering marketing / product launch technical sales -> Harvard - MBA -> skyline ventures - investor in healthcare startup -> abroretum ventures - investor in healthcare startup technology

chapter 2: climb the growth curve - combine EQ with IQ to multiply impact & reach

- Aetna -> unified women's healthcare

chapter 3: build & transform - drive system level impact through innovation & scale

- hopscotch health -> blue cross blue shield

chapter 1 (personal career development) -> chapter 2 (bigger impact / how to run a team) -> chapter 3 (how to systematically change healthcare)

- healthcare is a flawed system right now, we spend x2 more than other countries however, isnt better

- we should incentivize physicians to know patients history

- improving systems would help healthcare

Conclusions/action items: She had an amazing career path after college. She didn't know what she was going to do, she just kept trying to develop her skills and the next right step. It was nice to know, and I will try too implement these skills and ideas for my career path and impacting healthcare. I really appreciated that she said to appreciate where you are right now. I will try to take on that attitude to be able to go after hard things with calmness and a sense of confidence.

Gianna Inga - Nov 07, 2025, 12:25 PM CST

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Gianna Inga - Nov 07, 2025, 12:26 PM CST

Download

image.jpg (1.98 MB)

Gianna Inga - Nov 07, 2025, 12:29 PM CST

Download

IMG_5950.jpeg (2.2 MB)

2025/09/10 - Porcine skin in drug safety testing

SARAH RAUBENSTINE - Sep 12, 2025, 11:18 AM CDT

Title: Establishment and characterstics of Gottigen minipig skin in organ culture and monolayer cell culture: relevance to drug safety testing

Date: 9/10/25

Content by: Sarah Raubenstine

Present: Self

Goals: Identify why porcine skin is used in drug testing

Content:

- Gottigen minipig skin conpared to human skin for growth conditions and sensitivity to irritants
- Study looked into optimal conditions for organ cultures, aiming to best preserve histological structure
    - serum-free growth factor free conditions with 1.5mM calcium concentrations
    - cultures in low calcium concentrations could not support tissue viability
- Optimal keratinocyte growth was found in a serum free, growth factor supported culture medium with 0.15mM calcium concentration
- Fibroblasts optimally grown in 1.5mM calcium

The conditions found to be optimal for the pig skin and isolated cell cultures was found to be the same for human skin and human skin cell cultures.

Ultimately study supports usage of porcine skin to act as a surrogate for human skin in ex vivo skin safety studies.

Conclusions/action items: Study provides reasoning for porcine skin usage to model human skin in studies. Consider calcium rich environments when selecting device material.

[1] M. K. Dame, D. M. Spahlinger, M. DaSilva, P. Perone, R. Dunstan, and J. Varani, “Establishment and characteristics of Gottingen minipig skin in organ culture and monolayer cell culture: relevance to drug safety testing,” *In Vitro Cellular & Developmental Biology - Animal*, vol. 44, no. 7, pp. 245–252, Jun. 2008, doi: https://doi.org/10.1007/s11626-008-9091-3.

2025/9/10 - Skin anatomy

SARAH RAUBENSTINE - Sep 12, 2025, 12:21 PM CDT

Title: Skin anatomy

Date: 9/10/25

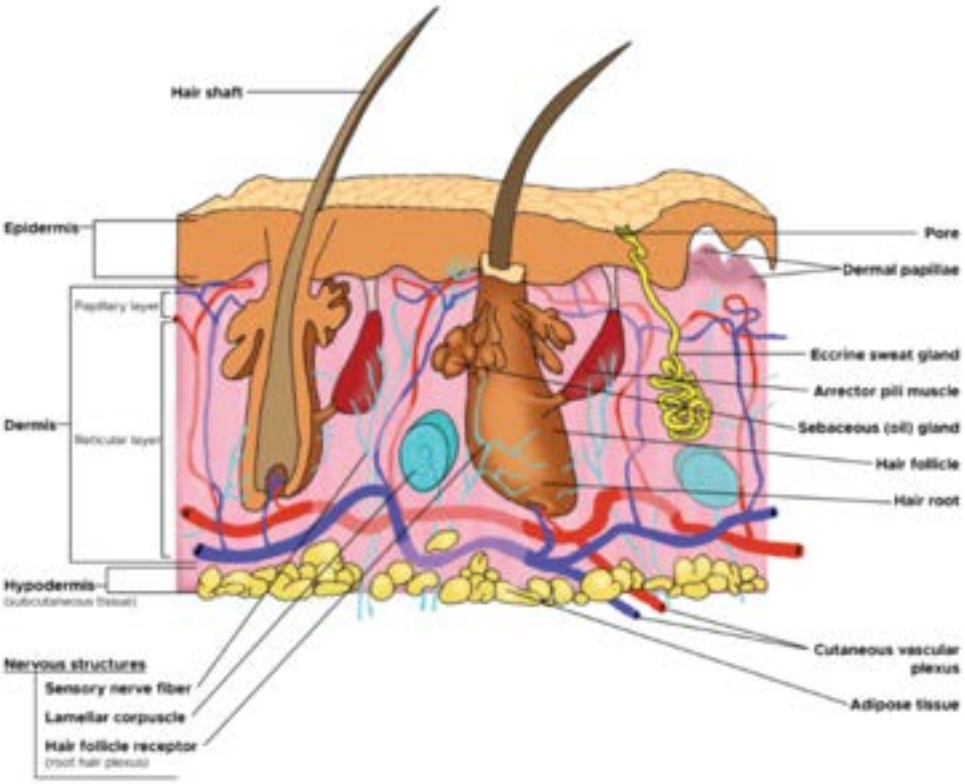
Content by: Sarah Raubenstine

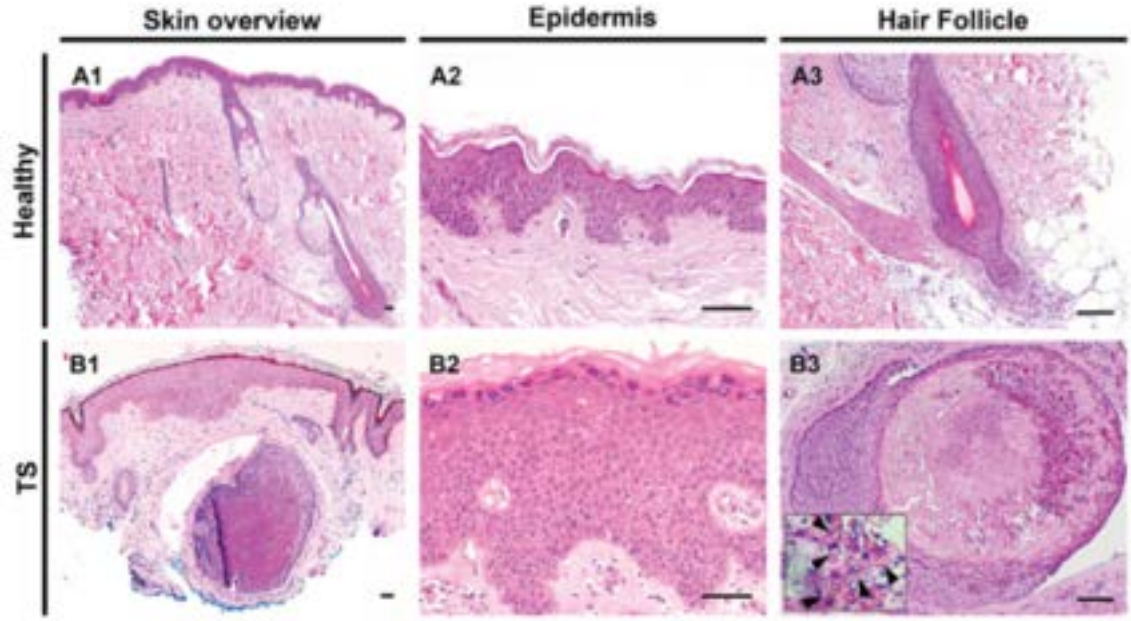
Present: Self

Goals: background information about keratinocytes

Content:

- The skin is largest organ, three layers epidermis, dermis, hypodermis each with different anatomical structures and functions
- Skin thickness varies by body region
- Epidermis, the most outer layer
    - the cells are cuboidal to columnar, active stem cells that constantly keratinocytes
    - melanocytes
- Keratinocytes are the main cells in the epidermis, originating from the basal layer
    - produce keratin and lipids essential for forming the epidermal water barrier
    - regulated calcium by enabling UVB light absorption
- Dermis connected to the epidermis by the basement membrane
- Hypodermis located beneath the dermis
- Act towards immunology defense, homeostatic regulation, endocrine functions, sensory functions
- Phases of wound healing
    - Hemostasis - blood clotting
    - Inflammation - immune cells clear debris
    - Proliferation - tissue and blood vessels
    - Remodeling - scar forming
- Keratinocytes
    - after injury, the cytes near the edge of the wound are activated by growth factors
    - They migrate across the wound bed - around the provisional matrix made of fibrin and fibronectin formed during blood clotting
    - Stem cells in the basal layer proliferate to replace the migrating cells, replenishing epidermal layer
    - covers wound bed and keratinocytes begin to stratify
- Keratinocyte behavior is regulated by wound microenvironment, oxygen levels, matrix stiffness, and immune cell signals.





Conclusions/action items: Learn more about keratinocytes, imaging similar to the imaging from client's lab, seeing the karatinocytes "crawling" along the wound surface.

2025/09/16 - Lab blade safety measures

SARAH RAUBENSTINE - Sep 18, 2025, 11:24 PM CDT

Title: Lab blade safety measures

Date: 9/16/25

Content by: Sarah Raubenstine

Present: Self

Goals: Learn about the safety recommendations for usage of sharps in a lab setting.

Content:

- Sharp injuries are significant hazard for lab workers however most often very preventable
  - penetration of the skin with biologically contaminated sharp device is major means of transmitting infectious agents
- A sharp is an item designed to cut or penetrate skin
  - needles, syringes with needles, scalpel blades, lancets, and razor blades
  - broken vials and slides with infectious agents as well
- Laboratories have sharps reduction policies in order to reduce injuries at the source
  - determine whether the use of sharps is critical to a task
- Safer sharps have engineered controls built into the product to prevent sharps injuries
  - protective shield over the needle/blade
- Training is critical to lab safety, improper use of sharps and poor technique can increase risk of injury
  - ensure proper training and supervision
- Safe and appropriate use of scalpals
  - do not use disposable scalpals that require you to place fingers next to the blade and apply force
  - use disposable safety scalpels with fixed blades when possible, eliminating the extra hazardous step of removing the blade
  - If using a reusable scalpel, consider blades with engineered safety features
  - do not use blades without a handle, must have handle to act as a barrier and help control
  - do not saw with a scalpel or use excessive force on it
- Sharps should be pointed away from handler
- Blades should never be temporarily exposed on the countertop
- Try to eliminate need for two handed techniques to eliminate risk
- If using a razor blade as a knife, secure it in a holder to avoid direct handling of the blade
  - be mindful unwrapping and replacing new blades
  - when replaceing, do not touch the blades directly, use forceps or removers
- Cover blades when not in use
- Ensure the item being cut is stable to minimize chances of slipping
- Use a suitable cutting surface so the blade does not become blunted or the work surface damaged

Conclusions/action items: Integrate these safety recommendations into the device design and also include in safety section of the PDS.

[1]" Cutting Safety – USC Environmental Health & Safety," *ehs.usc.edu*. https://ehs.usc.edu/research/lab/cutting-safety/ [2] "Safe Handling of Sharps in the Biological Research Laboratory – Biosafety." https://research.uga.edu/biosafety/procedures/safe-handling-of-sharps-in-the-biological-research-laboratory/

2025/09/17 - Types of surgical/lab blades

SARAH RAUBENSTINE - Sep 18, 2025, 11:58 PM CDT

Title: Different types of surgical blades

Date: 9/17/25

Content by: Sarah Raubenstine

Present: Self

Goals: Learn about the different classes and types of surgical blades, also take note of the pricing for PDS info.

Content:

- Surgical blades are known for precision, made from stainless steel or carbon steel
  - make clean precise incisions with minimal tissue damage
- Scalpels are small straight knives that have a handle and replaceable blade element
  - make incisions and cuts with accuracy
- These blades are used in a wide range of surgical procedures, general and specialized surgeries, and also research and laboratory use for dissection and preparation of specimens
- Standard blades have different shapes and size for different applications
  - for skin, the #10 blade is most commonly used for initial incisions and excising tissue
- Specialty blades, ophthalmic blades, neurosurgical blades, micro blades
- To choose the right blade, consider blade size and shape, blade material
- Blade material
  - stainless steel - strength, sharpness, and resistance to rust and corrosion, reliable
  - carbon steel - excellent sharpness and edge retention, more prone to rust
- Sterilization - autoclaving commonly used for reusable blades and handles, chemical sterilization for instruments not able to withstand high temperatures, single use sterile packaging
- Handle type - fixed handle, detachable, ergonomics of design
- Disposable scalpel blades are razor sharp, come in many shapes and sizes, many uses
  - reusable handle and disposable scalpel blades sold seperately
- Blades are sterile, individually packaged designed for a single use
  - eliminate inconsistencies with sharpening reusable blades
  - to replace disposable blades, grasp the blade with a needle holder just above opening of the non cutting side, align the groove on the handle to the blade opening, slide blade until click into place

- Scalpels come in packages of 100 individually packed sterile units

^^^^ WPI feather scalpel blades individually packaged, $61 for a pack of 100 blades

Conclusions/action items: Keep in mind blade styles and disposable blades for our device design.

[1] “Exploring Surgical Blades and Scalpels: A Full Guide,” *Mycomedical.com*, 2024. https://www.mycomedical.com/post/exploring-surgical-blades-and-scalpels [2] “Stainless Steel Scalpel Blades | Surgical Scalpel Blades,” *Wpiinc.com*, 2024. https://www.wpiinc.com/products/surgical/scalpels-blades/scalpel-blades?srsltid=AfmBOop4LiEn1G3-A400Zxy9zcCzHtl8z7u27G7i4S9iZxt4sdIBqwqd (accessed Sep. 19, 2025).

2025/09/18 - Machining clear plastics

SARAH RAUBENSTINE - Sep 19, 2025, 1:39 PM CDT

Title: Machining clear plastics

Date: 9/18/25

Content by: Sarah Raubenstine

Present: Self

Goals: Gauge what clear plastics are machinable and how to best go about machining with these materials.

Content:

Polycarbonate (PC)

- Known for durability, stability and clarity
- Shatter proof windows, jet canopies, electrical circuits, lab lenses, and other plastic parts
- Excellent impact strength, easily machined, molded, thermoformed
- Polycarbonate is transparent, amorphous thermoplastic
    - high impact strength, high elastic modulus
    - UV resistant
    - High tensile strength at high temperatures
- PC rod and plates are easy to machine, good dimensional stability
    - Non-aromatic water soluble coolants are recommended for ideal finishes and tolerances
    - coolants also extend tool life

Acrylic (PMMA)

- lightweight, transparent plastic for manufacturing
- tough and impact resistant, great for applications requiring clarity and increased durability
- cast acrylic better choice for machining than extruded acrylic (less likely to crack or chip during machining)
- Affordable
- Low moisture absorption

HDPE

- good for machining, not as transparent

Conclusions/action items: Take these materials into consideration and continue research on being able to sterilize each plastic.

https://aipprecision.com/machining-polycarbonate-pc-a-plastics-guide/

https://sybridge.com/key-differences-acrylic-and-polycarbonate-machining/

https://aipprecision.com/machining-hdpe-plastics-guide/

2025/10/04 - Burn Healing Background

SARAH RAUBENSTINE - Oct 24, 2025, 4:32 PM CDT

Title: Burn Healing Background

Date: 10/4/25

Content by: Sarah Raubenstine

Present: Self

Goals: Gain background information about the wound healing process for preliminary report.

Content:

[1]

Skin tissue regeneration for burn injury

- Skin is the largest organ, also the most vulnerable to damages, having the most direct contact with the environment
- Burns are one of the most common injuries worldwide, more than one million patients annually in the US alone
- A burn is described as the skin being damaged by heat, radiation, electricity or chemical exposure
- Many possible complications with burn injuries - sepsis dues to bacterial infection, hypovelmia, scaring tissue contraction, etc.
    - damage of skin causes death of skin cells, leading to an enormous loss of body fluids, dehydration, renal, and circulatory failure
    - The burn skin is very susceptible to pathogens becuase of loss of protective layer, important to promptly cover a burn injury
- Survival rates have improved significantly due to development of various skin grafts
    - autologous skin grafts have been less effective
    - skin substitutes, cell sheets, scaffolds, hydrogels, high efficacy and low cost comparatively
- Three major layers - dermis, hypodermis, and epidermis
- Epidermis
    - main barrier between external environment
    - thin and stratafied layer
    - Majorly made up of keratinocytes, responsible for this stratafied structure
    - Melanocytes synthesizing melanin
- Dermis
    - thick layer containing connective tissue
    - more heterogenous than the epidermis
    - includes follicles, sweat glands, blood and lymph vessels etc.
    - collagen types I and III, enables skins strength
    - elastin provides elasticity and flexibility
    - Consistently remodeled because of proteolytic enzymes synthesized by fibroblasts, neutrophils, keratinocytes, etc.
    - Fibroblasts produce components of the ECM and secretes growth factors
        - essential for skin remodeling and wound healing
    - Various immune cells migrate throughout
- Hypodermis
    - adipocytes structured in lobules
- Several factors influence skin healing after burn injuries - causes of burn, degree, size, general condition of the patient, etc.
- Superficial burns recover within two weeks and minimally scar
    - Re-epithelialization from keratinocytes migration from skin dermal appendages within the first few hours of injury
- Deeper burns the healing starts around the edges because of the necessity of rapid wound closure

[1] A. Shpichka et al., “Skin tissue regeneration for burn injury,” Stem Cell Res. Ther., vol. 10, p. 94, Mar. 2019, doi: 10.1186/s13287-019-1203-3.

Conclusions/action items: Include information in preliminary report.

2025/10/04 - Burn Injury Demographic Info

SARAH RAUBENSTINE - Oct 24, 2025, 4:47 PM CDT

Title: Burn injury demographic information

Date: 10/4/25

Content by: Sarah Raubenstine

Present: Self

Goals: Gain information on typical burn injury demographics for preliminary report.

Content:

[1]

- Burn injuries are typically under appreciated for how substantially they are associated with morbidity and mortality
- Severe burns accompanied by immune and inflammatory responses, metabolic changes, and shock that can lead to organ failure
- Injury affects not only the physical health but also the mental health and quality of life of a patient
    - long term and progound alterations that must be addressed to improve quality of life
    - Burn care providers faced with challenges in acute and critical care as well as long term rehabilitation

[2]

- Globally, 11 million people experienced burns requiring medical intervention
- Greater risk in developing countries, with management of severe burns being a major concern due to lack of specialized facilities
- Main cause of death in patients suffering from burns are sepsis and widespread infections throughout the body, multiple organ failure
- Most frequent mortalities in middle aged individuals
    - what gender is more impacted varies by location, in the US typically working men with occupational hazards

[1] M. G. Jeschke, M. E. van Baar, M. A. Choudhry, K. K. Chung, N. S. Gibran, and S. Logsetty, “Burn injury,” Nat. Rev. Dis. Primer, vol. 6, no. 1, p. 11, 2020, doi: 10.1038/s41572-020-0145-5.

[2] S. Tasleem et al., “Mortality patterns and risk factors in burn patients: A cross-sectional study from Pakistan,” Burns Open, vol. 8, no. 1, pp. 13–18, Jan. 2024, doi: 10.1016/j.burnso.2023.11.003.

Conclusions/action items: Include this information in the background section of preliminary report.

2025/10/06 - RENEW Wisconsin Lab

SARAH RAUBENSTINE - Oct 24, 2025, 4:58 PM CDT

Title: RENEW Wisconsin Lab

Date: 10/6/25

Content by: Sarah Raubenstine

Present: Self

Goals: Establish info about client's lab

Content:

[1]

- RENEW (Regeneration, Engineering, and Novel Epidermal Wound-healing) lab conducts research in three primary areas
  - burn wound microenvironment and healing prognosis
  - human and comparative models for wound healing research
  - novel technologies for wound healing
- Angela Gibson
  - surgeon scientist trained in burn surgery and the cellular and molecular biology of wound healing
  - fascinated with human response to injury and wound healing
  - involved in multiple clinical trails of skin substitutes
  - looking into the knowledge gap in the burn surgery field on the role of autologous regeneration
- RENEW lab aims to conduct translational wound healing research with a focus on making clinical advancements for patients with burn injury
- Long term goal to identify the basic cellular and micro-environmental requirements for autologous burn wound regeneration to help develop technologies and biologics

[1] “RENEW Wisconsin Lab,” Department of Surgery. Accessed: Sep. 16, 2025. [Online]. Available: https://www.surgery.wisc.edu/research/researchers-labs/dr-gibsons-lab/

Conclusions/action items: Use this information within preliminary report.

2025/11/07 - Tong Distinguished Lecture

SARAH RAUBENSTINE - Nov 07, 2025, 12:47 PM CST

Title: Tong Distinguished Lecture - Kristin Myers

Date: 11/7/25

Content by: Sarah Raubenstine

Present: All BME Students

Goals: Gain professional insight into building a career of impact - why healthcare needs more engineers

Content:

- Kristin Myers
  - BS in BME
  - MBA in Harvard
  - COO at Blue Cross Blue Shield
- Run towards the hard problems - they are the ones that change the world
- "The foundation" - solve tangible problems, work hard, add value
- "Climb the growth curve" - combining EQ and IQ to multiply impact and reach
  - Aetna chief of staff to CEO
  - Unified women's healthcare president and COO
  - First chapter about personal growth and showing what she could do
- "Build and Transform" - drive system-level impact through innovation and scale
  - Hopscotch Health - founder and CEO
  - Blue Cross Blue Shield Association - COO
  - Now working to enable access, affordability, outcomes and 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
  - Its a realllly tough thing to be a doctor in this country right now, improved provider experience is important as well
  - A lot less time on patient care and outcomes, more on charting etc.
- How much do we spend on healthcare in the US? - $5.3 billion and 18% GDP
  - BUT US ranked last on equity, access and outcomes
  - Lower life expectancy
  - Physician burnout etc.
  - We have a very archaic system and there are a bunch of things that need to be changed at the core of it
  - Large inequities - 10-15 year gap between zip codes
- "Healthcare isn't broken because people don't care - its just broken because it was never designed to be one system"
- What if we build an integrated system to enable health and wellness for all?
  - the future of healthcare is an integrated ecosystem of health and care
- Healthcare needs better systems - and systems are what engineers build best
  - Aligned incentives and measurement
    - everyone rewarded for outcomes, not activity
    - Performance is transparent an known to all
  - Much lesser incentives for primary care physicians, lots of reimbursement for specialties
    - really good preventative care for primary care, but people run towards the money
- Advice:
  - work hard and build range - take on the hardest projects, classes, and experiences you can find. effort and range are your foundation
  - once she got first professional job, it was really easy to get a job afterwards
  - Seek diverse exposure - explore different sectors, teams, and geographies, gain perspective and learn how systems connect, not just how parts work
  - Choose your people wisely - surround yourself with curious, drive, and high integrity people. They will shape who you become

- Know your values and protect them - define what matters most, family and friends, health, career and impact, values, making decisions that align
- Embrace challenge and keep growing - run towards the hard problems, growth lives on the edge of discomfort where big impact starts

Conclusions/action items: Take this advice moving forward into the professional sphere after graduation.

2025/9/10 - Biopsy punches and pricing

SARAH RAUBENSTINE - Sep 18, 2025, 10:26 PM CDT

Title: Biopsy Punches

Date: 9/12/25

Content by: Sarah Raubenstine

Present: Self

Goals: Look at existing biopsy punches and take note of pricing.

Content:

On the Fisher scientific website they have many different biopsy punches, many this retractable pen design, think about taking inspiration of the retractable plunger system.

^^^Biopsy punch with plunger system, $25

^^^^This Biopsy punch with plunger system has the same plunger mechanism yet a much higher quality blade, being priced at $471 !!!

^^^Disposable biopsy punches $340 for a case of 100 punches

^^^Precision reusable biopsy punch with plunger system, $28

Conclusions/action items: Many existing derivatives of biopsy punches, think about using similar design. The pricing on these varies greatly, mainly depending on the blade quality and the reusability of the device. Range from ~$25 - ~$400! Think about this for pricing considerations with the PDS.

[1] "World Precision Instrument Reusable Biopsy Punch, Various Sizes-504533," *Fishersci.com*, 2025. https://www.fishersci.com/shop/products/biopsy-punch-6mm-w-plunger/NC1060510#?keyword= (accessed Sep. 12, 2025).

2025/09/18 - Plunger vs. Stylet biopsy punches

SARAH RAUBENSTINE - Sep 19, 2025, 12:17 AM CDT

Title: Plunger vs. Stylet biopsy punches

Date: 09/18/25

Content by: Sarah Raubenstine

Present: Self

Goals: Look at different biopsy punch mechanisms

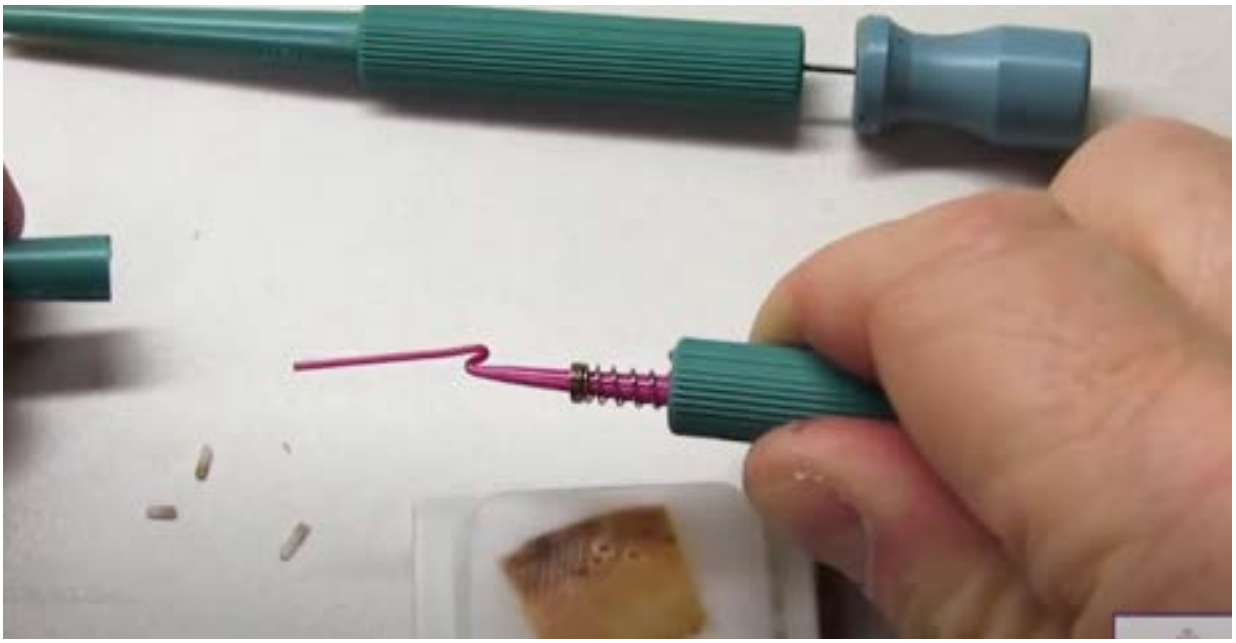
Content:

- Plunger mechanism meant to help eject the tissue sample quickly and safely, giving the user precise control of sample ejection
  - the plunger is depressed to eject the sample
  - can be used for routine use in dermatology with full thickness samples

^^^ Top biopsy punch uses a stylet method of ejecting the sample, manually pushing down a needle-like stylet to remove the biopsy sample from the pen. The bottom punch uses the plunger mechanism, using an internal mechanism to eject the biopsy sample when the plunger is depressed. The plunger is brought back up by unlocking it's position on the side.

As samples are continued to be taken, the needle with the stylet performed consistently due to the strength of the stainless steel stylet removing the sample.

The punch with the plunger with the internal plastic plunger rod collapsed after several punches of the tough skin tissue sample because it's plastic interior was not designed for this tough of a use



^^^ failure of the internal plastic plunger mechanism

Conclusions/action items: Keep in mind the plastic interior element failure when designing our cutting device, especially if building off of existing biopsy punch.

[1] Arraymold Jandi J. Eyre, “Punching With A Needle and Stylet vs Plunger Needle 2,” *YouTube*, Jul. 03, 2018. https://www.youtube.com/watch?v=a6jb4DHYlk4 (accessed Sep. 18, 2025).

2025/09/18 - Inspiration from other slicing tools

Title: Taking inspiration from other slicing tools

Date: 9/18/25

Content by: Sarah Raubenstine

Present: Self

Goals: Find devices from other fields with mechanisms that could serve as inspiration for our device.

Content:

^^^ Guillotine paper cutter $64.99 (original inspiration from Gianna!)

Paper cutter able to cut stacks of 20-25 sheets of paper at once with precision and accuracy. Can come in many different sizes and styles, handheld, tabletop, to heavy duty industrial machines. where the paper is placed for cutting, including alignment markers, rulers, etc. to guide the user for accuracy. The cutting arm can be used manually or powered by a lever or motor depending o guards or locking mechanisms to protect the user.

^^^ Kitchen slicer ("fruit guillotine") meant for chopping fruits and vegetables, similar to the able paper cutter design yet on a smaller scale and intended for food use. $42.82

^^^ Stainless steel handheld fruit and mushroom slicer, $33.99. Device intended to expedite the preparation of small fruits and vegetables, having 7 stainless steel blades that create uniform slic storage, dishwasher safe!

^^^ small stainless steel mandolin, intended to consistently slice fruits and vegetables, switchable blades, consider the motion of pushing the sample into the blade rather than the blade into the

^^^ Bagel slicer intended to cut bagels in uniform halves by pushing the guarded blade into the bagel. The blade is encased between two clear acrylic safety shields.

Conclusions/action items: Keep in mind some of these slicing mechanisms when coming up with preliminary designs.

Product Links for image citations:

[1] "What is a Paper Cutter?," *Whitaker Brothers*, 2025. https://www.whitakerbrothers.com/blogs/news/what-is-a-paper-cutter?srsltid=AfmBOooIXLYvAtcJSlWP1da
2025).

https://www.officedepot.com/a/products/347924/Westcott-Trim-Air-Wood-Guillotine-Paper/?utm_source=google&utm_medium=sag?utm_source=google&utm_medium=cpc&utm_campaign=pla_
match&mediacampaignid=71700000119141386&utm_source=google&utm_medium=cpc&gclsrc=aw.ds&gad_source=1&gad_campaignid=21410298162&gbraid=0AAAAAD2Eb4d0ABxUE4j6C
ETrtel7Ysfluo8vevvgZvWUJwsMjzNicBg3QZF4aAtqjEALw_wcB

[2] "Louis Tellier Stainless Steel Handheld Fruit and Mushroom Slicer N4194," *WebstaurantStore*, 2022. https://www.webstaurantstore.com/louis-tellier-stainless-st
utm_source=google&utm_medium=cpc&gbraid=0AAAAAD_Dx-tJkPFy24kCFHPdb-q70ZaLO&gclid=Cj0KCQjw267GBhCSARIsAOjVJ4EmfX6RHb0F-U58VpZiFsnVAJRBokKmCm
2025). [3] "Sur La Table Stainless Steel Mandoline," *Sur La Table*, 2022. https://www.surlatable.com/product/sur-la-table-stainless-steel-mandoline/7203805?
srsltid=AfmBOooehZdrBU1UrsGlHd1Gf2jyXHnyqx7hLEckuEcp1JpMFZnS8PCoUnU (accessed Sep. 19, 2025).

https://www.knifecountryusa.com/store/product/227596.227600/kitchen-dao-knives-0250-kitchen-cutter-slicer-with-wood-handle.html?gad_source=1&gad_campaignid=
fhWRrFrwmoWon&gclid=Cj0KCQjw267GBhCSARIsAOjVJ4HszHuQbZrwkt5BghxZaLGFT4DJ5rqvOSbJbAf7Kv4AdQvwYnyY8OAaAlwbEALw_wcB

[4] "Williams Sonoma Bagel Cutter," *Williams-sonoma.com*, 2021. https://www.williams-sonoma.com/products/williams-sonoma-bagel-cutter/?
catalogId=79&sku=9636952&cm_ven=FreePLA&cm_cat=Google&cm_pla=Cooks%27%20Tools%20%3E%20Mandolines%20%26%20Spiralizers (accessed Sep. 19, 2025).

2025/09/25 - Visikol 3D Printed Tissue Slicers

SARAH RAUBENSTINE - Sep 26, 2025, 9:50 AM (

Title: Visikol 3D Printed Tissue Slicers

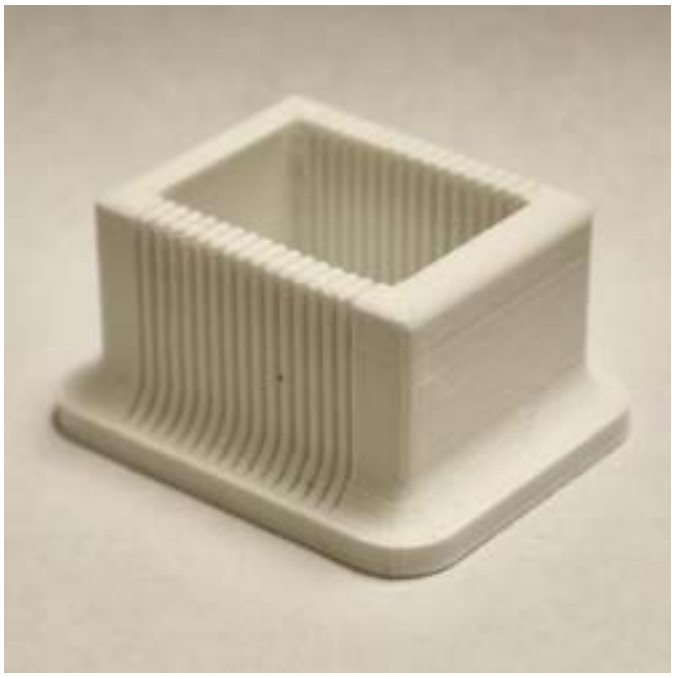
Date: 9/25/25

Content by: Sarah Raubenstine

Present: Self

Goals: Examine other devices for tissue slicing in the lab environment available on the market.

Content:



^^^ Visikol 3D Printed Tissue Slicer, specimen is placed inside the container and blade is run along the tracks, aiming to get thin and even cuts on the tissue sample. 3D printed out of PLA, claim easily washed and cleaned between each usage. Designed for use with standard razor blade.

^^^ 3D Printed slicers for more particular uses are available with shapes catered to different specimen. (Also from Visikol)

Prices for these 3D printed pieces range from $150-$200 depending on the size, wow.

Conclusions/action items: Market comparison for 3D printed slicing device, also runs along a track using a standard razor blade, similar to our design.

Citations:

[1] "Tissue Slicers | Visikol," *Visikol.com*, 2021. https://visikol.com/product/tissue-slicers/ (accessed Sep. 26, 2025).

2025/09/25 - TruSlice Tissue Slicing System

SARAH RAUBENSTINE - Sep 26, 2025, 9:50 AM (

Title: TruSlice Tissue Slicing System

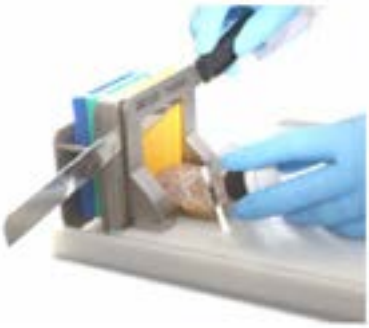
Date: 9/25/25

Content by: Sarah Raubenstine

Present: Self

Goals: Examine other devices for tissue slicing in the lab environment available on the market.

Content:



^^^TruSlice Tissue Slicing System $1878.75

Designed for accurate and consistent slicing of tissue in a lab setting. Aims to eliminate dissection inaccuracies associated with conventional cutting. Suitable for fresh and fixed tissues. Reduce to cut gross specimens. Includes an "immobilization plate" so the user can control the pressure to the specimen and make sure tissue slices aren't deformed.

Different color coded inserts determine specimen thickness, having inserts facilitating cuts of 2mm, 3mm, 4mm, and 5mm thick. Inserts made of HDPE.

Made out of 316 Stainless Steel for optimal sanitization.

^^^ TruSlice Immobilization Plates $45.70

^^^ System is designed for use with these long Black Diamond Lung Knives, a box of 10 knives goes for $149.70. Stainless Steel knives, meant to be disposable to eliminate contamination. 250 long.

Conclusions/action items: Take into account similar devices on the market and their price when finalizing our design, consider blade compatibility, material, etc.

Citation:

[1] "TruSlice Tissue Slicing Systems," *Tedpella.com*, 2015. https://www.tedpella.com/dissect_html/TruSlice.aspx

2025/09/25 - Rodent Brain Slicing Instruments

SARAH RAUBENSTINE - Sep 26, 2025, 10:35 AM CDT

Title: Rodent Brain Slicing Instruments for Lab Use

Date: 9/25/25

Content by: Sarah Raubenstine

Present: Self

Goals: Get ideas and inspiration for other types of tissue / whole organ slicers intended for lab use.

Content:

From WPI Instruments [1]:

^^^ WPI Acrylic Rodent Brain Matrix intended for thin and uniform brain slices for histological analysis. Meant to produce consistent and accurate slices for better analysis and comparison of specimens in experimental conditions. This model is made of acrylic. Include slots/channels that you hold the brain in place with during slicing. Designed for sagittal or coronal slices. Different sizes availble for different species. Yields consistent 1 mm thick slices and brain sectioning. Material can be chilled and/or sterilized. $197.00

^^^ WPI Stainless Steel Rodent Brain Matrices, meant for thin and uniform brain slices. Made of durable stainless steel. Include precison cut channels to run the balde through, making 1 mm thick slices. Also availible in different sizes for different species. Easily chilled and or sterilized. Stainless steel useful when heat transfer or maintaining a specific temperature range is required. $345.00

Both. of these pieces are designed to be best compatible with the WPI blades, offering a lower end single edge razor blade package ($72.00) and a higher end ceramic pack of blades ($595.00).

From Braintree Scientific Inc [2]:

^^^ Designed to aid in freehand dissection of rodent brain. Meant for consistent and reproducable sections at varying intervals depending on item purchased, show is designed for 1 mm slices. Different models avaible for safittal cuts and coromal cuts. Cast in High Grade Zinc using the actual animal prain for cavity definition. Can be chilled and sterilized.

Patented Self-Cleaning Slot Design for easy maintenance and cleanability - explore these patents in a later note.

Conclusions/action items: Consider design and prices of whole tissue slicers when making our design.

Citation:

[1] “Tissue Slicers | World Precision Instruments,” *Wpiinc.com*, 2024. https://www.wpiinc.com/products/instruments/brain-tissue-slicers?srsltid=AfmBOoq2xlwBc0n4CbVKIDJemBomzLx2yxGogZj0iDXN1Dz5Z-eUJYn_ (accessed Sep. 26, 2025).

[2] “Precision Brain Slicer,” *Braintree Scientific*, 2025. https://www.braintreesci.com/neuroscience-physiology/brain-matrice-tissue-punches/precision-brain-slicer/ (accessed Sep. 26, 2025).

2025/09/16 - Rough Initial Design Brainstorm

SARAH RAUBENSTINE - Sep 18, 2025, 9:43 PM CDT

Title: Rough sketches of potential design ideas

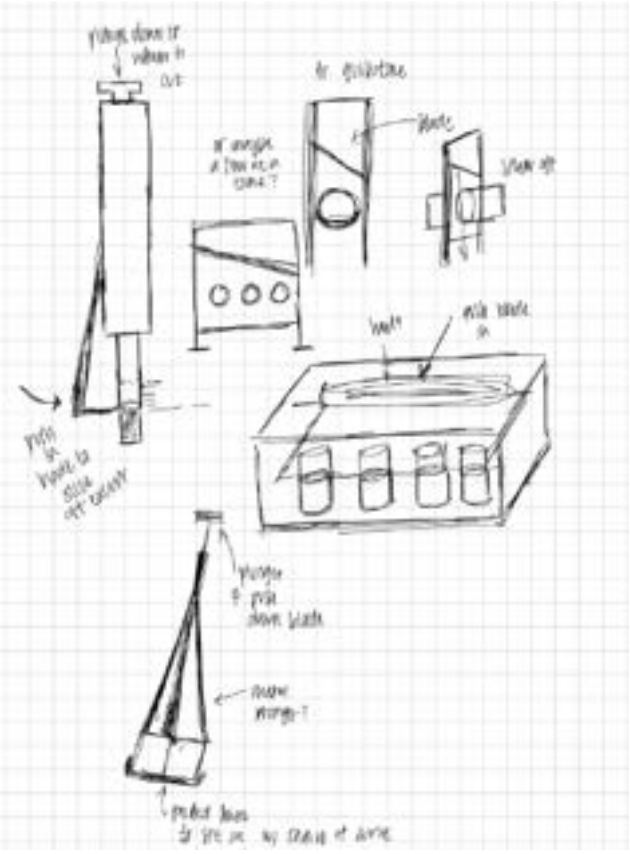
Date: 9/16/25

Content by: Sarah Raubenstine

Present: Self

Goals: Prepare some rough sketches to bring design ideas to team brainstorm meeting

Content:



Conclusions/action items: Bring these design ideas to the team brainstorming meeting!

2025/9/24 - Biopsy Punch CAD drawing

SARAH RAUBENSTINE - Sep 25, 2025, 11:23 PM CDT

Title: Biopsy Punch Design Idea CAD Drawing

Date: 9/24/25

Content by: Sarah Raubenstine

Present: Self

Goals: Create a sketch in OnShape modeling the biopsy punch design.

Content:

Conclusions/action items: Use this drawing for design matrix and preliminary presentation!

2024/9/22 - OSHA and Biosafety Training

SARAH RAUBENSTINE - Sep 22, 2024, 10:21 PM CDT

Title: Biosafety Training Documentation

Date: 03/10/24

Content by: Sarah Raubensitne

Present: Sarah Raubenstine

Goals: OSHA and Biosafety Lab Training

Content:

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

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

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

2024/09/22 - Machining and Shop Tools Certification

SARAH RAUBENSTINE - Sep 22, 2024, 10:24 PM CDT

Title: TEAMLab Training Documentation

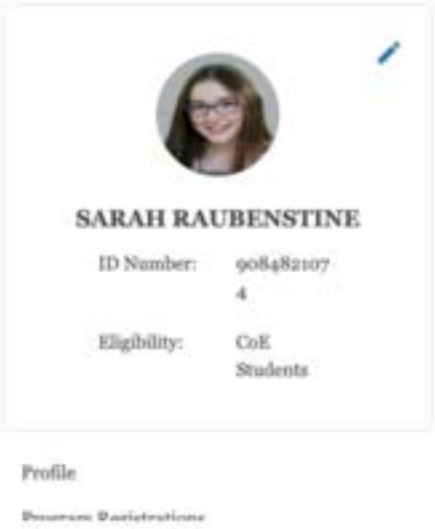
Date: 03/10/24

Content by: Sarah Raubensitne

Present: Sarah Raubenstine

Goals: TEAMLab Machine Training Certification

Content:



SARAH RAUBENSTINE

ID Number: 908482107 4

Eligibility: CoE Students

Profile

My Memberships

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

2025/10/23 - CITI Training Documentation

SARAH RAUBENSTINE - Oct 24, 2025, 5:02 PM CDT

Title: CITI training documentation

Date: 10/23/25

Content by: Sarah Raubenstine

Present: Self

Goals: Obtain human testing certification from CITI online training

Content:

CITI PROGRAM

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

This is to certify that:

Sarah Raubenstine

Not valid for renewal of certification through CME.

Has completed the following CITI Program course:

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

Under requirements set by:

University of Wisconsin - Madison

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

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

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

2025/10/26 - Biosafety 105 Training

SARAH RAUBENSTINE - Oct 28, 2025, 12:39 PM CDT

Title: CITI training documentation

Date: 10/26/25

Content by: Sarah Raubenstine

Present: Self

Goals: Certification of Biosafety 105 Training - Fume hood training

Content:

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

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

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

Conclusions/action items: Upload training documentation.

2025/09/10 - Improving Research Biopsy Quality

Simon Nam - Sep 12, 2025, 12:50 PM CDT

Title: What Can Be Done to Improve Research Biopsy Quality in Oncology Clinical Trials?

Date: 2025/09/10

Content by: Simon Nam

Present: N/A

Citation: K. V. Ferry-Galow *et al.*, "What Can Be Done to Improve Research Biopsy Quality in Oncology Clinical Trials?," vol. 14, no. 11, pp. e722–e728, Oct. 2018, doi: https://doi.org/10.1200/jop.18.00092.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC6237512/

Goals: To learn more about the improvements of biopsy quality and procedure

Content:

A high percentage (26%) of tumor biopsy samples collected for research in oncology clinical trials are of insufficient quality for their intended pharmacodynamic or genomic analyses. Common reasons include insufficient viable tumor content, necrosis, and fibrosis.

This high failure rate compromises clinical trial data, wastes resources, increases the number of patients needed for studies, and is a significant barrier to precision medicine trials where tissue quality determines eligibility.

Key issues identified were a lack of awareness among radiologists about the specific requirements of research biopsies, poor communication between oncologists and interventional radiologists, and insufficient academic and financial recognition for the extra time and expertise required.

- Key Recommendations:
  - Improve Communication: Include interventional radiologists on the research team early in protocol design to discuss research goals and sample requirements.
  - Collect Multiple Cores: Obtain multiple biopsy cores (e.g., 3-5) per procedure when safe, which significantly increases the likelihood of obtaining a usable sample.
  - Provide Feedback: Establish a system to give radiologists feedback on biopsy quality and sufficiency.
  - Use Pre-Screening: Implement a pre-biopsy scoring system to assess a lesion's likelihood of yielding sufficient material before enrolling a patient.
  - Formalize Procedures: Create detailed, protocol-specific standard operating procedures for biopsy collection and handling.
  - Increase Recognition: Acknowledge the radiologists' contribution through co-authorship and advocate for better financial reimbursement for their research efforts.

Implementing these strategies at the NCI's clinic improved the success rate of obtaining sufficient paired biopsy samples for analysis from 50% to over 80%.

Conclusion Action Items: Improving interdisciplinary communication and collaboration is the most efficient method for enhancing biopsy quality across all settings. Look more into other ways of biopsy processes.

2025/09/11 - Biopsy Samples Processing

Simon Nam - Sep 12, 2025, 11:18 AM CDT

Title: How Biopsy and Cytology Samples are processed

Date: 2025/09/11

Content by: Simon Nam

Present: N/A

Citation: "How Biopsy and Cytology Samples Are Processed," *www.cancer.org*, 2024. https://www.cancer.org/cancer/diagnosis-staging/tests/biopsy-and-cytology-tests/testing-biopsy-and-cytology-samples-for-cancer/how-samples-are-processed.html

Link: https://www.cancer.org/cancer/diagnosis-staging/tests/biopsy-and-cytology-tests/testing-biopsy-and-cytology-samples-for-cancer/how-samples-are-processed.html

Goals: To learn more about biopsy samples in terms of scales and methodology

Content:

- Purpose: Biopsy and cytology samples are processed to preserve them and prepare them for microscopic examination to diagnose diseases like cancer.
- Routine Processing:
  - The sample is placed in formalin to preserve it.
  - A gross examination is performed to document the sample's physical characteristics and identify critical areas.
  - The tissue is processed overnight, embedded in a paraffin wax block, sliced into thin sections, stained with dyes, and placed on slides for the pathologist to examine under a microscope (histology).
- Frozen Section:
  - Used during surgery to provide rapid results (within 10-20 minutes) to guide the surgeon.
  - Tissue is frozen, sliced, stained, and examined immediately.
  - Key reasons include: determining if a tumor is cancerous (benign vs. malignant) and checking surgical margins to ensure all cancer has been removed.
- Mohs Surgery:
  - A specialized, slow process for skin cancer where thin layers of tissue are removed and examined one at a time until no cancer cells are found, preserving as much healthy skin as possible.
- Cytology Processing:
  - Samples (e.g., fluid or smears) are concentrated if needed, stained, and examined.
  - A cytotechnologist often screens the slides first, marking abnormal cells for a pathologist to diagnose.
- Sample Retention:
  - Federal (CLIA) regulations require labs to keep samples for minimum periods:
    - Cytology slides: 5 years
    - Histology slides: 10 years
    - Paraffin blocks: 2 years
  - Some states require longer retention.
- Implications for Patients:
  - Saved samples allow for a second opinion (pathology review).
  - They enable comparison of new tumors to old ones to determine if a cancer is a recurrence or a new primary cancer.

- Additional tests can be performed on old paraffin blocks years later.

Conclusion/Action items:

For the actual process of biopsy, one can request a copy of your pathology report and know that your tissue samples are preserved for a significant time, enabling you to seek a second opinion or future testing if necessary. Look more into human factors/ethics with biopsy research and apply any tools/mechnical devices that may raise issues that is against policy.

2025/09/11 - Abdominal Adipose Tissue Biopsy

Simon Nam - Sep 12, 2025, 12:48 PM CDT

Title: A Technique for Subcutaneous Abdominal Adipose Tissue Biopsy via a Non-diathermy Method

Date: 2025/09/11

Content by: Simon Nam

Present: N/A

Citation: V. Chachopoulos, P. C. Dinas, M. Chasioti, A. Z. Jamurtas, Y. Koutedakis, and A. D. Flouris, "A Technique for Subcutaneous Abdominal Adipose Tissue Biopsy via a Non-diathermy Method," *Journal of Visualized Experiments*, no. 127, Sep. 2017, doi: https://doi.org/10.3791/55593.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC5752356/

Goals: To learn more about different methods of biopsy techniques and procedure

Content:

- The main objective is to standardize a safe and effective surgical method for obtaining subcutaneous abdominal adipose tissue biopsies without using diathermy (electrocautery) for hemostasis.
- While standard, diathermy can cause side effects like skin lesions, flash fires, and release toxic surgical smoke into the operating environment.
- Key Advantage of Surgical vs. Needle Biopsy: The surgical technique provides larger (approx. 1g), higher-integrity tissue samples suitable for complex analyses
    - Examples include mRNA expression, protein concentration, histology), unlike needle biopsies which can destroy tissue architecture and yield smaller samples.
- Protocol Summary:
    - Performed under local anesthesia (2% xylocaine) at the bedside.
    - A 2-2.5 cm incision is made 3-5 cm from the navel.
    - Approximately 1g of adipose tissue is excised using scissors and forceps.
    - Hemostasis is achieved with sterile gauzes and pressure; a mosquito forceps is reserved for excessive bleeding.
    - The incision is closed with a suture.
- Tissue Handling: The sample is divided for different analyses:
    - Two pieces (150 mg & 350 mg) are flash-frozen in liquid nitrogen for molecular studies.
    - One piece (500 mg) is preserved in formalin for histology.
- Safety & Results: The method was tested on 115 healthy men.
    - The rate of excessive post-operative bleeding was very low (2.61%, 3 out of 115 cases).
    - The three individuals with bleeding were significantly older, suggesting age may be a risk factor.
    - No other side effects (e.g., infections, skin wounds) were reported after three months.
- Limitations: The technique can cause temporary discomfort. It was standardized on healthy men, and results may differ in clinical populations.

Conclusion/Action Items:

This study successfully standardizes a safe and viable alternative to diathermy for obtaining high-quality surgical adipose tissue biopsies. Researchers can adopt this non-diathermy method to eliminate the risks of diathermy (toxicity, fires, lesions) while still acquiring intact tissue samples sufficient for a comprehensive range of molecular and histological analyses.

2025/09/14 - Sterilizing Practices

Simon Nam - Sep 18, 2025, 8:42 PM CDT

Title: Sterilizing Practices

Date: 2025/09/14

Content by: Simon Nam

Present: N/A

Goals: To learn & adapt to sterlization techniques in laboratory setting for biopsy purposes

Link: https://www.cdc.gov/infection-control/hcp/disinfection-sterilization/sterilizing-practices.html

Citation: CDC, “Sterilizing Practices,” Infection Control, 2024. https://www.cdc.gov/infection-control/hcp/disinfection-sterilization/sterilizing-practices.html

Content:

Sterility depends on proper unit design, thorough cleaning, correct packaging/loading, appropriate cycles, and continuous monitoring—ideally centralized in a processing department with standardized practices across all care settings.

- Before clinical use (cycle verification):
  - Upon install/relocation/major repair/failure, test steam/ETO/low-temp sterilizers with biological & chemical indicators.
  - Run three consecutive empty steam cycles with BI+CI; test each steam cycle type separately; prevacuum units also get a daily Bowie-Dick test.
  - Do not use the sterilizer until all BIs are negative and CIs are correct; quarantine evaluation loads until three consecutive negatives.
- Facilities/layout & environment:
  - Separate areas for decontamination, packaging, and sterilization/storage with physical barriers and proper airflow.
  - Typical specs: decon under negative pressure with ≥6 ACH (AAMI: 10)
    - sterilizer equipment room 10 ACH positive pressure; sterile storage limited access, ≤75°F, 30–60% RH (≤70% RH in sterile storage).
  - Use non-shedding, cleanable surfaces.
- Cleaning (pre-sterilization):
  - Clean ASAP with water + detergents/enzymatics to remove soils that block sterilant.
  - Use mechanical washers/ultrasonic where appropriate
    - Handle all used items as contaminated with PPE and engineering controls for sharps; disassemble multi-part items.
  - Visual “clean” can still hide debris—meticulous technique matters.
- Loading the sterilizer:
  - Arrange for free sterilant circulation.
  - General rules:
    - perforated trays parallel to shelf
    - non-perforated basins on edge
    - small items loose in wire baskets; peel-packs on edge in perforated racks
- **Storage & shelf life (important note for PDS)***
  - Transition from time-related to event-related shelf life—items remain sterile until a contaminating event (ex, tear, wetness).
  - Maintain spacing from floor/ceiling/walls; keep dry; inspect dropped items; wet packages are contaminated.
  - Evidence shows no time-trend toward contamination in covered storage; handling increases risk.
- Routine monitoring:
  - Use mechanical (time/temp/pressure) + chemical + biological indicators (BIs) together.
  - CIs are convenient but can over-call marginal cycles—do not replace BIs.

    - Place external CI on every pack and preferably an internal CI to confirm penetration; perform daily Bowie-Dick in dynamic-air-removal steam units.
- Biological indicators (who/when/which):
    - BIs are the closest to an “ideal” process monitor (use resistant Bacillus/Geobacillus spores).
    - Typical use: weekly for steam & low-temp sterilizers (daily if heavy use), and every load containing implants (ideally hold implants until BI negative).
    - Species: G. stearothermophilus for steam/H_2O_2/peracetic acid; B. atrophaeus for ETO/dry heat.
    - Rapid-readout BIs are validated for steam; FDA-cleared rapid ETO BI exists.
- If a BI is positive (steam):
    - One positive doesn’t automatically mean failure—retest immediately
    - if repeated positives, stop use, service the sterilizer, recall/reprocess as indicated.
    - A more conservative stance recalls all loads from last negative to next satisfactory BI (especially for non-steam methods).
    - Assess patient risk if items were used (consider CI results, charts, parameters, bioburden).
- Test packs & records:
    - Use standardized BI test packs (ex: AAMI 16-towel pack for steam) placed in the most challenging chamber location (front bottom near drain).
    - Keep mechanical/chemical/biological records per regulatory retention requirements (e.g., Joint Commission ~3 years).

Conclusions/action items: Look further into practices of biopsy containment and sterilization procedure. Research on the current application of autoclaving in scalpels and cutting devices specifically. Apply it to PDS criterion afterwards for reference.

2025/09/14 - Long-term storage of small surgical instru.

Simon Nam - Sep 18, 2025, 8:52 PM CDT

Title: Long-term storage of small surgical instruments in autoclaved packages

Date: 2025/09/14

Content by: Simon Nam

Present: N/A

Goals: To understand the packaging & storage techniques for surgical instruments

Link: https://pubmed.ncbi.nlm.nih.gov/14530104/

Citation: W. Bhumisirikul, P. Bhumisirikul, and P. Pongchairerks, “Long-term storage of small surgical instruments in autoclaved packages,” Asian Journal of Surgery, vol. 26, no. 4, pp. 202–204, Oct. 2003, doi: https://doi.org/10.1016/S1015-9584(09)60303-1.

Content:

Hospitals often re-sterilize unused instruments every few weeks, though policies differ and are not strongly evidence-based

Objective of the articles was to compare sterility duration of autoclaved instruments in double-wrapped linen vs. plastic-paper envelopes.

360 orthopedic screws divided into 3 groups:

- Group 1: double-wrapped linen
- Group 2: plastic-paper envelope
- Group 3: unwrapped control

-Sterilized by autoclave (135°C, 2.15 bar, 5 min)

-Stored openly in operating room for 96 weeks.

-Periodic microbial cultures taken.

Results:

- Groups 1 & 2: No microbial growth for 96 weeks.
- Group 3 (controls): Heavy bacterial growth, except 2 early samples.

Discussion:

- Both linen and plastic-paper wraps maintain sterility equally well.
- Contradicts older claims of sterility lasting only 3–7 weeks.
- Findings apply to small metal instruments, not large sets or gauze.
- Proper storage conditions (dry, clean, dust-free) are essential.

Conclusions/action items: Autoclaved small surgical instruments in either double-wrapped linen or plastic-paper envelopes remain sterile for at **least 96 weeks** under ideal storage conditions. Future steps should focus on confirming these findings with larger instrument sets and different storage environments.

2025/09/23 - Skin Biopsy

Simon Nam - Sep 25, 2025, 7:51 PM CDT

Title: Skin Biopsy

Date: 2025/09/23

Content by: Simon Nam

Present: N/A

Goals: To learn more about the practice of skin biopsy & safety concerns for user/operator

Link: https://www.ncbi.nlm.nih.gov/books/NBK470457/

Citation: M. L. Ramsey and S. Rostami, "Skin Biopsy," *PubMed*, 2023. https://www.ncbi.nlm.nih.gov/books/NBK470457/

Content:

Skin biopsy is a fundamental diagnostic tool in dermatology, used to evaluate skin and systemic diseases with cutaneous manifestations.

Types:

- Incisional: shave, scissor, curettage, punch.
- Excisional: full-thickness scalpel excision, deep shave/scoop excision.
- Anatomy considerations: Must account for nearby blood vessels, nerves, and muscles—especially in cosmetically or functionally sensitive areas (face, hands, feet).
- Indications: Diagnosis of skin disorders and systemic diseases with skin involvement.
- Contraindications (relative): Allergy to anesthetics, active infection, tattoos at site, bleeding disorders/anticoagulation (require precautions but not absolute).
- Equipment needed: Disinfectant, local anesthetic (lidocaine ± epinephrine, buffered to reduce pain), biopsy tools (punch, scalpel, scissors, razor), specimen fixative (formalin or alternatives), hemostatic agents, sterile ointment/dressing.
- Personnel: Usually performed by one clinician; assistant improves efficiency.
- Preparation: Careful biopsy type/site selection, obtain clinical photos, disinfect/mark site before anesthetic, prepare all equipment in advance.
- Techniques:
    - **Shave biopsy:** superficial, best for nonmelanoma skin cancers or surface lesions.
    - Scissor biopsy: for small, pedunculated lesions (e.g., skin tags).
    - **Punch biopsy:** full-thickness; useful for inflammatory dermatoses, pigmented lesions.
    - Wedge biopsy: elliptical section from larger lesion; useful for melanomas or keratoacanthoma.
    - Excisional biopsy: entire lesion removed; ideal for small lesions or suspected melanoma.
- Hemostasis: Aluminum chloride or Monsel's solution for small wounds; sutures or Gelfoam for deeper/punch sites; electrocoagulation for excisions. Petrolatum and nonstick dressings preferred post-procedure.
- Complications include low risk overall (<1% infection). Possible bleeding, hematoma, infection, scarring, allergic or vasovagal reactions.
- Clinical significance is to provide tissue for histopathology; communication with pathologists (history, lesion details, differential) is essential for accurate interpretation.
- Inter-professional collaboration (clinicians, nurses, pharmacists, pathologists) ensures safety, accurate diagnosis, and effective patient-centered care.

Conclusions/action items: Skin biopsies are safe, reliable diagnostic tools when proper technique, site selection, and communication with pathology are applied. Future practice should emphasize professional collaboration to enhance diagnostic accuracy and patient outcomes. More studies to be done on how such cutting tools can improve the accurate measurement and research on skin biopsy.

2025/10/06 - Safety & Efficacy of Novel Appraoch

Simon Nam - Oct 10, 2025, 9:50 AM CDT

Title: Safety and efficacy of a novel robotic, fractional micro-coring device in a swine model

Date: 10/06/2025

Content by: Simon Nam

Present: N/A

Goals: research deeper into cutting mechanisms for skin biopsy (porcine models)

Link: https://pubmed.ncbi.nlm.nih.gov/36683728/

Citation: Y. Ramot, U. Vazana, O. Cacical, and A. Nyska, "Safety and efficacy of a novel robotic, fractional micro-coring device in a swine model," *Journal of Toxicologic Pathology*, vol. 36, no. 1, pp. 11–19, 2023, doi: https://doi.org/10.1293/tox.2022-0079.

Content:

- The study evaluated a robotic micro-coring device designed to excise micro-columns of dermal tissue without thermal energy.
- Used porcine dorsal skin as a human analog to analyze both safety and mechanical precision during repeated coring.
- Achieved uniform 400–600 µm core diameters, and maintained structural integrity of epidermal and dermal layers.
- No evidence of tearing or over-compression; suggests that controlled downward velocity and torque optimize tissue yield.
- Histology revealed rapid re-epithelialization by Day 7, that confirms minimal trauma.
- Demonstrates that mechanical coring is safer and less inflammatory than thermal ablation approaches.
- Authors highlight importance of blade geometry, penetration angle (≈ 90°), and dwell time < 0.5 s for efficient excision.

Conclusions/action items: The findings define a biomechanical envelope for safe skin excision (depth, speed, angle). Integrate these mechanical parameters into the design testing matrix. Prototype evaluation should include tissue recovery metrics (deformation, tearing, surface uniformity) and healing progression. Future iterations could test sensor-based feedback to monitor penetration force in real-time.

2025/11/26 - Porcine skin viability over time

Simon Nam - Dec 06, 2025, 2:47 PM CST

Title: The Viability change of pigskin in vitro

Date: 11/26/2025

Content by: Simon Nam

Present: N/A

Goals: To understand more about how long porcine skin tissue samples can be exposed in BSC for precision cutting and maintain vitro condition

Link: https://www.sciencedirect.com/science/article/pii/S0305417909004495?via%3Dihub

Citation: L. Ge *et al.*, "The viability change of pigskin in vitro," *Burns*, vol. 36, no. 4, pp. 533–538, Jun. 2010, doi: https://doi.org/10.1016/j.burns.2009.08.001.

Content:

Room-temperature exposure (≈25 °C) severely limits viable working time

These conditions are most similar to: samples sitting in the lab under a BSC while being trimmed or processed.

- Porcine skin in normal saline at 25 °C drops to 70% viability within 6 hours and then declines very quickly, falling below 30% by 18 hours.
- In DMEM at 25 °C, viability increases slightly for the first 4 h but still falls to ~60% by 24 h.

Implication for device use:
For maintaining physiologically relevant in-vitro conditions during precision biopsy cutting, you should complete all handling well within 6 hours of exposure, ideally <3 hours to avoid early viability decline.

2. Cold storage (4 °C) preserves samples much longer, but only before exposure

- At 4 °C, pigskin remains ~70% viable for 72 h in saline and 96 h in DMEM.
- However, these times no longer apply once the tissue is removed from cold storage and placed at room temperature for processing.

Implication:
Keep samples on ice or chilled until the moment you begin cutting, then minimize bench-top time to limit viability loss.

3. Threshold for acceptable tissue quality is ~70% viability

The study used 70% of fresh tissue viability as the cutoff for graft performance. Grafts at 70% viability showed no significant functional difference from fresh skin in transplantation tests.

Implication:
Cutting workflow should aim to keep samples above this threshold.
At 25 °C, hitting 70% viability happens at ~6 hours, so this becomes the upper boundary for any extended manipulation.

4. Cryopreserved skin after thawing remains viable for only short periods at room temperature

- Quick-freeze thawed samples maintain ~70% viability for 6 hours at 25 °C, similar to fresh tissue.
- Viability falls rapidly afterward.

Implication:
If cryopreserved samples are used, thaw and prepare them immediately before cutting, staying within the same <6-hour window.

Conclusions/action items:

Maximum recommended time that samples can remain under the biosafety cabinet:

≤ 6 hours at room temperature, with preferably < 3 hours of active exposure to maintain near-fresh viability.

Use this information as a reference to keep note of efficiency of device and also considering its before & after cutting procedure when sanitization occurs

Simon Nam - Dec 06, 2025, 2:41 PM CST

The viability change of pigskin in vitro

Download

1-s2.0-S0305417909004495-main.pdf (313 kB)

2025/12/06 - Surgical Blades types for clinical research

Simon Nam - Dec 06, 2025, 2:55 PM CST

Simon Nam - Sep 18, 2025, 8:28 PM CDT

Title: Surgical Blades

Date: 12/06/25

Content by: Simon Nam

Present: N/A

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

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

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

Content:

Razor Blade

Surgical blades offer higher precision and consistency than razor blades

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

Relevant blade sizes and their advantages for porcine skin cutting

Blade #10

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

Blade #11

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

Blade #12

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

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

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

Why Blade #15 is the strongest candidate

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

Conclusions/action items:

Discuss with client furthermore about deciding on a specific type of blade to proceed with project for next semester

2025/09/10 - Pork Skin Removal Machine

Simon Nam - Sep 12, 2025, 11:19 AM CDT

Title: Pork Skin Removal Machine

Date: 2025/09/10

Content by: Simon Nam

Present: N/A

Citation: “Pork Skin Removal Machine,” *VER Food Solutions*, Mar. 10, 2025. https://www.verfoodsolutions.com/products/meat-portioning/pork-skinning-machine/pork-skin-removal-machine/ (accessed Sep. 10, 2025).

Link: **https://www.verfoodsolutions.com/products/meat-portioning/pork-skinning-machine/pork-skin-removal-machine/#:~:text=Overview,robust%20performance%20and%20high%20efficiency.**

Goals: To research any practical devices that is able to remove fat layers of the pig skin

Content:

A specialized machine for efficiently removing subcutaneous fat and skin from various meats (pork, beef, sheep, game, etc.).

The key benefit is that it produces an intact, aesthetically pleasing skin that enhances product marketability.

High processing speed (18-24 meters per minute) to improve productivity.

This machine features an adjustable German blade for precise peeling thickness (0.3mm - 6mm), maximizing yield and minimizing waste.

It handles a wide range of raw material sizes and types of meat on an extra-wide workbench.

It constructed entirely from corrosion-resistant 304 stainless steel for easy cleaning and compliance with food safety standards.

User-friendly with a convenient foot control switch for safe, hands-free operation and low-noise performance.

This device includes a compressed air back flush system for easy cleaning, moving wheels for portability, and a powerful copper motor for stable operation.

It comes in four models (MSPM-300, 435, 500, 620) with varying power, cutting width, and capacity to suit different operation sizes.

Conclusions/action items: Look more into other application of tools or devices that may aid in cutting with precision and high accuracy performance for skin layers including fat

2025/09/16 - Surgical tools

Simon Nam - Sep 19, 2025, 10:41 AM CDT

Title: Surgical tools

Date: 2025/09/16

Content by: Simon Nam

Present: N/A

Goals: To know more about what common surgical tools are available in modern, medical environment.

Link:
https://pre.weill.cornell.edu/mri/pages/book/chapter_6.html#:~:text=Many%20surgical%20tools%20are%20simple,through%20tissue%20with%20less%20resistance.

Citation: "Cornell MRI Research Lab Summer Immersion," Cornell.edu, 2025. https://pre.weill.cornell.edu/mri/pages/book/chapter_6.html (accessed Sep. 19, 2025).

Content:

- Surgical tools are organized by function and assist in cutting, clamping, separating, and maneuvering tissue.
- Basic instruments include scalpels, scissors, forceps, clamps, and retractors for tissue exposure and manipulation.
- High-tech tools include laser scalpels (precise cuts, cauterization), drills (penetrating bone), and arthroscopic shavers (cutting and suctioning tissue).
- Wound closure methods include sutures (absorbable or non-absorbable, mono- or multifilament, often antimicrobial), tissue adhesives (cyanoacrylates for small wounds), vacuum-assisted closure (negative pressure therapy for chronic wounds), artificial/synthetic skin, and bone cement (prosthesis fixation).
- Minimally invasive devices like endoscopes allow visualization and insertion of instruments for cutting, shaving, and repair with reduced infection risk and faster recovery.
- Robotic surgery improves precision, reduces tissue damage, and enables minimally invasive procedures,
    - However higher costs and uncertain long-term benefits remain.
- Irrigation and drainage are essential for clearing surgical sites of debris and fluids, using syringes, pressurized canisters, and vacuum systems with tips (Frazier for small, Yankauer for large settings).

Conclusions/action items: Current surgical equipment ranges from basic manual tools to advanced robotic systems, each addressing unique needs in tissue manipulation, wound closure, and surgical efficiency. Further research should focus on improving cost-effectiveness, safety, and integration of high-tech solutions possibly like robotics and synthetic biomaterials. Exploration of novel wound closure techniques and minimally invasive tools can certainly push advacements in surgical care.

2025/09/23 - Zivic Tissue Slicers

Simon Nam - Sep 25, 2025, 7:54 PM CDT

Title: Zivic Tissue Slicers

Date: 2025/09/23

Content by: Simon Nam

Present: N/A

Goals: To find out any other available devices for skin cutting/biopsy related

Link: https://www.zivicinstruments.com/tissue-slicers-matrix-section.html#

Citation: "Online Source for Zivic Tissue Slicers and Matrices: inexpensive instruments for sectioning / blocking tissue samples (e.g. brain, heart, lung, liver, or spinal cord). Each matrix is economical and reliable. Expedited shipping available.," *Zivicinstruments.com*, 2025. https://www.zivicinstruments.com/tissue-slicers-matrix-section.html# (accessed Sep. 23, 2025).

Content:

- This device is designed for researchers to slice animal tissues (brain, heart, kidney, liver, lung, spinal cord) into consistent sections for histology, biochemistry, or infarction studies.
- Their function is to provide repeatable coronal, sagittal, or axial sections;
    - ALso aids in blocking before microtome sectioning and isolating reproducible tissue regions.
- Material composition: made of polished acrylic or stainless steel; durable and precise.
- Orientation options:
    - Coronal: slice channels cut perpendicular to long axis.
    - Sagittal/axial: channels cut parallel to long axis.
- Range of products: Specialized slicers for multiple species (mouse, rat, pig, hamster, monkey, guinea pig, rabbit).
- Applications: Useful for brain, heart, kidney, and tumor slicing.
- Advantages: Economical, reliable, and designed by researchers for research use.
- Disadvantages: Limited application tool for broader organ systems rather than speciific skin layer types

Conclusions/action items: Zivic slicer matrices offer cost-effective, standardized sectioning for diverse animal tissues with multiple orientations and species-specific options. They serve as a reliable competitor product, emphasizing precision, durability, and versatility in preclinical research. Our developing design needs to show better performance than this comepetiting design.

2025/10/07 - Slicer prototype for partitioning punch biopsies

Simon Nam - Oct 10, 2025, 9:54 AM CDT

Title: Skin biopsy processing for rapid molecular diagnosis and histopathologic interpretation: application to Kaposi sarcoma in East Africa

Date: 10/07/2025

Content by: Simon Nam

Present: N/A

Goals: To look further into mechanical principles and efficiency optimization for skin-harvesting cutters

Link: https://infectagentscancer.biomedcentral.com/articles/10.1186/s13027-025-00671-1?

Citation: J. C. Manning *et al.*, "Skin biopsy processing for rapid molecular diagnosis and histopathologic interpretation: application to Kaposi sarcoma in East Africa," *Infectious Agents and Cancer*, vol. 20, no. 1, Jun. 2025, doi: https://doi.org/10.1186/s13027-025-00671-1.

Content:

- The project basically designed a manual slicing apparatus using paired razor blades separated by fixed spacers to cut biopsies into uniform layers.
- Evaluated slice thickness repeatability: mean = 0.57 mm ± 0.04 mm in porcine tissue (n = 60).
- This device showcased that mechanical guides reduce operator variability compared to free-hand scalpel slicing.
    - Low cutting resistance observed when maintaining a consistent downward motion and stable compression.
- Device is made from 3D-printed PLA frame and stainless-steel blades; autoclaving tested for sterilizability.
- Users reported greater safety and ease-of-use due to fixed blade positioning and reduced exposure risk.

Conclusions/action items: This design validates a simple, low-cost slicing mechanism suitable for controlled-thickness tissue preparation. It gives a sense of idea of adjustable spacer modules (0.3–1.0 mm) to enable variable slice thickness in biopsy press design. Explore materials compatible with repeated sterilization (e.g., nylon or BioMed resin) for the structural frame.

-Benchmark slice uniformity, operator safety, and time efficiency against this slicer's metrics.

2025/10/27 - Neoprene Rubber

Simon Nam - Oct 31, 2025, 2:00 AM CDT

Title: Neoprene Rubber

Date: 2025/10/27

Content by: Simon Nam

Present: N/A

Goals: To select a proper material type for base design

Link:https://www.everestrubber.com/neoprene-rubber/

Citation: Neoprene Rubber | Neoprene rubber sheet and roll," Everest Rubber, 2022. https://www.everestrubber.com/neoprene-rubber/ (accessed Oct. 27, 2025).

Content:

- Neoprene is described as a versatile elastomer with a good balance of mechanical and chemical properties at a moderate cost.
- It's available in sheet and roll form, suitable for applications like equipment supports, vibration isolation, gaskets, and machinery bases.
- Key physical / chemical specs:
- Shore A hardness: ~60-65.
- Minimum tensile strength: ~510 psi.
- Minimum elongation: ~420%.
- Temperature range: approximately -13 °F to 221 °F.
- Rated as "Good" for oils, acids, outdoors; "Medium" for abrasion.
- Format / size options listed: Plates size ~3'3″ × 3'3″ in thicknesses from 1/16″ to 3″. Sheets ~3'3″ wide by various lengths and thicknesses.
- Noted applications include:
    - Use under machinery for vibration isolation.
    - Contact with greases, oils, hydrocarbons without losing performance.
    - Use outdoors and in varying temperature/conditions; supports low temperature and resists weathering.
        - Compatible with fume hood lab environment conditions
- A NIST-type paper titled "Frictional properties of rubber" shows that rubbers can show very high friction coefficients (ex. ~1 to >4 under certain conditions) depending on speed and contact conditions.

Conclusions/action items:

- Using a neoprene rubber sheet on the bottom of the device to contact the fume hood surface is supported by the material's good grip (high friction) and chemical/resistance durability.
- Choosing thickness in the 3-5 mm range remains reasonable (not explicitly in the sources, but compatible with the product data sheet range and typical usage).
- Ensuring a smooth finish or textured as required may influence friction further (the product listing "Textured Neoprene Rubber" offers a non-slip surface).

2025/10/27 - EOS StainlessSteel 316L

Simon Nam - Oct 31, 2025, 2:12 AM CDT

Sep 18, 2025, 8:28 PM CDT

Title: EOS StainlessSteel 316L

Date: 2025/10/27

Content by: Simon Nam

Present: N/A

Goals: To identify and select additional material for adding weight and structural stability for the base design along with the rubber layer

Link: “EOS StainlessSteel 316L Material Data Sheet Metal Solutions.” Accessed: Oct. 27, 2025. [Online]. Available: https://www.eos.info/ko/var/assets/03_system-related-assets/material-related-contents/metal-materials-and-examples/metal-material-datasheet/stainlesssteel/material_datasheet_eos_stainlesssteel_316l_en_web.pdf

Citation: **https://www.eos.info/ko/var/assets/03_system-related-assets/material-related-contents/metal-materials-and-examples/metal-material-datasheet/stainlesssteel/material_datasheet_eos_stainlesssteel_316l_en_web.pdf**

Content:

Material Overview:

- Type: Austenitic stainless steel alloyed with molybdenum (Mo ≈ 2.25–3 wt%) for enhanced corrosion resistance.
- Meets ASTM F138 (surgical-implant grade 316L).
- Density: ≥ 7.97 g/cm³ → heavy enough to provide stable weight and low vibration.
- Very low defect content (< 0.02 %) → excellent structural integrity.

Mechanical Properties (Typical):

- Yield strength: ≈ 470–550 MPa
- Ultimate tensile strength: ≈ 600–650 MPa
- Elongation at break: ≈ 40–50 %
    - Strong, tough, and ductile → resists deformation while absorbing operational loads.

Thermal & Physical Properties:

- Coefficient of thermal expansion: 15.7 × 10^{-6} / K (25–100 °C)
    - Stable dimensionally under small temperature variations inside fume hood.
- CTE and high density ensure dimensional consistency and vibration damping for precision cutting.
- Chemical & Environmental Resistance:
- Excellent corrosion resistance to chloride, chemical, and humid environments (marine-grade).
    - Ideal for fume hood use where reagents or cleaning solvents are present.
- Compatible with sterilization or washing; retains strength after heat exposure.

Structural Suitability for Base:

- High weight density + surface hardness = non-vibrating, stable support for biopsy cutting motions.
- Maintains flatness and surface finish; can be bonded with neoprene rubber pads for friction without warping.
- Complies with ISO 9001 quality and reproducibility standards.

Conclusions/action items: 316L stainless steel provides mechanical rigidity, chemical stability, and mass density required for a non-slip, corrosion-resistant, and vibration-damped base in lab environments—making it an ideal structural material for the Biopsy Press base design.

2025/11/03 - Effect of Ethanol/Sterlization on Neoprene

Simon Nam - Nov 07, 2025, 3:33 PM CST

Title: Compatibility Studies on Elastomers and Polymers with Ethanol

Date: 11/03/2025

Content by: Simon Nam

Present: N/A

Goals: To validate whether if neoprene rubber for material selection is feasible with the sterlization/autoclaving procedure for the design

Objective of the paper was to evaluate long-term compatibility of elastomers (Neoprene, Nitrile, HNBR, PVC/NBR) and plastics with ethanol-blended fuels (E5 and E10) to understand effects of prolonged ethanol exposure.

Link: https://onlinelibrary.wiley.com/doi/10.1155/2014/429608

Citation: J. S. Dhaliwal, M. S. Negi, G. S. Kapur, and S. Kant, “Compatibility Studies on Elastomers and Polymers with Ethanol Blended Gasoline,” Journal of Fuels, vol. 2014, pp. 1–8, Jan. 2014, doi: https://doi.org/10.1155/2014/429608.

Content:

Appearance:

- In E10 (≈ 10% ethanol), specimens became soft, brittle, and pitted, showing visible surface degradation.
- After drying, neoprene became harder and shrunken, with cracks and material leaching.

Weight / Volume:

- ~100% increase in both weight and volume (ethanol absorption → swelling).
- Significant mass loss on drying → polymer leaching and chemical breakdown.

Mechanical Integrity:

- Completely decomposed after 500 hours in ethanol-rich fuel.
- Tensile strength dropped to zero — sample crumbled during testing.
- Hardness decreased from ~74 → 50 (softened when wet) then over-hardened when dried.

Implications for Ethanol / Sterilization Exposure

- Neoprene shows poor chemical stability under repeated ethanol exposure, especially at elevated temperature and prolonged contact.
- Short contact (e.g., 70% ethanol wipe) is safe for brief disinfection, but repeated soaking or long-term exposure leads to swelling, softening, and eventual embrittlement.
- The degradation mechanism parallels what occurs under repeated IPA or ethanol sterilization—alcohol penetrates and extracts plasticizers, causing volume expansion then shrinkage.
- Under heat or autoclave cycles, similar oxidative embrittlement would accelerate.\

Conclusions/action items:

Neoprene (50–60 A) is acceptable for quick ethanol wipe-downs but not durable for repeated immersion or sterilization cycles.

For devices cleaned frequently with ethanol, IPA, or mild bleach, in the near future we can possibly switch materials such as

- EPDM (resistant to alcohols, peroxides, and steam), or
- FKM (Viton) or Silicone (for repeated sterilization cycles).

2025/11/15 - Effect of Chemical Cleaning on PLA

Simon Nam - Dec 06, 2025, 3:31 PM CST

Simon Nam - Sep 18, 2025, 8:28 PM CDT

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

Date: 2025/11/15

Content by: Simon Nam

Present: N/A

Goals: To understand the effect of detergent cleaning on PLA material for biopsy samples

Link: https://pubmed.ncbi.nlm.nih.gov/32328212/

Citation: J. C. Fleischer, J. C. Diehl, L. S. G. L. Wauben, and J. Dankelman, "The Effect of Chemical Cleaning on Mechanical Properties of Three-Dimensional Printed Polylactic Acid," *Journal of Medical Devices*, vol. 14, no. 1, Feb. 2020, doi: https://doi.org/10.1115/1.4046120.

Content:

- The study investigated 3D-printed PLA tensile specimens made under different printer settings, then subjected them to repeated chemical cleaning / disinfection protocols.
- Treatments included immersion in disinfectant solutions (such as chlorine-based, glutaraldehyde-based) over periods of days or repeated short-cycle exposures.
- Some of the treated PLA samples showed changes in mass — up to +8.3% weight increase in certain batches.
- Mechanical properties also shifted: median tensile strength in some cases increased by ~12.5%, while the largest observed decrease was ~8.8%.
- Stiffness (modulus) varied across treatments: in one set stiffness dropped by ~3.6%, while in others it increased up to ~13.6%.
- The variability in mechanical behavior depends strongly on initial 3D printing parameters (infill, layer adhesion, surface quality) and surface porosity — both of which influence how cleaning/disinfectant penetrates and interacts with the PLA.
- The article conclude that, provided surface porosity is minimized and print quality is high, reuse of disinfected 3D-printed PLA tools may be acceptable from a mechanical standpoint.

Implications for Material-Choice in Device Design (Simple Detergent Cleaning Method):

- Cleaning/disinfection methods (soap/water or other chemicals) can alter PLA's mass and mechanical properties. That means the design must assume some degree of variability if PLA is used.
- The performance of PLA after cleaning is not guaranteed uniform; changes depend on print settings and surface quality. Use conditions must be tightly controlled.
- If aiming for reusable components made from PLA, manufacturing should minimize surface porosity and maximize layer adhesion / print quality to reduce disinfectant penetration and material degradation.
- For single-use or limited-use components, PLA remains viable if cleaned carefully; but long-term or repeated cleaning cycles may lead to unpredictable mechanical behavior; risking very subtle deformation or weakening.
- If the device requires high dimensional stability, rigidity, or precise mechanical performance (such as repeated precise positioning), PLA's variability under cleaning argues for exploring alternate materials or stricter validation after cleaning cycles.

Conclusions/action items:

PLA may survive cleaning with acceptable mechanical integrity if designed and printed with high quality and minimal porosity.

Repeated cleaning and disinfection cycles might introduce variability in strength, stiffness, or dimensions, which could reduce the reproducibility or precision needed for the project

For a biopsy/cutting device, if rigid geometry and consistent behavior are required, PLA might pose a risk unless each part is carefully quality-controlled and perhaps considered for limited-use only.

11/07/25 - Tong Lecture

Simon Nam - Nov 07, 2025, 12

Title: Tong Lecture - Building a Career of Impact

Date: 11/07/25

Content by: Simon Nam

Present: Kristin Myers, BME Class of 2022

Goals: To understand why health care needs more engineers

Content:

-Run towards the hard problems...the ones that change the world

Table of Contents:

Chapter #1: The Foundation - Solve Tangible Problems, work hard, add value

Chapter #2: Climb the Growth Curve - Combine EQ with IQ to multiply impact & reach

Chapter #3: Drive system-level impact through innovation & scale

Quardruple Aim

- Improved Provider Experience

- Improved Patient Outcomes

- Lower Cost of Care

-Improved Patient Experience

https://www.healthsystemtracker.org/chart-collection/health-spending-u-s-compare-countries/?gad_source=1&gad_campaignid=22940294074&gbraid=0AAAAAD-0VUex6BP0pM6TQAy3FpG80O8Xh&gclid=CjwKCAiAzrbIBhA3EiwAUBaUdfWthwzRpLr-OI87won_LGE13drND5l6nP_M_dRGUxbs7wL26slxZRoCYSYQAvD_BwE#Health%20expenditures%20per%20capita,%20U.S.%20dollars,%202023%20(current%20prices%20and%20PPP%

Build an integrated system to enable health and wellness for all

Tip: Work Hard & Build Range

Take on the hardest projects, classes and experiences you can find. Effort and range are your foundation

Seek Diverse Exposure:

Explore different sectors, teams, and goegraphies. Gain perspective and learn how systems connect, not just how they are shaped

Choose your Social Surroundings wisely

Sroround yourself with curious, driven, high-integrity people. They will shape who you become

Know your Values & Protect Them

Define what matters most - family/friends, health, career/impact, values - make decisions that align

Conclusions/action items:

2025/09/17 - Design idea & sketch

Simon Nam - Sep 18, 2025, 9:15 PM CDT

Title: Initial Design idea + sketch

Date: 2025/09/17

Content by: Simon Nam

Present: Simon Nam

Goals: To create a design that is possibly applicable for the project using the client's background resource and objective proposed

Content:

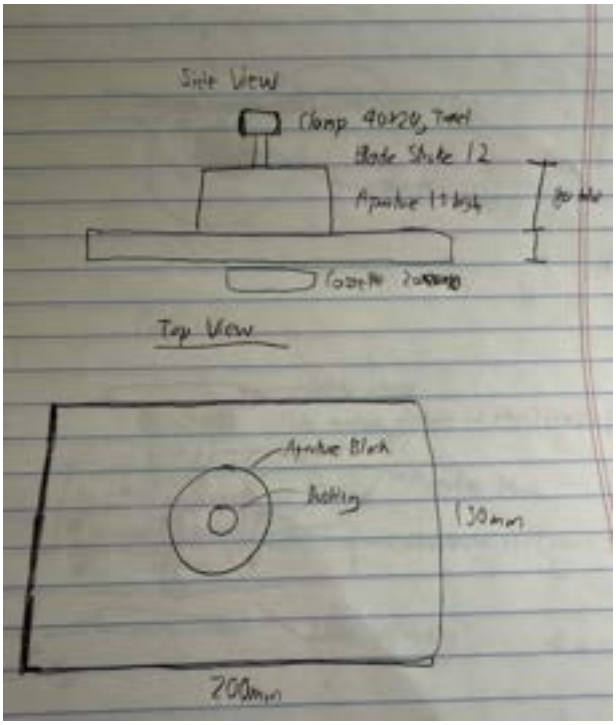


Figure 1: Sketch design drawing (Top & Side made by Simon Nam

Figure 2: Finalized sketch drawing with components labeled by Simon Nam

Summarized description of the Simon's design & functionality:

- Base Plate – stainless steel foundation for stability and sterilization.
- Cassette Tray – collects trimmed biopsy samples.
- Aperture Block – holds bushings, aligns the tissue.
- Bushing – interchangeable inserts for different biopsy diameters.
- Clamp Pad – applies controlled force to stabilize tissue.
- Blade Carriage – guided stroke holding the cutting blade.
- Safety Shield – transparent guard with interlock for operator safety.

Where the biopsy sample goes:

- The pigskin biopsy core (or human biopsy equivalent) is inserted vertically into the central bore of the bushing, which sits inside the aperture block.
- The chamfered entry at the top of the bushing helps guide the cylindrical tissue into place.
- Once seated, the sample rests against the retention lip (bottom of the bushing), preventing it from slipping out before cutting.

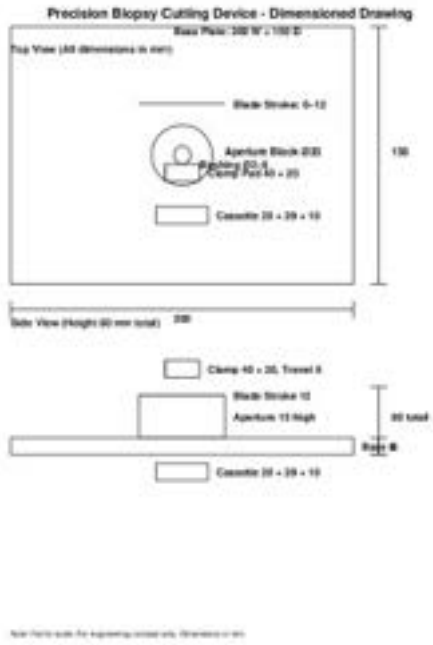
- The clamp pad is then lowered from above to hold the biopsy steady in the bore without crushing it (target clamp force: 0.5–1 N).
- The blade carriage then shears across the top surface of the bushing/aperture block, making a clean transverse cut.
- The trimmed piece of tissue falls through the bottom opening into the cassette tray for collection.

Mechanism flow of the sample during operation:

1. Load sample → biopsy inserted into the bushing bore.
2. Secure sample → clamp pad lightly presses the tissue to prevent wobble.
3. Cut sample → blade sweeps down across the top face of the aperture block.
4. Collect sample → cut section drops into cassette tray below for retrieval.

Conclusions/action items: Present the idea to the rest of the team members and discuss the potential 3 choices for the creation of Design Matrix deliverable that is due next week. Incorporate some of the design's function/mechanism with other members' ideas for possible integration.

Simon Nam - Sep 18, 2025, 8:59 PM CDT



Download

biopsy_cutter_dimensioned.pdf (2.35 kB)

2025/10/8 - Notes from client meeting about final design

Simon Nam - Oct 10, 2025, 9:39 AM CDT

Title: Notes from client meeting about final design (Biopsy Press)

Date: 10/8/2025

Content by: Simon Nam

Present: Biopsy Badger team members, Dr. Gibson, Bailey, Grace from medTECH

Goals: To organize certain criterias and feedbacks recieved from the clients about the final design modifications

Content:

Feedback Highlights:

- Uneven compression issue due to biopsy thickness variation — suggested reducing wells from 4 → 2.
- Blade slit too long — shorten for better control and safety.
- Current prototype fits #22 surgical blade, which is preferred but may be costly; explore razor blade alternative.
- Add handle for safer razor blade use (Ella's suggestion).
- Increase well diameter to 13 mm to fit 12 mm biopsy punches.
- Increase hole depth to ~10 mm for better sample stabilization and compression.

Additional Comments:

- Dr. Gibson emphasized the need for a slicing (not squishing) motion.
- Surface area of base aids stability; consider resizing for ease of use.
- Razor blades are available in the lab; Bailey can provide 12 mm biopsy punches.
- Grace can supply #22 blades from the anatomy lab.

Next Steps:

- Revise CAD model with feedback (reduced wells, adjusted slit, larger/deeper holes).
- Reprint updated design next week.
- Test with styrofoam or clay before using tissue samples.
- Pick up materials and sample tools from Bailey next week.

Overall Outcome:

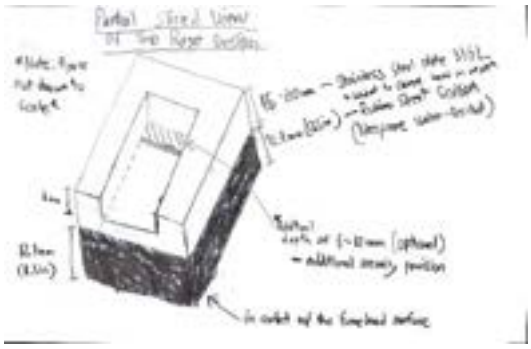
- Client satisfied with progress and direction.
- Final prototype fabrication and testing to begin following material pickup.

Conclusions/action items: Initiate on fabrication of the final design after collecting necessary materials and tools from the clients and Grace

2025/10/22 - Base Design Initial Sketch

2025/10/29 - Base Design Sketch Update

Simon Nam - Oct 31, 2025, 2:12 AM CDT



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base_design.pdf (474 kB)

2025/09/6 - CITI Program Training Certificate(s)

Simon Nam - Sep 12, 2025, 11:14 AM CDT

Download

citiCompletionReport_13837589_65815633.pdf (78.7 kB)

Simon Nam - Sep 12, 2025, 11:14 AM CDT

Download

citiCompletionCertificate_13837589_65815633.pdf (77.2 kB)

2014/11/03-Entry guidelines

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

John Puccinelli - Nov 03, 2014, 3:20 PM CST

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items:

2025/00/00 - Template for Research*

Simon Nam - Sep 18, 2025, 8:44 PM CDT

Simon Nam - Sep 18, 2025, 8:28 PM CDT

Title:

Date:

Content by:

Present:

Goals:

Link:

Citation:

Content:

Conclusions/action items: