BME Design-Fall 2025 - RENEE SOBANIA
Complete Notebook

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Team contact Information

EVELYN OJARD - Sep 19, 2025, 11:36 AM CDT

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Comments

Randolph Ashton Sep 19, 2025, 11:28 AM CDT

Feel free to add you client and advisor information.

Project description

EVELYN OJARD - Sep 19, 2025, 11:32 AM CDT

Course Number: BME 300/200

Project Name: Paracervical Block Training Model

Short Name: PBT Model

Project description/problem statement:

A paracervical block (PCB) is a medical procedure which consists of injecting the tissue where the vaginal wall meets the outer part of the cervix, the cervicovaginal junction, with lidocaine in
four locations; 2, 4, 8, and 10 o'clock. This procedure is done to reduce pain during intrauterine device (IUD) insertion and other gynecological procedures. Many women have to endure the
procedure without the help of a PCB, or only have access to other less effective methods because of limited provider training and lack of realistic affordable models to practice on. Current task
trainers that are used to practice IUD insertions typically do not have a cervicovaginal junction, which is making these models less realistic as you are unable to practice a paracervical block. This results in fewer providers learning proper PCB technique and thus more patients who are unable to have access to this procedure.

Our team is tasked with creating a realistic, reproducible, and low cost model that includes a realistic cervicovaginal junction to simulate PCB injections to train healthcare professionals to make this procedure more accessible. Creating an anatomically accurate model with materials that better simulate the mechanical properties of the female reproductive tissues by having a needle insertion resistance of 1.09N, and elasticity of 1.94 kPa/mm. This will allow providers to practice needle placement, injection, and IUD insertion in a supervised safe learning environment. Ultimately, our goal is to improve provider access to learning the PCB procedure and expand patient access to pain management in women's healthcare.

About the client:

The client, Dr. Jessica Dalby, is a family medicine doctor at UW health as well as an associate professor in the department of family medicine and community health. She frequently performs and teaches IUD insertions and is seeking a more accurate training model for paracervical blocks to better teach students the procedure.

Comments

Randolph Ashton Sep 19, 2025, 11:29 AM CDT

Update with your latest Problem Statement from your Progress Report #2

9/12 Initial Client Meeting

NORA LORENTZ - Sep 12, 2025, 2:06 PM CDT

Title: Initial Client Meeting

Date: 9/12

Content by: Nora

Present: All

Goals: Meet with our client to better understand her goals, success criteria, budget, and constraints.

Content:

- She's a professor in family medicine and works in family medicine, works with a lot of gyneocology-related

- Residents trained to place IUDs every year, push right now for better pain management during IUD placements

- Current training model is Roma tomato in a condom, stretched over a dixie cup (dixie cup and condom model vagina) (tomato is uterus). Syringe w needle and lidocaine, practice like tomato is cervix. Easy, accessible, cheap. But may not really demonstrate "feel" of paracervical block.

- Needle in paracervical block should be alongside cervix, not inside uterus

- What she's looking for: something fairly easy to build and replicate. So components could be household-items/can find in a store, but could also work to have designed models for her to use year-after-year in teaching. She would be happy either way.

- Need: 10 models not easily reproducible, or just a model she can make with over the counter things

- Trains large groups (10-20) residents at once, so would need approx. 10 models

- Budget: a few hundred is good, past $500 would need more justification

- Price per model: currently $1.50, she wants it to be fairly inexpensive so below $50, potentially up to $100

- If model involves specialized skills (i.e. 3d printing), we should make all 10 of them

- Aim for: about the right size, some similar visual characteristics, "feel" is more important than perfect replica of human body. Feeling: are you in the right place, how deep, etc.

- To show an error, you could simply visually check where needle is. Does not need to be super fancy. Make sure they know to not inject in a vessel (NOT necessary but model could involve blood vessels to aspirate from if in the wrong place)

- Current feedback from model is that it's fairly good and does a good job simulating block injection into cervix, not good at mimicking paracervical block

- Only IUD specific paracervical block

- Practice IUD insertion in the model as well

- For current model, she goes through all the steps and mimics troubleshooting IUD. Simulating if they need dilators, placing IUD, hiding strings, looking at taking it out w no strings, etc.

- Model should be flexible along o'clock positions (if there is a "right" way, 2, 4, 6, 8)

- Currently she has the students build their own model at conferences and just passes out supplies, but if it was fancier she would have prebuilt ones

- No preference between which way we do model (prebuilt versus reproducible)

- Wants residents to focus on the technique using visual landmarks (MOST IMPORTANT). Depth is SECOND most. Feel is THIRD.

- Likes model to replicate looking for landmarks through small speculum window

- Teaching a conference in a few weeks, could have someone observe current model and how its taught. SEPT 23, at Community classroom in clinic 1102 south park street, at around 11-11:30 will confirm times later.

- UW has a simulation center (she hasn't used) and she assumes they have some things for us to look at. We could reach out there for gynecologic task trainer model.

- She will look in clinic for realistic models.

- Her times going forward to meet: 1:30 at fridays, even a little earlier since she has to leave at 2. We established that we would keep 1:30 time.

- Further into the semester, could meet in person to go through the feel etc.

- SUMMARY: she will see in clinic for cervix models, she will nail down times for upcoming training, and a picture of the current tomato/dixie/condom model.

Conclusions/action items:

During our first meeting with the client, we learned a lot about her current model and how she uses it with her resident students. She gave us two pathways to look at moving forward: an easily reproducible model she can replicate, or designing ten models using more specialized design processes. She also gave us price ranges, requests for things to focus on, and more details for us to look at.

- Each team member will create a design by Wednesday.

- Each team member should continue researching further.

10/10 Final Design Discussion

NORA LORENTZ - Oct 10, 2025, 1:44 PM CDT

Title: Final Design Discussion

Date: 10/10

Content by: Nora

Present: All

Goals: To share our final design with our client to make sure it satisfies all her requirements, and to see if she has any advice or requests.

Content: (underlined - things to work on with final design)

- Asked her about design matrix and slideshow, she said she looked through the report and other documents, but it was unclear how to interpret the matrix.

- Said current final design idea sounds great! Client liked that all her most important goals were hit (i.e. tenaculum to grab cervix, CV junction, and potential for IUD placement.

- Something to work on: <u>if people are using water to inject (though can inject nothing), wondering where water would go?</u>

    - Water would likely go outside model or into uterus if injected deeply, but we will have to figure that out once we are further along with fabricating the model.

- Client says <u>it would be nice for cervix to move somewhat when tenaculum is attached</u>. If possible, would like to replicate this. For example, tenaculum is used to straighten uterus, change visibility, etc.

    - Will likely be more of a future work goal.

- For ordering materials, send client's financial person an itemized invoice.

    - Many of our materials (ex. wood and PVC) will be bought from vendors who work with ShopUW+.

    - They can pay with department credit card, check, interdepartmental transfer, etc. as long as we pass invoice along.

- We can reach out to the client and set up a time to look at the model and have her check it for accuracy.

Conclusions/action items:

The client liked our final design and said it hit many of her most pressing requests. She had a few questions regarding the model and payment, which we will have to look into going forward. Model-wise, we will look into where the injections go and the tenaculum-cervix interactions. The team feels ready to continue moving forward and progressing with our final design.

- Look into the areas that our client had questions and requests about

- Begin ordering materials within the next 1-2 weeks

- Email Pucinelli regarding invoice/paying for materials. Look into how money should/can be transferred

10/17 Materials/Ordering Consult

NORA LORENTZ - Oct 17, 2025, 1:39 PM CDT

Title: Materials/Ordering Consult

Date: 10/17

Content by: Nora

Present: All

Goals: To discuss our ordering plans and materials with our client to make sure we are on the same page.

Content:

Q: We currently have list of everything to be purchased, should we order enough for one model and then order the rest when we know it works, or order all at once? A: unclear

- Explained the spread sheet to her, and the ordering system.

- She will have to run questions through her finance person

- Shared cost estimate (depends on if she wants 10 fresh models or add components onto her old models). She would prefer 10 new models. Cost estimate 1 model: $110. 10 models: $181.

- Proposed the idea of waiting to purchase ecoflex for her to test properties (via practicing injections etc). (Tues and Thurs best for her)

Conclusions/action items:

During our meeting with our client, we were able to explain the ordering process and spreadsheet system to her. There are a few questions we/her will have to clear up with professors/financial people before we can fully begin the process. We will coordinate with her in the future to set up a date to test our materials for accuracy.

- Begin ordering materials by sending her the shopping list

- Set up time to test materials

10/31 - Initial Review

EVELYN OJARD - Dec 10, 2025, 9:25 AM CST

Title: Initial Review

Date: 10/31

Content by: Evelyn

Present: Evelyn and Renee

Goals: Review with our client the initial model.

Content:

make the opening of the cervix wider so that the IUD can fit in --> research on IUD diameter

the cervix feels accurate to what it is like to inject into

funnel shape instead of a flat shape, so that the cervix is more hidden. to help teach residents how to really use the tenaculum to visualize the cervicovaginal junction

double the thickness of the cervicovaginal junction

Conclusions/action items: Work with the team to come up with different design ideas for the cervix

11/18 - First Prototype Review

EVELYN OJARD - Nov 18, 2025, 12:12 PM CST

Title: First Prototype Review

Date: 11/18

Content by: Evelyn

Present: Evelyn, Ellie, and Renee

Goals: Review our current prototype

Content:

Shorten the pipe so that when you insert the speculum, the edges sit around the cervix

Make the cervix dimensions a little smaller to better reveal the junction

- the length is fine but we want the dimensions of the actual cervix smaller and less perfectly circular

Change the uterus so that when you inject there is an area for it

Adjust stiffness of uterus

make uterus bigger

Conclusions/action items:

RENEE SOBANIA - Dec 10, 2025, 1:32 PM CST

Conclusion/ action items:

The uterus should be adjusted as well as the cervical dimensions.

9/12 - Initial Advisor Meeting

EVELYN OJARD - Sep 12, 2025, 1:18 PM CDT

Title: Initial Advisor Meeting

Date: 9/12/2025

Content by: All

Present: All

Goals: Have our initial meeting with Dr. Ashton

Content:

Progress Report:

good content but add Gantt chart

Problem statement and PDS will get better defined and sets up the quantitative benchmarks

The second paragraph might change and add more quantitative information (i.e. injection warnings and mechanical properties)

problem statement will become more engineering focused

Design Notebooks:

- graded each week
- next weeks grade will count for this and last week

Question Help:

why is it hard to do the injections?

should we account for each clinician's different methods?

is there a way/do they want us to have a red light if they do it wrong?

The pressure needs to be similar to the pressure applied to a human. Is it variable? How much does it vary?

what material's can she provide? tenaculum, etc

Conclusions/action items:

RENEE SOBANIA - Dec 10, 2025, 1:33 PM CST

Conclusion/Action items: Make appropriate changes to the PDS.

9/19 - Post PDS Meeting

RENEE SOBANIA - Dec 10, 2025, 1:36 PM CST

Title: Meeting 2

Date: September 19th, 2025 * edited 12/10/25

Content by: Renee Sobania

Present: PBTM Group

Goals: Discuss our progress with Professor Ashton.

Content:

- Anatomical realistic
- Important not to go too deep, that should be a focus of the design.
- Safety might be important for design matrix
- What is important to our design is what should be in the matrix?
- Nice sketches, LABEL THINGS
- Visual landmarks? Names be specific.
- Cost should be less than 50$ per model
- Reproducible? How?
- Criteria should be quantitative!!

Conclusions/action items:

In conclusion, we discussed some important aspects our design should include.

9/26 Design Matrix Meeting

RENEE SOBANIA - Sep 26, 2025, 1:36 PM CDT

Title: 9/26 Design Matrix Meeting

Date: September 26th, 2025

Content by: Renee Sobania

Present: Paracervical Block Team

Goals: to get advice on our design matrix to make any improvements or changes and to hear any concerns he has about it.

Content:

- Think about the weight for the task trainer. How can we prevent it from tipping when inserting the speculum, models etc.
- Ask if it is currently tipping due to the force
    - potentially using sand and water to weigh down the base of the task trainer.
- Presentation: labels, describe the anatomy
- Change to procedurally realistic
- Talk to CAD about 3D printing
- Current model would be great for show and tell.
- Real diagram with labels
- Background should be why we are doing the project, what the procedure is and how it is normally done, talk about the procedure and anatomy at the same time.
- material properties for cervicovaginal junction. Similar thickness? How can we mess it up?
- Challenges are molding, design first and extra time add in a way to tell if they have inserted the needle wrong/ too far.
- Should be realistic in material sense, hits price point
- Order materials ASAP - buy enough so you can mess up a few times.

Conclusions/action items: In conclusion, we got some advice on changes we should make to the design and some tips for the preliminary presentation.

10/10 - Post Presentation Meeting

EVELYN OJARD - Oct 10, 2025, 1:14 PM CDT

Title: Post Presentation Meeting

Date: 10/10/2025

Content by: All

Present: All

Goals: Talk with Dr. Ashton about our presentation and purchasing materials

Content:

- Discussed our presentation and current design
- Discussed how to go about purchasing materials and logistics
- Advised us to get our initial design accomplished and then add extra components if we have time

Conclusions/action items:

RENEE SOBANIA - Dec 10, 2025, 1:38 PM CST

Conclusion/Action items: Think about how to make improvements based on presentation feedback.

10/17 - Initial Fabrication

EVELYN OJARD - Oct 17, 2025, 1:20 PM CDT

Title: Initial Fabrication

Date: 10/17

Content by: All

Present: All

Goals: Show him our initial 3D printed pieces for the model

Content:

Show him our 3D printed pieces to help have actual visuals for our model

Described how we made our list of purchasing --> make sure we keep track of receipts

Testing to show the biomimicry of ecoflex using MTS Testing --> talk to puccinelli about scheduling testing

Do measurements in sufficient quantities for stats

Conclusions/action items: Continue purchasing process and prototyping

11/4 - First Official Prototype

EVELYN OJARD - Nov 14, 2025, 1:26 PM CST

Title: First Official Prototype

Date: 11/14

Content by: Evelyn

Present: Ellie, Abigayle, Renee, and Evelyn

Goals: Talk through our current progress and first prototype

Content:

Showed our current model and talked him through all the components

Talked him through our progress from the last few weeks:

- MTS Testing
- Current Model
- Meeting with our client during Show & Tell

Conclusions/action items: Continue working on making final prototypes

Files provided by client

EVELYN OJARD - Dec 10, 2025, 11:25 AM CST

Title: STL Files provided by client

Date: 09/10

Content by: N/A

Present: N/A

Goals: Download and review the clients provided by our client

Content:

Files attached below.

Conclusions/action items: 3D print these files.

EVELYN OJARD - Dec 10, 2025, 11:25 AM CST

Download

uterus_2_.stl (127 kB)

EVELYN OJARD - Dec 10, 2025, 11:25 AM CST

Download

connecting-ring_2_.stl (49.7 kB)

EVELYN OJARD - Dec 10, 2025, 11:25 AM CST

Download

cervix_3_.stl (89.4 kB)

Modify the Cervix

EVELYN OJARD - Dec 10, 2025, 11:29 AM CST

Title: Modify the Cervix to include the cervicovaginal junction

Date:

Content by: Evelyn and Renee

Present: Evelyn and Renee

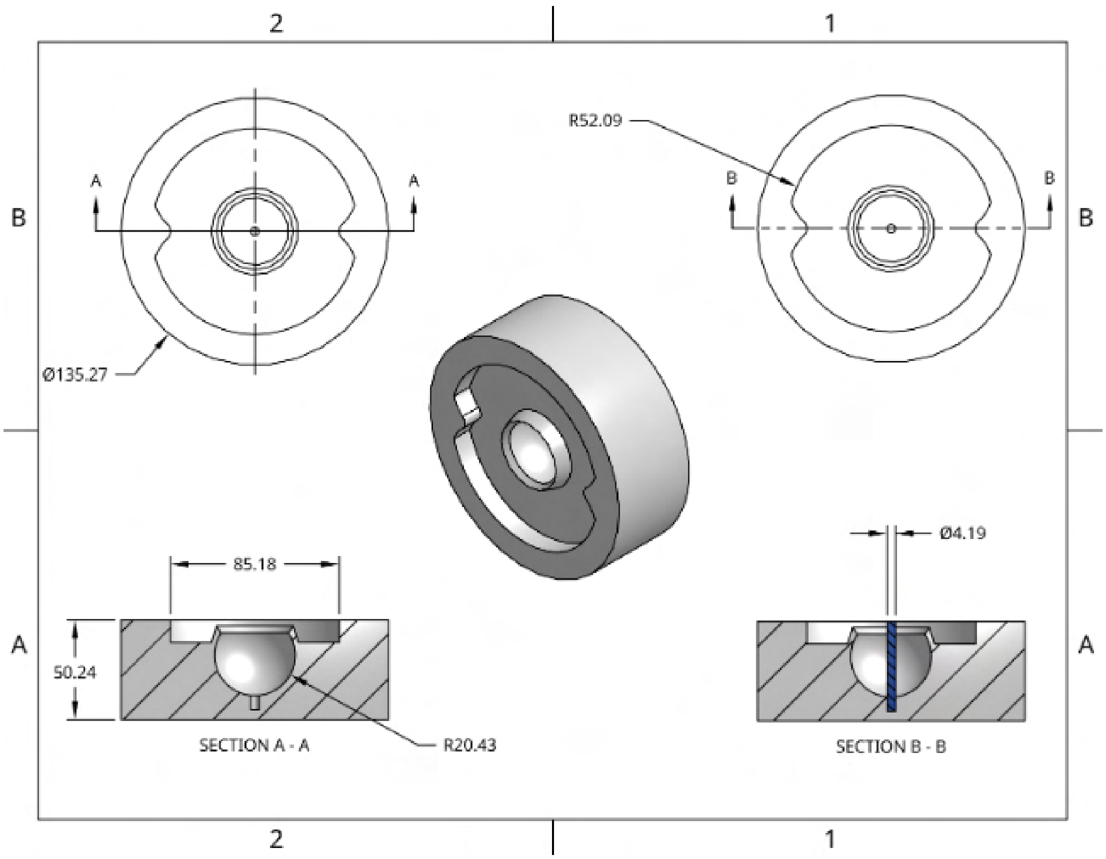
Goals: Work with Jesse Darley to create a cervicovaginal junction to the cervical mold.

Content:

We met with Jesse Darley to discuss how to modify the current mold provided by our client to include a cervicovaginal junction.

Discussed multiple options for molds.

He guided us through how to upload the file to onshape and rework the geometry.



Conclusions/action items: 3D Print the new mold and then cast in silicone.

Vaginal Mold

EVELYN OJARD - Dec 10, 2025, 11:34 AM CST

Title: Initial Vaginal Mold

Date:

Content by: Renee

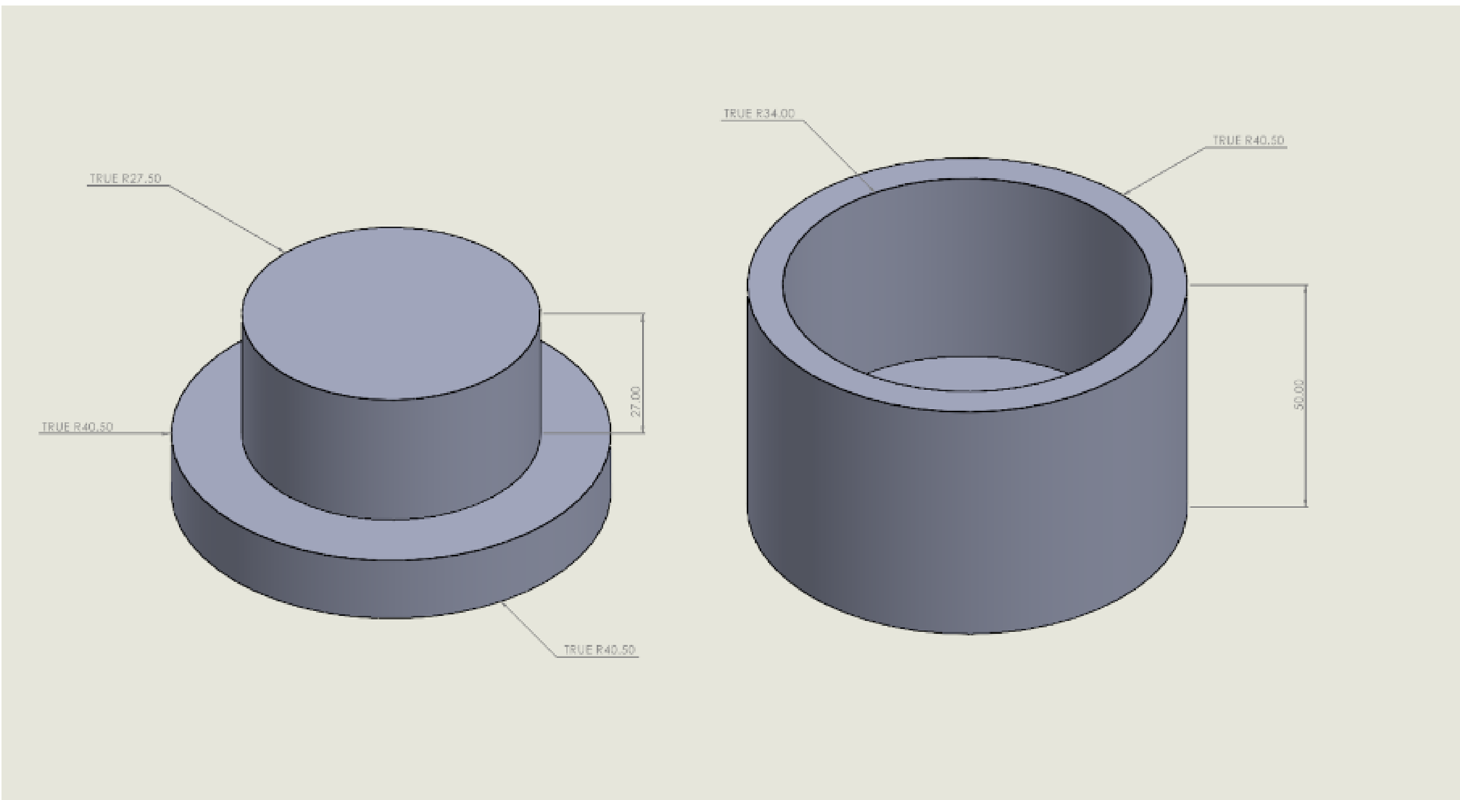
Present: N/A

Goals: Create a vaginal opening mold to place on the charlotte pipe.

Content:

Created a two-part mold to fabricate the vaginal opening, which will be cast in Ecoflex-002.

Consists of an inner portion to push the silicone around to create a sleeve that holds the vaginal opening to the pipe.



Conclusions/action items: Cast the mold with silicone.

Extended vaginal walls from cervix.

EVELYN OJARD - Dec 10, 2025, 11:37 AM CST

Title: Extend vaginal walls from the cervix

Date: 11/7/25

Content by: Evelyn

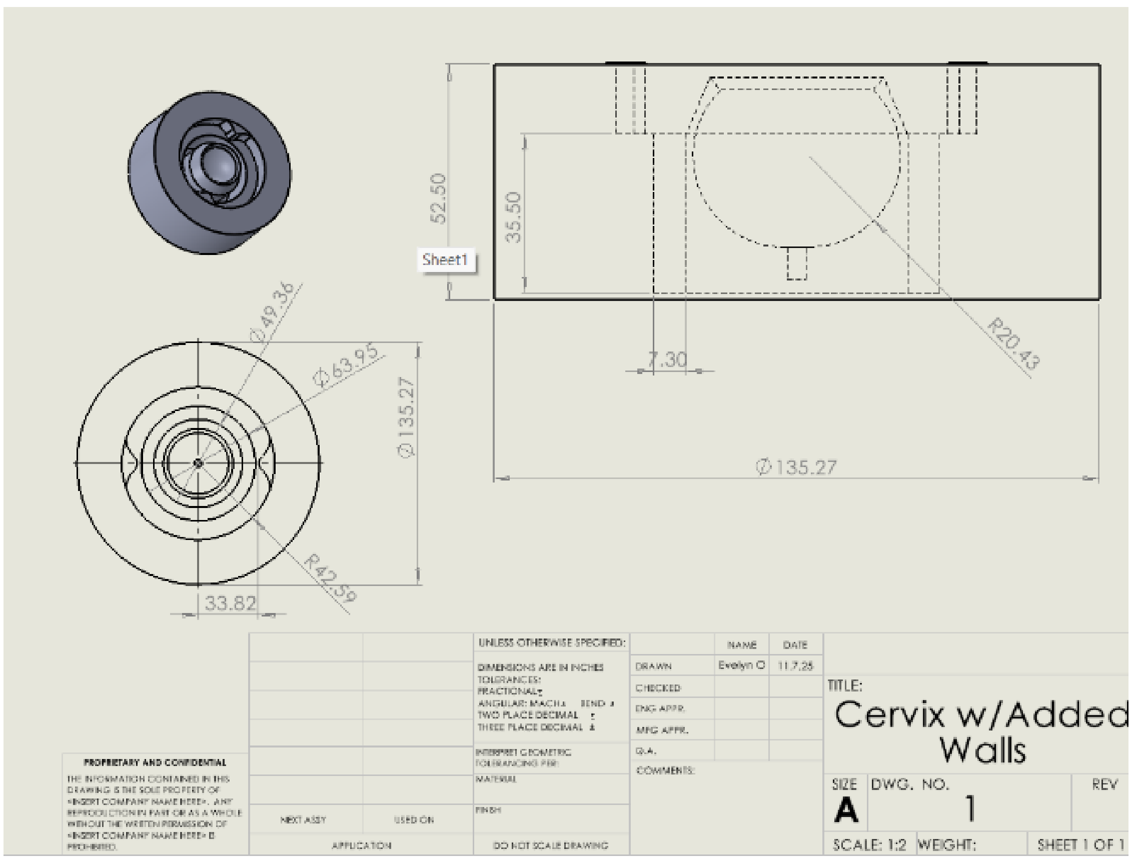
Present: Evelyn

Goals: Modify the cervical mold based on client feedback to extend vaginal walls for anatomical reality.

Content:

After initial meeting with client to show her all current prototypes, she commented that to better mimic the shape of the cervix the vaginal walls needed to be snugger to the sides of the cervix.

Met with the team to discuss ideas to fix this issue. Moved forward with just extending walls from our current mold rather than modifying the entire thing.



Conclusions/action items: Cast in mold and review it with our client.

Cervical shape change

EVELYN OJARD - Dec 10, 2025, 11:40 AM CST

Title: Cervical shape change

Date: 11/31

Content by: Evelyn

Present: Evelyn and Renee

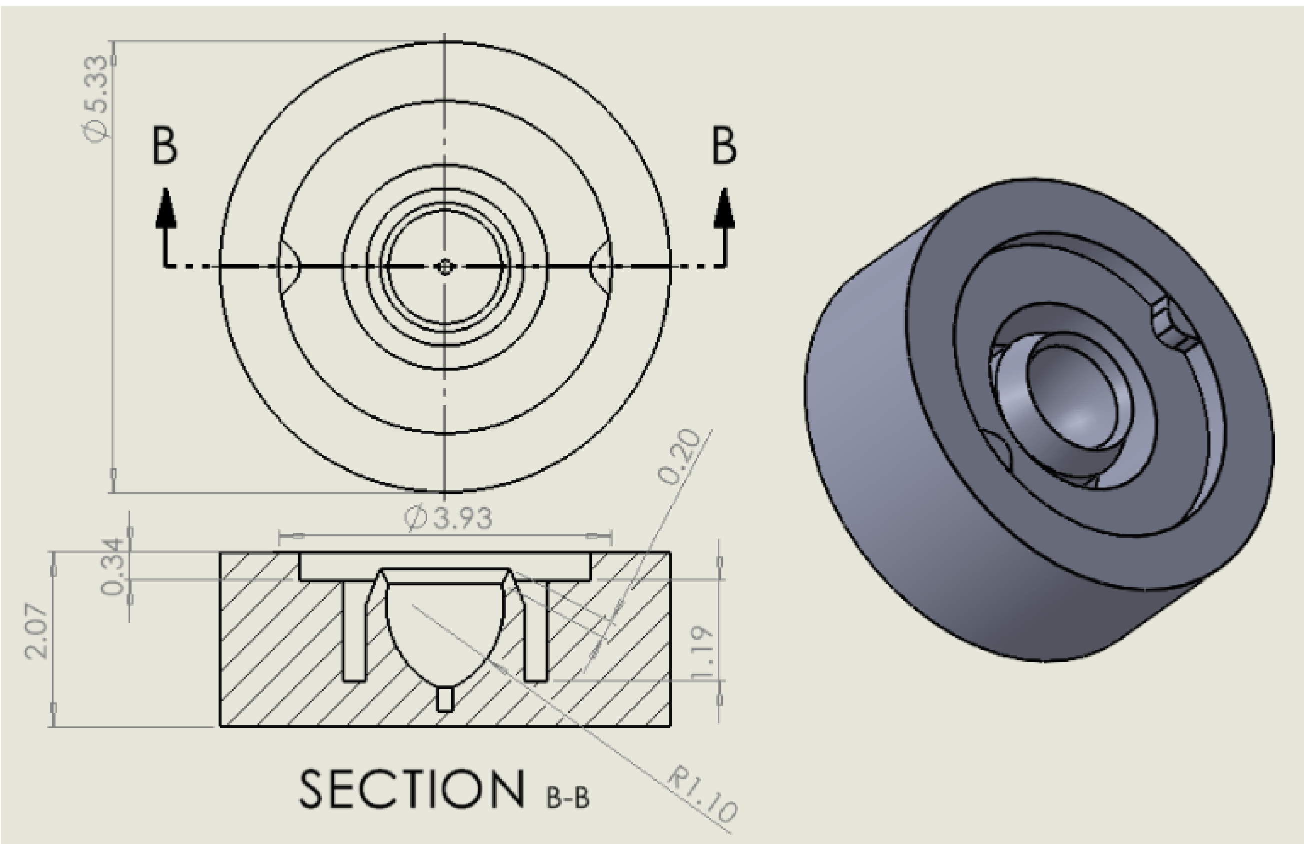
Goals: Modify the cervix based on comments from our client.

Content:

Comments from our client included:

Modifying the shape of the cervix to be more elliptical, as well as increasing the width of the cervicovaginal junction so that it can be better visualized.

She said that it was difficult to move the cervix with the tenaculum enough to visualize the junction.



Conclusions/action items: Cast in silicone and receive feedback from client.

Charlotte Pipe

EVELYN OJARD - Dec 10, 2025, 11:44 AM CST

Title: Charlotte Pipe

Date: 11/31

Content by: Evelyn

Present: Evelyn and Renee

Goals: Modify the length of the charlotte pipe (vaginal canal) so that the clinical tools used during training can be used

Content:

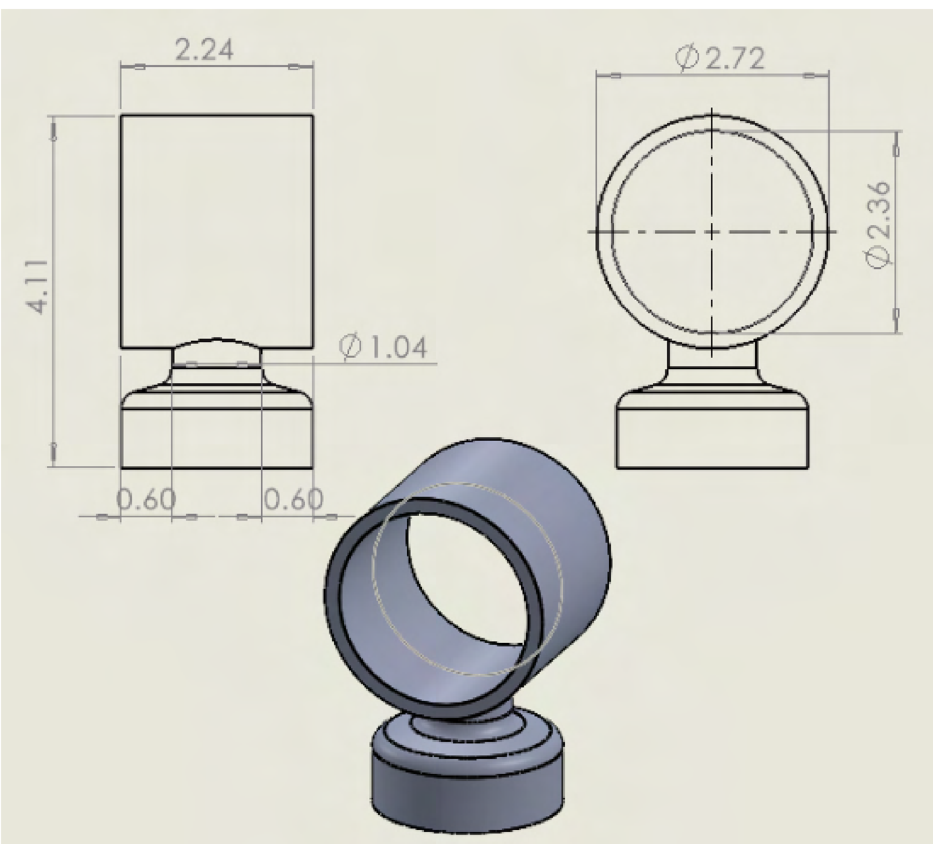
Client comments:

She said it was challenging to place the speculum in the correct position and near impossible to reach the cervicovaginal junction with the materials used, --> lacked anatomical accuracy.

asked us to create a new Charlotte pipe that maintained the exact width but reduced the length.

Design process:

- created a new Charlotte pipe that reduced the length as well as the width at the neck of the pipe to ensure that the connecting piece and vaginal opening still had room to be placed on either side. Made sure that the width at the bottom still remained the same so that it could still be used with our current PVC pipe that acted as the base and repurchasing other materials would not need to be done.



Conclusions/action items: Print and validate with our client that the materials are still usuable.

Vaginal Opening Mold Modifications

EVELYN OJARD - Dec 10, 2025, 11:47 AM CST

Title: Vaginal Opening Mold Modifications

Date: 11/31

Content by: Renee

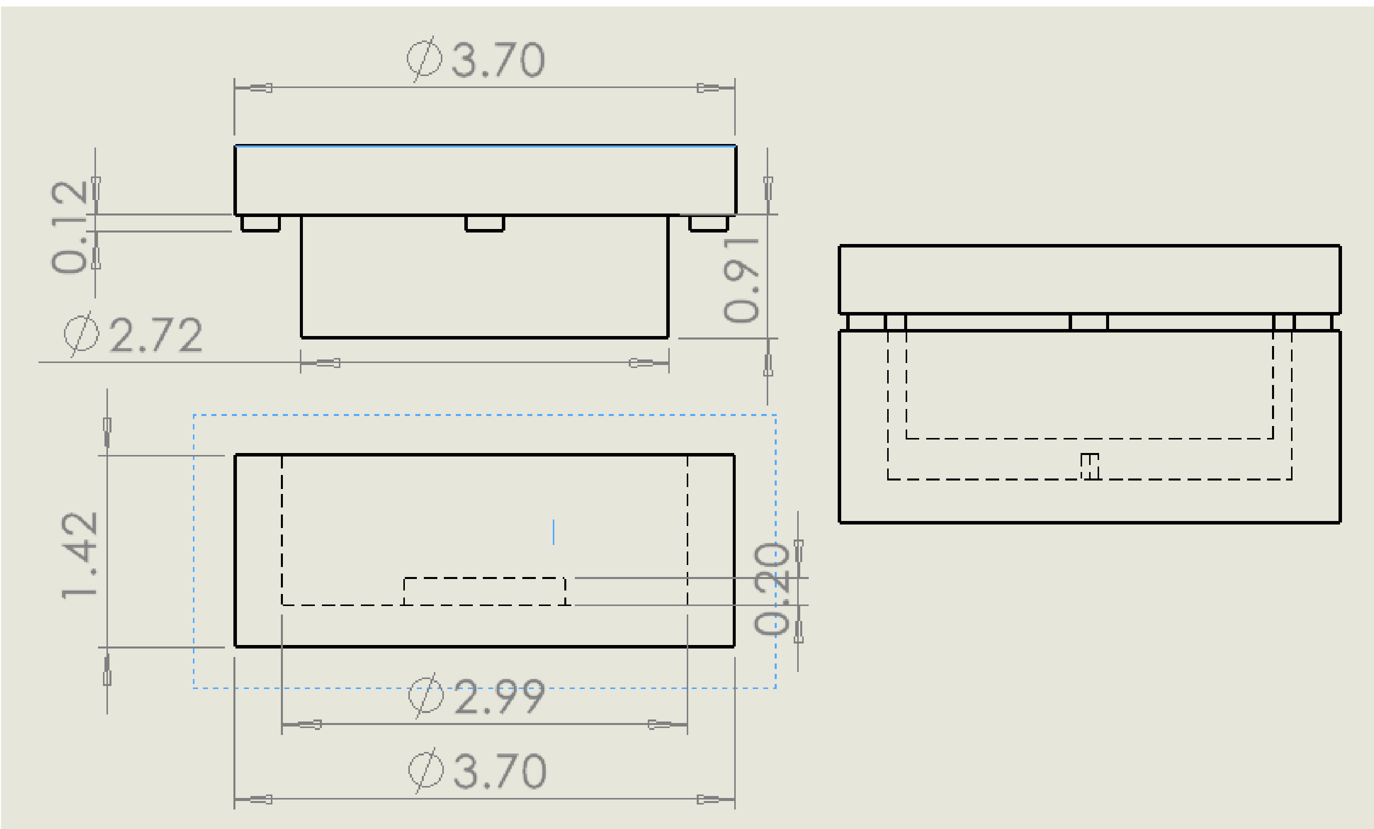
Present: Evelyn and Renee

Goals: Modify the vaginal opening dimensions

Content:

adjusted the vaginal opening mold to improve its geometry and increase its length so that it was more stable on the pipe and would not risk being pulled off during speculum removal.

also incorporated the vaginal opening directly into the mold to improve consistency in the size of the opening,



Conclusions/action items: Cast in silicone and ensure it still fits on Charlotte pipe.

Uterus Modification

EVELYN OJARD - Dec 10, 2025, 11:49 AM CST

Title: Uterus Modification

Date:

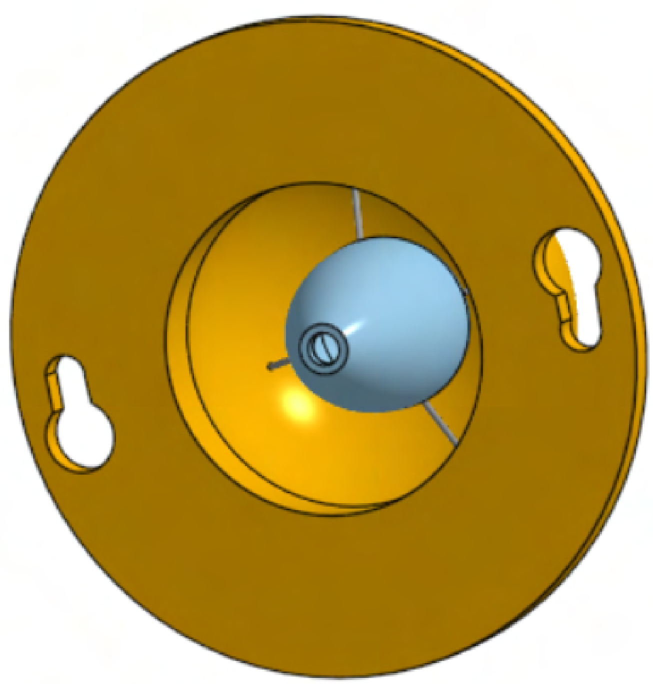
Content by: Evelyn

Present: Evelyn and Renee

Goals: Modify the uterus to include an internal component that has a more anatomically accurate shape while still maintaining the outer shape to collect water when injected.

Content:

The team developed a SolidWorks model of a potential design that incorporated a more anatomically accurate internal section based on a current IUD insertion model. However, this model failed to 3D print using the intended material of ClearV5. Although it was able to print in PLA, the supports that required for a successful print were unable to be removed without also removing the supports that had been included in the design; the supports also filled the interior portion and rendered the interior portion unusable.



internal shape mimicked from:

Conclusions/action items: Attempt to modify the entire uterus shape to create this model

BPAG Spreadsheet

Cadence SEYMOUR - Dec 10, 2025, 10:10 AM CST

Title: BPAG Spreadsheet

Date: 12/09/2025

Content by: Cadence Seymour

Present: N/A

Goals: The goals for the spreadsheet are to track the finances of our group throughout the semester. As the BPAG, I intended to keep track of everything we purchased through both the client and makerspace, and add it all up in the spreadsheet to monitor our budget throughout the semester.

Content:

https://docs.google.com/spreadsheets/d/10vnKeYtF-GGpaNh5TeKckwvFz5Igfgr63E31MT7JfRo/edit?usp=sharing

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	QTY	Cost Each	Total	Link
Category 1										
3D Printed Proto	Preliminary prototype of mold fo	Makerspace	PLA basic	N/A	N/A	10/16/2025	1	$8.39	$8.39	
3D Printed Proto	Preliminary prototype of mold fo	Makerspace	PLA basic	N/A	N/A	10/16/2025	1	$5.10	$5.10	
3D Printed Dog E	MTS testing dog bone mold	Makerspace	PLA basic	N/A	N/A	10/30/2025	1	$3.21	$3.21	
3D printed Proto	Prototype of Uterus (clear)	Makerspace	PLA basic	N/A	N/A	11/05/2025	1	$20.27	$20.27	
Wood Sheet	Plywood sheet 1/4 in 28x36	Makerspace	N/A	N/A	N/A	11/04/2025	1	$7.50	$7.50	
3D printed proto	Preliminary prototype	Makerspace	PLA basic	N/A	N/A	11/04/2025	1	$1.59	$1.59	
3D printed proto	Vaginal openeing prototype mol	Makerspace	PLA basic	N/A	N/A	11/05/2025	1	$1.92	$1.92	
rinted Prototype	2nd cervix mold prototype	Makerspace	PLA Basic	N/A	N/A	11/07/2025	1	$3.81	$3.81	
3D Printed proto	new connecting piece	Makerspace	PLA basic	N/A	N/A	11/12/2025	1	$0.94	$0.94	
3D printed proto	New cervix mold	Makerspace	PLA basic	N/A	N/A	11/12/2025	1	$3.71	$3.71	
3D printed proto	New vagina opening mold	Makerspace	PLA basic	N/A	N/A	11/17/2025	1	$1.89	$1.89	
3D printed proto	New Uterus mold	Makerspace	clear v5	N/A	N/A	11/22/2025	1	$22.31	$22.31	
3D printed proto	New cervix mold	Makerspace	PLA Basic	N/A	N/A	11/20/2025	1	$6.44	$6.44	
3D Printed proto	New cervix mold	Makerspace	PLA basic	N/A	N/A	12/01/2025	1	$1.59	$1.59	
3D printed proto	New uterus mold	Makerspace	PLA basic	N/A	N/A	12/01/2025	1	$1.39	$1.39	
3D printed proto	New connecting piece	Makerspace	PLA Basic	N/A	N/A	12/02/2025	1	$3.80	$3.80	
3D printed proto	New run of the new uterus	Makerspace	PLA basic	N/A	N/A	12/02/2025	1	$3.20	$3.20	
3D printed proto	New vaginal opening mold	Makerspace	PLA basic	N/A	N/A	12/02/2025	1	$1.13	$1.13	
rinted prototype	New connecting piece	Makerspace	PLA basic	N/A	N/A	12/04/2025	1	$0.76	$0.76	
								Category 1 Total:	**$80.64**	
Category 2										
Tubing	Charlotte pipe coupling 1.5" x 2"	N/a	01020600HD	Homedepot	472476	10/23/2025	10	$1.59	$15.90	https://www
Tubing	Hub increaser/reducer PVC pipe	N/a	PVC0711206(	Homedepot	193844	10/23/2025	1	$7.32	$7.32	https://www
Ecoflex	Ecoflex 00-20	N/a	N/a	Smooth-On	N/a	10/23/2025	3	$32.43	$64.86	https://shop
Tubing	PVC DWV All Hub Sanitary Redu	N/a	PVC0240064!	Homedepot	74323400	10/23/2025	10	$6.28	$62.80	https://www
Adhesive	Gorilla construction adhesive – 1	N/a	801000300	Homedepot	10013781500	10/23/2025	1	$9.98	$9.98	https://www
Adhesive	Hook and loop tape with adhesi	N/a	90277B	Homedepot	23953600	10/23/2025	1	$20.93	$20.93	https://www
Ecoflex Coloring	Ecoflex Silc Pig Red	N/a	N/A	Smooth-On	N/A	11/03/2025	1	$24.39	$24.39	https://shop
Ecoflex 00-20	Ecoflex 00-20	N/A	N/A	Smooth-On	N/A	11/03/2025	3	$33.44	$100.36	https://shop
								Category 2 Total:	**$181.79**	
								OVERALL TOTAL:	**$361.38**	

Conclusions/action items: In conclusion we stayed below our $500 budget for the semester.

Protocol for Fabrication of a Paracervical Block Model

RENEE SOBANIA - Dec 10, 2025, 2:29 PM CST

Title: Protocol for the Fabrication of a Paracervical Block Model

Date: December 10th, 2025

Content by: Renee Sobania

Present: NA

Goals: To help the client rebuilt models in the future.

Content:

Protocol for Fabrication of a Paracervical Block Model

Objective: Create a fabrication protocol so the model can be remade by our client when needed.

Materials & Equipment:

- 100g Ecoflex 00-20 (Part A)
- 100g Ecoflex 00-20 (Part B)
- Smooth On Ease Release Spray
- 6in length x 1.5 in Diameter PVC Pipe
- ¾” x 10” x 10” Wooden Base
- 1.5" x 2" Charlotte pipe coupling PVC DWV Hub x Hub increaser/reducer
- Hot Glue Gun
- Super Glue
- Stir Sticks
- Disposable plastic cup
- Smooth On Silc. Pig- Red Silicone Pigment
- Scale

3D Printed Pieces:

- PLA Charlotte Pipe
- PLA Connector Piece
- Clear V5 Uterus
- PLA Cervix Mold
- PLA Vaginal Opening Mold
- PLA Pin Plate for Cervix Mold

Procedure:

Ecoflex Preparation:

1. Obtain the Vaginal Opening mold and the Cervix mold.
2. Spray each component with Smooth On Ease Release Spray, ensuring that all faces of the mold are covered. Let it dry for 5 minutes.
3. Spray molds with an additional layer of Ease Release and let sit for 5 minutes before adding silicone.
4. Measure out 110g of Ecoflex 00-20 (part A) in a disposable cup using a scale.
5. In the same cup add an additional 110g of Ecoflex 00-20 (part B).
6. Stir the silicone mixture using a stir stick.
7. Add in Smooth On Silc. Pig- Red Silicone Pigment to the mixture until you get the desired color
    a. *Smooth On Pigment is very concentrated so little coloring is needed. Dipping the tip of the stir stick into the pigment then mixing with the Ecoflex silicone should produce a nice, pink color.

8. Pour the Ecoflex 00-20 mixture into the cervical mold until full, then add the pin plate so the pin is centered and goes into the hole.
9. Pour remaining Ecoflex into the vaginal opening then add the cover.
10. Allow both components to sit for 24 hours (or according to manufacturer instructions) to ensure both components are fully cured.

Base Component & Assembly:

1. Take the wooden base and center the Charlotte pipe coupling.
2. Add Superglue onto the base (larger, 2” diameter end) of the coupling and secure it to the wooden base.
3. Allow it to dry for around 20 minutes.
4. Once superglue is dry, add hot glue to further secure the Hub component to the wood.
5. Allow the hot glue to dry for around 10 minutes.
6. Attach the 6” PVC pipe onto the hub
7. Attach the Charlotte pipe to the PVC pipe with the long end on the backside of the model.
8. Attach the connector piece onto the long end of the charlotte pipe.
9. Once the vaginal opening and cervical component has dried, remove them from the molds
    a. *Do so slowly as they can be difficult to demold but could tear if not removed carefully.
10. Attach the cervix onto the back of the connector piece with the cervix and vaginal walls extruding into the pipe and the flat face pointing outwards from the pipe. The indents on the cervix should align with the pins on the connector piece.
11. The vaginal opening should be placed on the front of the model (short end of the charlotte pipe)
12. The clear uterus should then be attached to the end of the model on the back of the connector piece. The holes on the uterus should align with the pins on the connector piece and should be locked into place.

Conclusions/action items: Recreate 10 models for our client.

RENEE SOBANIA - Dec 10, 2025, 2:27 PM CST

Protocol for Fabrication of a Paracervical Block Model

Objective: Create a fabrication protocol so the model can be remade by our client when needed.

Materials & Equipment:
- 100g Ecoflex 00-20 (Part A)
- 100g Ecoflex 00-20 (Part B)
- Smooth On Ease Release Spray
- 6in length x 1.5 in Diameter PVC Pipe
- ¾" x 10" x 10" Wooden Base
- 1.5" x 2" Charlotte pipe coupling PVC DWV Hub x Hub increaser/reducer
- Hot Glue Gun
- Super Glue
- Stir Sticks
- Disposable plastic cup
- Smooth On Silc. Pig- Red Silicone Pigment
- Scale

3D Printed Pieces:
- PLA Charlotte Pipe
- PLA Connector Piece
- Clear V3 Uterus
- PLA Cervix Mold
- PLA Vaginal Opening Mold
- PLA Pin Plate for Cervix Mold

Procedure:

Ecoflex Preparation:
1. Obtain the Vaginal Opening mold and the Cervix mold.
2. Spray each component with Smooth On Ease Release Spray, ensuring that all faces of the mold are covered. Let it dry for 5 minutes.
3. Spray molds with an additional layer of Ease Release and let sit for 5 minutes before adding silicone.
4. Measure out 110g of Ecoflex 00-20 (part A) in a disposable cup using a scale.
5. In the same cup add an additional 110g of Ecoflex 00-20 (part B).
6. Stir the silicone mixture using a stir stick.
7. Add in Smooth On Silc. Pig- Red Silicone Pigment to the mixture until you get the desired color
    a. *Smooth On Pigment is very concentrated so little coloring is needed. Dipping the tip of the stir stick into the pigment then mixing with the Ecoflex silicone should produce a nice, pink color.
8. Pour the Ecoflex 00-20 mixture into the cervical mold until full, then add the pin plate so the pin is centered and goes into the hole.

[Download](#)

Protocol_for_Fabrication_of_a_Paracervical_Block_Model.pdf (89.6 kB)

Cervix Mold #1

Cadence SEYMOUR - Dec 10, 2025, 3:53 PM CST

Title: Cervix Mold #1

Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: This document contains an image of the first mold we made for the cervix design, and will discuss our findings on its imitation of the real anatomy.

Content:

-

-This is the first image we have of our cervix mold.

-This is the mold we used for the first version of the model with the thinner cervicovaginal junction.

-The cervicovaginal junction proved to be too thin for the procedure, and therefore, we had to remake it.

Conclusions/action items: From here, we wanted to create a more realistic cervix mold with a thicker cervicovaginal junction to improve procedural realism.

Cervix Mold #2

Cadence SEYMOUR - Dec 10, 2025, 3:53 PM CST

Title: Cervix Mold #2

Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: This entry contains the second cervix mold we attempted to make in the Wendt makerspace.

Content:

-This is our second mold of the cervix and cervicovaginal junction.

-This mold obviously possessed mechanical failure as well as incorrect cervix geometry.

Conclusions/action items: We wanted to improve the cervix geometry and print a new model that wouldn't fail during the printing process to make our first prototype.

Cervix Mold #3

Cadence SEYMOUR - Dec 10, 2025, 3:53 PM CST

Title: Cervix Mold #3

Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: This entry contains the third cervix mold we attempted to make in the Wendt makerspace.

Content:

-This is our third mold of the cervix and cervicovaginal junction.

-This mold possessed still too thin of a cervicovaginal junction.

-This mold, however, now has the right geometry of the cervix, which was to be a little more oblong than the original design.

-We also incorporated the vaginal walls into this design; however, they were too long, making it too difficult to remove from the mold.

Conclusions/action items: We wanted to improve the wall length and print a new model that wouldn't be too hard to remove to make our first prototype.

Cervix Mold #4

Cadence SEYMOUR - Dec 10, 2025, 3:53 PM CST

Title: Cervix Mold #4

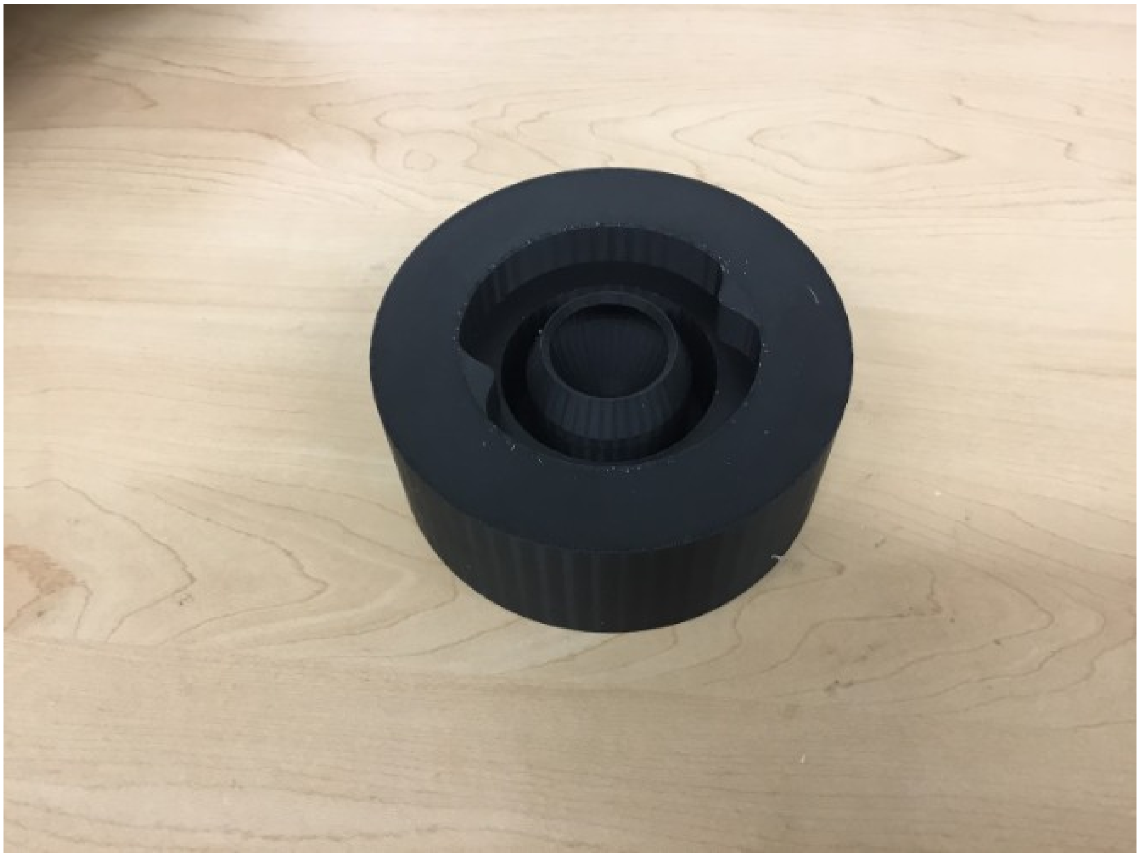
Date: 12/10/2025

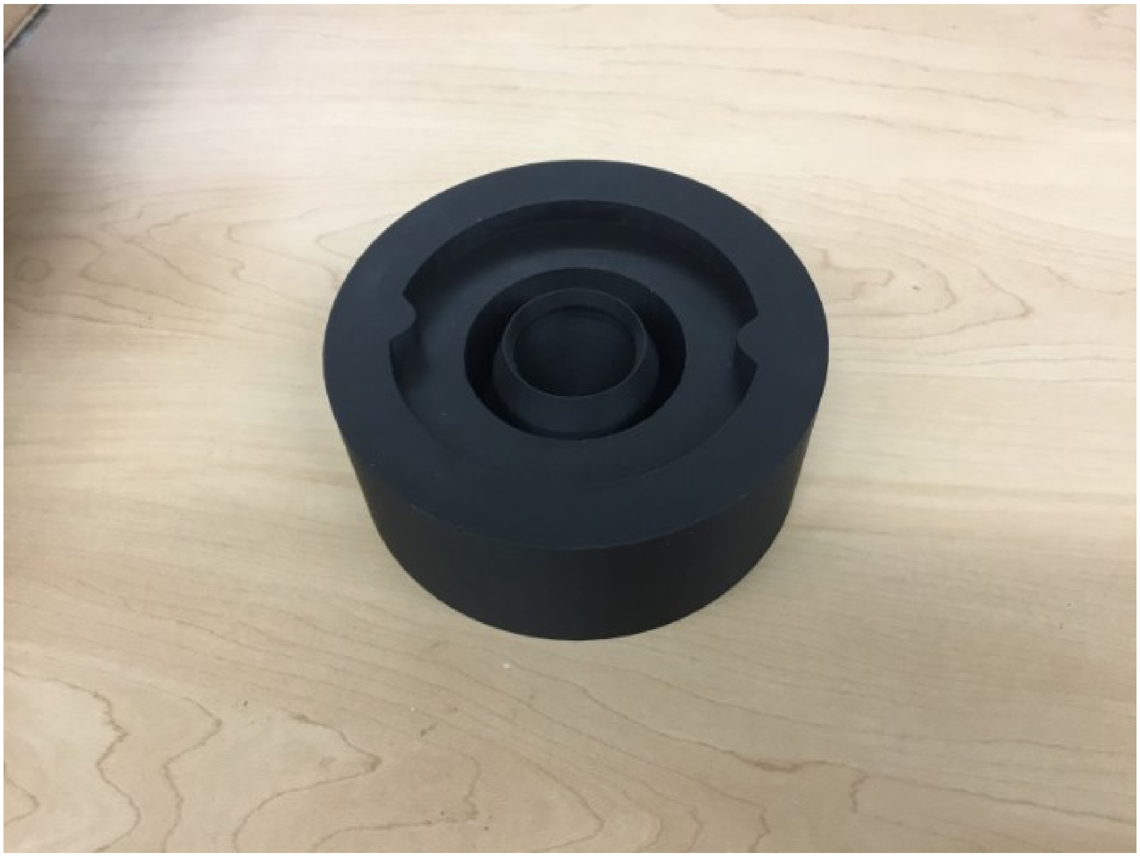
Content by: Cadence Seymour

Present: PBTM

Goals: This entry contains the fourth cervix mold we attempted to make in the Wendt makerspace.

Content:





-This is our fourth and final mold of the cervix and cervicovaginal junction.

-This mold possessed the right thickness of a cervicovaginal junction.

-This mold also now has the right geometry of the cervix, which was to be a little more oblong than the original design.

-We also incorporated the vaginal walls into this design; this time, they were the perfect length, making it easy to remove from the mold.

Conclusions/action items: After this mold, we now have the means to cast our first component of the final design.

MTS Testing Molds

Cadence SEYMOUR - Dec 10, 2025, 3:53 PM CST

Title: MTS Testing Molds

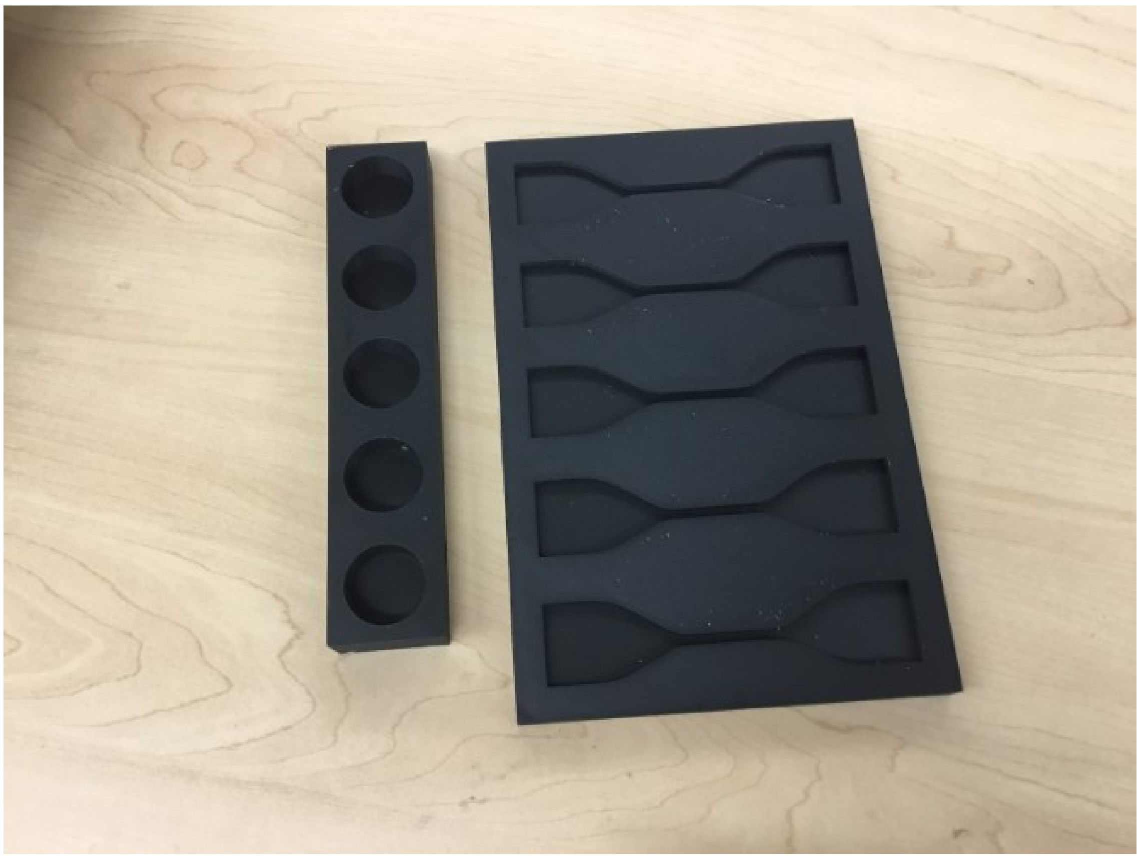
Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: The goals for this print were to create molds of the correct length, width, and height according to ASTM standards so that we, as a team, can begin to mechanically test our materials to make sure they fall within the literature value ranges of the female anatomy.

Content:



-This print was successful on the first try, and these molds were ready to be used on the MTS testing.

-You can find more information about our testing process and results in that section of the notebook.

Conclusions/action items: From here, we as a team went to the wet lab in ECB and conducted MTS testing experiments to ensure our materials were within the literature value ranges as mentioned earlier.

Unsuccessful Connecting Pieces

Cadence SEYMOUR - Dec 10, 2025, 3:53 PM CST

Title: Unsuccessful Connecting Pieces

Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: The goals for this portion of the project were to print a connecting piece that was the right thickness, diameter, and shape to fit well with the other components of our design.

Content:

-Above are all the failed connecting pieces.

-They each failed for a different reason, or a combination of a few. The reasons are as follows,

1) The wrong pin length and the cervix component did not fit between the two connecting pieces.

2) wrong size overall, ie, wrong diameter

3) didn't fit in with new design ideas after being fabricated.

Conclusions/action items: We had to make the appropriate changes and re-measure the pipe we were attaching these to and reprint the piece.

Pin Plate

Cadence SEYMOUR - Dec 10, 2025, 3:54 PM CST

Title: Pin Plate

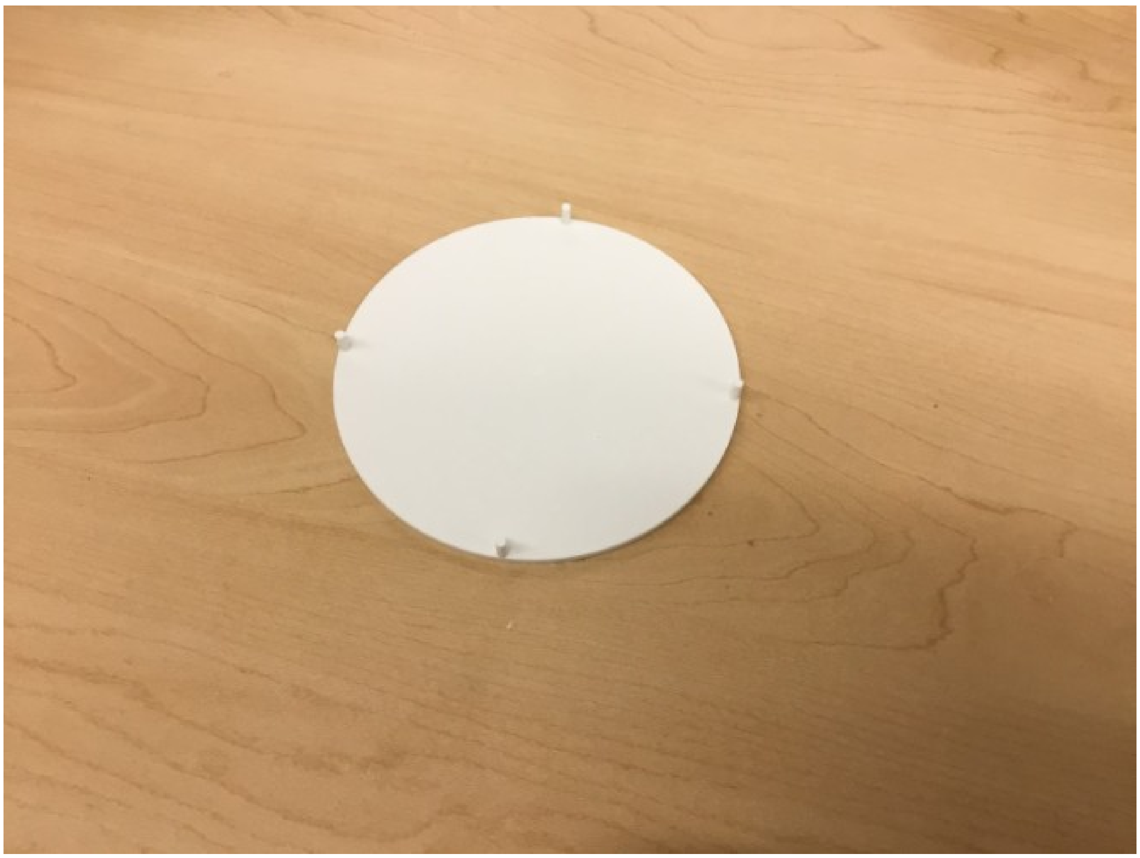
Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: The goals for this print were to make a "pizza table" like design to better secure a hole in the exact center of our cervix mold, so that IUDs can be placed into our model.

Content:



-This run of the print failed due to a mechanical failure and will require a new print of differing dimensions, more compatible with the 3D printer.

Conclusions/action items: As I mentioned, we will need to reprint the design with more compatible dimensions once we determine what caused the failure.

Failed Vaginal Openings

Cadence SEYMOUR - Dec 10, 2025, 3:54 PM CST

Title: Failed Vaginal Openings

Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: The goals for this portion of the project were to incorporate a vaginal opening piece made of EcoFlex. This piece would give the speculum something to hold onto when being inserted, so the physician can practice working through the narrow opening the speculum provides. In order to make this opening, we need to make a 3D printed mold.

Content:

-These are all the prints we made in an attempt to make a vaginal opening; however, they all failed.

-They all failed due to either incorrect length, size, or no opening

Conclusions/action items: We needed to print a new mold that was the appropriate size for our model, as well as secure the opening.

Cervix Prototype 1

Cadence SEYMOUR - Dec 10, 2025, 3:54 PM CST

Title: Cervix Prototype 1

Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: The goals for this were to cast our first prototype of the cervix and cervicovaginal junction piece using our first mold, seen a couple of entries back.

Content:

-This cervix was too perfectly round for the client's liking, as well as had a cervicovaginal junction far too thin for repeated use as intended.

-This design also did not have the vaginal walls that we incorporated in our final design.

Conclusions/action items: We needed to cast a new cervix in our second mold.

Failed Cervix Casts

Cadence SEYMOUR - Dec 10, 2025, 3:54 PM CST

Title: Failed Cervix Casts

Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: The goals for this were to cast a new prototype of the cervix and cervicovaginal junction piece using our second and third mold, seen a couple of entries back.

Content:

-These cervix casts were again too thin of a cervicovaginal junction for repeated use as intended by the client.

-The casts also had some of the wrong cervix shapes, as you can see in the top left image, the cervix is far too big.

-Lastly, some of the casts also have too thick of a plate for the connecting piece to work properly.

Conclusions/action items: We needed to cast a new cervix in our final (4th) mold.

Failed Anatomically Accurate Uterus

Cadence SEYMOUR - Dec 10, 2025, 3:54 PM CST

Title: Failed Anatomically Accurate Uterus

Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: The goals for this design were to integrate the inner and outer components of the uterus into our design to make it more anatomically realistic for procedures. This would allow the medical students to feel when they have entered the uterus versus the space surrounding it.

Content:

-Clearly, when trying to 3D print this portion of the design, there was a mechanical failure.

-This failure can unfortunately not be worked around to our understanding, so we are limited in what we can do to integrate this component into the final product.

Conclusions/action items: Because this print was an additional aspect to the design, we scrapped it and decided to go with the original uterus as it was still sufficient at replicating the uterus.

Final Cervix Model

Cadence SEYMOUR - Dec 10, 2025, 3:54 PM CST

Title: Final Cervix Model

Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: The goals for this were to cast our final prototype of the cervix and cervicovaginal junction piece using our last (4th) mold, seen a couple of entries back.

Content:

-This cervix was shaped more accurately as an oblong shape mentioned earlier, and was up to the client's liking.

-The cervicovaginal junction was also thick enough to withstand repeated use now.

-The cervix now has the vaginal walls we need, at the right length for removal from the mold, and has the more anatomically accurate coloring to it, making it our final prototype.

Conclusions/action items: We need to replicate this cervix 10 more times to make 10 molds for the client.

Final Vaginal Opening Mold

Cadence SEYMOUR - Dec 10, 2025, 3:54 PM CST

Title: Final Vaginal Opening Mold

Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: The goals for this print were to correct the previous failures and make a mold suitable for our final prototype.

Content:

-The final mold we are going to use for our design presentation is good enough, as it fits the pipe it's attached to, and opens as intended.

-However, when we give the client our final 10 products, we will likely be using a different mold that adheres better to the pipe.

-This mold is somewhat loose.

Conclusions/action items: We need to improve the tightness of the mold to better hold the speculum in place.

Final Connecting Piece, Clear Uterus, and Custom PVC Pipe

Cadence SEYMOUR - Dec 10, 2025, 3:54 PM CST

Title: Final Connecting Piece, Clear Uterus, and Custom PVC Pipe

Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: The goals for this were to combine some of the completed components of the design to start piecing it all together.

Content:

-As mentioned in the title, the components pictured above (from left to right) are the final connecting piece, the custom Charlotte pipe, and the clear uterus.

-These components all fit nicely with one another, and together are the correct anatomical length of the vaginal to cervix.

-If they require extra security, they can be hot-glued together.

Conclusions/action items: Now we have to secure them together and finalize the base of the design for presentations.

Final Vaginal Opening

Cadence SEYMOUR - Dec 10, 2025, 3:54 PM CST

Title: Final Vaginal Opening

Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: The goals for this were to cast the final vaginal opening from the final vaginal opening mold we verified in the previous entry and ensure it fits onto our design.

Content:

-The vaginal opening is lightly loose and could be slightly smaller in diameter. This is a change we might make before giving the client our final model.

-Another way we could combat the issue is by securing the piece on with hot glue.

-Similar to the final cervix, this opening has the more anatomically accurate coloring as well for procedural realism with the landmarks.

Conclusions/action items: We might choose to redesign this component before giving the client all of our models.

Initial Uterus - Not Clear

Cadence SEYMOUR - Dec 10, 2025, 3:54 PM CST

Title: Initial Uterus - Not Clear

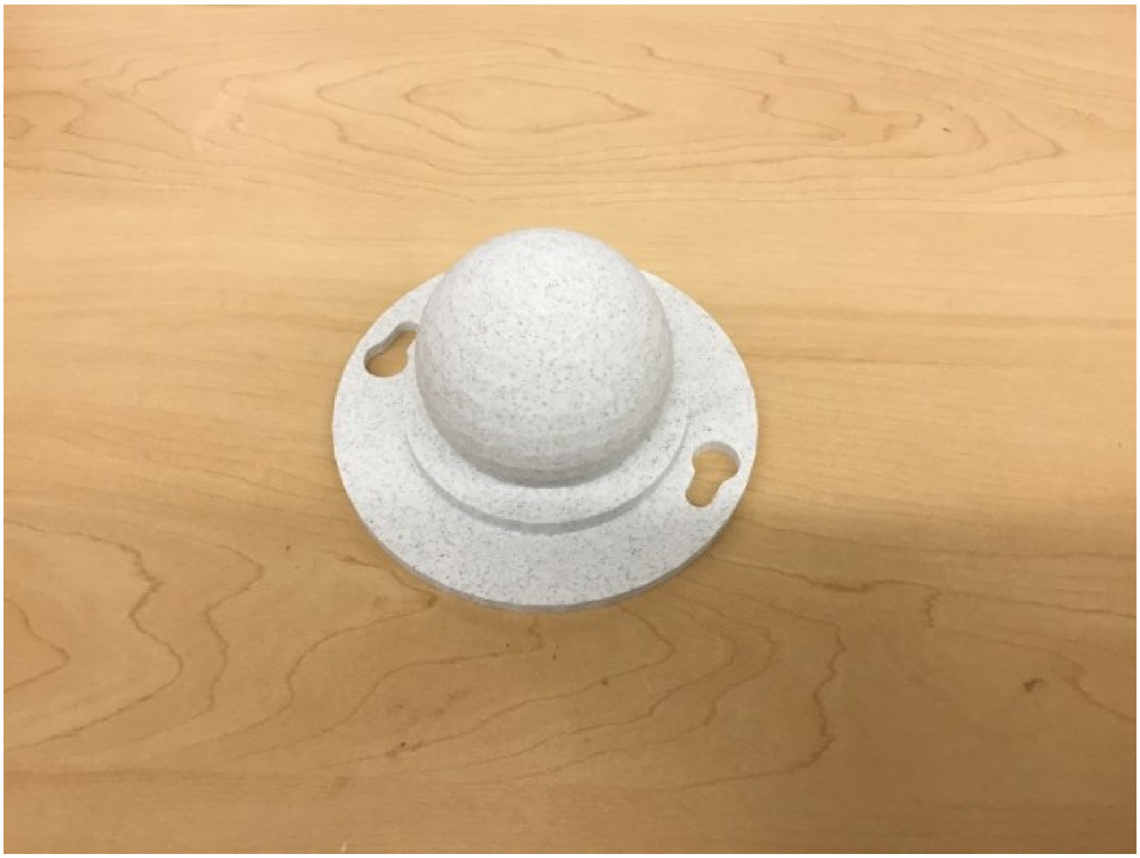
Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: The goals for this portion of the design process were to check in with our client and see what might need changing about our original uterus design.

Content:



-The biggest correction we got from our client was that she wanted to uterus to be a clear material instead of white.

-She wanted the uterus to be clear so you can see the depth of your insertions without having to remove the back component.

Conclusions/action items: we needed to figure out how to make the uterus clear as per the client's request.

Base Plate With Removable Components

Cadence SEYMOUR - Dec 10, 2025, 3:55 PM CST

Title: Base Plate With Removable Components

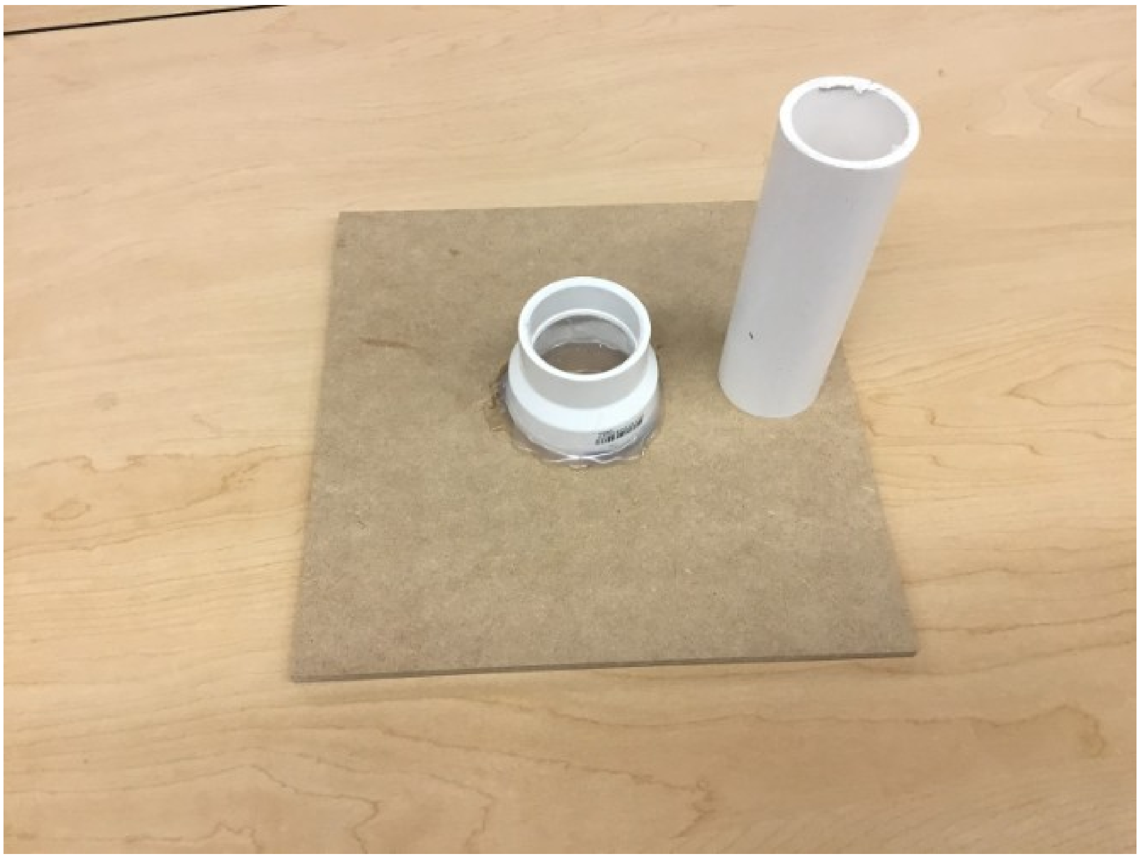
Date: 12/10/2025

Content by: Cadence Seymour

Present: PBTM

Goals: the goals here were to make sure the bases of the design could be isolated from one another for easy transportation and compactability.

Content:



-You can clearly see that the pieces above can be removed from the base plate, making it easy to travel with and decompose.

Conclusions/action items: We need to reproduce 9 more bases to complete the 10 models for the client.

Final Model Images

Cadence SEYMOUR - Dec 10, 2025, 3:59 PM CST

Title: Final Model Images

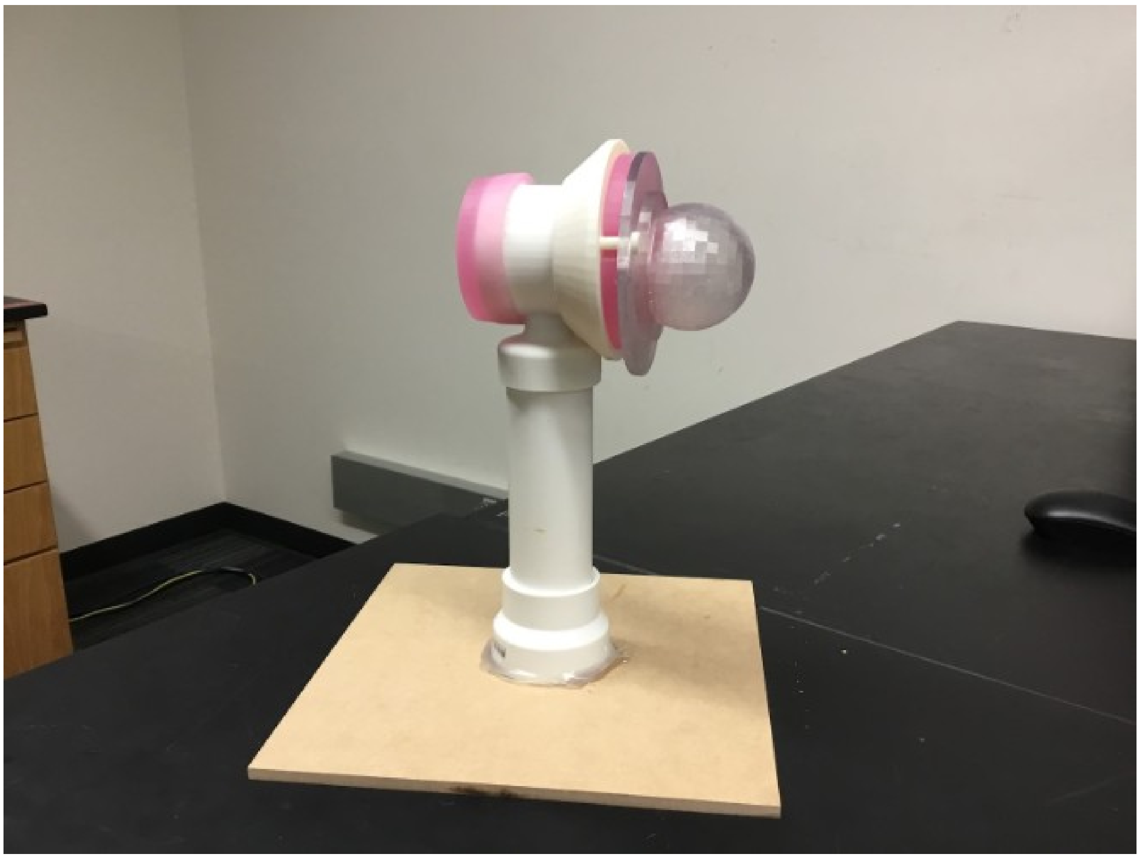
Date: 12/10/2025

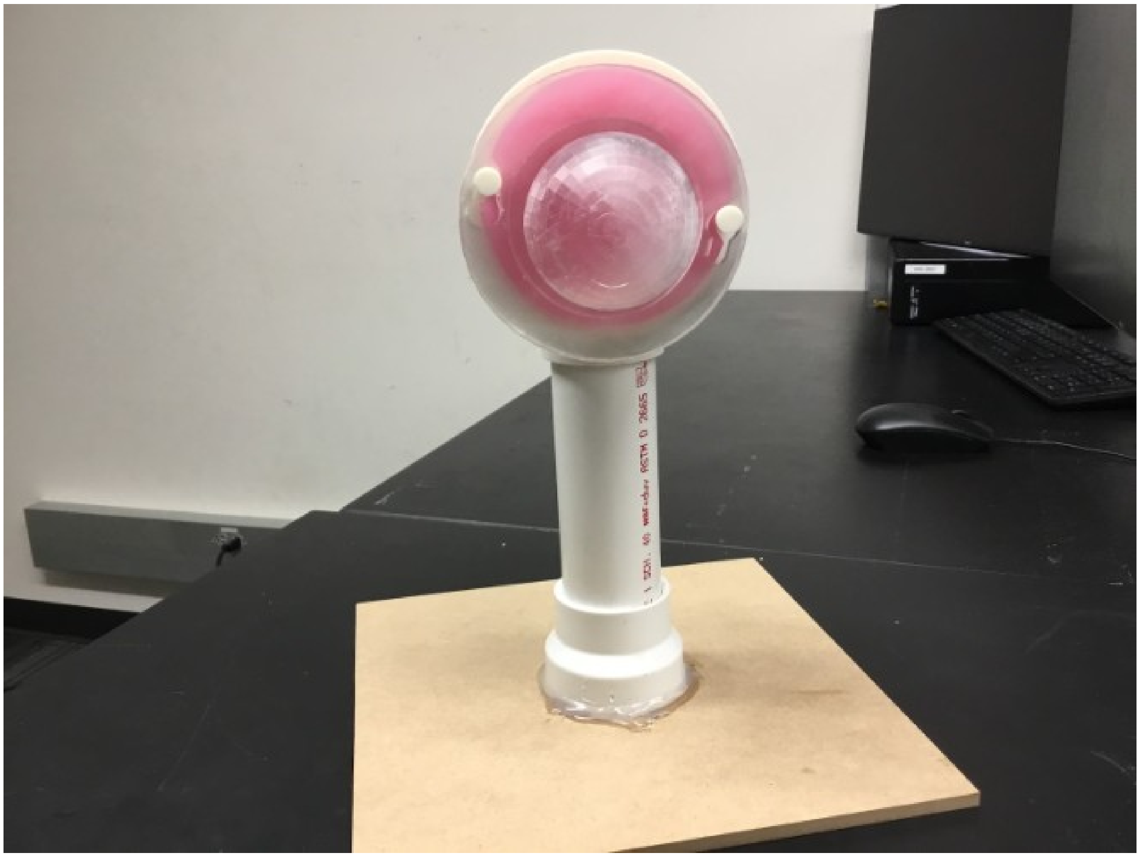
Content by: Cadence Seymour

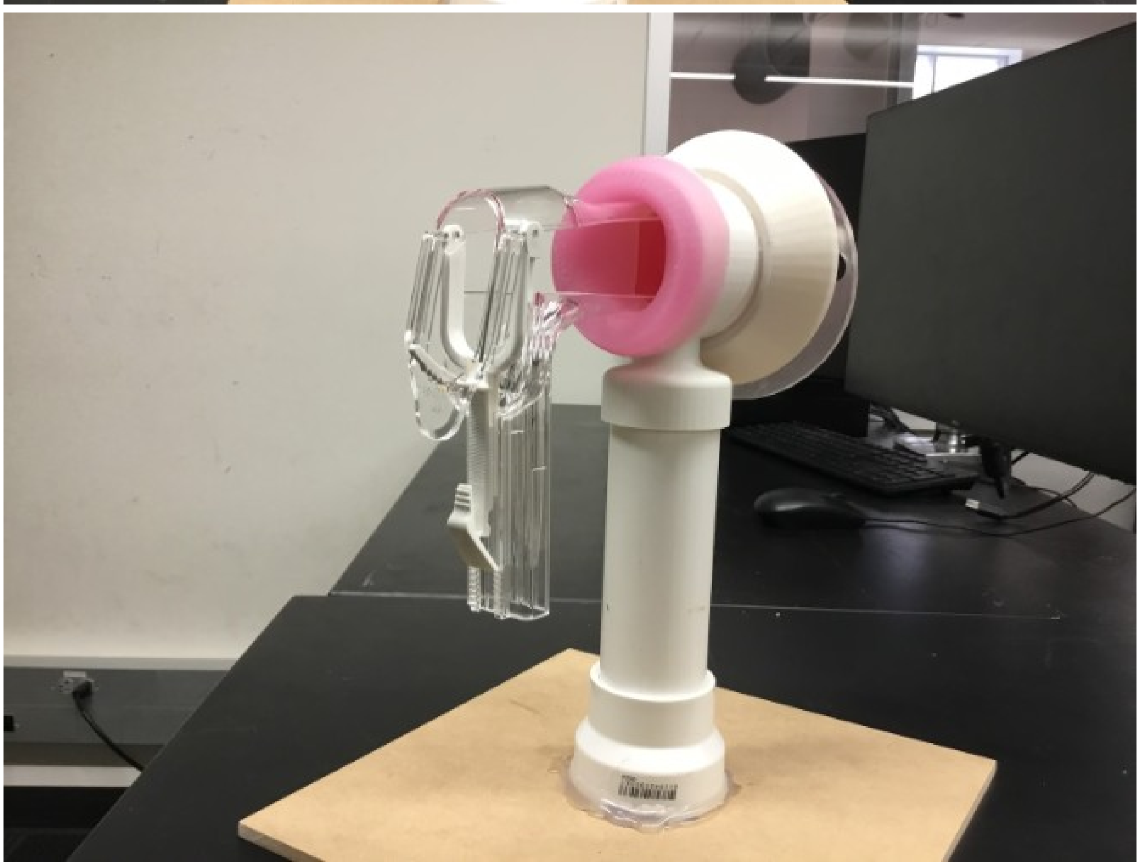
Present: PBTM

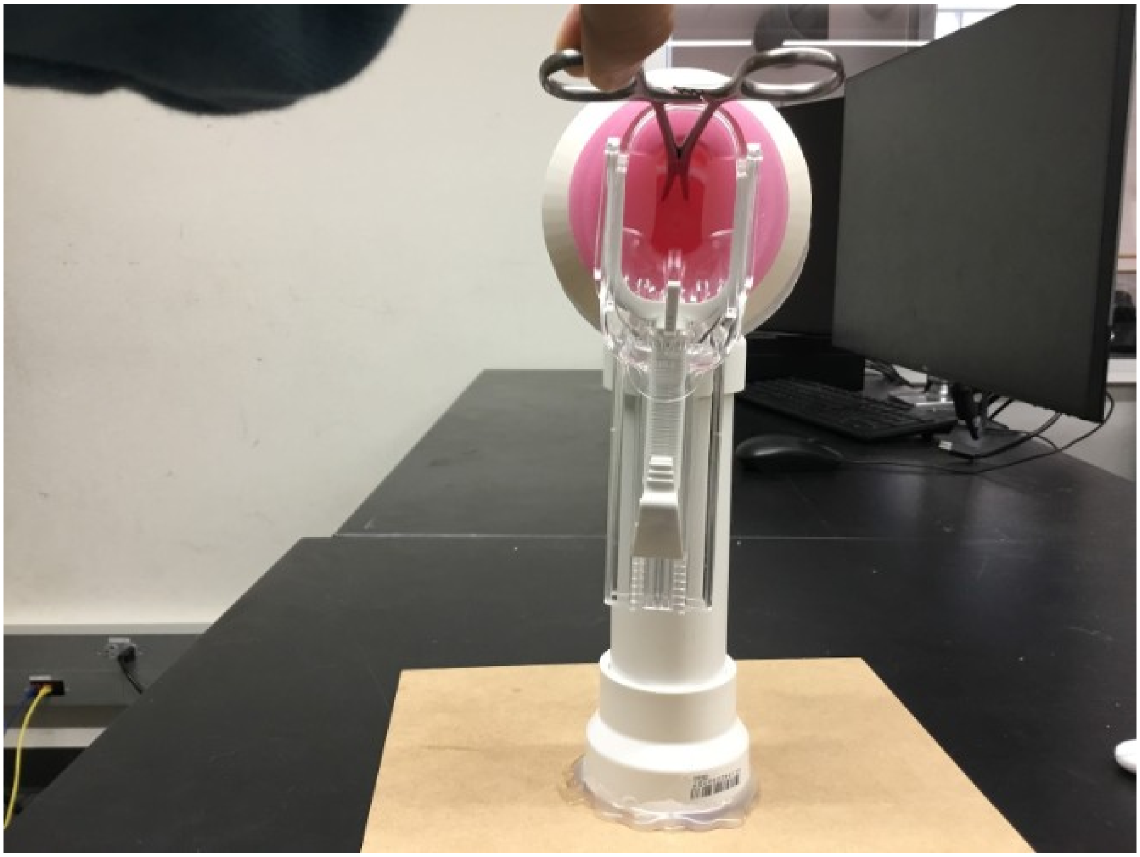
Goals: The goals for this entry were to document the final product we have made.

Content:




SCH. 40
ASTM D 2665





-Above are several images of our final design from multiple angles.

-In these images, you can see how each component fits into the overall design.

-Lower down on the entry, you can see how the speculum will look inserted into the design, as well as how the tenaculum can be placed through that opening procedurally.

Conclusions/action items: Now we have to produce 9 more of these final design products, 10 total, and get them to our client.

Final Design with IUD Insertion

Cadence SEYMOUR - Dec 10, 2025, 4:04 PM CST

Title: Final Design With IUD Insertion

Date: 12/10/2025

Content by: Cadence Seymour

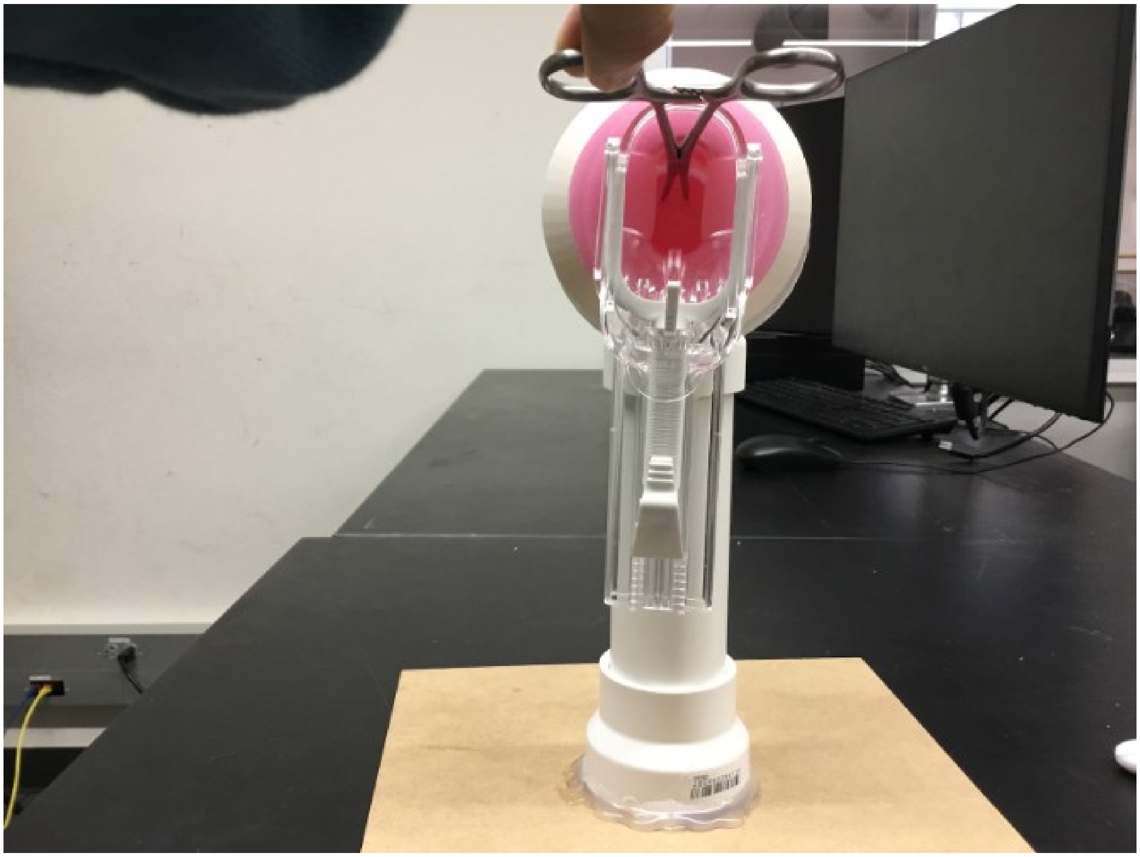
Present: PBTM

Goals: The goals for these images were to show how the IUD insertion process can be demonstrated and practiced on our model kit as intended.

Content:

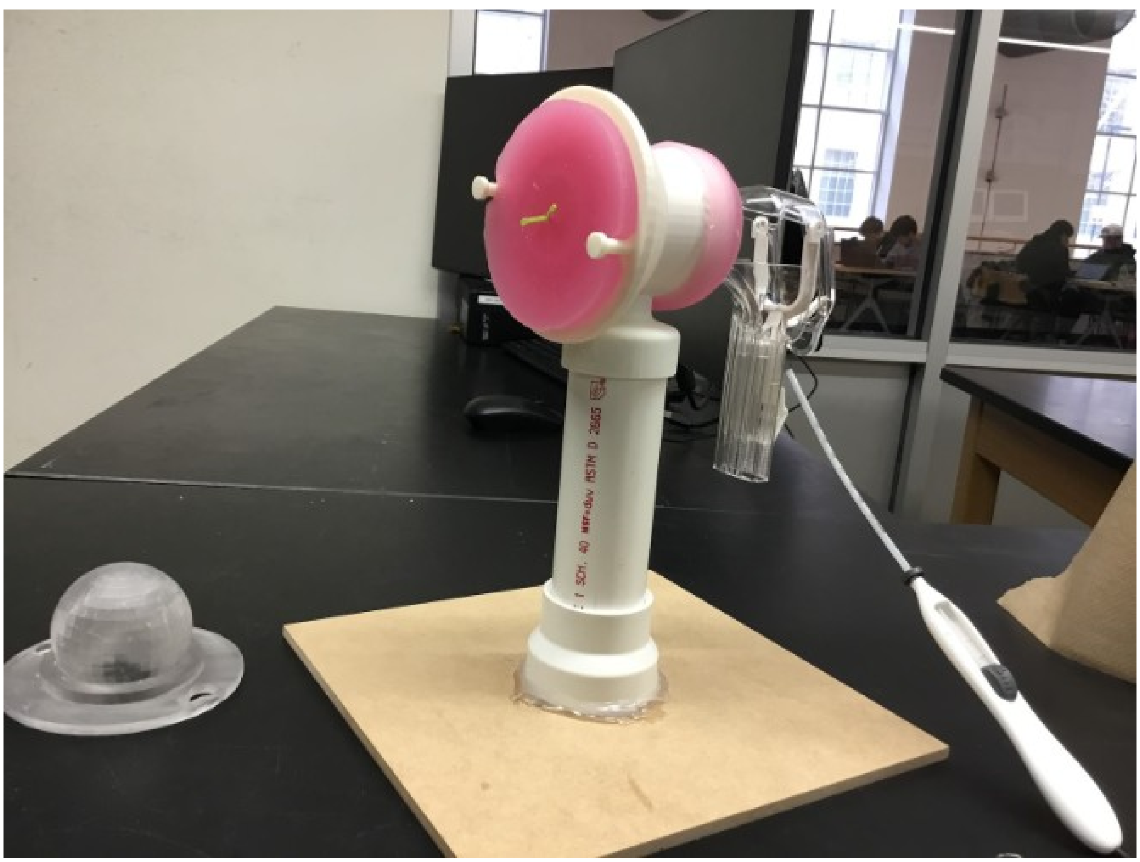
-The physician will first insert the speculum into the vaginal opening

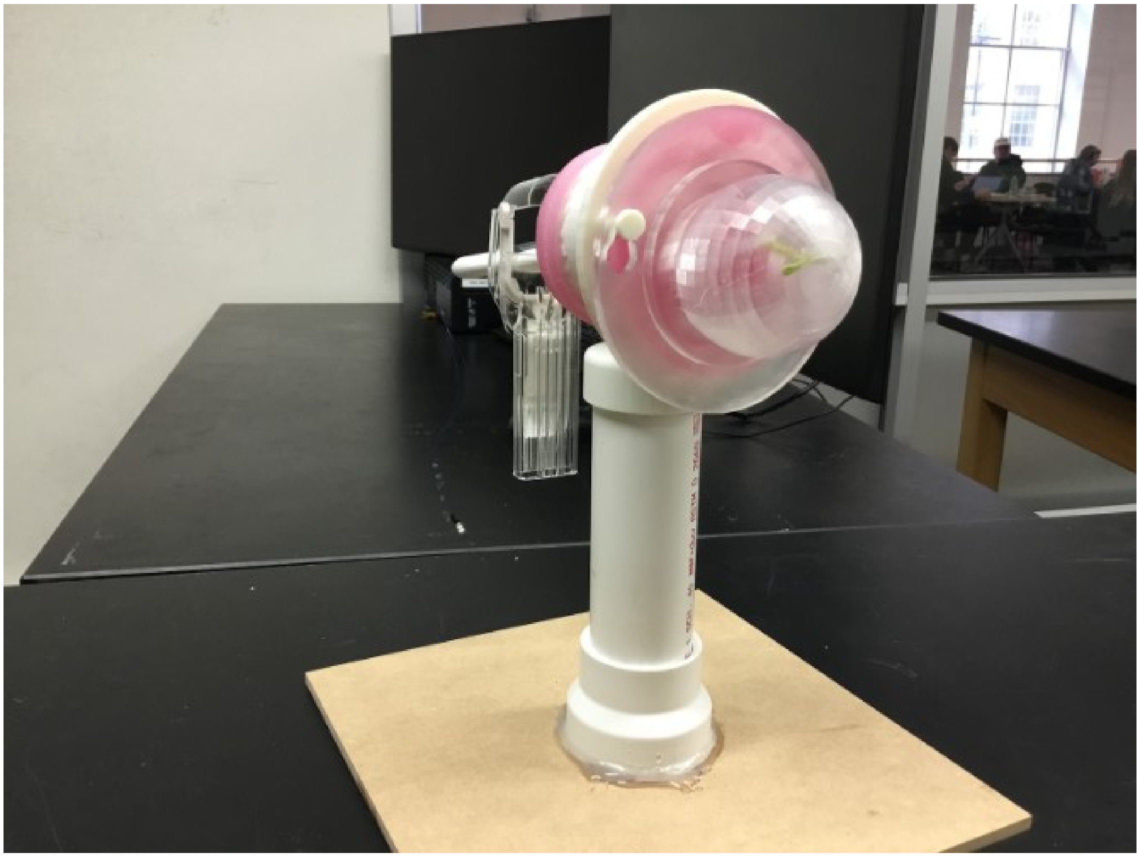
-Then they will grab the cervix with the tenaculum and pull to reveal the cervicovaginal junction.



-Then they will do the PCB injections which we dont have pictured because we dont have a needle to demonstrate with.

-Then the will insert the IUD catheter into the cervix opening and into the uterus. When you are done you can see the IUD both by taking off the uterus component, or by looking through for the green color.





Conclusions/action items: We now have a working model that is up to par with our clients standards, we just need to produce 9 more and get them to her before the semester is over.

11/30/25 MTS Protocol

ELLINORE LETTS - Dec 03, 2025, 5:15 PM CST

Title: MTS Protocol

Date: 11/30/25

Content by: Ellinore Letts

Present: N/A

Goals: Create Protocol for MTS testing of Ecoflex 00-20 samples in compression and tension.

Content:

MTS Tensile Testing Protocol – ASTM D412 Type C

Objective:
To evaluate the tensile properties (stress–strain behavior, Young's modulus, ultimate tensile strength) of Ecoflex 00-20 using standardized dumbbell-shaped specimens.

Materials and Equipment:

- Ecoflex 00-20 silicone elastomer
- ASTM D412 Type C dumbbell molds (6 mm × 3 mm cross-sectional area, 33 mm gauge length)
- MTS uniaxial testing machine with 100 N load cell
- Digital caliper or micrometer
- Data acquisition software (MATLAB or MTS proprietary software)
- Timer/stopwatch

Procedure:

Sample Preparation:
a. Mix Ecoflex 00-20 according to manufacturer instructions.
b. Pour into Type C dumbbell molds and cure at room temperature overnight.
c. Remove samples from molds.
d. Measure gauge length, width, and thickness with a caliper to calculate cross-sectional area.

MTS Setup:
a. Install a 100 N load cell on the MTS machine.
b. Set crosshead speed according to ASTM D412 recommendations.

Testing:
a. Secure the specimen in the grips, aligning it so the gauge section is centered and straight.
b. Begin the tensile test, recording force and extension continuously.
c. Continue the test until specimen failure.

Data Acquisition:
a. Record force (N) and displacement (mm) throughout the test.
b. Calculate engineering stress.
c. Calculate engineering strain.

Data Analysis:

a. Plot stress–strain curves for each sample and average.
b. Determine Young’s modulus from the slope of the linear elastic region.
c. Determine ultimate tensile strength and elongation at break.
d. Analyze at least six replicate samples to assess reproducibility.

Reporting:

a. Report average Young’s modulus, ultimate tensile strength, and standard deviations.

Conclusions/action items: Pour Ecoflex samples. Perform testing and analyze data.

ELLINORE LETTS - Dec 03, 2025, 5:15 PM CST

Download

Cervical_Block_TM_Design.HEIC (1.93 MB)

11/30/25 ASTM Standards - Copy

ELLINORE LETTS - Dec 03, 2025, 5:15 PM CST

Title: ASTM Standards

Date: 12/30/25

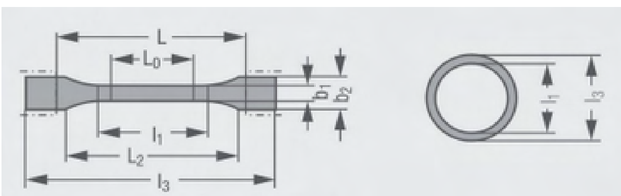
Content by: Ellinore Letts

Present: N/A

Goals: Determine ASTM standards for testing Ecoflex 00-20 in tension and compression.

Content:

Tensile Testing - Dogbone Model



Standard	Type	Note	l3 mm	l1 mm	b2 mm	b1 mm	h mm	L0 mm	Shape
ASTM D412	C	Preferred specimen	≥115	33	25±1	6+0.05	1.3 ... 3.3	25±0.25	Dumbbell specimen

Thickness: 3mm

Compression Testing - Cylinder Model

Standard	Type	Note	h mm	Dia mm	Shape
ASTM D575	C	Preferred specimen	12	25±0.25	Cylinder

Conclusions/action items: Pour Ecoflex samples. Perform testing and analyze data.

12/10/25 ECOFLEX 00-20 Protocol

ELLINORE LETTS - Dec 10, 2025, 1:59 PM CST

Title: Ecoflex 00-20 Protocol

Date: 12/10/25

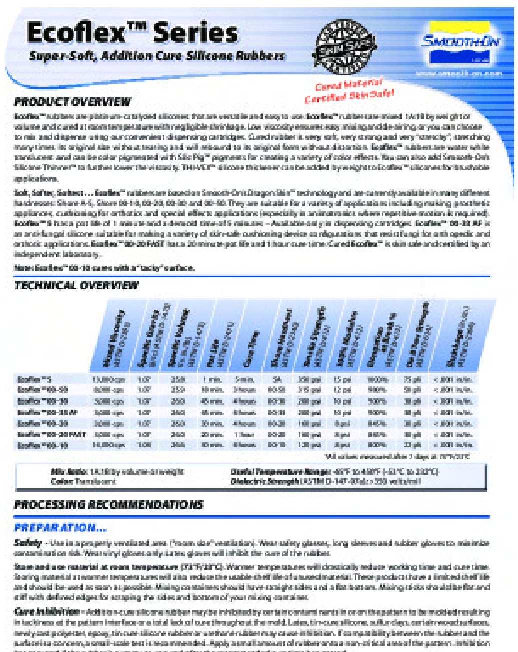
Content by: Ellinore Letts

Present: N/A

Goals: Create Protocol for casting Ecoflex 00-20.

Content: See attached.

ELLINORE LETTS - Dec 10, 2025, 1:59 PM CST



Ecoflex™ Series

Super-Soft, Addition Cure Silicone Rubbers

PRODUCT OVERVIEW

TECHNICAL OVERVIEW

PROCESSING RECOMMENDATIONS

PREPARATION...

Download

ECOFLEX_00-20_PROTOCOL.pdf (584 kB)

11/30/25 MTS Tensile Data

ELLINORE LETTS - Dec 03, 2025, 5:15 PM CST

Title: MTS Tensile Data

Date: 12/30/25

Content by: Ellinore Letts

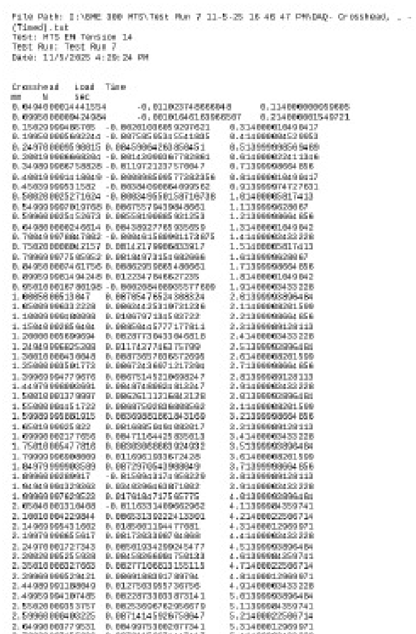
Present: N/A

Goals: Store MTS raw data.

Content: Attatched.

Action Items: Write MATLAB Code to determine graph and youngs modulus.

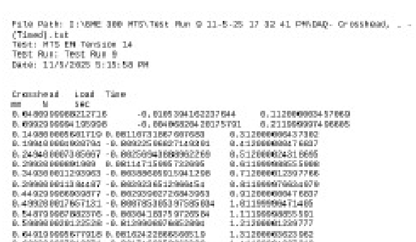
ELLINORE LETTS - Dec 03, 2025, 5:15 PM CST



Download

Sample6.txt (488 kB)

ELLINORE LETTS - Dec 03, 2025, 5:15 PM CST



[illegible]

[Download](#)

Sample4.txt (482 kB)

ELLINORE LETTS - Dec 03, 2025, 5:15 PM CST

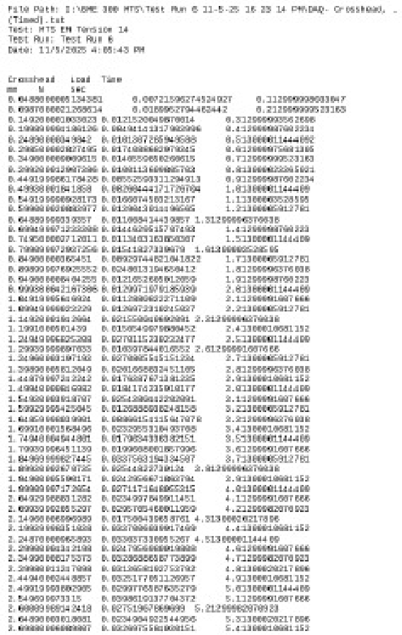
```
File Path: I:\BME 300 MTS\Test Run 8 11-5-25 17 18 40 PM\DAQ- Crosshead, . - (Timed).txt
Test: MTS EM Tension 14
Test Run: Test Run 8
Date: 11/5/2025 4:52:58 PM

Crosshead	Load	Time
mm	N	sec
```

[illegible]

[Download](#)

Sample5.txt (509 kB)

ELLINORE LETTS - Dec 03, 2025, 5:15 PM CST

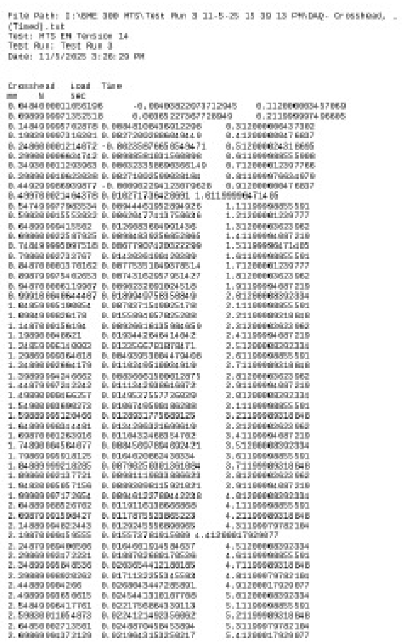

File Path: I:\BME 300 MTS\Test Run 6 11-5-25 16 23 14 PM\DAQ- Crosshead, . - (Timed).txt
Test: MTS EM Tension 14
Test Run: Test Run 6
Date: 11/5/2025 4:08:43 PM

Crosshead Load Time
mm N sec

Download

Sample1.txt (494 kB)

ELLINORE LETTS - Dec 03, 2025, 5:15 PM CST

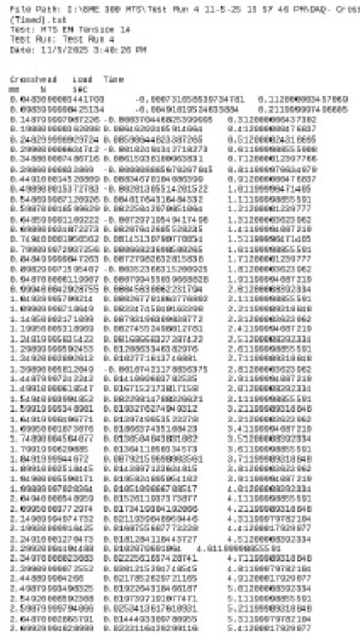

File Path: I:\BME 300 MTS\Test Run 3 11-5-25 15 39 13 PM\DAQ- Crosshead, . - (Timed).txt
Test: MTS EM Tension 14
Test Run: Test Run 3
Date: 11/5/2025 3:26:29 PM

Crosshead Load Time
mm N sec

Download

Sample2.txt (297 kB)

ELLINORE LETTS - Dec 03, 2025, 5:15 PM CST



File Path: I:\BME 300 MTS\Test Run 4 11-5-25 15 57 46 PM\DAQ- Crosshead, ... - (Timed).txt
Test: MTS EM Tension 14
Test Run: Test Run 4
Date: 11/5/2025 3:40:26 PM

Crosshead Load Time
mm N sec

[Download](#)

Sample3.txt (492 kB)

12/02/25 MTS Compressive Data

ELLINORE LETTS - Dec 03, 2025, 5:16 PM CST

Title: MTS Compressive Data

Date: 12/02/25

Content by: Ellinore Letts

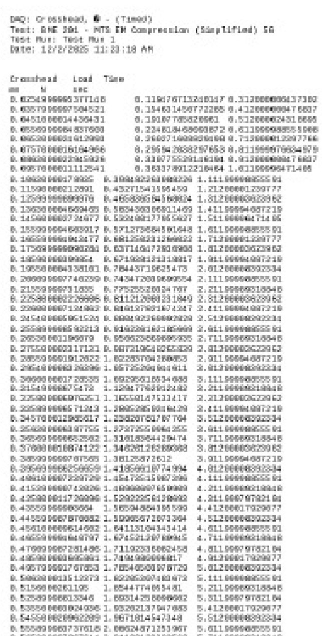
Present: N/A

Goals: Store MTS raw data.

Content: Attatched.

Action Items: Write MATLAB Code to determine graph and youngs modulus.

ELLINORE LETTS - Dec 03, 2025, 5:16 PM CST


DAQ: Crosshead, - (Timed)
Test: BME 301 - MTS EM Compression (Simplified)
Test Run: Test Run 1
Date: 12/2/2025 11:20:18 AM

Crosshead Load Time
mm N sec

[Download](#)

PBTM_MTS_comp.txt (31.3 kB)

11/30/25 MATLAB Tensile Code

ELLINORE LETTS - Dec 03, 2025, 5:17 PM CST

ELLINORE LETTS - Dec 03, 2025, 5:17 PM CST

Title: MATLAB Code

Date: 12/30/25

Content by: Ellinore Letts

Present: N/A

Goals: Write MATLAB Script to analyze MTS Data.

Content:

```
%% Load data
filename = 'BME300MTStension.txt';
data = readmatrix(filename); % use readtable if header exists
% Assume columns: 1 = time (s), 2 = displacement (mm), 3 = force (N)
time = data(:,1);
displacement = data(:,2); % mm
force = data(:,3);        % N
%% Sample geometry
L0 = 33;  % mm, gauge length
A = 18;   % mm^2, cross-sectional area
%% Calculate stress and strain
strain = displacement / L0;       % strain
stress = force / A;               % stress in N/mm^2 (MPa)
%% Plot stress-strain curve
figure;
plot(strain, stress, 'LineWidth', 2);
xlabel('Strain (mm/mm)');
ylabel('Stress (MPa)');
title('Stress-Strain Curve');
grid on;
%% Optional: calculate Young's modulus (linear region)
linear_region = strain < 0.1; % adjust range as needed
p = polyfit(strain(linear_region), stress(linear_region), 1);
E = p(1); % Young's modulus
disp(['Young''s modulus = ', num2str(E), ' MPa']);
```

Action Items: Repeat for Compressive testing.

12/02/25 MATLAB Compression Code

ELLINORE LETTS - Dec 03, 2025, 5:18 PM CST

Title: MATLAB Code

Date: 12/30/25

Content by: Ellinore Letts

Present: N/A

Goals: Write MATLAB Code to Analyze MTS Compressive data.

Content:

```
%% MATLAB Script for Compression Testing

% Title: Compression Test Analysis

% Date: 12/30/25

% Author: Ellinore Letts

% Purpose: Analyze MTS compression data and plot stress-strain curve


%% Load data

filename = 'PBTM MTS comp.txt'; % change filename for compression data

data = readmatrix(filename); % use readtable if header exists


% Assume columns: 1 = time (s), 2 = displacement (mm), 3 = force (N)

time = data(:,1);

displacement = data(:,2); % mm

force = data(:,3); % N


% Ensure compression is positive

%force = -force; % flip sign if MTS records compression as negative


%% Sample geometry
```

```
L0 = 12; % mm, initial height for ASTM D575 cylinder

d = 25; % mm, diameter

A = pi*(d/2)^2; % cross-sectional area in mm^2


%% Calculate stress and strain

strain = displacement / L0; % engineering strain (mm/mm)

stress = force / A; % stress in N/mm^2 = MPa


%% Plot stress-strain curve

figure;

plot(strain, stress, 'LineWidth', 2);

xlabel('Strain (mm/mm)');

ylabel('Stress (MPa)');

title('Compression Stress-Strain Curve');

grid on;


%% Optional: calculate Young's modulus (linear region)

linear_region = strain < 0.1; % adjust as needed (e.g., 0–10% strain)

p = polyfit(strain(linear_region), stress(linear_region), 1);

E = p(1); % Young's modulus

disp(['Young''s modulus (linear region) = ', num2str(E), ' MPa']);


%% Optional: save stress-strain data

 csvwrite('compression_stress_strain.csv',[strain, stress]);
```

Action Items: Analyze testing results.

12/10/25 Feedback Form Results

ELLINOR

Title: Feedback Form Results

Date: 12/10/25

Content by: Ellinore Letts

Present: N/A

Goals: Gather feedback from form to determine the success of our model.

Content:

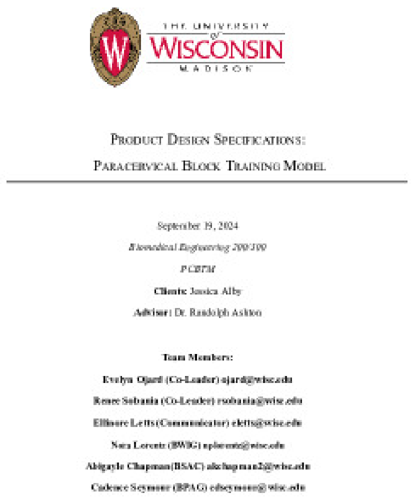
What is your role?	Have you used any paracervical block training models before?	On a scale of 1-10, how much experience do you have using training models? 0 being none, 10 being extensive experience. - Experience	How realistic was the anatomy of the model in terms of... - Anatomical accuracy	How realistic was the anatomy of the model in terms of... - Tissue feel	How realistic was the anatomy of the model in terms of... - Response to needle insertion	How realistic was the anatomy of the model in terms of... - Visualization of anatomical landmarks	Were there any anatomical features that felt inaccurate or missing?	How easy was it to... - Identify the landmarks for the block	How easy was it to... - Insert the needle	How easy was it to... - Use a speculum	How easy was it to... - Perform general procedures	How intuitive was the model? - Intuitivity	Did you encounter any technical issues with the model?	If you did run into technical issues, please elaborate.	Would you reccomend this model to others?	What aspects of the model were most beneficial?	What improvements would make this model better?	Overall, how satisfied are you with this training model? - Satisfaction	Com to ot train meth how effec this r - Effec
Physician	Yes	10	7	6	8	5	Hard to replicate vagina	4	6	6	4	10	Yes	Using the small plastic speculum, I didn't have enough room to expose the cervical vaginal angle. When I switched to a metal speculum with a wider aperture, I could visualize the model better.	Yes	Being able to grasp the cervix with a tenaculum and expose the cervical vaginal angle for injection	Vaginal opening was difficult to get to stay in place, and when I placed the specula the uterus locking mechanism disengaged	7	8
Physician	No	7	9	1	9	8	A real cervix slightly tougher tissue. But this is more realistic than any other model I've	10	10	9	9		Yes	Would be helpful if it were angled slightly forward instead of parallel to	Yes	Length and landmarks were appropriate. Excellent model for using a needle or other	As above	9	9

							ever worked with.							the ground		cervical procedures.			
Physician	No	7	7	5	4	9	Vaginal length is a little short	9	9	7	10	10	Yes	Speculum hangs down and somewhat requires holding it, which takes away a free hand. I worry that repeated use of tenaculum placement and injection will destroy the cervix tissue	Yes	The movement of the cervix is great	Perhaps a little bit of different colors of vaginal wall vs cervix. Longer vaginal canal to allow the speculum to stay in place.	7	7
Physician	No	2	8	9	8	8	No	10	0	10	10	10	No		Yes	-very realistic	If the silicone portions could be a lighter pink to emulate real tissue, that would be a bonus	10	10
Physician	Yes	7	7	5	8	8	The consistency of the cervix was very soft with tenaculum placement, otherwise felt realistic	9	8	7	9	9	No		Yes	Seeing the landmarks and being able to see how deep the needle goes through	Making the tissue pink/more realistic in color	9	9
Resident	No		9	5	6	9	No, color could be more realistic which would help with identification of landmarks.	10	10	10	10	10	No		Yes	Pretty realistic	Potentially having more give on the cervix would provide better simulation. The cervix often pushes away when trying to insert the needle in real life. Overall very satisfied with the model.	10	10

Action Items: Complete data analysis to quantify feedback results.

Product Design Specifications

RENEE SOBANIA - Sep 18, 2025, 8:16 PM CDT



THE UNIVERSITY of WISCONSIN MADISON

PRODUCT DESIGN SPECIFICATIONS:

PARACERVICAL BLOCK TRAINING MODEL

September 19, 2024

Biomedical Engineering 200/300

PCBTM

Client: Jessica Alby

Advisor: Dr. Randolph Ashton

Team Members:

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Cadence Seymour (BPAG) cdseymour@wisc.edu

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Product_Design_Specification_PDS_PCB.pdf (582 kB)

Research 1: Evolution of a Novel 3D-Printed Task Trainer

RENEE SOBANIA - Sep 10, 2025, 12:10 PM CDT

Title: Evolution of a Novel 3D-Printed Task Trainer for the Simulation of Gynecological Procedures at a Medical Academic Center

Date: September 9th, 2025

Content by: Renee Sobania

Present: NA

Goals: To learn about the current 3D printed task trainers for gynecological procedures to see what improvements must be made to our design.

Source:

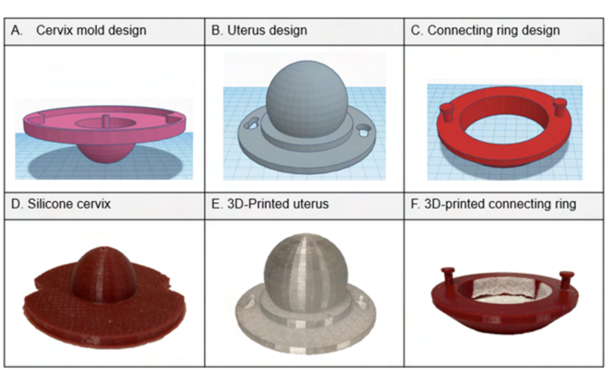
Citation: J. Monico and K. Carlson, "Evaluation of a Novel 3D-Printed Task Trainer for the Simulation of Gynecological Procedures at a Medical Academic Center." Accessed: Sep. 10, 2025. [Online]. Available: https://www.unmc.edu/obgyn/_documents/monico_and_carlson_evaluation_of_3d-printed_gynecological_task_trainer.pdf

Link: monico_and_carlson_evaluation_of_3d-printed_gynecological_task_trainer.pdf

Content:

- Learning and mastering gynecological procedures is very important in the early phases of education
- The innovative gynecological task trainer was created with 3D-printed plastic, silicone and a tabletop base. The task trainer was used to perform gynecologic procedures
- the simulation was realistic and provided practice with medical instruments, enhanced learning, increased comfort with procedures and gave an opportunity for a successful procedure completion
- Easy to assemble with basic hardware supplies, a 2part silicone mixture and access to a 3D printer
- *Goal: Low cost, provides realistic and deliberate practice, offers safe and effective way to develop clinical skills, improve decision making, prepare health care professionals to deliver high quality patient care.*
- *Few low cost, realistic simulation models for gynecologic procedures exist*
- Fourth year medical students and first year residents need to incorporate simulation training to prepare them for patients
- A papaya has been used to simulate the uterus, but it is not anatomically realistic or conductive to performing gynecologic procedures
- Another simulation used a polyvinyl chloride (PVC) tabletop model with a racquetball to simulate the uterus
- Wanted it to be *reusable and realistic*
- *Want the model to have a realistic cervix and be durable, with reusable parts*
- Digital simulator design is a manufacturing process in which 3-dimensional solid objects are created from a digital file allowing shapes to be made from small amounts of material in an economical and fast process
- A uterus, cervix mold and connecting ring was designed

Figure 1: 3D-Printed Plastic and Silicone Components
The cervix mold (A), uterus (B), and connecting ring (C) were created using 3D design software. The cervix was created by pouring a dyed silicone mixture into the cervix mold (D), and the uterus (E) and connecting ring (F) were printed with a 3D printer.

- 

- Cervix mold was used to create an average sized and realistic silicone cervix model.
- The *average human cervix measures 2.5cm in length and 2.5cm in width*
- Their design was 3cm length and 3.8cm width

- *Average size of an adult female nongravid uterus is 8cm* (same as 3D-printed uterus with cervix in place)
- The cervix is held in place between the uterus and a connecting ring that interlocks
- the task trainer consists of a wooden base, PVC tubing and a PVC sanitary "T" connector piece
- The novel uterus and cervix are affixed to the sanitary "T" piece with hook and loop tape and *a gel can be put inside to simulate tissue*. The gel can be obtained and extracted during endometrial biopsy and manual vacuum aspiration procedures
- The *translucency* of the uterus allows learners to visualize instruments when passed through tht cervix and into the uterus
- Costs $15.38 per model
- Participants appreciated the ability to retrieve simulated uterine tissue/contents during the procedures and liked the realism of being able to apply the tenaculum to the cervix and apply gentle traction
- Constructive criticism: "It would be nice to have a **cervicovaginal junction** to practice paracervical blocks before the procedure", If the PVC pipe simulating the vaginal vault had a **silicone lining,** it would help keep the speculum from slipping out", Simulator doesn't have **vaginal walls** + uterus is **immobile plastic**,"
- Components can be repeatedly used and easily cleaned with soap and water
- Silicone cervix and 3D printed parts
- Because a single-toothed tenaculum is appliued to the silicone cervix in many procedures, this portion of the model may need to be replaced eventually
- Each trainer was used for about 18 simulation sessions
- Human factors such as ergonomics were not assessed

Conclusions/action items:

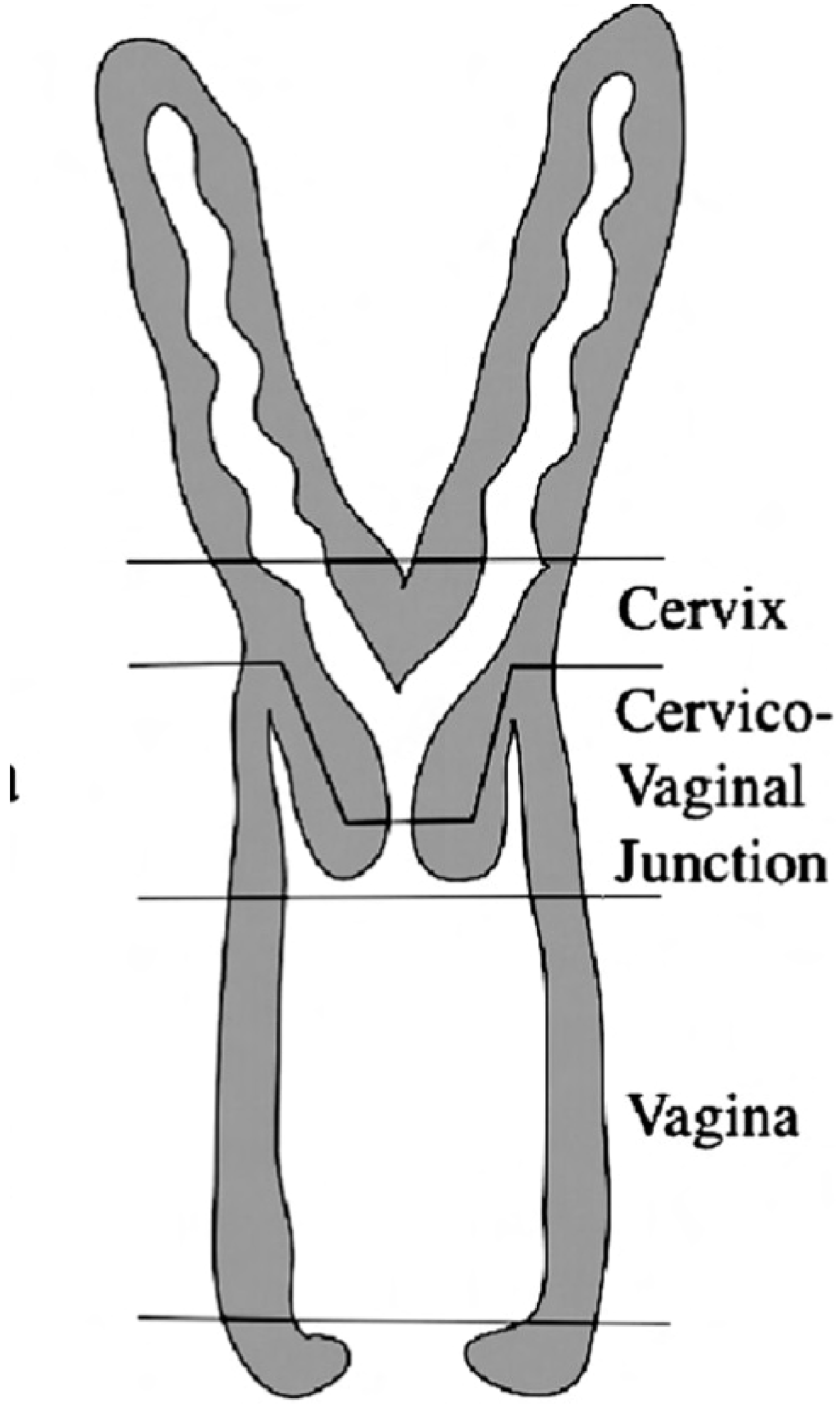
In conclusion, I found from this paper that our goal is to make an affordable realistic model for training during paracervical blocks to prepare healthcare professionals for this procedure. We want this model to be a realistic representation of the cervix and also be durable. While there is already a task trainer that provides a very good model, it is missing important aspects for a paracervical block such as a cervicovaginal junction. Feedback also showed that it would be nice to have a silicone lining, vaginal walls and be a material other than immobile plastic to make it more realistic. Their model was around $15.38 so we should aim around that price range. We also should try to make the models reusable. Our model should also have the proper ergonomics.

Additional helpful readings: How to create this Gynecological Task Trainer:

[How to Create this Gynecological Task Trainer]

J. Monico and K. S. Carlson, “How to Create this Gynecological Task Trainer,” *DigitalCommons@UNMC*, 2024. https://digitalcommons.unmc.edu/com_obgyn_pres/1/ (accessed Sep. 10, 2025).

(Not from this article) Cervico vaginal Junction


Cervix
Cervico-
Vaginal
Junction
Vagina

Evaluation of a Novel 3D-Printed Task Trainer for the Simulation of Gynecological Procedures at a Medical Academic Center

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evaluation_of_3d-printed_gynecological_task_trainer.pdf (711 kB)

Research 2: Paracervical Block Video

RENEE SOBANIA - Sep 10, 2025, 1:06 PM CDT

Title: Paracervical Block Video

Date: September 9th, 2025

Content by: Renee Sobania

Present: NA

Goals: To learn about how a paracervical block works so that we can make a realistic model that will provide good training for future doctors.

Source: Hologic, Inc

Citation: Hologic, Inc., "Paracervical block video - Animation," *YouTube*, Nov. 04, 2015. https://www.youtube.com/watch?v=m0EyyHouT00

Link: Paracervical block video - Animation

Content:

Medications for Paracervical Block

- Lidocaine (With or without epinephrine)
  - With Epinepherine
    - Advantage: Rapid onset
    - Disadvantage: Effect wears off quickly
- With Marcaine
  - Advantage: long lasting
  - Disadvantage: Takes longer to achieve adequate block
- Lidocaine + Marcaine
  - Rapid onset and long-acting block

- The nerves to the uterus are formed on either side by a continuation of the hypogastric plexus the sacral sympathetic efferent fibers from the second, third and fourth sacral nerves and by a few filaments form the first two sacral ganglia.
- The sensation for pain for the patient is mainly due to impulses passing by sensory pathways down the lateral and posterior portions of the cervix into the area of the cardinal and uterus sacral nerves.
- Para cervical block injects a medication in this region to block the impulses leaving the uterus at this junction. Because of this variation there is variability in the technique used to achieve a paracervical block and this may range from a very simplistic two quadrant or four quadrant paracervical block in which the bulk of the material is injected into the uterus echo ligament region.
- However, it may be more complex where a component of the block involves an intracervical injection
- Once the cervix is visualized the anterior lip can be grasped with a single tooth tenaculum for manipulation after which a small amount of anesthetic is injected at two o'clock, four o'clock, eight o'clock, and ten o'clock.
- And in each case, this is injected in the immediate submucosal region so that a small wheel of anesthetic is raised prior to injecting the anesthetic. Aspirating the syringe will ensure that you're not in the intravascular space. After the injection the anesthetic will dissipate into the adjacent tissue, thus delivering the anesthetic to the nerves.
- Experience has shown that patients undergoing an outpatient office based intimate relation can receive significant anesthetic benefits from para cervical block
- The medications for a paracervical block are premixed prior to the procedure, initially the paracervical medications are injected into the 12 o'clock position of the cervix after aspiration to allow the

Conclusion:

This video showed that we ened to have the cervicovaginal junction where the needle would go for the injection so that healthcare professionals could practice the block. There should be an anterior lip on the model that can be grasped with the tenaculum because they need to hold this to perform the injection. We should potentially find a way to replicate the aspiration of the needle to check if they have gone too far.

Future Research: Submucosal Region, Needle Aspiration

Research 3: How to Make Gynecological Task Trainer

RENEE SOBANIA - Sep 10, 2025, 12:56 PM CDT

Title: How to Create this Gynecological Task Trainer

Date: September 10th, 2025

Content by: Renee Sobania

Present: NA

Goals: To learn about how to make the Gynecological task trainer to see if we might want to simulate some of their methods or steps to make the base model which we would modify to make more realistic.

Source: University of Nebraska - Medical Center

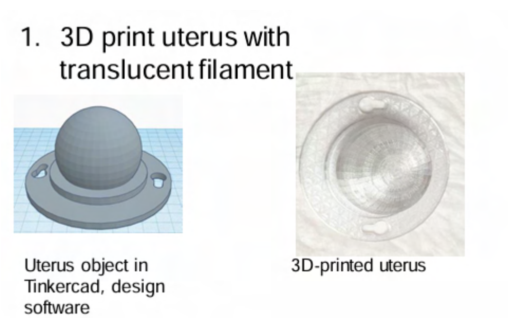
Citation: J. Monico and K. S. Carlson, “How to Create this Gynecological Task Trainer,” *DigitalCommons@UNMC*, 2024. https://digitalcommons.unmc.edu/com_obgyn_pres/1/ (accessed Sep. 10, 2025).

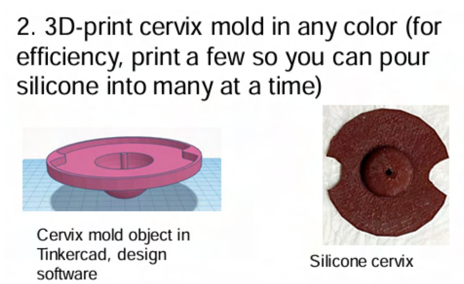
Link: [How to Create this Gynecological Task Trainer](https://digitalcommons.unmc.edu/com_obgyn_pres/1/)

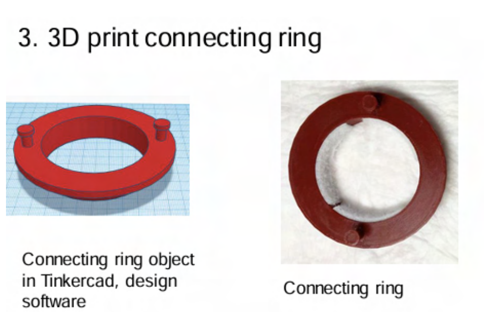
Content:

- Features
    - Tabletop design
    - Reusable
    - Silicone cervix
        - Pliable materials
        - Patent cervical os
    - Viscous substance inside uterus represents tissue
- Simulate gynecological procedures, including
    - Tenaculum placement on the cervix
    - Cervical cancer screening
    - Measure uterine depth with a sound
    - Endometrial biopsy
    - Intrauterine device placement and removal

    - Manual vacuum aspiration
- The simulation can be done with multiple learners due to their tabletop design
- the 3D printing takes the longest amount of time (Durable)
- Silicone cervix was made using EcoFlex 00-20 and take 4 hours to cure. The silicone cervix should last for repeated users but can be damaged from the tenaculum placement

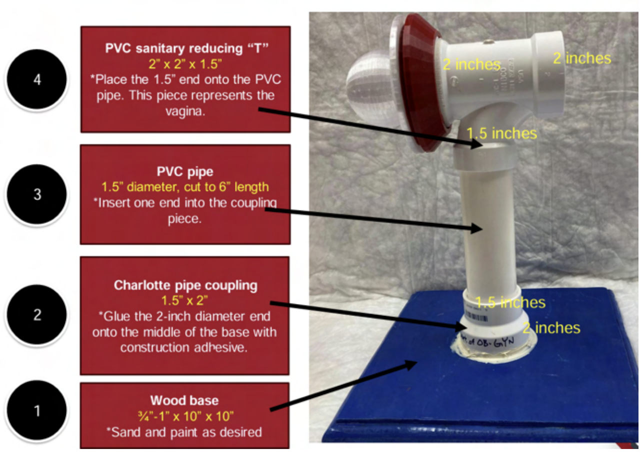
- Base is wooden and PVC pieces to mount the model
- Supply List
  - Task trainer Base
    - Wood base, 3/4" x 10" x 10"
    - Charlotte pipe coupling 1.5" x 2" PVC DWV Hub x Hub increaser/reducer
    - PVC pipe 1.5 inch diameter x 6 inch length
    - PVC DWV All hub sanitary reducing Tee 2 x 2 x 1.5 inches
    - Gorilla construction adhesive - 1 tube
    - Hook and loop tape with adhesive - white, 3/4 in, 5" per task trainer
  - 3D Printed Items
    - For each trainer, create a uterus and a connecting ring and a 3D printed cervix mold- mix and pour silicone into the mold to create the cervix
      - uterus- print with translucent PLA or other hard plastic, 48grams (attached below)
      - Connecting ring- print with red PLA or other hard plastic, 35 grams (below)
      - Cervix mold - print in any color of PLA or other hard plastic, 38g (below)
  - Silicone Cervix
    - Ecoflex 00-20 super soft shore platinum silicone rubber compound
      - Approximately 3oz per cervix (part A 1.5oz and part B 1.5oz)
      - Silicone ease release, 1 can
    - Silc Pic silicone pigments - blood color
    - Stir sticks
    - 3 disposable plastic cups, 12-16 oz
    - Painters plastic or plastic wrap to cover work surface when creating silicone cervix
  - Polyps
    - Red Pipe cleaners- approximately 2 in for each polyp
  - Gel- to simulate uterine tissue/contents
    - Thick-it liquid thickener
    - Red food coloring
    - water
- 






Uterus, cervix, connecting ring, and PVC apparatus
- Silicone Cervix
  1. Assemble supplies for the silicone cervix
  2. Protect work surface with plastic

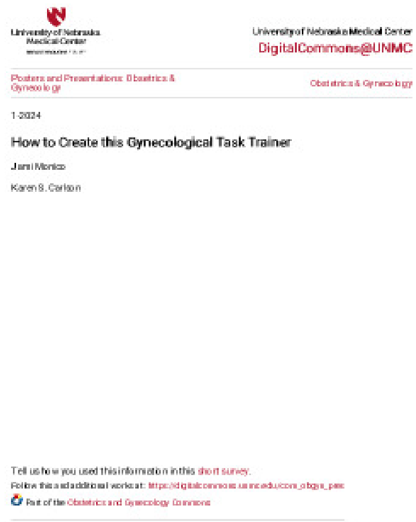
3. Place cervix mold, curved side down on a disposable cup
4. Spray release onto the cervix mold
5. Part A:
    - Pour 1.5oz (3tablespoons) of part A into a plastic cup. Add a small amount of red dye and mix well
6. Part B:
    - Silicone
    - Pour 1.5oz (3 tbsp) of part B into the A cup and mix well
7. Pour the mixture into the mold and allow to cure per manufacturer instructions
8. Gently remove the cervix from the mold

- Cervical polyps may be added to the cervix prior to the simulation. Follow these directions prior to placing the uterus/cervix/connecting ring into the PVC apparatus
    - Cut red pipe cleaner about 2" in length
        - Twist the ends together to form a loop in the middle
    - Make a small incision in the cervix at the desired location of the polyp
    - Insert the pointed end of the polup into the incision
- Assemble the task trainer
    - 

- Uterus and Cervix Assembly
    1. Apply sticky back hook and loop tape (velcro) to the outer edge of the end of the PVC pipe where the uterus will be placed. The velcro should last for repeated uses
    2. Apply the other side of the hook-and-loop tape to the inner edge of the connected ring
    3. if using simulated uterine tissue mix, Thick it with water until a pudding like consistency. Add a drop of red food coloring and pour into the uterus
    4. Assemble the uterus, cervix and connecting ring. Pass the knobs on the outer ring through the holes on the uterus and twist the uterus to secure the pieces.
    5. Place the connecting ring onto the end of the PVC sanitary "T"

Conclusion:

In conclusion, I learned how to make and assemble the different parts of the task trainer. We can potentially use alot of these aspects for our design and some of the 3D prints could also be helpful. In their podel they used Ecoflex 00-20 for the cervix and that is a potential material we could use but it needs more research to confitm that the mechanical conditions are the same to ensure that it would be an accurate representation of the cervical tissue. We need to make our model easy to assemble, take apart, and clean so it is reusable.



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How to Create this Gynecological Task Trainer

Jami Monico

Karen S. Carlson

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RENEE SOBANIA - Sep 10, 2025, 1:14 PM CDT

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cervix.stl (89.4 kB)

RENEE SOBANIA - Sep 10, 2025, 1:14 PM CDT

Download

connecting-ring.stl (49.7 kB)

RENEE SOBANIA - Sep 10, 2025, 1:14 PM CDT

Download

uterus.stl (127 kB)

Research 4: Paracervical Block Technique

RENEE SOBANIA - Sep 10, 2025, 3:04 PM CDT

Title: Paracervical Block Technique

Date: September 10th, 2025

Content by: Renee Sobania

Present: NA

Goals: To learn about how to perform a paracervical block, and what the technique is so I can get a better understanding of how to make a model that would provide accurate training.

Source: Ipas

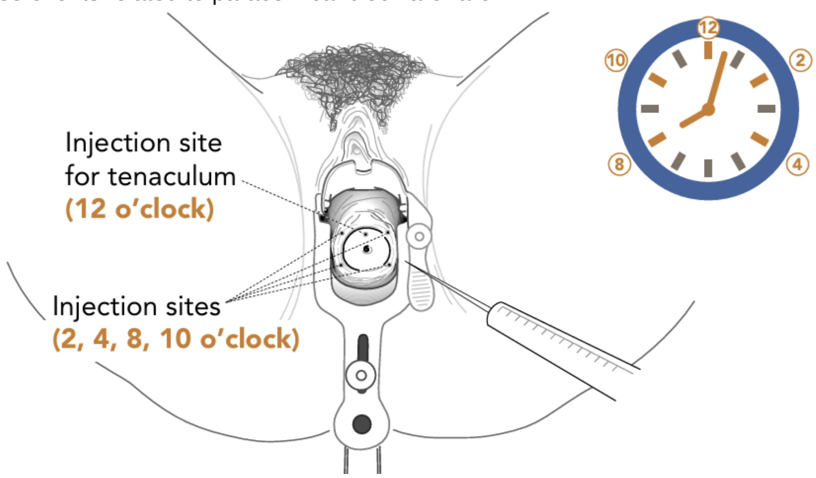
Citation: pdf

Link: Paracervical-Block-Technique-PARABLK-E21.pdf

Content:

1. Prepare lidocane syringe using 20mL of 1% lidocane and a 3cm (1in) needle
2. Place the speculum and perform cervical antiseptic prep
3. Inject 2mL of lidocane superficially into the anterior lip of the cervix where the tenaculum will be placed (12'o'clock)
4. Grasp cervix with the tenaculum at 12' o'clock
5. Inject remaining lidocaine in equal amounts at the cervicovaginal junction, at 2,4,8, and 10 o'clock
6. Begin Procedure without delay

Practice Tips
-Don't exceed the lidocaine max dose of 4.5mg/kg or 200mg total
- if 1% lidocaine unavailable, 10mL of 2% can be substituted. A two point paracervical block technique (injecting at 4 o'clock and 8 o'clock) may be used
-Deep injection of lidocaine (3cm or 1in) provides more effective pain relief than superficial injection
-Aspirate before injecting to prevent intravascular injection
-Possible side effects seen with intravascular injection include peri-oral tingling, tinnitus, metallic taste, dizziness or irregular/slow pulse
-Midlevel providers trained to provide paracervical block demonstrate similar safety and efficacy as physicians
-Serious adverse events related to paracervical block are rare



Conclusion:

In conclusion, this onesheet showed how a paracervical block is performed along with some practice tips. It shows that there are typically 5 total injections and it shows how much dosage should be done for the injections. Now I want to do more research on the anatomy of the cervix to get a better understanding of what our model should look like.

RENEE SOBANIA - Sep 10, 2025, 1:15 PM CDT

PARACERVICAL BLOCK TECHNIQUE

Injection site for tenaculum (12 o'clock)

Injection sites (2, 4, 8, 10 o'clock)

1. Prepare lidocaine syringe using 20mL of 1% lidocaine and a 3cm (1in) needle.
2. Place the speculum and perform cervical antiseptic prep.
3. Inject 2mL of lidocaine superficially into the anterior lip of the cervix where the tenaculum will be placed (12 o'clock).
4. Grasp cervix with the tenaculum at 12 o'clock.
5. Inject remaining lidocaine in equal amounts at the cervicovaginal junction, at 2, 4, 8 and 10 o'clock.
6. Begin procedure without delay.

PRACTICE TIPS

- Do not exceed the lidocaine maximum dose of 4.5mg/kg or 200mg total.
- If 1% lidocaine is unavailable, 10mL of 2% may be substituted. A two-point paracervical block technique (injecting at 4 and 8 o'clock) may be used.
- Deep injection of lidocaine (3cm or 1in) provides more effective pain relief than superficial injection.
- Aspirate before injecting to prevent intravascular injection.
- Possible side effects seen with intravascular injection include peri-oral tingling, tinnitus, metallic taste, dizziness or irregular/slow pulse.
- Midlevel providers trained to provide paracervical block demonstrate similar safety and efficacy as physicians.
- Serious adverse events related to paracervical block are rare.

For more information, visit www.ipas.org/clinicalupdates.

Ipas Partners for Reproductive Justice

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Paracervical-Block-Technique-PARABLK-E23.pdf (191 kB)

Research 5: Cervix

RENEE SOBANIA - Sep 18, 2025, 8:12 PM CDT

Title: Cervix

Date: September 10th, 2025

Content by: Renee Sobania

Present: NA

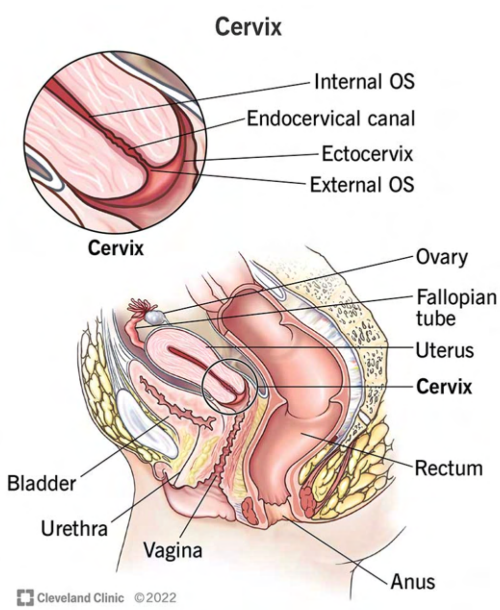
Goals: To learn more about the cervix, its functions, and its anatomy to get a better understanding of what it is and what it looks like so we can make a realistic model.

Source: Cleveland Clinic

Citation: Cleveland Clinic, "Cervix: Anatomy, Function, Changes & Conditions," *Cleveland Clinic*, Jun. 15, 2022. https://my.clevelandclinic.org/health/body/23279-cervix

Link: Cervix: Anatomy, Function, Changes & Conditions

Content:

- The cervix is a small canal that connects your uterus and vagina. It allows fluids to leave and enter your uterus
- 

- The cervix is a muscular, tunnel like organ. It's the lower part of your uterus and it connects your uterus and vagina
  - * Cervix is also a common site for cell changes that may indicate cancer
- Your cervix is a passage that allows fluids to flow inside and out of your uterus. It's also a powerful gatekeeper that can open and close in ways that make pregnancy and childbirth possible
- Period blood has to pass from your uterus and through your cervix before exiting the vagina
- During intercourse when sperm is released into the vagina, the sperm travels through the cervix to reach your uterus and fallopian tubes to fertilize an egg
- Your cervical mucus plays a role in how easily you can become pregnant. Around ovulation (body releases egg), your cervix secretes mucus that's thinner and less acidic than usual making it easier for sperm to pass through to your uterus
- During pregnancy your cervix secretes a mucus plug that seals entry to your uterus, when it's time for the baby to be born the mucus plug dissolves and your cervix becomes softer and thinner.
- Your cervix prevents objects inserted into the vagina from slipping into the uterus

- The cervix is located inside the pelvic cavity, anywhere from 3-6 inches inside your vaginal canal. It begins at the base of your uterus and extends downward onto the top part of your vagina. The place where your cervix bulges onto the uppermost part of your vagina is called your ectocervix.
- Your vagina, cervix and uterus are located behind your bladder and urethra, and in front of your rectum and anus
- Your cervix is shaped roughly like a cylinder or tube and connects your uterus to your vagina. Your cervix is wider in the middle and narrow at both ends, where it opens to your uterus (top) and vagina (bottom)
- Your cervix consists of:
    - Internal OS: The opening that leads to your uterus.
    - Endocervical canal: a tunnel that extends from your internal OS to your ectocervix
    - Ectocervix: The part of your cervix that bulges onto the top of your vagina
    - External OS: the opening that leads to your vagina
- The place where the endocervical canal overlaps with the ectocervix is the transformation zone (TZ) which is where cell change happens most.
- The cervix is about an inch long but cervical sizes vary
    - Generally larger if you have given birth
    - Larger among people in reproductive years than those who've gone through menopause
- During your menstrual cycle, if you insert your longest finger into your vaginal canal, you should reach a barrier preventing your finger from sliding in further, this is the cervix
- It may feel firm and tight or soft and spongy. The location and texture depends on if you are ovulating or not
- Your cervix is made of strong fibromuscular tissue. Two main types of cells line your cervix
    - Glandular cells: these cells line the endocervical canal, the innermost part of your cervix
    - Squamous cells: these cells cover the ectocervix, the outermost part of your cervix, and your vagina
- These different cell types meet at the TZ, where cell changes frequently take place.

Conclusions/action items:

In conclusion, I learned about the structure and anatomy of the cervix. This information will help build an anatomically accurate model for the paracervical block model because the locations and distances between each part of the cervix is important to having an accurate structure.

Research 6: How to Do a Paracervical Block

RENEE SOBANIA - Sep 12, 2025, 12:31 PM CDT

Title: How to Do a Paracervical Block

Date: September 12th, 2025

Content by: Renee Sobania

Present: NA

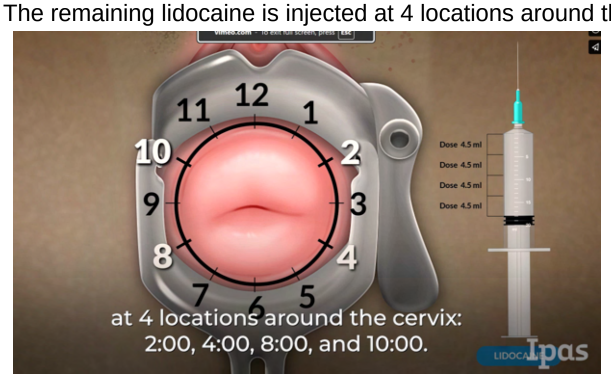
Goals: To see a real paracervical block and understand how the real procedure is done on a person so I can make a model that can help train healthcare workers.

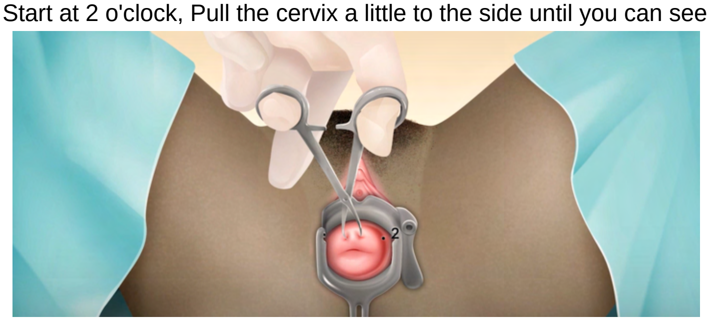
Source: Ipas

Citation: Ipas, “How to do a Paracervical Block,” *Vimeo*, Mar. 21, 2022. https://vimeo.com/690508206 (accessed Sep. 12, 2025).

Link: [How to do a Paracervical Block on Vimeo](https://vimeo.com/690508206)

Content:

- Draw up either 20mL of 1% lidocaine or 10mL of 2% lidocaine
- Clean the cervix with antiseptic
- Then do the paracervical block
  - First inject 1-2mL of lidocaine into the cervix at the 12'oclock position
    - Pull back on the syringe so that you do not inject into a blood vessel
  - Attach the tenaculum at that location
  - The remaining lidocaine is injected at 4 locations around the cervix, the 2, 4, 8 and 10 o'clock positions
  - 

  - Dose of 4.5mL
  - Start at 2 o'clock, Pull the cervix a little to the side until you can see where the smooth cervix joins the vagina
  - 
    - insert the needle deeply to give better pain relief
    - pull back on the syringe to avoid injecting into a blood vessel
    - insert the dose of lidocaine
  - Continue around the cervix, injecting an equal amount of lidocaine at each location
  - The woman may still feel cramping after the injection, but it will not hurt as much

Conclusions/action items:

in conclusion, i got a better idea of how to perform a paracervical block by watching an actual procedure being done. I also got a better idea of where the injection goes. In our model we will need to try to figure out a way to make the area where the smooth cervix joins the vagina (cervicovaginal junction) so the paracervical block can be performed.

Research 7: A Synthetic Cervix Model and the Impact of Softness on Cerclage Integrity

RENEE SOBANIA - Oct 01, 2025, 12:28 PM CDT

Title: A Synthetic Cervix Model and the Impact of Softness on Cerclage Integrity

Date: 10/1/2025

Content by: Renee Sobania

Present: NA

Goals: To find some different materials that we could potentially use to model the cervix with correct mechanical properties.

Source: PubMed

Citation: A. Baumer, A. C. Gimovsky, M. Gallagher, and M. C. Leftwich, "A synthetic cervix model and the impact of softness on cerclage integrity," *Interface Focus*, vol. 9, no. 5, pp. 20190009–20190009, Aug. 2019, doi: https://doi.org/10.1098/rsfs.2019.0009.

Link: A synthetic cervix model and the impact of softness on cerclage integrity - PMC

Content:

- Cerclage procedure: a purse string suture to close the cervix
- Purpose is to understand the limitations of the cerclage procedure
- They created a 3 dimensional model of the cervix from ultrasound images
- To fabricate synthetic cervices they used silicone rubber to mimic the qualitative feel of the cervix according to collaborating physicians
- They performed material testing for quantitative analysis
- Max force for synthetic tissue to rupture due to the cerclage stich was recorded and the impact of material softness on the integrity of the cerclage was investigated
- Anatomically, the cervix is attached to the pelvic sidewall and the sacrum via the cardinal and uterosacral ligaments.
- Outer diameter of the synthetic cervix is 38mm
- Inner diameter varies
- length of the synthetic cervix is 30mm (slightly longer than the physiological length of a short cervix but will allow investigation into the effects of cervical softness in the current studies while reserving cervical length for future analysis.

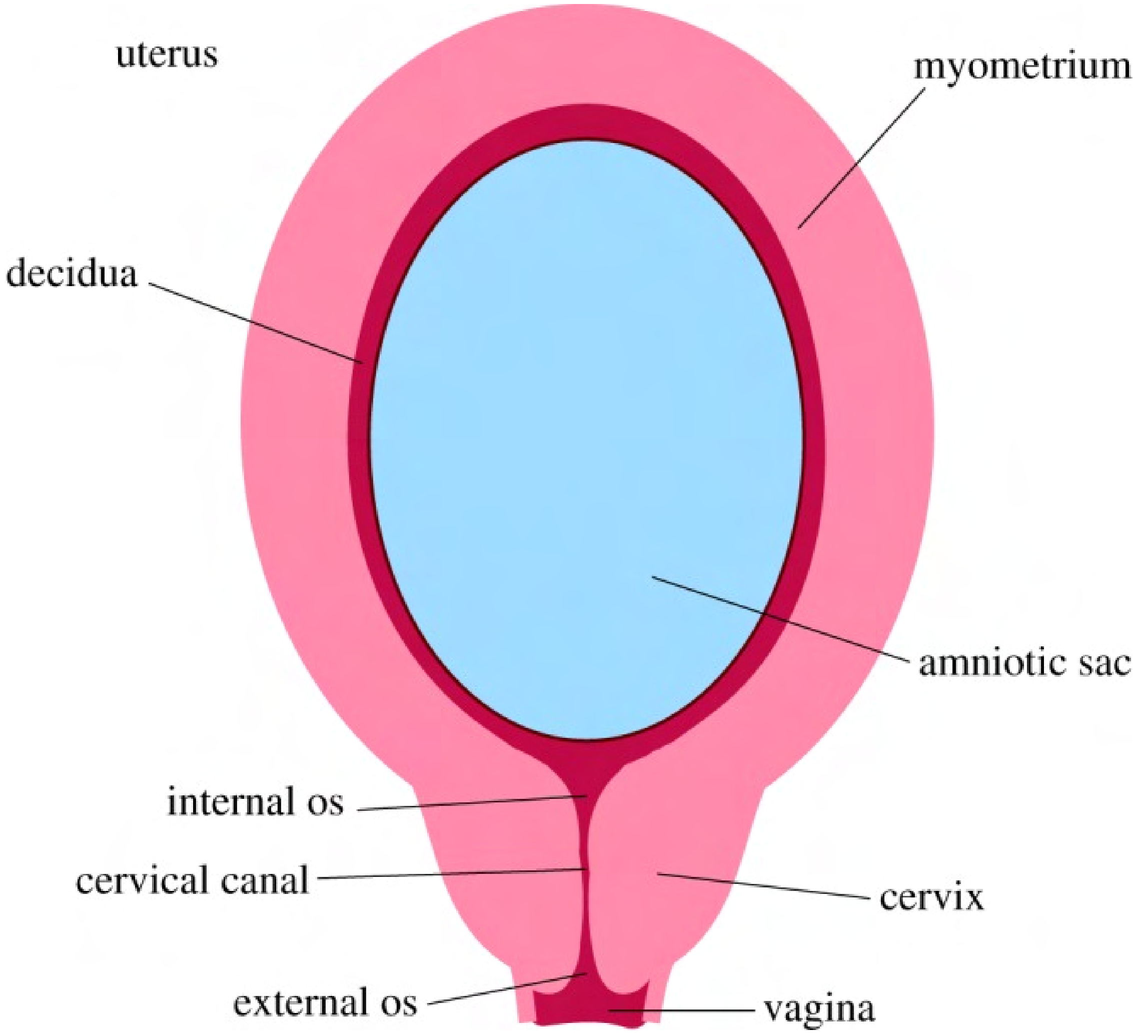
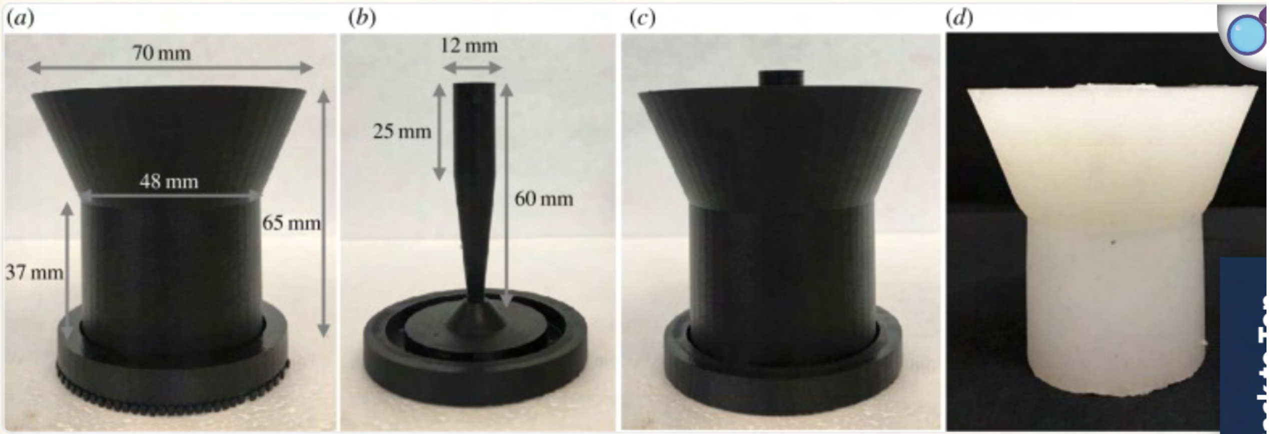
- 
uterus
myometrium
decidua
amniotic sac
internal os
cervical canal
cervix
external os
vagina

Figure 4.

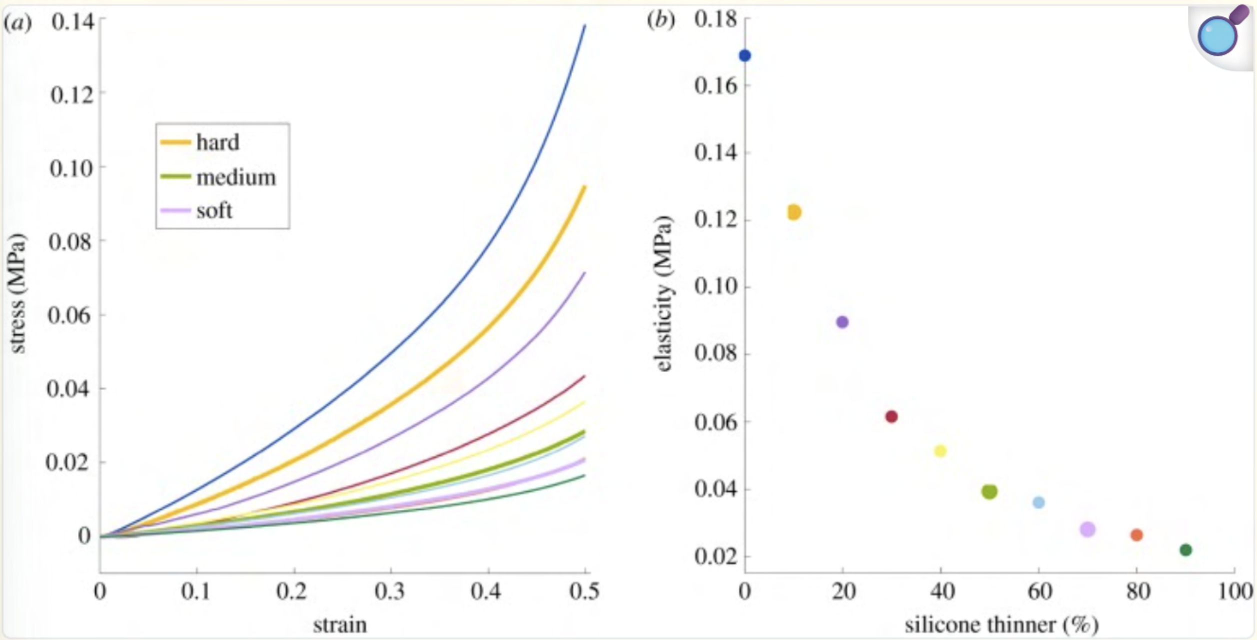


Open in a nev

Panel (*a*) shows the outer piece of the cervical mould; (*b*) shows the inner section of the cervical mould used in these experiments. Panel (*c*) shows the outer and inner pieces assembled into one and (*d*) shows the resulting silicone model removed from the mould after curing. (Online version in colour.)

-
- the middle section has a funneling diameter where the widest part is 12mm
- Fabricated using **EcoFlex 00-20 (Smooth On, Inc, Macungie, PA, USA)**
  - parts A + B were mixed in equal amounts
  - Silicone thinner was added to adjust the material softness
  - Once the thinner was added, the mixture was placed in a vacuum chamber to remove any air bubbles
  - Mixture poured into prints and left to cure for 8 hours
- 10 different types of synthetic cervical tissue with increasing softness by varying the percentage of silicone thinner from 0% by volume up to 90%
- Samples were tested with uniaxial compression testing to find stress-strain relationship using an MTS machine
  - Load cell model LPS.503 with a force rating of 5kN
  - Extension rate 10mm min^-1
- Elastic modulus E of 10 different silicone mixtures with different % of thinner

Figure 5.



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The material testing results of the silicone samples (*a*) The stress–strain curves for e
of the 10 types of silicone tested. (*b*) The modulus of elasticity of the linear region is
reported as a function of silicone thinner added to the sample. (Online version in colo

- the silicone mixtures were identified by the physicians who found the most similar % to the feel of a cervix at different times. Hard (10%, E=0.12MPa), medium (50%, E= 0.04MPa), soft (70%, E= 0.03MPa)
- Increased tissue stiffness also increased the force to rupture

Conclusions/action items:

In conclusion, I found that a good material would be Ecoflex 00-20 and that we could potentially add a silicone thinner to adjust for mechnaical properties. Probably between 10-50% would be a good amount to add to get an accurate mechanical strength. I need to identify more studies that find the strength of the cervical stiffness however.

Future reads

[Cervical stiffness evaluated in vivo by endoflip in pregnant women - PubMed]

[Mechanical and biochemical properties of human cervical tissue - ScienceDirect]

Research 8: Mechanical and Biochemical Properties of Human Cervical Tissue

RENEE SOBANIA - Oct 01, 2025, 1:12 PM CDT

Title: Mechanical and Biochemical Properties of Human Cervical Tissue

Date: October 1st, 2025

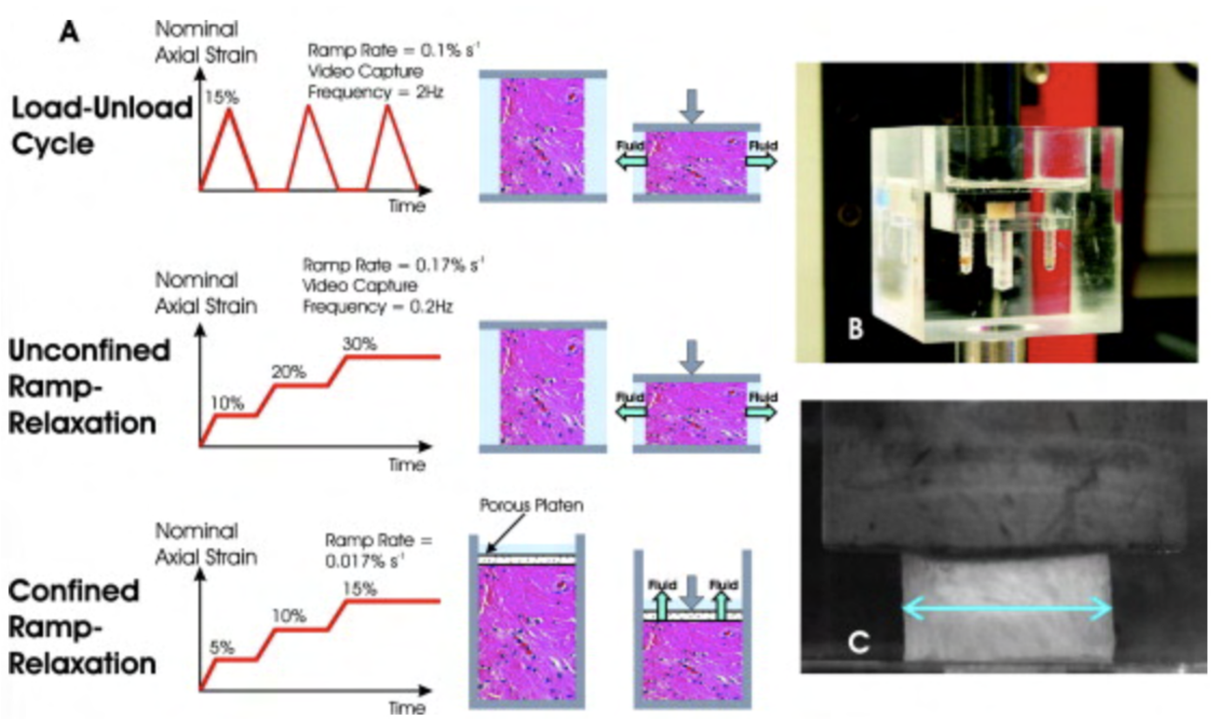
Content by: Renee Sobania

Present: NA

Goals: To determine the mechanical properties of the cervix so I can find a material with similar properties to mimic this.

Content:

- Cervix is firm and rigid at the beginning of a pregnancy
- Did this test on nonpregnant hysterectomy patients with no previous vaginal deliveries
- Tissue samples were tested in confined compression, unconfined compression and tension
- Nonpregnant tissues are stiffer in tension and compression
- Investigations on quantitative measurements of the tissue mechanical properties is very limited
- Nonpregnant cervix is significantly more deformable compared to nonpregnant cervix
- An aspiration device was developed to measure cervical softness
    - Study on nonpregnant human cervical tissue concluded that variations in the mechanical properties of the cervix measured in vitro and in vivo were negligible
- Mechanical testing done with Zwick Z2.5 with specimens immersed in PBS bath in custom designed acrylic fixtures
    - 20N load cell for compression
    - 500N load cell for tension



-
- Peak and equilibrium stresses for unconfined compression, confined compression

Table 4. Peak and equilibrium stresses for unconfined compression

Obstetric case	N_c	N_s	10% Peak (kPa)	20% Peak (kPa)	30% Peak (kPa)	10% Equilibrium (kPa)	20% Equilibrium (kPa)	30% Equilibrium (kPa)
NPND	5	7	0.66±0.46	3.2±3.2	12±14	0.31±0.24	0.72±0.53	1.2±0.78
NPPD	3	9	0.39±0.38	1.6±2.3	6.0±9.6	0.21±0.17	0.50±0.39	0.82±0.76
PCS	2	3	0.15±0.12	0.30±0.24	0.56±0.64	0.10±0.06	0.17±0.15	0.28±0.23

Table 5. Peak and equilibrium stresses for confined compression

Obstetric case	N_c	N_s	5% Peak (kPa)	10% Peak (kPa)	15% Peak (kPa)	5% Equilibrium (kPa)	10% Equilibrium (kPa)	15% Equilibrium (kPa)
NPND	5	9	1.8±3.7	5.6±9.4	14±17	0.38±0.57	0.99±1.1	1.5±1.4
NPPD	3	8	0.82±2.0	2.9±5.7	7.8±13	0.23±0.40	0.55±0.78	1.1±1.2
PCS	2	5	0.12±0.07	0.17±0.10	0.28±0.18	0.07±0.07	0.10±0.08	0.12±0.08

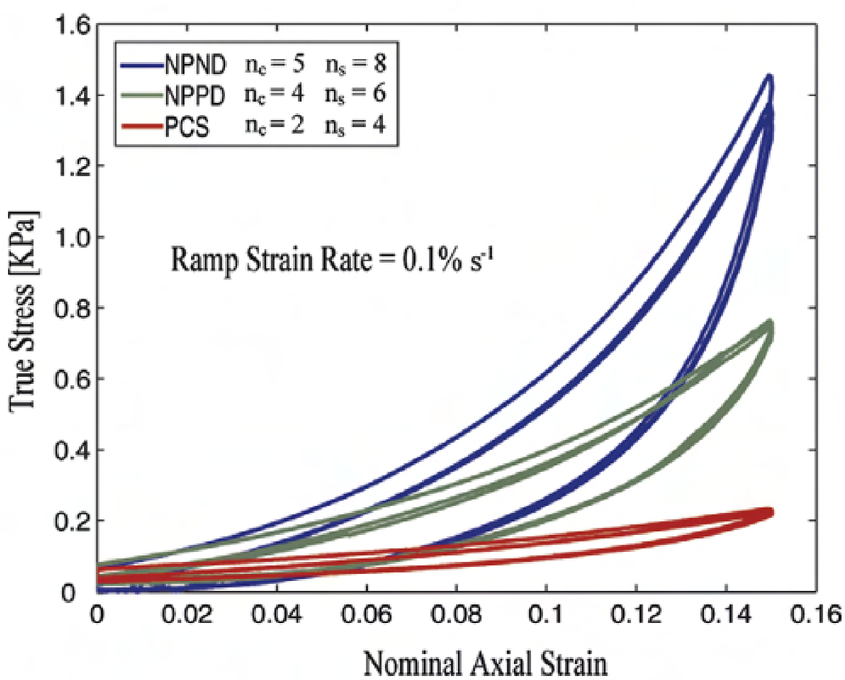


Fig. 5. Cervical stroma response to uniaxial compression cycles. Experimental curves were averaged for each obstetric case.

NPND (Non-pregnant, no previous deliveries)

From Table 4 – Unconfined compression

- 10% strain: Peak = 0.66 kPa → $E = 0.66/0.10 \approx 6.6\,\mathrm{kPa}$
- 20% strain: Peak = 3.2 kPa → $E = 3.2/0.20 \approx 16\,\mathrm{kPa}$
- 30% strain: Peak = 12 kPa → $E = 12/0.30 \approx 40\,\mathrm{kPa}$

So modulus range ~**7–40 kPa** (≈ **0.007–0.04 MPa**).

From Table 5 – Confined compression

- 5% strain: Peak = 1.8 kPa → $E = 1.8/0.05 \approx 36\,\mathrm{kPa}$
- 10% strain: Peak = 5.6 kPa → $E = 5.6/0.10 \approx 56\,\mathrm{kPa}$
- 15% strain: Peak = 14 kPa → $E = 14/0.15 \approx 93\,\mathrm{kPa}$

So modulus range ~**36–93 kPa** (≈ **0.036–0.093 MPa**).

Conclusions/action items:

In conclusion I was able to find some stress vs. strain graphs for compression and tension.

Future read: doi:10.1016/j.media.2005.06.001

Research 9: Mechanical Properties of the Human Uterine Cervix: An In Vivo Study

RENEE SOBANIA - Oct 10, 2025, 12:28 PM CDT

Title: Mechanical Properties of the Human Cervix: An In Vivo Study

Date: 10/10/2025

Content by: Renee Sobania

Present: NA

Source: Biomedical Engineering Society

Citation: Linked Below

Link: Below

Goals: To continue looking into the mechanical properties of the cervix to help guide our search on a material that will replicate these properties.

Content:

- This study measures the anisotropic mechanical properties of the human uterus using optical coherence tomography (OTC), instrumented spherical indentation and video extensometry
- Spherical indentation and digital image correlation to obtain the tissue's force and deformation response to a ramp-hold loading regimen
- identified the mechanical properties of human uterine specimens taken across different anatomical locations and layers from non-pregnant and pregnant.
- the study aimed to characterize the anisotropic mechanical properties of human uterine tissue
- Researchers used a combination of optical coherence tomography (OCT) to map fiber architecture, spherical indentation with video extensometry to measure mechanical response and inverse finite element analysis (IFEA) with a genetic algorithm to fit constitutive models to the experimental data.
- Tissue samples from one non-pregnant (NP) patient with fibroids and one pregnant (PG) patient with placenta accreta.
- Full thickness uterine specimens were taken from three anatomical locations (anterior, posterior, fundus) and sliced into layers, OCT imaging revealed fiber bundle orientation and dispersion, while four level ramp hold indentation tests quantified force-strain behavior under controlled hydration and strain conditions. This allowed comparisons across different uterine wall layers and locations
- NP and PG uterine tissues showed preferential collagen fiber alignment but with distinct patterns: NP tissues had more oblique fiber orientations, while PG tissue had more longitudinally aligned fibers, consistent with adaptation to uterine expansion in pregnancy.
- PG tissues had more dispersed fiber distributions, suggesting structural remodeling that distributes strain more uniformly during gestation
- uterus displayed nonlinear, anisotropic and time dependent force-strain responses to indentation
- On average, the fitted constitutive parameters were: **Young's modulus ~1.76 ± 0.67 kPa**, **Poisson's ratio ~0.33 ± 0.12**, and **fiber stiffness ~0.39 ± 0.34 kPa**.
- These properties varied across anatomical sites and tissue depth, with the posterior wall generally stiffer than the anterior or fundus in the Np uterus,.
- Uterus has heterogeneous, anisotropic mechanical behavior

-

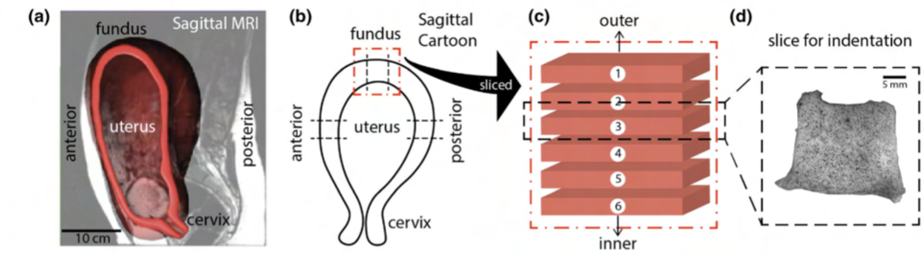


FIGURE 1. Human anatomy, tissue collection, and specimen preparation. (a) The uterus and cervix are segmented from an MRI of a 24-week pregnant patient.[12] (b) Uterine specimens were collected through the full thickness at three anatomical locations: the anterior (front) wall, the posterior (back) wall, and the fundus (top). (c) Each specimen was sliced through the thickness, parallel to the uterine wall surface, into multiple slices with a height of 3 to 5 mm. The tissue slices were numbered 1 to 6 from the outermost to the innermost layer. (d) A representative specimen slice viewed from the bottom (with speckling pattern for digital image correlation analysis ("Digital Image Correlation (DIC)" section)).

TABLE 2. Uterine specimen dimensions.

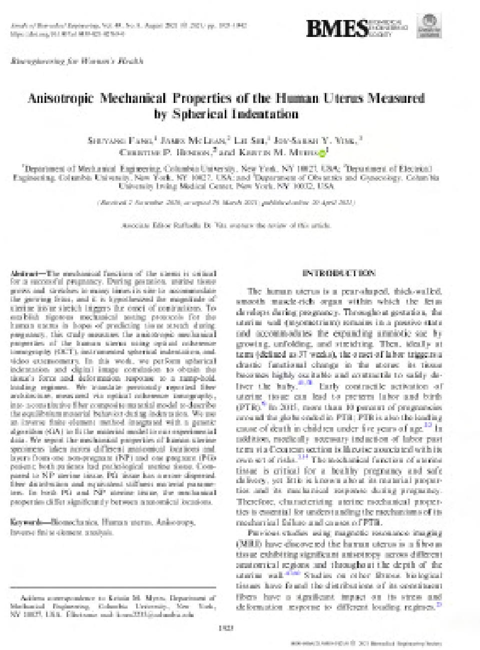
Tissue type	Length (mm)	Width (mm)	Thickness (mm)
NP	23.07±2.40	20.41±2.91	4.84±0.61
PG	25.30±3.21	20.82±3.70	4.43±0.93

-

Conclusions/action items:

In conclusion, I was able to find more numbers that show the young's modulus of the different Anatomical regions to find a material that will replicate them.

RENEE SOBANIA - Oct 10, 2025, 12:10 PM CDT



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s10439-021-02769-0.pdf (9.69 MB)

Research 10: Mechanical Properties of Femals Reproductive Organs

RENEE SOBANIA - Oct 10, 2025, 12:38 PM CDT

Title: Mechanical Properties of Female Reproductive Organs and Supporting Connective Tissues

Date: October 10th, 2025

Content by: Renee Sobania

Present: NA

Source: ASME

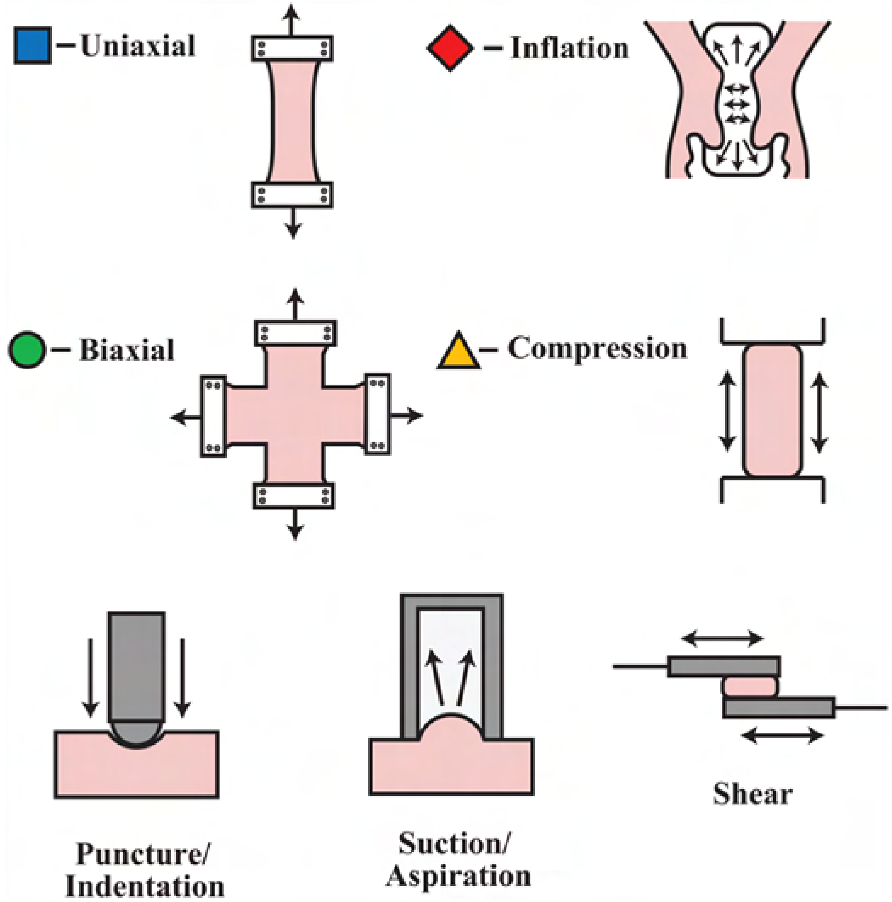
Citation: A. Baah-Dwomoh, J. McGuire, T. Tan, and R. De Vita, "Mechanical Properties of Female Reproductive Organs and Supporting Connective Tissues: A Review of the Current State of Knowledge," *Applied Mechanics Reviews*, vol. 68, no. 6, Sep. 2016, doi: https://doi.org/10.1115/1.4034442.

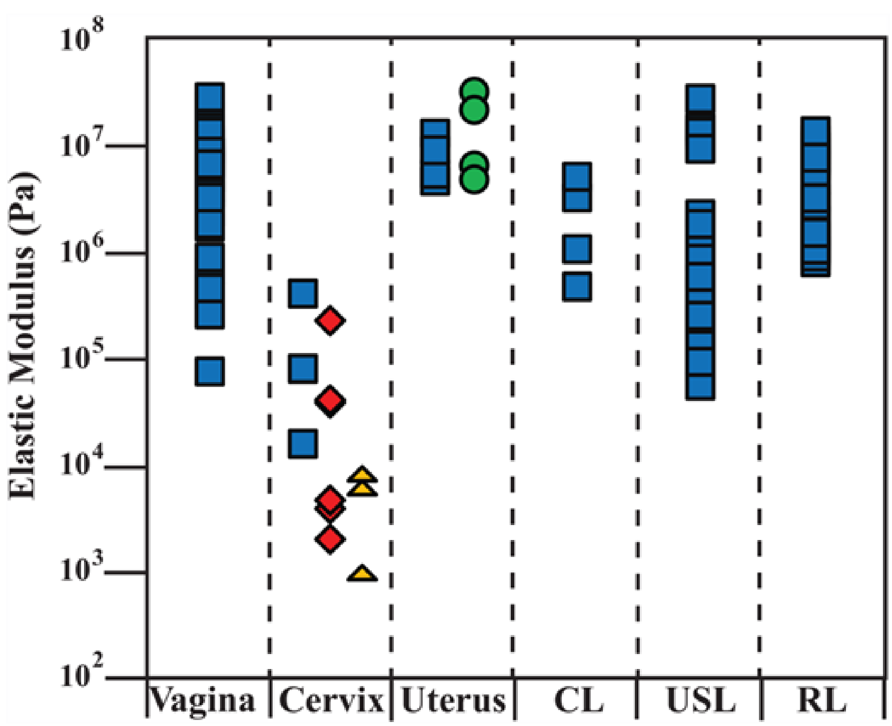
Link: [Mechanical Properties of Female Reproductive Organs and Supporting Connective Tissues: A Review of the Current State of Knowledge | Appl. Mech. Rev. | ASME Digital Collection]

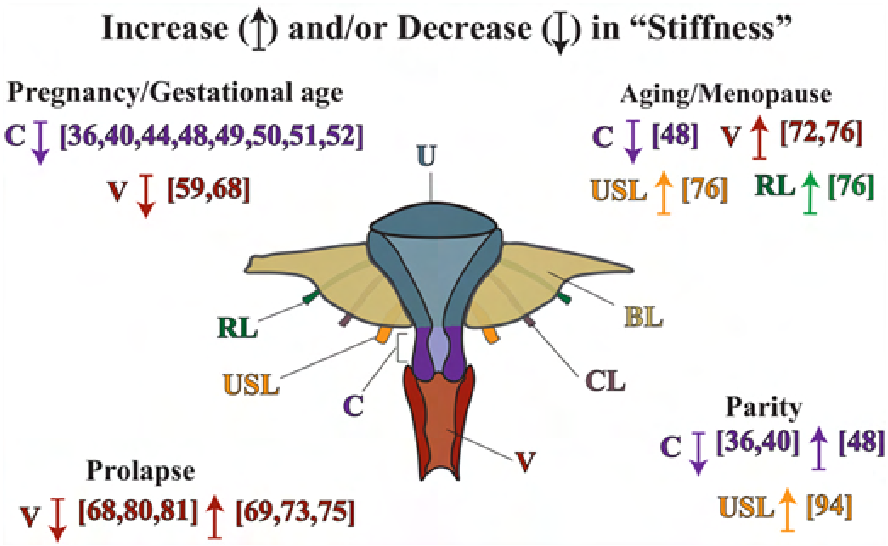
Goals: To learn more about the mechanical properties of the uterus and vagina as well as the cervix.

Content:

- Scientists used ex vivo tests on removed tissue for things like tension, compression, and indentation
- They also did in vivo tests on living patients such as ultrasound and aspiration
- They measured how tissues stretch, compress and recover, which tells us how flexible they are
- The uterus is highly adaptable and stretches many times its size in pregnancy and contracts powerfully in labor. Its stiffness changes with pregnancy stage
- The cervix starts firm but softens and remodels in stages (softening, ripening, dilation, repair) to allow birth. Pregnant cervical tissue is much softer and more compliant that nonpregnant tissues
- Vagina is elastic and can remodel after pregnancy or prolapse. Stiffness changes with age, menopause and childbirth
- Pelvic ligaments support the organs and become stiffer or weaker with age, pregnancy or prolapse which can contribute to pelivic floor problems
- No standardized testing methods and results vary widely betwen studies. Most data comes from patients with medical conditions or animal models. More consistent research is needed to design better surgical repairs, prevention strategies and biomaterials for womens's health

- 

- Elastic moduli were reported to be in the range of 0.02–1.4 MPa for the uterus, 2.5–30 MPa for the vagina, 2.17–243 kPa for the cervix, 0.75–29.8 MPa for the uterosacral ligament, 0.5–5.4 MPa for the cardinal ligament, and 9.1–14.0 MPa for the round ligament.
- 



Conclusions/action items: In conclusion, I was able to find some more numbers on the young's/elastic modulus of the vagina, cervix and uterus and while these numbers are very inconsistent, they could provide a good range to stick in.

Research 11: MTS Insight Machine

RENEE SOBANIA - Oct 16, 2025, 6:02 PM CDT

Title: MTS Insight Machine

Date: October 16th, 2025

Content by: Renee Sobania

Present: NA

Goals: To learn more about the MTS insight machine so I am prepared for testing with Eco Flex 00-20 and can write a procedure for how to perform testing.

Source: MTS

Citation: "MTS," *MTS*, 2025. https://www.mts.com/en/applications/materials/test-standard/iso/iso-527-4 (accessed Oct. 16, 2025).

Link: ISO 527-4: Tensile Properties - Isotropic & Orthotropic FRP Composites

Content:

MTS Insight - Model 5kN

- Bionix Enviro Bath - Bio chamber and controller (use ss fixtures)
- Load cells: 50N, 250N, 1kN (2), and 10kN
- **Compression** Fixtures: 1kN, and 10kN
- **Tensile grips**: 100N rubber, 100N (SS), 2kN, and 10kN
- Bend Fixtures: 3- & 4-point 60mm (SS) and 3&4 point 60mm
  - **Eco flex 00-20 is an isotropic material so it has the same value when measured in different directions
- Uniaxial tensile force is applied to a flat test specimen to investigate stress/strain behavior and critical materials properties including tensile modulus, tensile strength, elongation at break and Poisson's ratio
- Tensile test is performed by placing a test specimen in the grips of either a servo hydraulic or an electromechanical testing machine and subjecting the specimen to controlled tension load until failure. The specimen response can be measured with a contacting or non-contacting extensometer or strain gages. ISO 527-5 is also commonly used for tensile testing of unidirectional fiber reinforced composites
- System components and operation:
  - Load frame provides mechanical loading via a DC servo motor and precision ball screw drive
  - PC with Test Works 4 software controls the test, and collects and analyzes the data
  - handset controller allows you to control the crosshead movement and test control near the specimen
- Test Works 4 Software essentials
  - Three test packages
    - essentials - preset standard methods (tensile, compressive, peel, flexure)
    - Advanced - adds non-motion control segments (hold, relax, dwell)
    - Creator allows you to build fully custom test sequences
  - Select test--> run test (monitor live data) --> review/ report results
  - Data can be customized, exported or automatically archived to your lab network.
- verify the load cell is recognized to prevent calibration entry effors
- ensure crosshead limits and travel ranges are defined to prevent over travel
- Install grips/fixtures using the anti-rotate pin to maintain alignment and prevent drops
- Zero the load, extension and strain channels before applying load
- Safety features

    - Emergency stop button
    - remote enable/disable switch
    - Adjustable mechanical limits
    - overheat shutoff
    - safe system voltage: 48V
- Check for proper specimen alignment, firmly secured grips, and crosshead limit switches set before motion
- Calibration and accuracy
    - Follow ASTM calibration standards on site to maintain +/- 0.05% speed accuracy and 0.01mm position accuracy
    - Load cells use TEDs autorecognition for easier calibration and error reduction
- Testing protocol
    - Power on and connect to load cell (verify TEDS recognition)
    - Set mechanical and software limits
    - mount specimen, check alignment
    - zero all channels
    - select proper test method in Test Works
    - run test and monitor force-displacement graph live
    - use emergency stop if needed
    - save and export data upon completion

Conclusions/action items:

In conclusion, I found out some very helpful and useful information to perform MTS testing. next steps: book an appointment/session to use the MTS machine once an Eco Flex strip has been poured.

RENEE SOBANIA - Oct 16, 2025, 12:31 PM CDT

[Download](#)

mts-insight-_manual.pdf (2.5 MB)

Research 12: Uterus Dimensions: Size, Shape & What it Means for Fertility

RENEE SOBANIA - Oct 24, 2025, 12:16 PM CDT

Title: Uterus Dimensions Explained: Size, Shape and What it Means for Fertility

Date: October 24th, 2025

Content by: Renee Sobania

Present: NA

Goals: To learn about the shape and dimensions of the uterus so I can replicate the shape in the model.

Source: Noida Fertility

Citation: admin, “Uterus Dimensions Explained: Size, Shape & Fertility Insights,” *Noida Fertility - My WordPress Blog*, Aug. 21, 2025. https://noidafertility.com/uterus-dimensions-fertility-guide/ (accessed Oct. 24, 2025).

Link: [Uterus Dimensions Explained: Size, Shape & Fertility Insights](https://noidafertility.com/uterus-dimensions-fertility-guide/)

Content:

- For most women of reproductive age, the average size of the uterus is about
  - **Length: 7-8cm**
  - **Width 4-5 cm**
  - **Thickness: 2-3 cm**
- The uterus size can change size depending on age, hormonal status, pregnancy history and medical conditions
- other factors that influence uterus dimensions
  - Age and hormonal changes
  - Pregnancy and child birth
  - medical conditions
  - fertility treatments and hormone therapies
- A typical uterus is pear shaped which is deal for embryo implantation and growth

Conclusions/action items:

In conclusion, these measurements will help me design a Solid Works to make a cavity for the uterus component.

Comments

Randolph Ashton Oct 30, 2025, 10:26 AM CDT

Good research and design work.

Research 13: WARF

RENEE SOBANIA - Nov 23, 2025, 3:02 AM CST

Title: WARF

Date: November 23rd, 2025

Content by: Renee Sobania

Present: NA

Goals: To learn about the process of meeting with WARF so we can start the patent process.

Content:

- WARF navigates the patent process for principal investigators, lending patenting and licensing expertise and covering patent costs which typically costs thousands of dollars
- Work with industry network to try and license our innovative solutions to establish companies or startups that have the resources required to put invention to work for public benefit.
    1. Tell then about our work
        - Submit innovation disclosure: initiate the WARF review process to help determine patentability and provide technical information for drafting an application
    2. Join for a disclosure meeting
        - informal, confidential meeting about the details and possible applications
    3. Decision committee makes a determination
        - decision is based on factors like patentability, market dynamics, licensing potential, public benefit and whether WARF can add value
    4. Disclosure goes through an equity review
        - The office of the vice chancellor for research and graduate education will perform an equity review to identify contracts or funding sources that may have intellectual property obligations
    5. Innovators will accepted inventions will enter into a memorandum agreement with WARF
        - This agreement defines the legal relationship and assigns ownership to WARF so they can work in partnership during the invention patenting and licensing process, and WARF agrees to share royalty income with you.
    6. We'll apply for the patent
        - work with seasoned intellectual property experts, most of whom are also registered patent agents, and patent attorneys to draft a patent application

Conclusions/action items:

In conclusion I was able to learn more about the process of filing a patent through warf.

Research 14: A Literature Review on Pain Management in Women During Medical Procedures

RENEE SOBANIA - Dec 07, 2025, 3:07 PM CST

Title: A Literature Review on Pain Management in Women During Medical Procedures: Gaps, Challenges and Recommendations

Date: 12/7/2025

Content by: Renee Sobania

Present: NA

Source: PubMed

Citation: K. Grinberg and Y. Sela, "A Literature Review on Pain Management in Women During Medical Procedures: Gaps, Challenges, and Recommendations," *Medicina*, vol. 61, no. 8, pp. 1352–1352, Jul. 2025, doi: https://doi.org/10.3390/medicina61081352.

Link: [A Literature Review on Pain Management in Women During Medical Procedures: Gaps, Challenges, and Recommendations - PMC]

Goals: To see and understand the disparities in women's healthcare.

Content:

- Women frequently receiving inadequate analgesia despite recording similar or higher pain levels compared with men.
- This issue is particularly evident across various medical and gynecological procedures
- Lots of unconscious biases
  - lack of gender specific clinical protocols
  - Cultural stereotypes contribute to the undertreatment of pain in women during procedures such as intrauterine device insertion
- persistent gender gaps in pain recognition and treatment
- Inadequate pain management for women is a documented issue in healthcare
- Women are less likely to receive adequate pain relief compared with men, even when reporting similar pain levels
- hormonal fluctuations such as variations in estrogen and progesterone influence pain thresholds and sensitivity in women
- Phycological and sociocultural factors play a substantial role in how individuals express pain and how their symptoms are perceived by healthcare providers
- men treated faster with more targeted pharmacological interventions where women's pain complaints are attributed to psychosocial causes such as anxiety or depression. Leads to delayed diagnosis and treatment and suboptimal care.
- Women are disproportionately affected by chronic pain conditions including endometriosis, fibromyalgia, interstitial cystitis and vulvodynia which are conditions frequently underdiagnosed and underfunded. ==> long term disability, diminished quality of life, physiological strain.
- research funding and clinical awareness remain insufficient despite prevalence and severity
- **Long standing gender biases embedded in medical history and education. historically women have ben portrayed in clinical discourse as more emotional or exaggerated which contributed to a systematic underestimation of their symptoms.**
- 56% of women felt their pain was dismissed by healthcare workers and 1/3 avoided or delayed care due to concerns about not being taken seriously
- Intrauterine device insertions and hysteroscopies are often conducted without adequate analgesia, despite consistent reports of significant pain during these procedures
- urgent need to promote evidence based, gender sensitive pain mamagement and address systemic biases in medicine
- Improving pain care for women is an ethical, professional and public health priority
- For the insertion of IUDs, only 30% of physicians offer anesthesia, despite 70% of women reporting moderate to severe pain.
- Findings revealed a consistent pattern of gender disparities in pain management with many women not receiving adequate treatment, even when pain levels are equal to or higher than men

- Women undergoing gynecological procedures report more sever pain than what physicians estimate.
- Research supports effectiveness of cervical anesthesia in reducing pain perception during procedures
- Many clinical protocols are based on research conducted primarily in male populations and fail to account for physiological differences between sexes including different responses to analgesics.

Conclusions/action items:

In conclusion, this is great information to use on our final report to show the lack of funding and research for women's health, in particular for their pain. This information should be cited and used in the final report.

Research 15: Barriers and Solutions in Women's Health Research and Clinical Care

RENEE SOBANIA - Dec 07, 2025, 3:21 PM CST

Title: Barriers and Solutions in Women's Health Research and Clinical Care

Date: December 7th, 2025

Content by: Renee Sobania

Present: NA

Source: PubMed

Citation: J. G. Regensteiner *et al.*, "Barriers and solutions in women's health research and clinical care: a call to action," *The Lancet Regional Health – Americas*, vol. 44, 2025, doi: https://doi.org/10.1016/j.lana.2025.101037.

Link: [Barriers and solutions in women's health research and clinical care: a call to action - PMC]

Goals: To better understand why there is a lack of funding and research in women's healthcare.

Content:

- Until 1990s women were excluded from most clinical trials and limited research including women focused primarily on disease affecting fertility and reproduction
- Prevention, diagnosis and treatment of chronic diseases in women continue to be based mainly on findings in men and sex-specific clinical guidelines are often lacking
- The health of women remains significantly understudied in spite of longstanding recognition that there are clear differences between the sexes affecting the prevalence, incidence and severity of a broad range of diseases
- Diseases of women's reproductive health (fibroids, endometriosis and menopause remains understudied and underfunded.
- Lack of inclusion of women in clinical trials and female animals in basic science studies resulted in extensive gaps in the data with which to make evidence based clinical recommendations. Women inconsistently included in trials and data is often not disaggregated by sex.
- Inadequate teaching and training tools for researchers and clinicians on content and methods relevant to sex differences.
- Inconsistent implementation of new research based evidence and guidelines into clinical practice

Conclusions/action items:

In conclusion, there are many clear gaps in healthcare for women compared to men. This information should be added into our final report.

Research 16: McKinsey Paper - Closing the Women's Health Gap Report

RENEE SOBANIA - Dec 07, 2025, 3:51 PM CST

Title: McKinsey Paper- Closing the Women's Health Gap Report

Date: December 7th, 2025

Content By: Renee Sobania

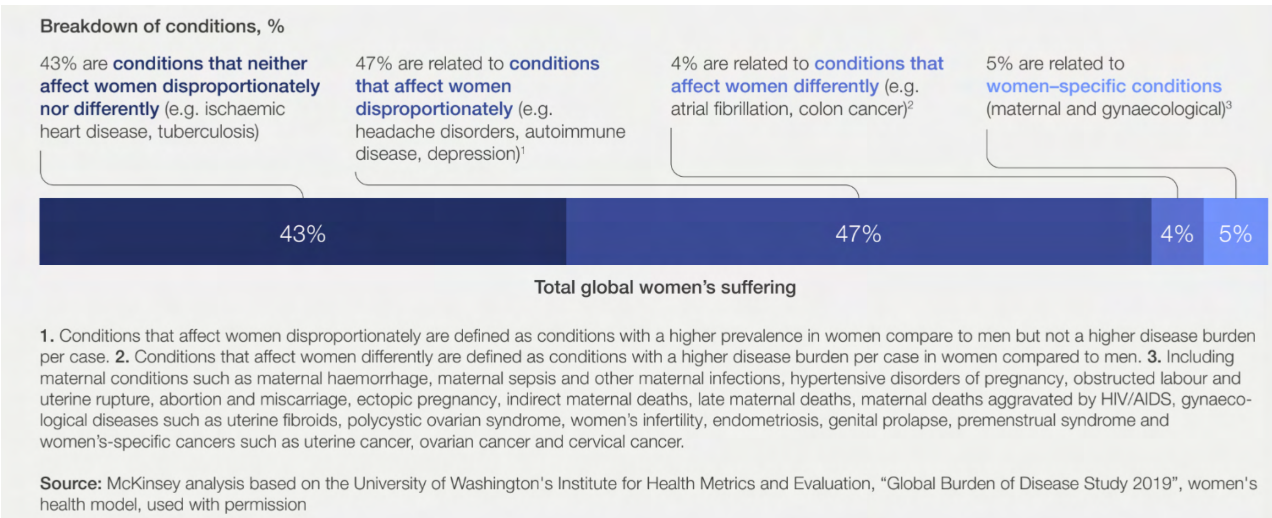
Source: Closing the Women's Health Gap: A $1 Trillion Opportunity to Improve Lives and Economies

Citation: McKinsey Health Institute, “Closing the women’s health gap: A $1 trillion opportunity to improve lives and economies | McKinsey,” *www.mckinsey.com*, 2024. https://www.mckinsey.com/mhi/our-insights/closing-the-womens-health-gap-a-1-trillion-dollar-opportunity-to-improve-lives-and-economies

Link: [Closing the women’s health gap | McKinsey]

Content:

- There is a large gap between men and women's health whether it's in research, data, care or investment.
- Narrowing of the women's health gap would allow 3.9 billion women to live healthier, higher quality lives and allow for at least $1 trillion to be pumped into economic productivity annually
  - Narrowing this gap could lead to fewer early deaths, fewer health conditions, extended economic and societal capacity to contribute and increased productivity.
- There are many ways to improve women's health
  - Investing in women-centric research
  - Collecting and analyzing sex, ethnicity and gender specific data
  - Enhancing access to gender-specific care
  - Creating incentives for new financing models
  - Establishing business policies that support women's health and strengthen women's representation in decision-making
- Even though women live longer than men (on average), women spend 25% more of their lives in poor health
- This report focuses on the economic implications of the women's health gap and the business case for closing it.
- Closing the women's health gap could:
  - Improve quality of life for 3.9 billion women
  - Add $1 trillion to the global economy annually by 2040
- The gap is caused by 4 main areas:
  - Science: study of the human biological defaults to the male body offering less understanding of the biological differences between men and women and results in less effective treatments for women.
  - Data: is missing or underrepresents women
  - Care delivery: women face barriers to care and experience diagnostic delays or suboptimal treatment.
  - Investment: is low in women's health and results in a weaker scientific understanding of women's bodies
- There must be more understanding on the broader effects of the women's health gap through

    - Investment in women centric research to fill the gaps in under researched, undiagnosed women's conditions and diseases that affect women differently or disproportionately.
    - Strengthening the systematic collection, analysis and reporting of sex and gender specific data
    - Increasing access to women-specific care in all areas from prevention to treatment
    - Create incentives for investment in areas of women's health innovation and develop new financing models.
    - Implement policies supporting women's health
- A woman will spend an average of nine years in poor health, affecting her ability to be present and/or productive at home, in the workforce, and in the community and reducing her earning potential.
- This health gap is in terms of DALYs (Disability-adjusted life years) and the extent to which this difference is due to the structural/systematic barriers women face.
- Women's health is covering both sex-specific conditions and general health conditions that may affect women differently or disproportionately.
- 

- Nearly 50% of the burden affects women of working age (20-64)
- Science and Biomedical Research
    - Women are underrepresented in clinical studies and research
    - 64% of studied interventions had lower effectiveness or access for women
    - Animal models and human studies often use males only
    - Women experience different symptoms and side effects (e.g. heart disease, asthma)
    - Gaps in pipeline development: more drugs are developed for cancer than for common gynecological conditions
    - Premenstrual Syndrome (PMS) is heavily under-researched, despite being widespread and impactful
    - There are more studies and drug development efforts for male-specific conditions than for menstrual conditions.
    - Animal and human studies often leave out females entirely, making it harder to develop effective treatments for menstrual-related symptoms
- Data Gaps
    - Women's health data is under-collected and under-analyzed:
        - Only 50% of interventions have sex-disaggregated data
        - Delays in diagnosis are common (endometriosis can take 10 years to diagnose)
        - Conditions like menopause are grouped vaguely in databases
    - Poor data leads to misdiagnosis, delayed care, and reduced investment
    - Menstrual health conditions including PMS and endometriosis are:
        - Under-recorded in health databases

        - Often misclassified, making them hard to track and study
    - Lack of sex-specific data contributes to delayed diagnoses, poor treatment and lower investment

- Gender-Responsive Care Delivery
    - Women face:
        - Higher insurance premiums, out of pocket costs
        - Delays in diagnosis (7x more likely to be misdiagnosed for heart attacks)
        - Barriers to contraceptives and menstrual products
    - Care systems often lack sex-specific education and tools
    - Solutions:
        - Improve medical curricula, standardize screening
        - Value-based care models can reduce costs and improve outcomes
    - Many women report their menstrual pain, and symptoms are dismissed or not taken seriously by healthcare providers
    - There is a shortage of medical tools and training that address period related and hormonal health
    - There are still barriers to accessing menstrual products and contraceptives especially in lower-income populations
- Investment in Women's Health
    - Public and private investment is disproportionately low
        - Only 11% of NIH funding goes to women-specific research
        - 5x more studies on erectile dysfunction than PMS
    - High-potential markets:
        - Endometriosis ($180-220B)
        - Menopause treatments ($120-230B)
    - FemTech and digital health startups are growing but still underfunded
    - PMS-related treatments and menstrual health innovations are significantly underfunded
    - Despite this, menstrual-related conditions like PMS and endometriosis represent billion-dollar opportunities for health innovation and investment
- Economic Opportunity
    - Addressing health gaps = workforce gains:
        - Could equal 137 million full time workers
        - Largest gains from reducing health conditions
    - Top 10 impactful conditions
        - PMS, depression, migraines, anxiety, gynecological conditions, etc.
    - Greatest gains in working aged women (20-64)
    - Menstrual-related conditions, including PMS are listed among the top 10 health conditions affecting women's productivity
    - Addressing these conditions could unlock significant economic gains and reduce workforce limitations for working-aged women
- Call to Action
    - Invest in sex-specific research and data
    - Improve access to care and education
    - Adjust medical systems and policy frameworks
    - Encourage business innovation and financing for women's health
- Visual Highlights
    - 75 million years lost per year due to women's health gap (DALYs)
    - ~60% of this is due to lower effectiveness or access to treatments for women

    - Economic impact tied closely to chronic conditions and lost productivity

Conclusion:

In conclusion, this helps to show the gap in women's healthcare.

Research 17: Contractile Properties of Vaginal Tissue

RENEE SOBANIA - Dec 10, 2025, 10:58 AM CST

Title: Contractile Properties of Vaginal Tissue

Date: December 10th, 2025

Content by: Renee Sobania

Present: NA

Goals: To better understand the contractile properties of vaginal tissue so I can site it in my paper.

Source: PubMed

Link: [Contractile Properties of Vaginal Tissue - PMC]()

Citation: A. Huntington, K. Donaldson, and R. De Vita, “Contractile Properties of Vaginal Tissue,” *Journal of Biomechanical Engineering*, vol. 142, no. 8, Jul. 2020, doi: https://doi.org/10.1115/1.4046712.

Content:

- Vagina is largely understudied in the field of biomechanics
- Alot of research focuses on characterizing the passive mechanical properties
- Vaginal contractions play a central role in sexual function, childbirth, and development and treatment of pelvic floor disorders
- Active mechanical properties of the vagina must be quantified
- Conflicting experimental findings are presented, illustrating the need for further research on the active properties of the vagina.
- disagreement as to whether the proximal vagina has equal or greater relative smooth muscle content than the distal vagina. Also, disagreement about if the wall of the proximal vagina is thicker or thinner than distal vagina.
- These types of tests are useful for revealing the effect of anatomic differences on the contractile properties of the vagina. Multiple strips of tissue can be isolated from various locations. Within the same organ/animal this reducing the potential of **animal-to-animal variability**.

Conclusions/action items:

based on this study I was able to obtain weak information that there is variation in the vaginal properties from person to person. This should be researched further.

Research 18: A Biomechanical Study of the Strength of Vaginal Tissues

RENEE SOBANIA - Dec 10, 2025, 12:57 PM CST

Title: A Biomechanical Study of the Strength of Vaginal Tissues

Date: December 10th, 2025

Content by: Renee Sobania

Present: NA

Goals: To confirm that tissue mechanical properties can vary person to person.

Source: European Journal of Obstetrics & Gynecology and Reproductive Biology - Elsevier

Link: A biomechanical study of the strength of vaginal tissues: Results on 16 post-menopausal patients presenting with genital prolapse - ScienceDirect

Citation: M. Cosson, E. Lambaudie, M. Boukerrou, P. Lobry, G. Crépin, and A. Ego, “A biomechanical study of the strength of vaginal tissues: Results on 16 post-menopausal patients presenting with genital prolapse,” *European Journal of Obstetrics & Gynecology and Reproductive Biology*, vol. 112, no. 2, pp. 201–205, Dec. 2003, doi: https://doi.org/10.1016/S0301-2115(03)00333-6.

Content:

- Tensile and bending strength of samples of vaginal tissue collected during corrective surgery of prolapse
- two samples of vaginal tissue 2x2cm collected during surgical correction of prolapse by vaginal route in 16 post-menopausal patients
- Collected from posterior vagina fundus, oriented and fixed on a plate holding edges and allowing tissue to be stretched over an orifice of 1cm.
- Tensile measurements were made using a suture passed over this distance in one of two samples by recording strength curve to evaluate force at rupture of collagen fibers.
- Pressure and tensile strength curves recorded up to rupture of the sample and value of tissue elongation
- great variability in measurements of max strength at rupture of the vaginal samples and in elongation before rupture of the samples
- great variability of results from one patient to another
- No relation between the values observed and patient age
- Results report how vaginal tissues are very variable in strength from one patient to another
- same finding for elongation values for vaginal tissue before rupture
- The results reported show that vaginal tissues are very variable in strength from one patient to another.

Conclusions/action items:

In conclusion, this paper was able to prove that vaginal and reproductive tissues greatly differ from person to person, which is a large cause of the large variability of Youngs modulus and literature values for the cervical tissue.

Research 19: Mechanical Properties of Pelvic Soft Tissue of Young Women and Impact of Aging

RENEE SOBANIA - Dec 10, 2025, 1:10 PM CST

Title: Mechanical Properties of Pelvic Soft Tissue of Young Women and Impact of Aging

Date: December 10th, 2025

Content by: Renee Sobania

Present: NA

Source: PubMed

Link: [Mechanical properties of pelvic soft tissue of young women and impact of aging - PubMed]()

Citation: P. Chantereau, M. Brieu, M. Kammal, J. Farthmann, B. Gabriel, and M. Cosson, “Mechanical properties of pelvic soft tissue of young women and impact of aging,” *International Urogynecology Journal*, vol. 25, no. 11, pp. 1547–1553, Jul. 2014, doi: https://doi.org/10.1007/s00192-014-2439-1.

Goals: To learn more about how the mechanical properties of pelvic tissue change based on aging to try to figure out if our numbers for mechanical properties would be different for younger women vs. older women.

Content:

- The female pelvic floor is complex network of ligaments and muscles whose mechanical properties aren't fully understood
- Goal is to understand the biomechanical properties of the pelvic floor tissue of young women and the impact on aging
- used biomechanical uniaxial tension tests on pelvic floor tissues (ligaments and organs) of sex young female cadavers
- samples were placed and clamped between grips of uniaxial machine without stretching tissue. Once clamped and extended to a distance where samples no longe compressed, length was measured
- Understand similarities and discrepancies between young and old patients
- Damageable, nonlinear elastic biomechanical behavior
- variation in stiffness among pelvic doors
- Ligaments and vaginal wall are the most rigid organs
- Ligaments and the vaginal wall of young women have similar mechanical behaviors while those of older women differ.
- Younger women's tissue differs slightly from older women's tissue
- Aging and diverse trauma have an impact on modifying mechanical behavior on pelvic floor tissues
- pelvic floor ligaments and vaginal tissues differentiate and acquire different mechanical behavior, as seen with literature in older cadavers.
- Strain = displacement/ initial length
- Stress = force/ initial cross section
- mean age of women were 29 = young
- 75& 83.5 was old 273 samples harvested and studies all together
- 30 utero sacral ligaments from old cadavers, 11 from young
- 45 round ligaments from old and 11 from young, 33 broad ligaments from old, 4 from young
- 32 vaginas from old, 21 from young
- Cyclic test with load and unload phases increasing the max stretch level at each cycle
- Pure stretching up to rupture for second test
- Monotonic load up to rupture to study nonlinear elastic behavior

Conclusions/action items:

In conclusion, this showed that tissue properties differ for many reasons due to age and other trauma. This further explains why such a large range in research data.

Research 20: Pelvic Tilt Angle Differences

RENEE SOBANIA - Dec 10, 2025, 1:22 PM CST

Title: Pelvic Tilt Angle Differences Between Symptom Free Young Subjects and Elderly Patients

Date: December 10th, 2025

Content by: Renee

Present: NA

Source: PubMed

Link: [Pelvic Tilt Angle Differences Between Symptom-Free Young Subjects and Elderly Patients Scheduled for THA: The Rationale for Tilt-Adjusted Acetabular Cup Implantation - PMC]

Citation: C. J. Marques *et al.*, "Pelvic Tilt Angle Differences Between Symptom-Free Young Subjects and Elderly Patients Scheduled for THA: The Rationale for Tilt-Adjusted Acetabular Cup Implantation," *The Open Orthopaedics Journal*, vol. 12, no. 1, pp. 364–372, Aug. 2018, doi: https://doi.org/10.2174/1874325001812010364.

Goals: To learn more about the correct tilt of the angle. We got feedback that the tilt could me more accurate, so I want to figure out the correct angle so a change can be made in the future.

Content:

- Can pelvic tilt angles measured in the supine position be adequate for the alignment of the acetabular cup without adjustment for anatomical differences between patients
- factors that can significantly affect PT angles
- Angles for 12 young subjects and 45 patients scheduled for total hip arthroplasty compared
- used a novel smartphone based navigated ultrasound measurement system
- Body position and group had significant effects on PT
- Significant interaction between body position and group
- mean PT increased by 8.1degrees from interiorly to neutral tilted position. 21.4 degrees from a neutral to a posteriorly tilted position with transition from supine to upright position
- Anterior pelvic plant is the plane through the right and left anterior superior iliac spines and the symphysis pubis
- 120 patients measured in supine and upright position and calculate their PT angles
- PT angle of 5.6 in supine
- 6.7 degrees in upright position
-

Conclusions/action items:

In conclusion, this data can be used to modify the angle of the model to be more anatomically accurate.

Competing Design 1: Uterus Simulation Model

RENEE SOBANIA - Sep 18, 2025, 9:51 PM CDT

Title: Uterus Simulation Model

Date: September 18th, 2025

Content by: Renee Sobania

Present: NA

Goals: To look into different competing designs to see what they did well and what they need to improve on to see if we can use any parts of their model, or see what gaps we need to fill when designing and fabricating our model.

Source: Google Patents

Citation: “US20210280085A1 - Uterus simulation model - Google Patents,” *Google.com*, Mar. 05, 2021. https://patents.google.com/patent/US20210280085A1/en (accessed Sep. 19, 2025).

Link: [US20210280085A1 - Uterus simulation model - Google Patents]

Content:

- This model contains artificial organs such as a uterus, cervix, abdominal walls and muscles that are housed inside of a container with a lid and an opening for access.
- The artificial abdominal wall has artificial skin, artificial subcuticular, artificial fat, artificial fascia
- This model is mainly used as a training simulation model for Cesarean sections
- Particularly made for underserved regions.
- This model takes around 50 seconds to assemble and costs around $3.03 per complete JCM C-section practice session.
- To remain accessible all materials and components must be cost effective, commercially available, and nontoxic. models should also be globally transportable
- Joel Cohen Method (JCM): The model must fit the standard 10-15cm transverse incision and 7-12cm longitudinal stretching of the abdominal wall
- Entails stretching of fat, skin abdominal muscles and uterus
- Materials selected for their respective tissue analogs should replicate native tensile moduli as reported in literature They must also have correct anatomical geometry
    - skin: 4.0±3.81 MPa, fat: 11.7±6.4 kPa, abdominal muscle: 42.5±9.0 kPa, myometrium at full term: 0.51-2.33 MPa)
    - A uterus at full term has dimensions of 35×25×20 cm and a myometrial thickness of 4.68±0.48 mm. The thicknesses of skin, fat, and abdominal muscle tissues are 1.2±0.3 mm, 13±2.7 mm, 9.8±1.7 mm
- Model should allow for 5-10 uses before replacement and cost 1$ per use, 3$ for full procedure
- Should be able to be assembled and disassembled in less than 5 minutes
- Uterus and abdominal wall can be swapped after multiple uses
- 3D printed part connects cervix/uterus to container for stability and allows for more incisions
- Different materials were tested for the Uterus (Dragon skin) but none hit the target modulus range of 0.51-2.33MPa, but the 2:1 Dragon Skin 30A plus Soma Foama mix was the most realistic because it felt most like real uterus when cut and stretched.
- The cervix has a thickness of 0.6cm and length of 36mm (active labor values). The material they used was platinum cured silicone (Shore 50A) + inner foam layer
- The uterus and skin were not exact modulus matches and the cervix accurately reproduced the stretching behavior of a cervix.

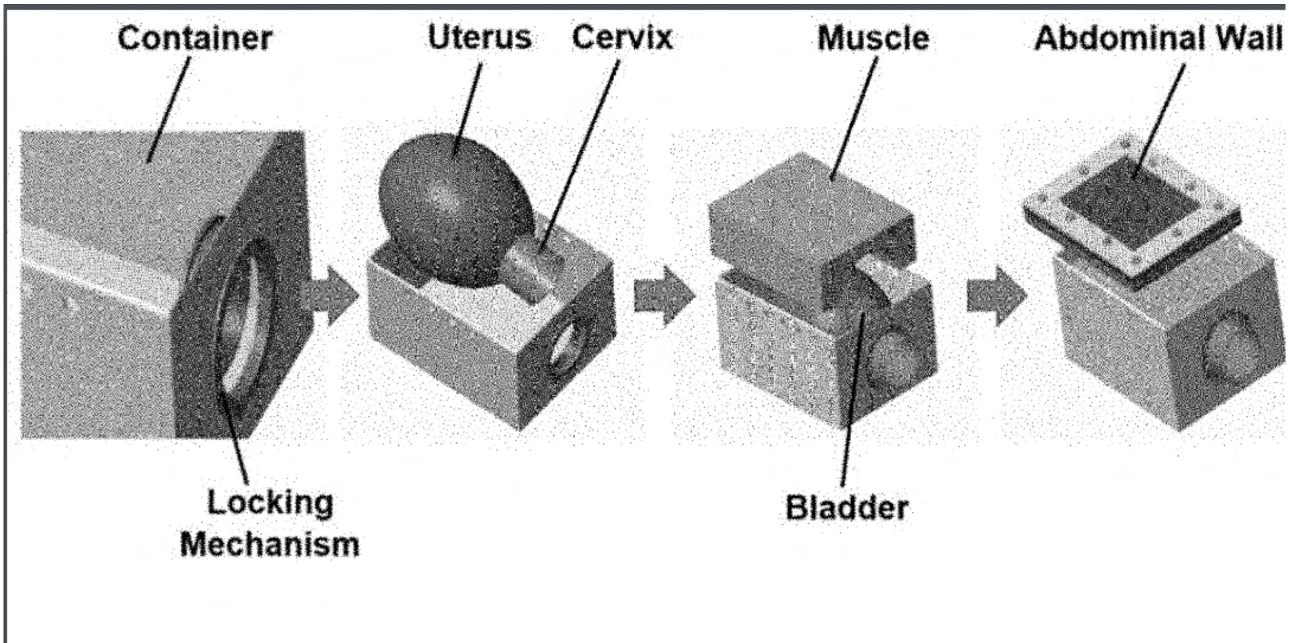
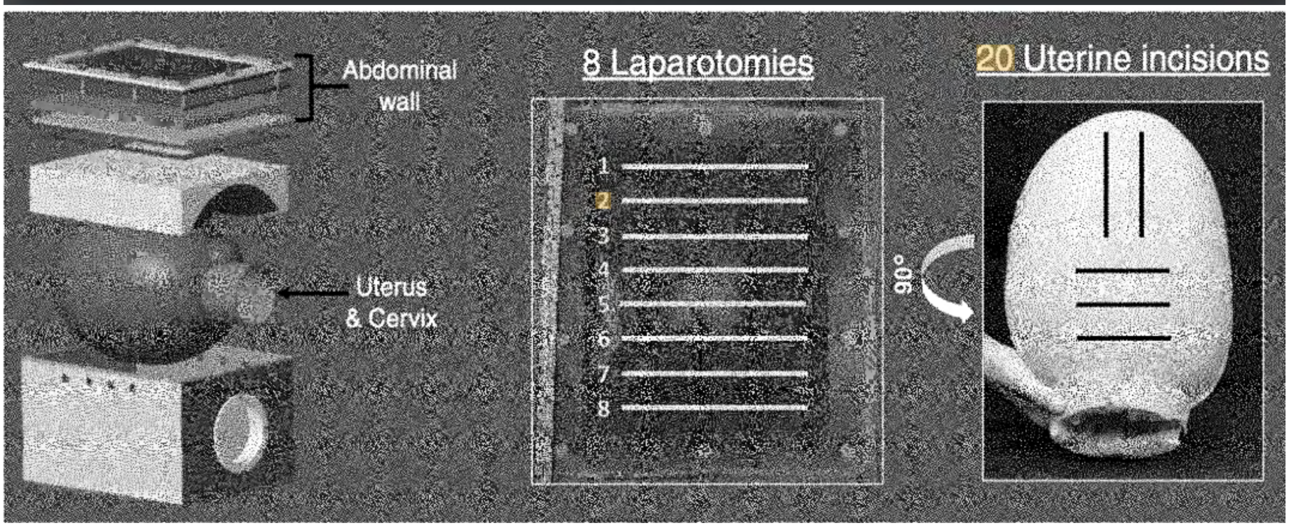
- 
Container
Uterus
Cervix
Muscle
Abdominal Wall
Locking Mechanism
Bladder

FIG. 1


Abdominal wall
Uterus & Cervix
8 Laparotomies
1
2
3
4
5
6
7
8
90°
20 Uterine incisions

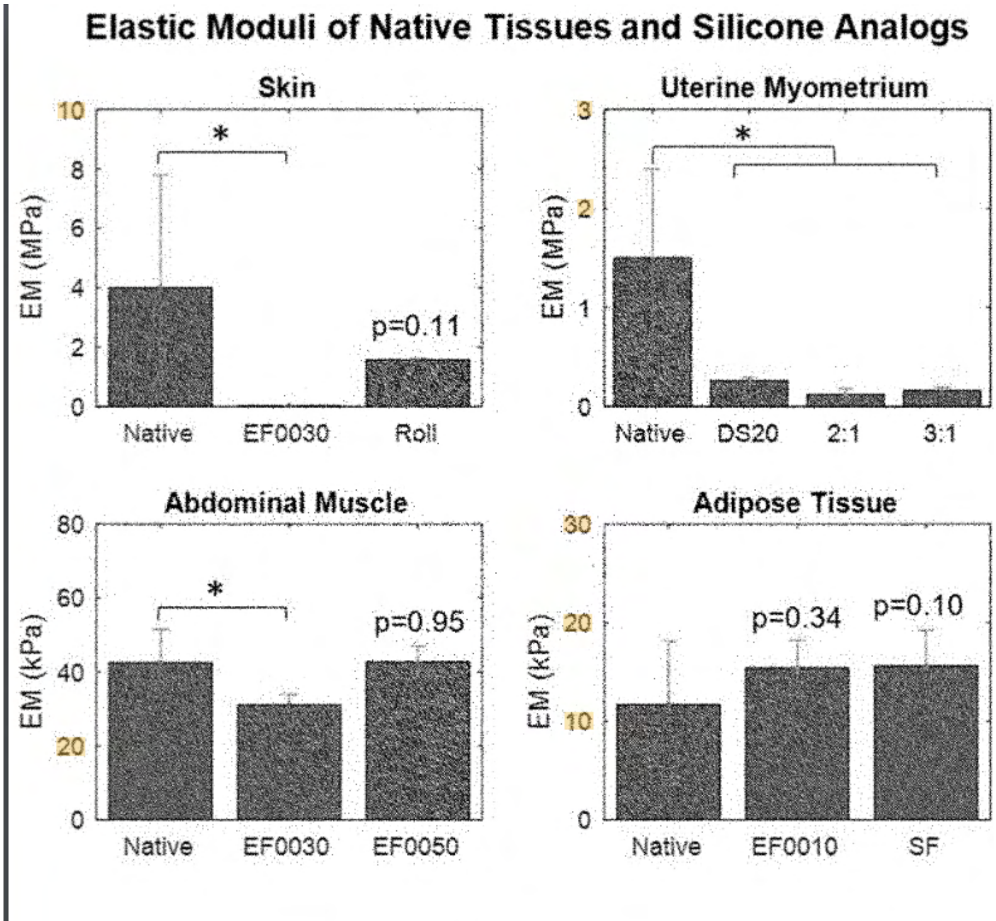


FIG. 3

Conclusions/action items:

In conclusion, some improvements that can be made from this model is to make the skin more realistic. This model was good however because the price for each use is very low and it was easy to transport.

Competing Design 2: The Miya Model

RENEE SOBANIA - Sep 18, 2025, 10:19 PM CDT

Title: The Miya Model

Date: September 18th, 2025

Content by: Renee Sobania

Present: NA

Goals: To look into different competing designs to see what they did well and what they need to improve on to see if we can use any parts of their model, or see what gaps we need to fill when designing and fabricating our model.

Source: Miyazaki Enterprises

Citation: "The Miya Model – Miyazaki Enterprises," *Miyazakienterprises.com*, 2024. https://miyazakienterprises.com/miya-model/ (accessed Sep. 19, 2025).

Link: The Miya Model – Miyazaki Enterprises

Content:

- The Miya Model is used to simulate the pelvic frame for practice of a variety of different medical procedures.
- This model features many different realistic organs such as a vagina, uterus, bladder, obturator complex, and perineum.
- This model also includes lifelike skin, realistic cutting and puncturing tension, palpable surgical landmarks, and a pressurized vascular system that is able to simulate bleeding, and an inflatable bladder that leaks water if a procedure is performed incorrectly.
- This model is designed so it can provide the trainee with accessibility and visibility to provide a realistic model.
- The full pelvic model with all the replaceable parts costs around $6,700.
- Has replaceable anatomic cartridges
- Mounted on a rotating stand with the top of the pelvis open
- Designed to provide access and visibility
- Enables supervising physicians and credentialing committees to have topical access and video capabilities, facilitating greater guidance and review
- Offers convenient transportation, setup, use and storage
- Good for all major vaginal surgical procedures
- Vulva Assembly
  - Realistic feel w self-healing properties
  - has lower abdomen, vulva, urethral opening, vaginal introitus, anus, and rectum
  - Soft, life like feel
  - Medical grade silicone construction
  - Realistic skin puncturing tension
  - Urethral hole allows for catheterization
- Multi-Procedural uterus
  - Medical grade silicone construction
  - Hollow gynecoid cavity allows for IUD insertion, uterine sounding and manipulation, endometrial biopsy, diagnostic hysteroscopy, and operative hysteroscopy with resection and electrocautery

- 
- 

Conclusions/action items:

In conclusion, I learned that they used medical grade silicone which could be a potential material we use for the model. However, this model is extremely expensive and not affordable, which is something we are aiming for in our model, an affordable and easy to make device. However, there was no specific type of silicone listed on their website, or the mechanical and elastic properties of the model, so we will need to find a specific silicone still.

Competing Design 3: Venus Diversity Trio

RENEE SOBANIA - Sep 18, 2025, 10:33 PM CDT

Title: Venus Diversity trio

Date: September 18th, 2025

Content by: Renee Sobania

Present: NA

Source: Grandville Biomedical

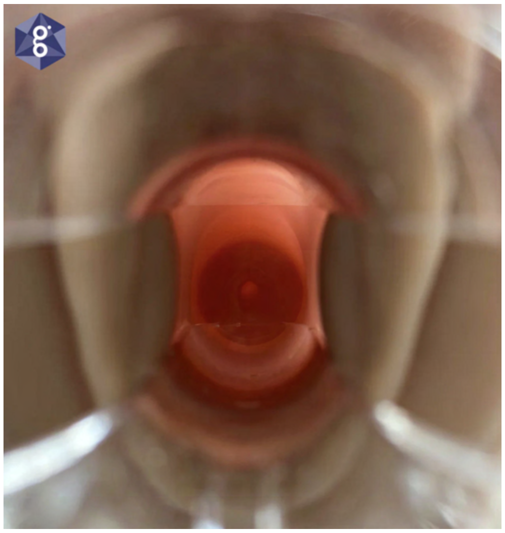
Goals: To look into different competing designs to see what they did well and what they need to improve on to see if we can use any parts of their model, or see what gaps we need to fill when designing and fabricating our model.

Citation: “Venus Diversity Trio - Pelvic Health Educational Models,” *Granville Biomedical Inc.*, 2020. https://www.granvillebiomedical.ca/products/venus-trio (accessed Sep. 19, 2025).

Link: Venus Diversity Trio - Pelvic Health Educational Models – Granville Biomedical Inc.

Content:

- The Venus diversity Trio is an education model used to provide hands-on learning opportunities by replicating realistic anatomy of a cervix and vaginal canal using life-like silicone.
- It provides practice of perineal massage techniques, pelvic exams, dry needling, and demonstration of cervical cell collection medical devices.
- This model comes in a pack of three and costs $398.00.
- Replicate lifelike anatomy with a visible cervix and vaginal canal
- life-like silicone texture
- Designed for procedural demonstrations
- Device testing and patient consultations
- Medical grade silicone, recyclable thermoplastic stand
- 9xm (w) x 11.5cm (h) x 9.7cm (d)
- Each Venus with standing base is packaging weights 0.8lbs
- Cleaning with mild soap water or alcohol wipes



Conclusions/action items:

In conclusion these models do not have a cervicovaginal junction which is something our model requires to do the paracervical block. It is also still a very expensive model, and we are trying to make a model that is much cheaper so it can be more affordable and reproducible.

Design Ideas Brainstorm

RENEE SOBANIA - Sep 26, 2025, 5:25 PM CDT

Title: Design Ideas Brainstorm

Date: September 26th, 2025

Content by: Renee Sobania

Present: NA

Goals: To record the drawings and sketches from my brainstorm ideas.

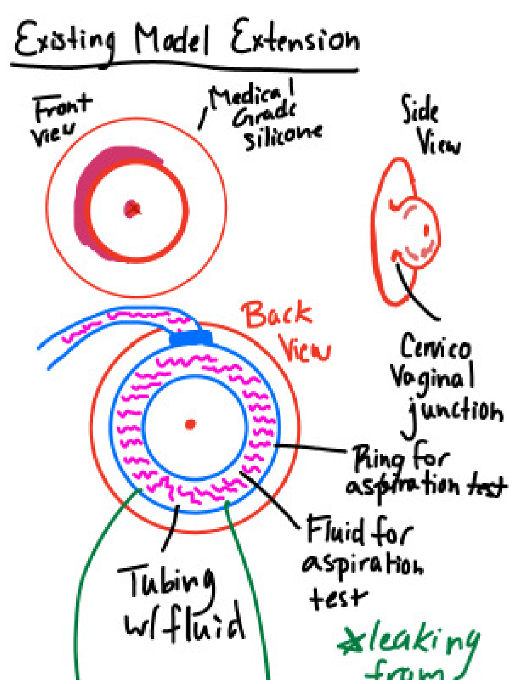
Content:

Attached Below

Conclusions/action items:

In conclusion, these are some of my brainstorming ideas which we will build our design around.

RENEE SOBANIA - Sep 26, 2025, 5:26 PM CDT



[Download](#)

Design_Brainstorm_2_.pdf (1.63 MB)

Design Idea 1: Modified Task Trainer

RENEE SOBANIA - Sep 26, 2025, 5:20 PM CDT

Title: Design Idea 1: Modified Task Trainer

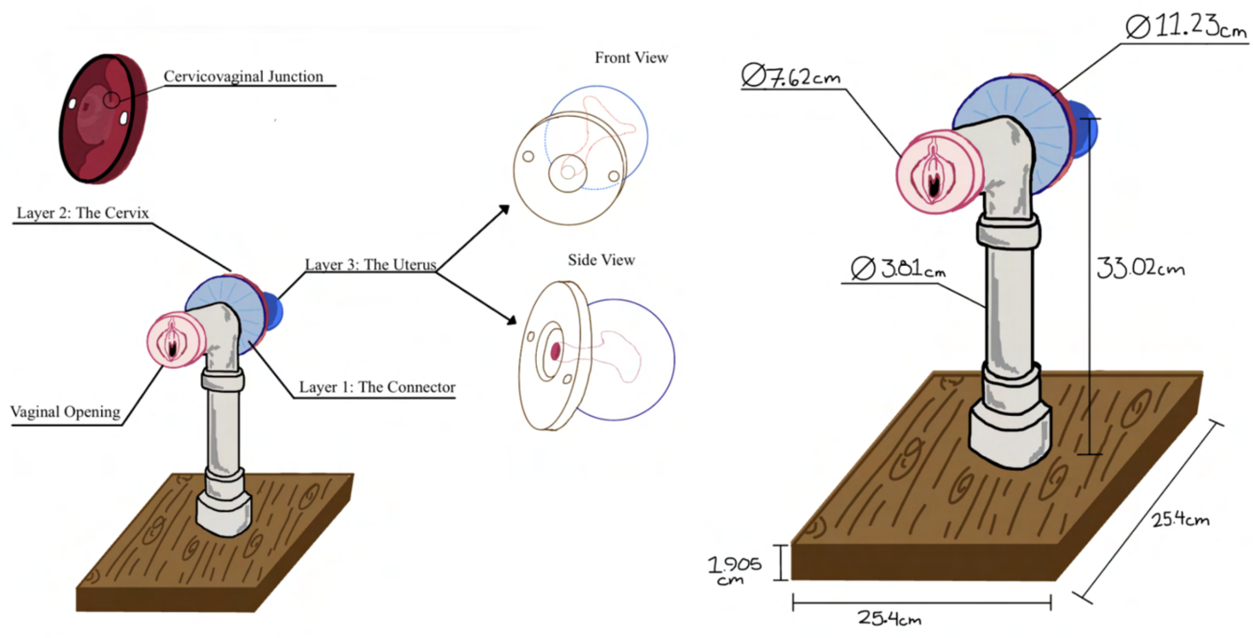
Date: 9/26/2025

Content by: Renee Sobania

Present: NA

Goals: To create a potential design for our project to compare it to others and see which one would be the best for our goals.

Content:



The current model with the stand is very close to being ideal, but lacking in a few areas. Specifically that of the shape of the cervix and the shape and mechanical properties of the uterus. We plan to alter the task trainer by modifying the mold for the cervix by creating a more accurate and visual cervicovaginal junction. We would also modify the shape of the uterus to make one that is more accurate (a t-shape) and pre-coat it in silicon to better mimic that of the uterine lining. We would also place threads on the PVC tubing so that the design can be easily taken apart and taken to different locations for trainer training. We also have talked about the potential of adding a base that can be filled with water to prevent it from tipping over during the procedure. A removable vaginal opening will also be added onto the device to create a more realistic feel of the procedure, allowing the clinician to know what it feels like to open up a speculum and look down the vaginal opeing through that speculum.

Conclusions/action items:

Design Idea 2: Box Design

RENEE SOBANIA - Sep 26, 2025, 5:20 PM CDT

Title: Design Idea 2: Box Design

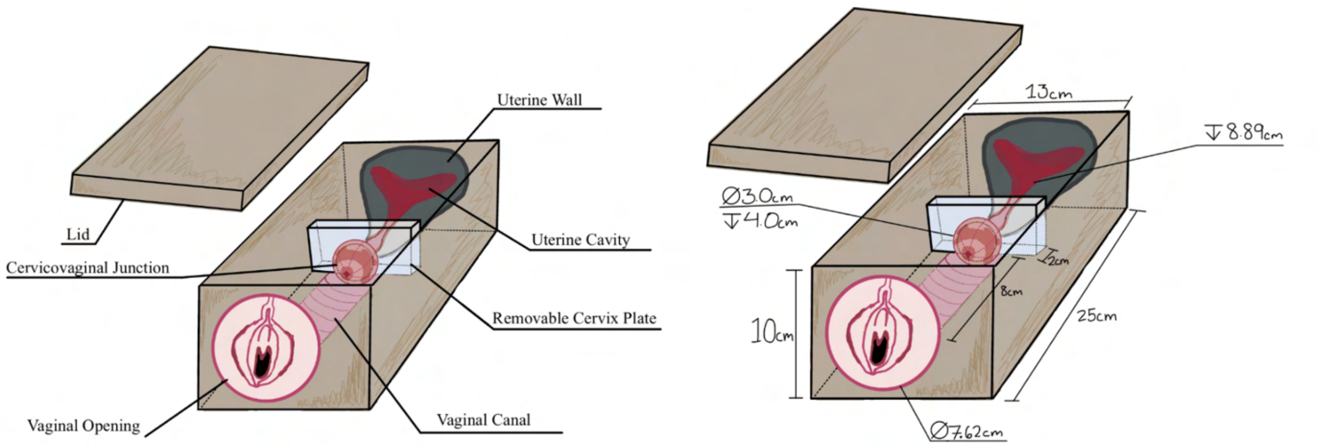
Date: 9/26/2025

Content by: Renee Sobania

Present: NA

Goals: To create a potential design for our project to compare it to others and see which one would be the best for our goals.

Content:



This design is a small box that would house a vaginal canal and uterus with a removable/replaceable cervix. We would use a PVC tube to cast the vaginal canal, a small rectangular box to cast the removable cervix, and a lightbulb to cast the shape of the uterus. We would cast using spray foam insulation and then remove the materials and coat the areas in silicon. The cervix would be created by modifying the task trainer design by including the cervicovaginal junction and changing the base shape to be that of a rectangle. The uterus would also be created by 3D printing a mold and then casting it with ecoflex. This model is not as anatomically accurate because the vaginal canal does not have a top to it and there is no stand which would cause the clinician to have to bend over or prop it up in order to practice. This design is also much harder to fabricate because you would need to cast each box individually. The process would take longer.

Conclusions/action items:

In conclusion this is the design and description for the Box design.

Design Idea 3: Modified Venus Design

RENEE SOBANIA - Sep 26, 2025, 5:19 PM CDT

Title: Design Idea 3: Modified Venus Design

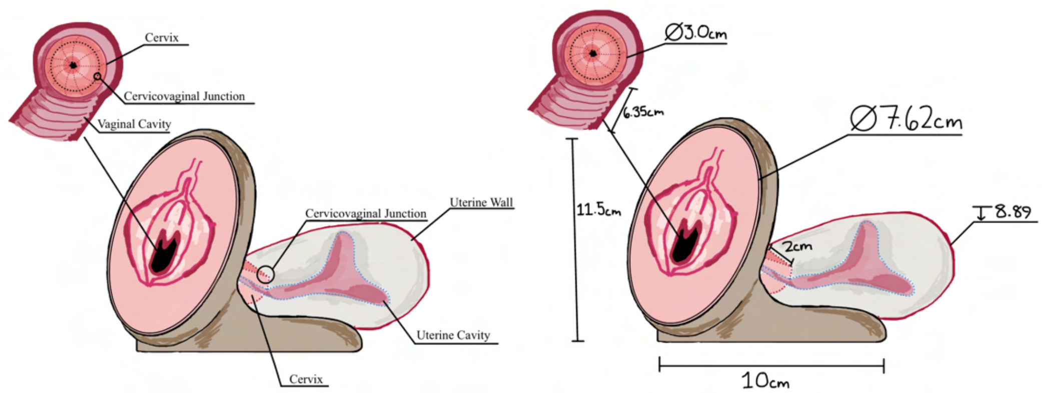
Date: September 26th, 2025

Content by: Renee Sobania

Present: NA

Goals: To create a potential design for our project to compare it to others and see which one would be the best for our goals.

Content:



This design is a simple tabletop design that includes a simplified vaginal opening, cervix, and the inclusion of the uterus. The current design only includes the vaginal opening and cervix but does not include a uterus. This design places the uterus behind the cervix in a ball shape configuration. Almost the entire model is made out of silicone and would need to be casted. This design also includes a cervicovaginal junction and a T-shaped uterus. This design does not include anu replaceable parts so the entire model would wear down quickly. It is also a tabletop model and doesn't provide the accurate height.

Conclusions/action items:

In conclusion, this is the design and description for the modified Venus design idea.

Design Matrix

RENEE SOBANIA - Sep 26, 2025, 5:09 PM CDT

Title: Design Matrix

Date: September 26th, 2025

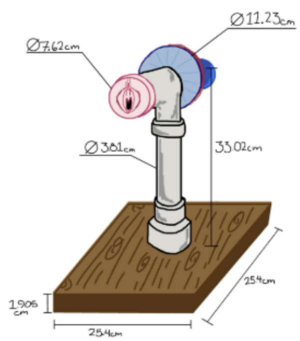
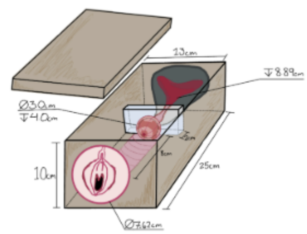
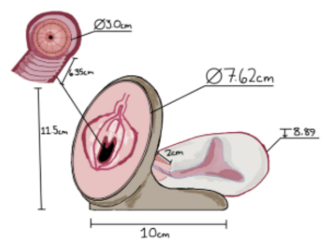
Content by: Renee Sobania

Present: NA

Goals: To compare our three designs to see which one would be the best for our project and for our clients needs.

Content:

Design Matrix: Paracervical Block Training Model

Criteria (Weight)	Modified Task Trainer 		Shoebox Design 		Modified Venus Design 	
Realistic (25)	5/5	25	4/5	20	2/5	10
Ease of Fabrication (25)	5/5	25	1/5	5	1/5	5
Anatomical Accuracy (20)	4/5	16	2/5	8	3/5	12
Cost (15)	5/5	15	3/5	9	4/5	12
Portability (10)	3/5	9	3/5	9	4/5	12
Safety (5)	4/5	1	5/5	5	5/5	5
Total (100)		91		56		56

<u>Score Justifications</u>

Realistic (25): This category assesses the models to simulate paracervical block procedure. The Modified Task Trainer received a 5/5 because this design is also the only one with a stand to better simulate the height clinicians would be at when performing the paracervical block procedure. The Shoebox design received a 4/5. Similar to the Modified Task Trainer, the materials used, ecoflex, are similar to that of the gynecological properties. However, the reason it received a lower score is because the height at which the procedure is performed is much lower than the clinician would actually expect. The Modified Venus Design, received a 2/5 because it is again performed at a lower angle than one would actually perform a paracervical block as well as having the uterus at an angle that is not accurate causing students when learning the procedure to unreliable estimate where to place the needle.

Ease of Fabrication (25): Ease of fabrication was weighted at 25/100, as it was one of the client's priorities to have something simple to replicate as needed. Due to the client's busy schedule, the replaceable parts of the product need to be easy and fast to recreate in between training sessions once worn out, and should not require extra time and research to reproduce. The Modified Task Trainer received a score of 5/5, because the client is already familiar with and has used former versions of the Task Trainer. The PVC tubing and stand can be easily assembled, and presence of the threads makes the device quick to disassemble as necessary when replacing pieces. The Shoebox Design scored a 1/5, because the building process requires multiple steps, including casting and 3D printing for the uterus, and would require substantial effort on the client's part to recreate. Similarly, the Modified Venus Design also scored a 1/5, as replicating its assembly would not be intuitive and low-effort when compared to the Modified Task Trainer. It would require learning and understanding how the uterus attaches to the cervix in the particular model, as our client would not be familiar with the new layout and materials.

Anatomical Accuracy (20): Anatomical accuracy was weighted at 20/100, as it is critical for a task trainer to visually replicate the anatomy it models. The model's ability to differentiate the vaginal canal, cervix, and uterus is essential to provide medical students with the most realistic training experience possible. The modified task trainer received a score of 4/5 because its attachments can be adjusted to meet various anatomical training needs, while its base structure remains unchanged. This model also incorporates the design of cervical folds, which are distinctive anatomical features that help differentiate the uterus from the cervix.The shoebox design scored 2/5 due to its poor visual representation of the uterus, cervix, and vaginal canal, despite maintaining basic biomechanical function. The modified Venus design received a score of 3/5, while it is also interchangeable and reflects the general appearance of uterine, cervical, and vaginal structures, it does not accurately represent the junctional angles between the cervix and uterus.

Portability (15): The portability of each design is weighted to be 15/100, since the final training model should be easily transported. This is an important aspect to consider when designing as the client needs to be able to transport ten task trainers to and from storage and training areas, and even hopefully between buildings in order to train providers in many locations. For all three designs, none of their sizes are prohibitively large, meaning that they are all adequate and relatively mobile. The Modified Task Trainer was rated a 3/5 as it does have a flat base, making it easy to set, store, and transport, however the unusual shape prohibits it from being packed efficiently together. On the other hand, the Shoebox Design's small, rectangular box shape makes it ideal for packing together and being easily transported in a box, car, or more. However, the replaceable cervix component is hard to transport comfortably. For these reasons, the Shoebox Design received a 3/5. The Modified Venus Design can be easily transported due to its flat base and simple, table-top design which allows it to safely stand up during transportation. The relatively simple and durable components also make it easily portable, thus giving the Modified Venus Design a score of 4/5.

Cost (15): The cost effectiveness of our design was weighted to be 15/100, this is due to the fact that this model will need to be made in larger quantities. This is an important factor for our client and our designing process because the client aims to use this product for classes/presentations. During these presentations she hopes to be able to hand out multiple of our trainers to the students so they can practice independently. Given that we have a $500 budget, each model will need to be produced at a cost effective rate, nearly $50 each. The modified task trainer receives a 5/5 on cost effectiveness because its pieces are easily accessible and purchased at a low cost, additionally it only requires a couple components, ultimately greatly reducing the cost to construct. The shoebox design receives a 3/5. This score arises because the design is the most complicated from a manufacturing standpoint, containing more molded components which are made of more expensive materials like silicone. Lastly, the modified venus design received a 4/5, this middle ground score makes sense because as previously stated the Venus design is relatively simple to construct and purchase components for, but possesses more complexity than the simple modified task trainer.

Safety (5): This category ranks the relative safety of each design. All designs essentially have the same level of safety which is why all designs received high scores. The Modified Task Trainer received a 4/5 because it is the only design that is elevated and puts it at a slightly higher risk of tipping. Both the Shoebox Design and the Modified Venus Design received a 5/5 because they have a lower center of mass on the table and have a very small risk of falling.

Conclusions/action items:

In conclusion, we found that the best model would be the Modified Task Trainer as it scored the highest for realistic, ease of fabrication, anatomical accuracy and cost.

RENEE SOBANIA - Sep 26, 2025, 5:21 PM CDT

BME Design
The Design Matrix
of
Paracervical Block Training Model
Fall 2025 BME 200/300
09/25/2025

Clients: Dr. Jessica Dalby

Advisor: Dr. Randolph Ashton

Team Members:

Evelyn Ojard (Co-Leader) ojard@wisc.edu

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Abigayle Chapman (BSAC) alchapman2@wisc.edu

Cadence Seymour (BPAG) cdseymour@wisc.edu

Download

Design_Matrix.pdf (807 kB)

Solidwork's Designs - Cervix

RENEE SOBANIA - Oct 10, 2025, 12:45 PM CDT

Title: SolidWorks Design - Cervix

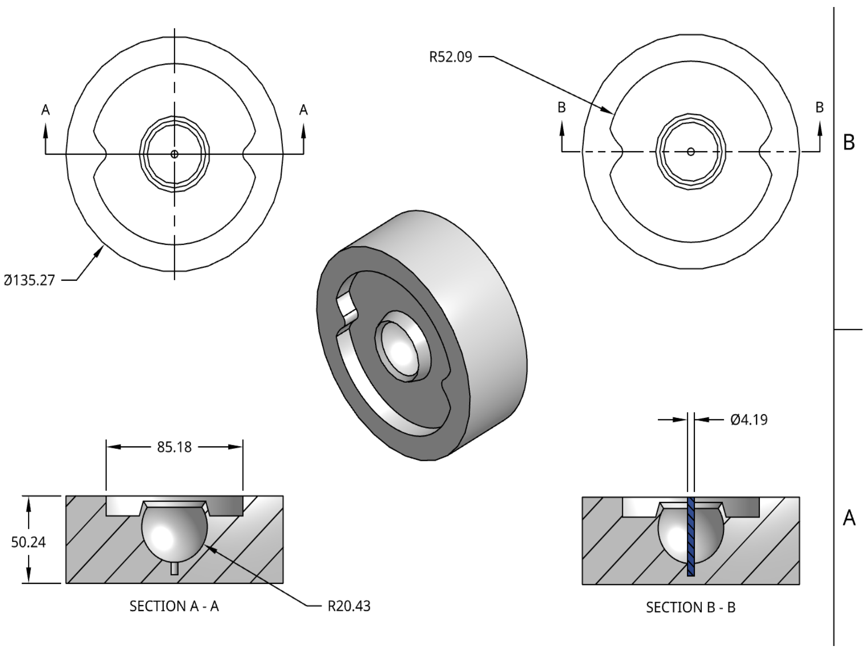
Date: October 10th, 2025

Content by: Renee Sobania

Present: Evelyn Ojard, Ellie Letts

Goals: To make a Solid Works design for the mold of the cervix that includes a cervicovaginal junction.

Content:



- Model consists of a circular disc with a cervix engraved in that has a cervicovaginal junction
- Fabricated in onshape

Conclusions/action items:

In conclusion, this is a sketch of the cervix mold that we will 3D print and fill with silicone to make the cervix component of our model. We need to go to the makerspace and see if there are any problems with the design and also need make sure that the cervix component would be able to be removed from the mold successfully.

SolidWork's Design 1- Vaginal Opening

RENEE SOBANIA - Oct 24, 2025, 3:01 PM CDT

Title: SolidWorks Design 1 - Vaginal Opening

Date: October 24th, 2025

Content by: Abigayle and Renee

Present: Abigayle and Renee

Goals: To make a mold for the vaginal opening

Content:

Conclusions/action items:

In conclusion, this is a good start to the design, however i want to add notches onto the inner piece so it is a set distance of how far down it should go into the mold

EcoFlex 00-20

RENEE SOBANIA - Oct 01, 2025, 12:44 PM CDT

Title: EcoFlex 00-20

Date: October 1st, 2025

Content by: Renee Sobania

Present: NA

Goals: To identify the properties and cost of Ecoflex 00-20 to see if it would be a good material to use for the cervix of our model.

Content:

- Smooth-On's Silicone thinner to lower viscosity
- THI-VEX silicone thickener can be added by weight to Eco Flex
- A release agent can be added to make demolding easier Ease Release 200
- Cure Time = 4hours
- Shore Hardness 00-20 (Cervix is between 10-30)
- Tensile strength = 160psi
- 100% Modulus = 8psi
- Reynolds Advanced Materials, Chicago
  - $32.43 for trial unit (2lbs)
  - $200.44 (16lbs)
- From Smooth On Store
  - $32.43 for trial unit (2lbs)
  - $200.44 (16lbs)
- The study re ports the Young’s modulus under compression ranges from 68.95 to 103.42 kPa.46 Our best-fit isotropic neo Hookean Young’s modulus EnH ranges from 0.35 to 3.99 kPa.

Conclusions/action items:

In conclusion, Ecoflex 00-20 would be a good material because it has a similar shore hardness to the cervix. The Elastic modulus will need to be investigated further however.

SolidWork's Design 2 - Vaginal Opening with Top Plate

RENEE SOBANIA - Oct 24, 2025, 3:25 PM CDT

Title: SolidWork's Design 2 - Vaginal Opening with Top Plate

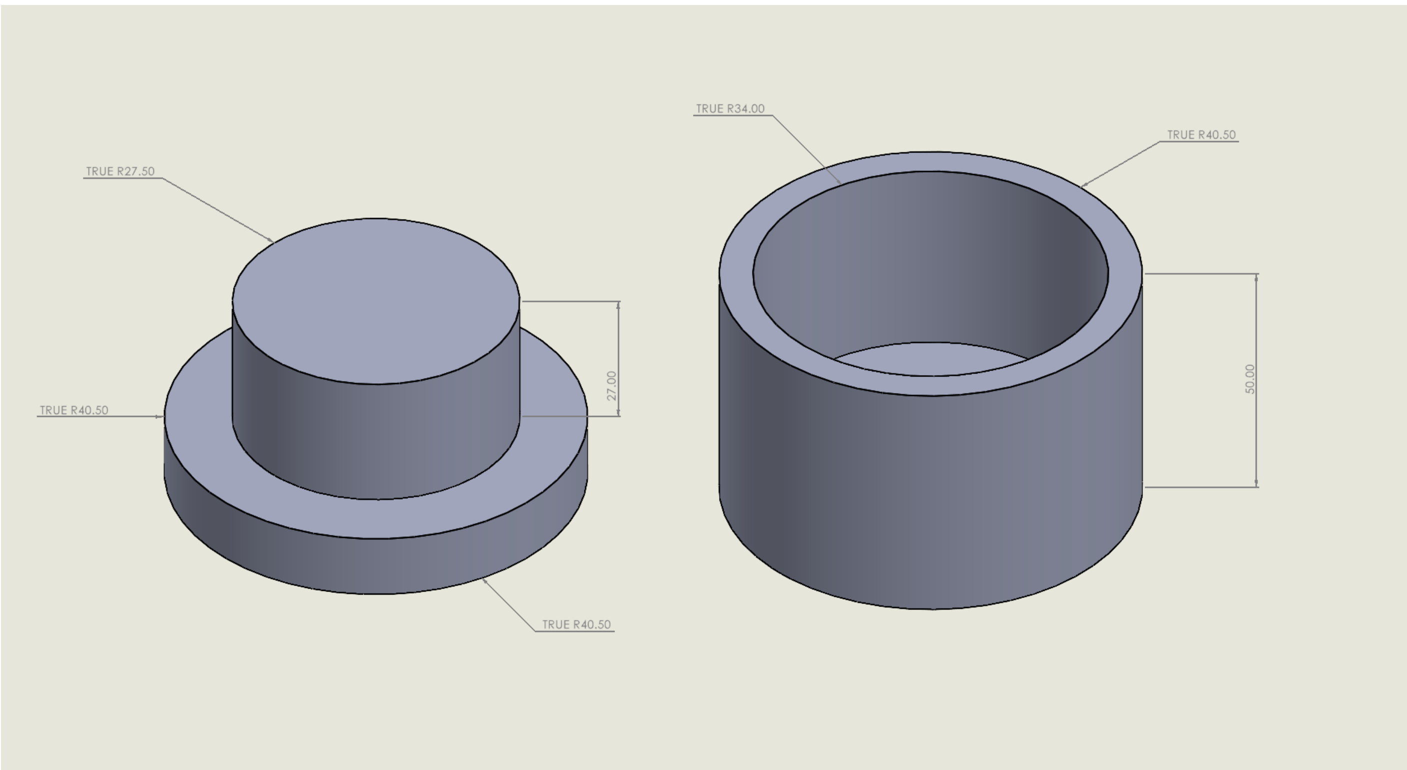
Date: October 24th, 2025

Content by: Renee Sobania & Abigayle

Present: Renee Sobania

Goals: To modify the original inner mold design to include a top plate so we can keep a constant thickness with the vaginal opening.

Content:



Conclusions/action items:

IN conclusion, this mold now includes a top plate. Now we need to 3D print and test it.

SolidWork's Design - MTS Testing Dog Bone

RENEE SOBANIA - Oct 28, 2025, 11:26 AM CDT

Title: Solidworks Design - MTS Testing Dog Bone

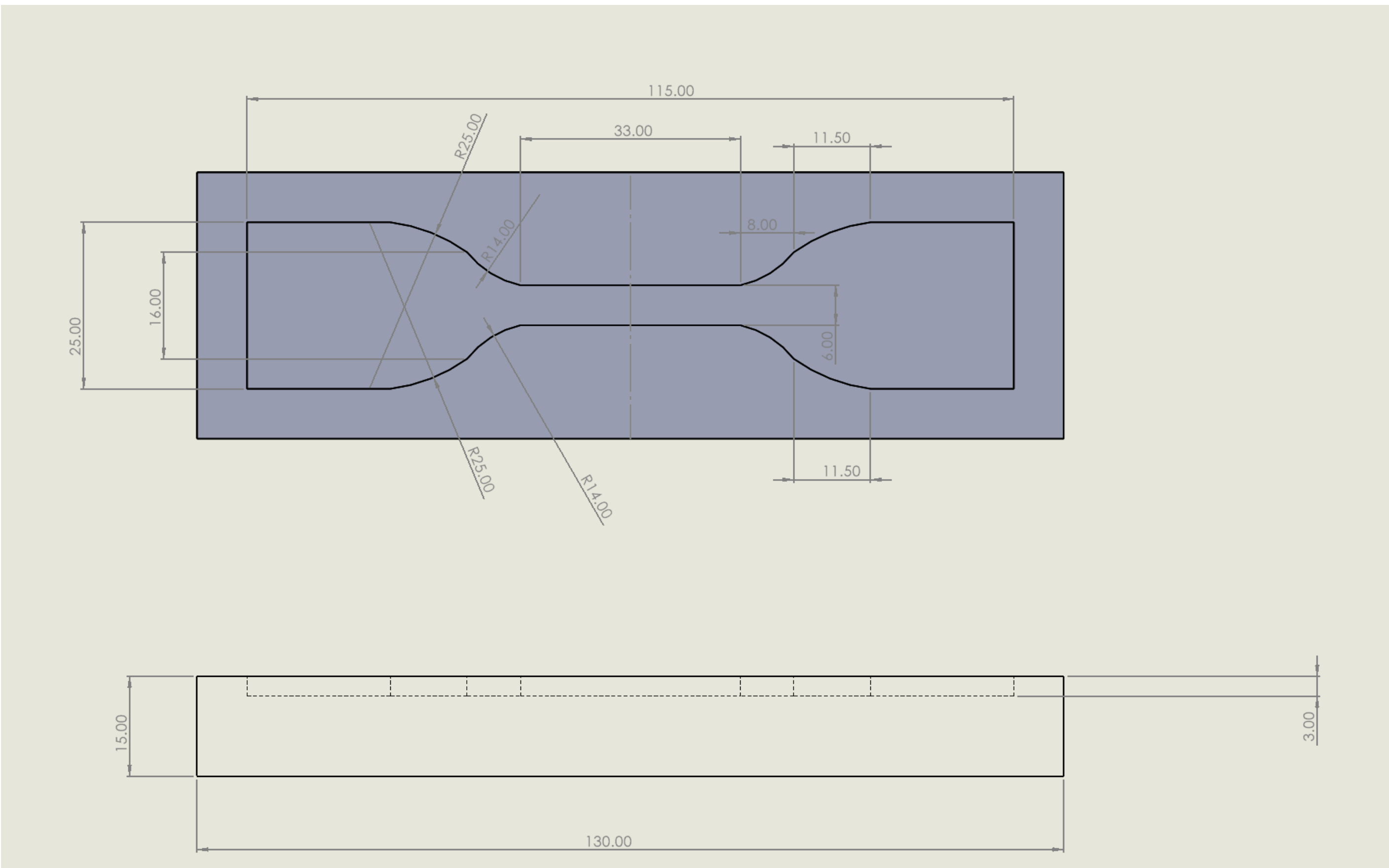
Date: October 28th, 2025

Content by: Renee Sobania

Present: NA

Goals: To build a MTS testing dog bone with proper dimensions according to ASTM standards before our meeting on Wednesday so I can show the sophomores how to make it in SolidWorks.

Content:



Conclusions/action items:

In conclusion, this is the drawing for the dog bone MTS testing mold so we can create a sample of Ecoflex 00-20 for mechanical testing. Next steps are to show the sophomores how to build this so they can learn how to do solidworks. Then we will need to print the mold, fill it with ecoflex, and perform mts testing.

SolidWork's Design - Vaginal Opening

RENEE SOBANIA - Nov 23, 2025, 2:46 AM CST

Title: SolidWorks Desing - Vaginal Opening

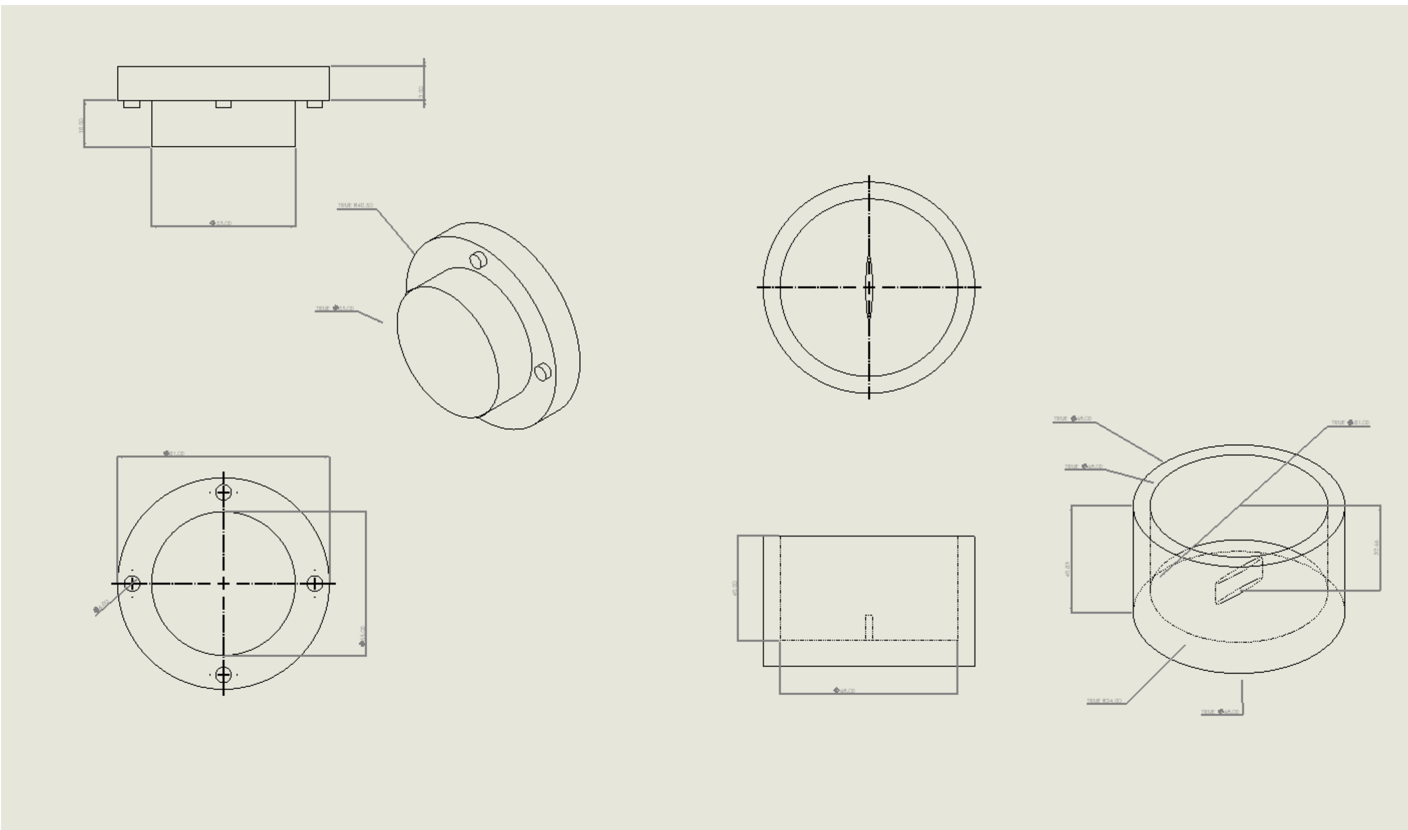
Date: November 23rd, 2025

Content by: Renee Sobania

Present: NA

Goals: To make a vaginal mold that is easier to open and has an opening.

Content:



Conclusions/action items:

In conclusion, I was able to make a vaginal opening that is easier to open and has lips. Now we need to test it to ensure it works.

PCB Model Brainstorm Sketches (Vaginal Opening and Walls)

RENEE SOBANIA - Dec 10, 2025, 2:40 PM CST

Title: PCB Model Brainstorm Sketches (Vaginal Opening and Walls)

Date: December 10th, 2025 (Sketches made throughout semester in sketchbook)

Content by: Renee Sobania

Present: NA

Goals: To show the process of design ides throughout the semester.

Content:

Sketches attached below

Conclusions/action items: In conclusion, these are sketches i made throughout the semester to show the design process, specifically for the vaginal opening.

RENEE SOBANIA - Dec 10, 2025, 2:39 PM CST

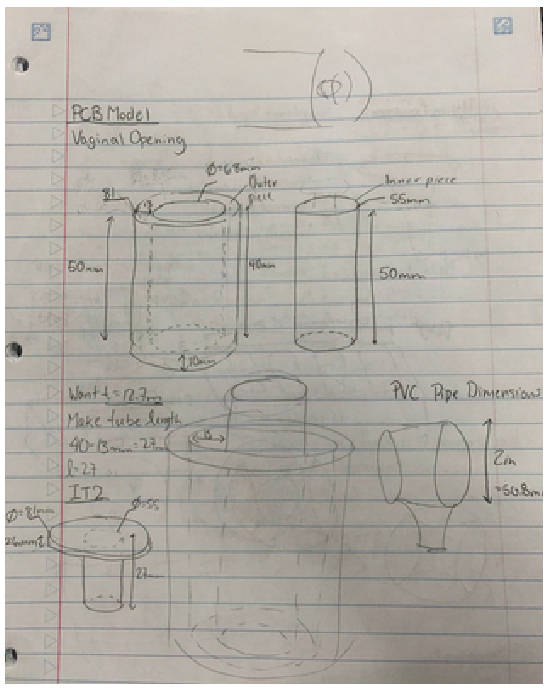


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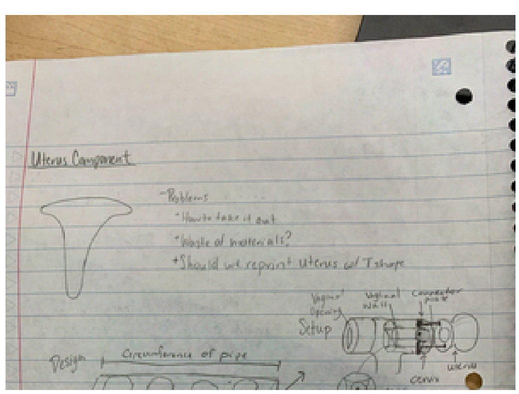
image3.jpeg (1.21 MB)

RENEE SOBANIA - Dec 10, 2025, 2:40 PM CST



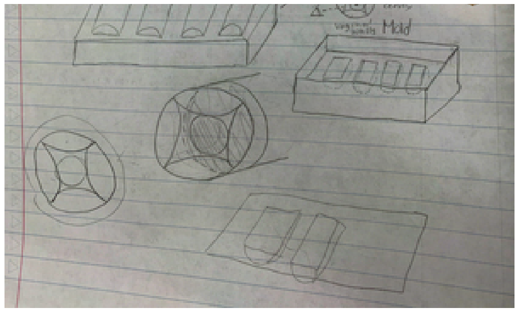


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image2.jpeg (1.29 MB)

RENEE SOBANIA - Dec 10, 2025, 2:40 PM CST

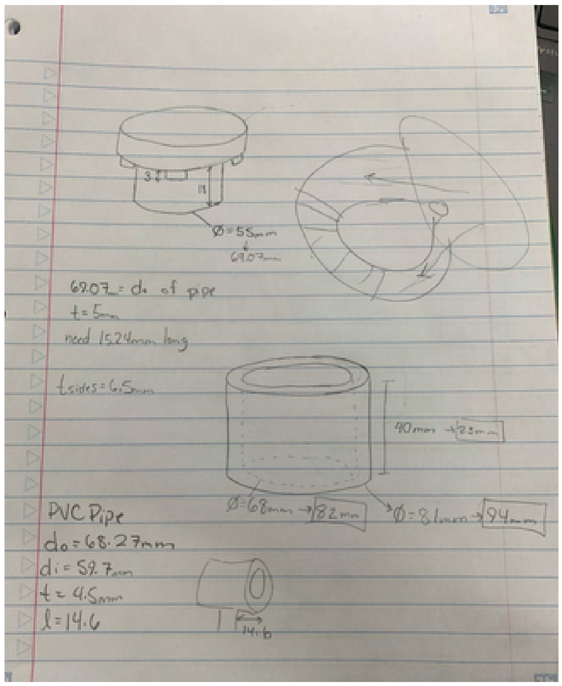

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image1.jpeg (1.09 MB)

RENEE SOBANIA - Dec 10, 2025, 2:40 PM CST

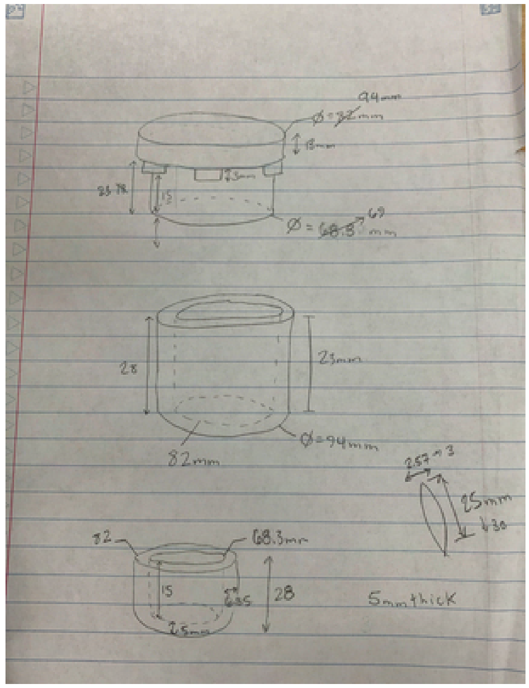

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image0_1_.jpeg (1.16 MB)

MTS Sample Procedure from 201

RENEE SOBANIA - Oct 16, 2025, 12:56 PM CDT

Title: MTS Sample Protocol from BME 201

Date: October 16th, 2025

Content by: Renee Sobania

Present: NA

Goals: To show a protocol from 201 that we can follow for our testing.

Content:

Testing Protocol

file --> new --> test from template --> BME 201 test compression -> 0.02mm/sec --> load, crosshead, strain, time --> right click on load and zero signal --> unlock machine w handset(light green) --> preload sample --> bring down so close to sample but not touching --> w less than a N worth of noise(force?) --> watch computer closely --> go down slow till it stops being negative (right around less than a Newton) --> zero the load (right click) --> zero crosshead --> zero signal --> lock button --> turn to buttons --> press play and put in diameter --> when it comes close to load limit, hit stop --> return to zero(yes) --> modulus is calculated --> calculate values on your own but take a picture of the given values --> export raw data --> google drive to section folder in canvas --> test samples in numerical order

Appendix I: MTS Testing Protocol

Materials:

- MTS mechanical testing system
- Prepared test sample
- Safety goggles

Procedure:

1. Make observations about your samples looking for defects, uneven surfaces, or other potential sources of error and make measurements with an accurate measuring tool such as a caliper for dimensions to obtain cross-sectional area and mass.
2. Place your sample into the fixture
3. Zero the meter for load
4. Unlock the machine
5. Preload your sample such that the load reads just above zero
6. Zero the meter for load and the meter for crosshead / displacement
7. Press the “play” button to start your test
8. Enter the appropriate parameters for your test on the “monitor” tab for diameter and test rate, etc.
9. Watch the load carefully so that it does not exceed your load cell capacity or fixture capacity
10. Stop your test or wait for break detection to occur (provided you have not exceeded the capacity)
11. Hit the emergency kill switch
12. Export your data
13. Power off the machine, return components, clean up your sample and leave the area cleaner than you found it!

Before testing, each sample was inspected for visible defects or surface irregularities, and key measurements such as cross-sectional area and mass were recorded using a caliper. The sample was securely placed in the fixture, and the load and displacement meters were zeroed following a preload. Test parameters including diameter and strain rate were entered into the MTS software. The test was initiated, and the load was monitored to ensure it remained within the safe limits of the load cell and fixture

Conclusions/action items:

In conclusion we can use this protocol as an outline to perform testing on our material.

Completed Course Trainings

RENEE SOBANIA - Dec 10, 2025, 3:09 PM CST

Title: Training Documentation

Date: December 10th, 2025

Content by: Renee Sobania

Present: NA

Goals: to record all of my training documentation, particularly the UW Human Subjects Protection Course.

Content:

Attached below.

Conclusions/action items:

In conclusion, these are the trainings I have completed so far at UW Madison, including the BME 300 required UW Human Subjects Protection Course

---

RENEE SOBANIA - Dec 10, 2025, 3:06 PM CST

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

This certifies that Renee Sobania has completed training for the following course(s):

Expand All Collapse All

Course	Assignment	Completion	Expiration
Biosafety 102: Bloodborne Pathogens for Laboratory and Research	Biosafety 102: Bloodborne Pathogens Safety in Research Quiz 2025	9/19/2025	9/19/2026
Biosafety 105: Biosafety Cabinet Use	Biosafety 105: Biosafety Cabinet Use Quiz	9/19/2025	No Expiration
Biosafety 106: Autoclave Use	Biosafety 106: Autoclave Use: Safety and Efficacy - Verification Quiz	9/19/2025	No Expiration
Biosafety 107: Centrifuge Safety	Biosafety 107: Centrifuge Safety Verification Quiz	9/19/2025	No Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	3/9/2025	3/9/2030
Biosafety Required Training	Biosafety Required Training Quiz 2024-2025	9/19/2025	9/19/2030
Chemical Safety: Cryogen Safety Training	Part 1 Final Quiz	9/18/2025	9/18/2030
Chemical Safety: Cryogen Safety Training	Part 2 Final Quiz	9/18/2025	9/18/2030
Chemical Safety: The OSHA Lab Standard	Final Quiz	3/9/2025	
Disposing of Hazardous Chemicals	Final Quiz	9/19/2025	9/19/2030
Stem Cell Ethics and Policy Training	Assurance	9/19/2025	9/19/2028
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	10/29/2025	10/29/2028

[Download](#)

Screenshot_2025-10-30_081936.png (374 kB)

Lecture 1: BME Career Prep

RENEE SOBANIA - Sep 18, 2025, 10:45 PM CDT

Title: BME Career Prep

Date: September 10th, 2023

Content by: Renee Sobania

Present: BME 300

Goals: To get tips on how to succeed at the career fair by getting resume and cover letter tips.

Content:

Job Search Tips

- Job Search Tips
  - Keep track of what you do - ECS tracking sheet
  - Quality of sources matters- Handshake, LinkedIn, Career Page on company website
    - Aggregator- Indeed
  - Connect BEFORE you are a candidate - use your people
    - Find a person to connect with, on LinkedIn
    - Schedule an appointment with ECS and find someone who will look at your application
  - Applying is setp 1- follow up is required (2-3 weeks)
  - Think beyond the title - focus on skills, industry, exposure
  - It takes time
    - Start early!!!
  - Don't let perfect be the enemy of good
  - Internships are for transferrable skills and knowledge, experience is important even if it is adjacent
- Resume Tips
  - Objective: What you want(summer, coop, internship), for unoccumpanied (ex. career fair) helps them know where to put you. Don't put it in if you are applying for a specific job
  - Tailor your resume to the position- quick change
    - helps make sure you are reading the job description and making connections
    - Find things that are relevant that you can put back on
    - Keywords (from job description)
    - processes or things listed multiple times
  - Create balance - show a full picture of your experience
  - Flawless product - ATS proofed resume is do able
    - MS Word
    - No columns, charts, colors
    - Design projects WITHOUT years or semesters- what did you do?
    - Technical skills and coursework
    - Jobs - organization + location, position title + dates
  - Find difference between what is part of academic curriculum, make it unique to you
  - Basic and simple is better for resume
  - Find a way to show employment (even if it is a restaurant), side histle, independent project
  - Lots of ECS help still available before the fair
  - Design Projects
    - List without years and semesters, put most relevant design project first
    - dont want dates because applicant tracking system mark dates as job
  - Skills should be real and technical and relevant
- Cover Letter Tips
  - Always based on the job posting
  - CUSTOM to each job

    - Amplifying your greatest selling points
    - Clear and concise support
    - Demonstrate employer knowledge
    - Address to person
    - Recommended vs. Required
    - You can combine experiences into a packaging without it being just one experience
    - Outline- basics
        - Intro: who you are, applying for, where you found it, and "thesis" statement
            - Based on my experience in A and B, I believe I would be able to make a difference in the X role at Y company
        - Paragraph all about A
        - Paragraph all about B
        - Why this employer/role + closing/next steps
- Career Fair Advice for BME
    - Identify your purpose - more than just an internship
    - Looking beyond the obvious - overlap with other disciplines
    - Research the employer - feedback from our partners
    - Develop your "values added" statement - why you
    - BME looks different at other companies
        - Biomaterials - material science and engineering '
            - articulate why your background in BME makes you a better fit for that role than a typical engineer in that role
            - WHY? what is the value that you are adding to them
            - How am I going to talk about BME with an employer
- Apply
    - GE healthcare, Epic, AbbVie, Exact Sciences, Plexus Corp

Conclusions/action items:

In conclusion, I learned some good tips on how to write my resume and cover letter. I also got some good advice on how give an elevator pitch at the career fair and other good advice.

Lecture 2: Exploring your Leadership Style

RENEE SOBANIA - Sep 18, 2025, 10:45 PM CDT

Title: Lecture 2: Exploring your Leadership Style

Date: September 17th, 2025

Content by: Renee Sobania

Present: BME 300s

Goals: To learn about leadership, different styles and what kind of leadership style I am.

Content:

- InterEGR 303- Leadership Competencies
- Effective Team Dynamics
- What are important qualities of an effective leader?
    - Communication
    - Organization
    - Confidence
    - Inclusive
    - Understanding
    - Assertive
- What makes up the anatomy of a good leader
    - Self-awareness: understanding strengths and weaknesses
    - Vision: provide direction and purpose, set goals
    - Transparent: Clear processes and open to feedback
    - Communication: articulate
- Different levels of leadership
    - Organizational
    - Team: facilitate team interactions, support others' development, design and improve team processes, empower others
    - Interpersonal: recognizing and responding to others' needs, active listening, building trust, engaging in difficult conversations
    - Personal: self-awareness & management, competency, goals
- Different Styles
    - Power model
        - leadership = power
    - Servant
        - leadership = mutual service
    - Authentic
        - leadership = authenticity
- Power Model:
    - Thought process: "someone has to take control, and it should be me"
    - Defining qualities
        - Great Man theory and trait theory - only certain people are born to lead
        - being in control is the most important thing
    - hierarchy, authority, command
- Servant Leadership
    - Thought process: Its not about me and my needs its about the needs of my followers that's most important
    - Defining qualities
        - being of service to others
        - Sharking power
        - Listening and understanding

  - Empathetic, empowering, shared decision making
- Authentic Leadership
  - By being my genuine self, I can gain and build trust
  - Defining Qualities:
    - Building self-esteem and self-awareness
    - Emotional intelligence
    - Creating authentic relationships
  - Transparency, genuineness, honestness
- People oriented leader: glue that holds team together, gets to know everyone individually. Skilled at building trust and an inclusive environment
- Process-oriented leader: sets the pace for the team; willing to work alongside everyone. You create systems and process so work gets done efficiently
- Thought-oriented leader: sees the big picture and anticipates the future, open to new ideas and innovative approaches
- Impact-oriented leader: set the bar high and push for excellent performance. You inspire people to follow your cause and mission.
- Leadership doesn't require a particular job title
- Explore and define how you want to lead:
  - Self-assess
  - observe
  - seek feedback

My Goals for the Semester:

- Look for mentors and connect with different professors and advisors
- Be a good leader during out BME class to help our team produce a successful project.
- Stay clean and organized throughout the semester regardless of how busy I am
- Keep my team organized and stay ahead of tasks so we aren't cramming
- Stay prepared for all reports, presentations, papers and assignments
- Help create an environment in our team where we can collaborate and communicate successfully without the feeling of being judged or unappreciated.

Conclusions/action items:

In conclusion, I was able to learn about the kind of leader I am and make some goals to have for myself for the semester.

Lecture 3: Peer Mentoring

RENEE SOBANIA - Sep 24, 2025, 2:09 PM CDT

Title: Lecture 3: Peer Mentoring

Date: September 24th, 2024

Content by: Renee Sobania

Present: BME 300

Goals: To learn about peer mentoring and the roles and responsibilities we have.

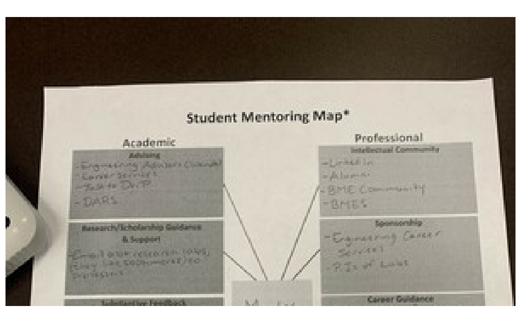
Content:

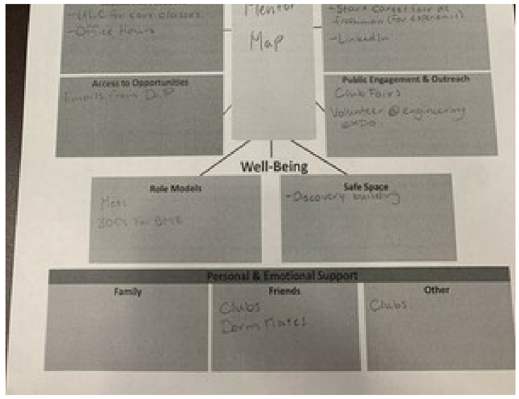
- General benefits of mentoring
    - Increased self-esteem/confidence
    - Increased patience
    - Build positive habits
    - foster personal growth
- What does it mean to be a good mentor?
    - being organized and communicative
    - Building trust
    - Psychological safety
    - Reliability
    - Support/enthusiasm
    - Being available
    - transparent
    - Humanizing their challenges, be the coach
- Listening Effectively
    - Get rid of distractions
    - stop talking
    - act like your interested
    - look at the other person
    - get the main idea
    - ask questions
- What do I wish I knew in BME
    - Mad grades
    - Spreadsheet with all the classes you need to take as Pre-recs
    - DARS
    - How to study
    -

Conclusions/action items:

Learned how to provide opportunities for mentees and made a career map on advice to give them.

RENEE SOBANIA - Sep 24, 2025, 2:11 PM CDT





Download

300.jpg (530 kB)

Lecture 4: Sustainability in BME

RENEE SOBANIA - Oct 01, 2025, 1:58 PM CDT

Title: Sustainability in BME

Date: October 1st, 2025

Content by: Renee Sobania

Present: BME 300

Goals: To learn about sustainability in biomedical engineering and the importance of sustainability.

Content:

- Why is sustainability so important?
- Circular economy: how we can keep resources in the economy instead of making waste
    - Recycling
    - Economically efficient
- Environmentally motivated
- Environmental impact of plastic speculum
    - How much do they weigh vs. metal
    - How much plastic goes into making a plastic vs. speculum --> environmental impact
    - Labor component for metal
    - You have to think about other factors for reusable things
        - Gloves, autoclave, cleaning materials etc.
- What happened to medical supplies during the pandemic? --> you couldn't get them, harvesting materials out of labs
- What if you can't get supplies?
- What can you do with your study
- We throw away a lot of medical devices
- Risk levels and category of infection risk
- What needs to be reprocessed
    - How much do i need to worry about infection
    - How easy is it to clean
- How do we use these tools to engineer a more sustainable world
- Less than 1% bound by mass you typically don't have to worry about it
- Bounds can be a complicated thing to identify sometimes.

How can we make our design more sustainable:

Conclusions/action items:

In conclusion, I was able to learn about how to make a project more sustainable. We can use this presentation to relate to our project with silicones and replaceable parts.

Lecture 5: Patents & Licensing with WARF

RENEE SOBANIA - Oct 08, 2025, 2:03 PM CDT

Title: Lecture 5: Patents & Licensing with WARF

Date: October 8th, 2025

Content by: Renee Sobania

Present: BME 300

Goals: To learn about WARF and the process of patenting ideas and designs.

Content:

- Intellectual Property overview
  - Four common types of IP:
  - Patents
  - Copyrights
  - Trademarks
  - Trade secrets
- Other, WARF, IP:
  - Biomaterials - industry might be interested in
  - Technique and know how (akin in some ways to Trade Secrets)
    - Insight researchers might have
  - Data
- Overview of Non-patent IP
  - Copyrights
  - Protection for creative works that are expressed in a tangible medium
  - Wide range of subject matter, software code
- Trademarks
  - protection for names, marks, logos, dress, etc.
  - Requires use in commerce
  - Source-identifying function
- Trade secrets
  - can be used to protect anything of value
  - Protection is good so long as it
- Patents generally
  - Property right, granted by a government agency
  - patent holder has right to exclude others from making, using, or selling or importing the claimed invention
  - There are three different types of US patents
    - Design (15 year term, limited to ornamental features)
    - Plant (new variety, 20-year term, asexually reproducing, non-tuber)
    - Utility
      - Provisional (effectively a 1-year placeholder)
      - Nonprovisional (20-year term, can claim priority to a provisional)
- Utility (Non-provisional) Patents
  - Issued for invention of a new and useful proves, machine, manufacture, or composition of matter
  - A quid pro quo with the USPTO and the public
    - Application gets a time limited monopoly on invention
  - Often takes 2-5 years to issue after filing (patent examination)
  - Cost, on average, 30K - mostly attorneys' fees
  - ~90% of patents issued by USPTO are non-provisional utility patents
- Requirements for patenting (Must be very thorough)
  - 101- eligible ; cannot be a product of nature, abstract idea, or natural phenomenon

    - 102 - Novel; it must be new
    - 103 - nonobvious; it cannot be simple modification or combination of existing concepts
    - 112 - enabled and described ; must provide enough detail to teach others how to make or use the invention
        - patent examiners are scientists hired and trained by the USPTO to review patent applications for these requirements
- Disclosing an innovation to WARF
    - Warf receives ~400 new innovation disclosures each year
- Disclosing:
    - Describe the innovation
    - identify its advantages and potential applications
    - Name contributors (inventors, authors)
    - Provide funding and public disclosure details
- Meeting with WARF:
    - Discuss the innovation in more detail
    - Ask questions about WARF and patenting processes
    - Discuss next steps
- Assessing university inventions
    - Warf bases its decision son accepting an innovation into our portfolio on: \
    - IP considerations
        - Type of IP protection
        - Potential breadth and strength of IP protection
        - Public disclosure (past and planned)
        - Stage of development
    - Licensing Considerations:
        - Applications
        - Likelihood of identifying a commercial partner
        - Likely return from licensing
- AI and IP
    - Can Ai invent? (no)
        - Inventor = natural person, conception
    - Limited to US only/ -no
        - South Africa is the exception
    - Can AI assist in inventing?
        - Evolving, but likely yes under Pannu factors

Conclusions/action items:

In conclusion I learned about the process of how to submit a patent on a design.

Lecture 6: Bioengineer it. Protect it

RENEE SOBANIA - Oct 15, 2025, 2:08 PM CDT

Title: Bioengineer it. Protect it

Date: October 15th, 2025

Content by: Renee Sobania

Present: BME 300

Goals: To learn about the legal/law side of engineering.

Content:

- Biomedical engineers create life-changing solutions
- IP protection allows research to safely transfer into products, processes, and/or systems
  - medical device --> patent filing --> marketplace
- IP enables investment, partnership, and ethical competition
- Building your IP knowledge:
  - legal career paths for biomedical engineering
  - protecting inventions and ownership
  - patent protection, searches and infringement
  - trademark, copyright, and trade secret protection
  - counterfeit products in the biomedical industry
- Career paths for engineers
  - Technical advisor - STEM degree
  - Patent agent - stem degree + patent bar
  - patent examiner - stem degree
  - patent attorney - law degree + patent bar
  - patent litigator - law degree
  - IP license attorney - law degree
  - tech transfer manager - stem degree preferred
  - engineer - stem degree
- Skills from Engineering to IP
  - Research = determine if an invention is truly new
  - Analytical reasoning = claim drafting/infringement analysis
  - Technical writing = translate complex technical concepts into clear, precise language
  - Communication = explaining tech to non-experts and Patent examiners
  - Creativity = problem solving in patents / creating competitive products
  - Collaboration = cooperate with colleagues and external professionals
  - Project management = manage resources, meet deadlines, and organize tasks (patent creation process form concept to product launch)
- Intellectual property ownership in the biomedical industry
  - University: disclose before publishing; university usually owns IP; possible license opportunities
  - Company: employer typically owns inventions, trademarks, copyrights and other IP; review employee agreements
  - Startup: you own IP; file early, use NDAs, document development
- Timing and Publication
  - Disclose internally first

- Publishing before filing and offers for sale = lost patent rights abroad and possible loss of rights in the US
- Poster or abstracts can count as public disclosures
- First to file system (not first to invent)

- Legal and Ethical Duties of Engineers
    - Respect others IP
    - Keep invention notebooks
    - Understand inventorship vs. authorship
    - maintain confidentiality agreements
- Patent protection
    - Novel - must be new
    - Non-obviousness - more than a routine change
    - Utility - must work
    - Enablement - must describe how to make and use
- What is a patent
    - Creates a monopoly/ stops others: from making, using, selling or importing the invention
    - Two main types
        - Utility patents
        - Design patents
    - Patents are especially critical in BMD where innovation drives competitive advantage
- Understanding the parts of a utility patent
    - front page
    - drawings (figures)
    - specification (written description)
    - Claims (legal definition of the invention)
    - Abstract (Brief summary)
    -

Conclusions/action items:

In conclusion I was able to learn about the different paths that I could take if i wanted to go down the legal career path for engineering in IP.

Lecture 7: Post Grad Discussion

RENEE SOBANIA - Oct 22, 2025, 2:34 PM CDT

Title: Post Graduate Discussion

Date: October 22nd, 2025

Content by: Renee Sobania

Present: BME 300

Goals: To learn about the different post graduate opportunities.

Content:

- Use undergraduate experiences to build a story
  - Gain experience while you can
  - Tie them together - big picture of who you are/want to go/want to be
  - Research = important for all post-degrees and helpful for industry
- Do your homework - never too late
  - What does ideal career look like
  - What programs have the opportunities you are looking for?
  - Location, career development, people, disease, research, courses
- Think about letter writers or references early - 3 strong ones
- School: prepare for the MCAT or GRE - summer before senior year
- Writing your story (Wrong)
  - Look of typical (and wrong) personal statement or cover letter
  - Legos --> engineer --> aunt dies of cancer ---> BME PhD or MD
  - Research/field interest: will do anything
  - I did this, then that, then the other thing
- Writing your story better
  - General: start with what you want to do - thesis statement
    - cancer stem cells, role, etc
    - Your narrow experiences and how that applies to your broad interest
    - Specific to each position or place
  - XXXXXXXXXXXXXXXXx
- Graduate school options
  - Masters, MS
    - Stepping stone/change directions/gain depth/ expand credentials for future
      - Medical school
      - phD programs
    - Industry focused
    - Generally, ONE YEAR
      - Reasons
        - rewrite your story
        - MD: need time to prep for MCAT or apply for med school
        - PhD: cannot fund a funding
          - opens doors (credentials and experience)
          - Higher starting salary
          - Another opportunity for summer for internships

            - can co-op during the MS as well
            - Time to find a job
        - MS will make you more desirable
            - Fill gaps in your resume
            - Higher level of skills - more lab time with less class time
            - More experiences - teaching, mentoring, research thesis
            - Older, more maturity
        - Really powerful if you add in industry experience
    - Doctoral, PhD
        - Desire to be an independent researcher
        - Write research grants
        - work in academia
        - Lead projects in industry, startups and consulting
- Three MS options with BME - 24 credits for you
    - Research (typically 1.5-2years)
        - For those continuing on for a PhD here
        - Can be funded as Ra/TA/PA (tuition remission and stipend)
        - thesis required
    - Accelerated programs (1 year)
        - Funding (TA only) stipend only (no tuition remission $1200/credit)
        - No co-op allowed (internship is okay)
            - Accelerated
                - coursework only
                - independent study/research is allowed
            - Biomedical innovation, design, and entrepreneurship
                - Project based - project required (BME Design project continuity)
                - Partnership with business school
- Applying for BME accelerated MS Programs
    - Applying online, pay fee and submit - Fall and Spring start available
        - Statement of purpose: why you want to pursue further education in BME
        - Research MS only: list the PI who plans to support you
    - Special for UW BME BS students
        -

Conclusions/action items:

In conclusion, I know who more about the processes and steps for getting a MS or PhD.

Lecture 8: Regulatory Pathways

RENEE SOBANIA - Oct 29, 2025, 2:06 PM CDT

Title: Lecture 8- Regulatory Pathways

Date: October 29th, 2025

Content by: Renee Sobania

Present: BME 300

Goals: to learn about the different regulatory pathways for medical devices and how they affect BME.

Content:

New medical Devices

- Class 1: Low Risk
    - Exemp
- Class 2: Moderate Controlled Risk
- Class 3: High Risk
    - 510K : There is already an existing device that has gone through testing so they don't need to go through as strenuous of testing
    - 510k De Novo less strenuous pathway
    - HDE
        - Probable benefit outweighs risk
    - PMA
        - Reasonable
        - Assurance of stability and efficacy
- Sometimes it takes years for some products (especially things that are put in your body) to be identified as toxic
- Brief history of medical devices
    - Most of American history there was no regulation of medical devices
    - Cardiac pacemaker
        - First one used a rechargeable nickel battery
        - Thought it would last 3-5 years
        - second one lasted ~6 weeks
        - subject had 28 pacemakers
        - Manufacturers said they would last 3-5 years, most didn't last hours
        - No FDA regulation
-

Conclusions/action items:

In conclusion I learned a lot about the different regulatory pathways for medical devices.

Lecture 9: The Framework Guiding Advanced Therapeutic Product Development

RENEE SOBANIA - Nov 05, 2025, 2:05 PM CST

Title: Lecture 9: The Framework Guiding Advance Therapeutic Product Development

Date: November 5th, 2025

Content by: Renee Sobania

Present: BME 300

Goals: To learn about the different regulations for therapeutic product developments.

Content:

- FDA Structure and advanced therapeutics
  - Device (CDRH) center for device and radiologic health
    - PMA - Premarket approval
    - 510K - device equivalent to existing device
    - IDE - Investigational device exemption
  - Drug (CDER)
    - IND- investigational new drug
    - NDA- new drug application
  - Biologic (CBER)
    - BLA - biologics licensing application
    - IND
- Genome editing - target a precise genome locus and delete, insert or change existing sequences
- Gene delivery - transfer molecular tools and assembled gene systems into the cell
- Cell Therapy - Use expanded cells to transfer medicinal bioactivity to regenerate damaged tissue or restore health
- FDA framework: Developing CGT products for Hemophilia
  - US Laws made by congress
  - Regulations are made by FDA based on laws
  - FDA guidance are made by FDA with help from the public to help industry and the public interpret regulations
- 21st century cures act (CURES) of 2016 - law that creates regenerative medicine advanced therapy (RMAT) framework, to speed development of innovative cell, gene and tissue products
- Coronavirus aid, relief, and economic security act (CARES) of 2020: in response to COVID outbreak, gives FDA greater responsibility for managing interruptions and disruptions in drug manufacturing
- Dramatic Implications: 351 vs. 361
  - Human cells, tissues, cellular and tissue-based products (HCT/Ps)
  - Homologous use: For the same function (doesn't have to be the same cell types or tissue). Taken from patient and goes back into patient, minimally manipulated = homologous use
    - Liposuction fat used for cosmetic bulking purposes
    - Function of the fat is not biological in nature but mechanical
- 351 products are regulated as drugs and/or biologics
- While 361 products, comparatively are largely unregulated
- Need FDA approval for 351
- More ideal to stay within 361
- Product Development Life Cycle
  - Each stage of the product development cycle faces its own risks and challenges, and proper management of these risks is vital for successful commercialization
  - Extremely important to be able to distinguish between studies that are "on the critical path" vs. "good research products"
- A target product profile (TPP) is your product vision
  - When to use it
  - Why to use it
  - How to use it

        - Patient identification: indication
        - Patient benefits: efficacy profile
        - Patient risks: Safety profile
        - Is it medically and commercially compelling.
- Considerations when developing a 351 Regulated CGT
    - Time = $
- Quality management system implementation: a system that documents policies, processes, internal rules, procedures, and other records to ensure consistent quality
    - Must be very detailed
-

Conclusions/action items:

In conclusion I was able to learn about the FDA regulations for therapeutic products.

Lecture 10: An Introduction to Research and the IRB

RENEE SOBANIA - Nov 12, 2025, 2:19 PM CST

Title: An Introduction to Research and the IRB

Date: November 12th, 2025

Content by: Renee Sobania

Present: BME 300

Goals: To learn about the IRB history/basics and understand the IRB review process.

Content:

- Many historical problems with research
    - US public health service untreated syphilis study at Tuskegee, 1932-1972
    - WWII Nazi prisoner experiments, 1941-1945
    - US public health service Guatemala syphilis experiments, 1946-1948
    - Willow brook state school hepatitis experiments
- Ethical Research frameworks
    - Nuremberg code, 1947: Emphasis on voluntary consent
    - Declaration of Helsinki 1964: Focus on medical research
    - National research act, 1974: US response to US public health service untreated syphilis study at Tuskegee. Publication of the Belmont Report (1979) and creation of institutional review boards (IRBs)
- Belmont Report
    - Respect for persons autonomy: The principle for persons thus divides into two separate moral requirements: the requirements to acknowledge autonomy and the requirement to protect those with diminished autonomy"
    - Beneficence: maximize possible benefits and minimize possible harms
    - Justice: Who ought to receive the benefits of research and bear its burdens
- Applying the Belmont Principles
    - 1991 Department of Health and Human services (DHHS) 45 CFR 46
        - Common Rule:
            - Criteria for approving research
            - protections for vulnerable groups
            - requirements for IRB operations
        - 2018 Revised Common Rule
- IRB Composition
    - Diversity of membership required
        - Race, gender, cultural backgrounds
        - Scientific expertise
            - MD, PhD, MPH
            - Faculty, clinicians
        - Non-Scientists
            - Community members
            - IRB staff
- IRB Purpose
    - protect rights and welfare of people enrolled in research
    - participants/subjects
    - IRBs review human research according to:
        - Ethical principles: Belmont Report
        - Federal regulations: Common Rule, HIPPAA< FERPA
        - State Laws
        - Institutional Policies
- IRB Review Requirements
    - UW Madison requires IRB review of all research involving human subjects, including exempt human subjects research
    - Research CANNOT begin until the IRB has reached a determination
        - No retrospective approval of research that has already been done
- Role of an Institutional Review Board (IRB)
- IRB Purpose
    - Protects rights and welfare of human research subjects
        - Ethical principles: Belmont report
        - Federal regulations

- Federal regulations
    - 45 CFR 46 Common Rule
    - 21 CFR 56 FDA regulations
- State Law
- Institutional Policy

Common Rule Criteria (45 CFR 46)

RISKS	• No unnecessary risks; unavoidable risks as low as possible • Appropriate monitoring to prevent adverse effects or identify adverse outcomes as soon as possible
BENEFITS	• Potential direct benefits to participants, or scientific/societal benefits
RISK/BENEFIT RATIO	• Risks reasonable in relation to potential benefits of the research • Study design enables researchers to answer the research question, with appropriate procedures/data collection, appropriate number of participants
EQUITABLE SELECTION OF SUBJECTS	• Appropriate to answer the research question • Appropriate recruitment strategies • Justification and safeguards for vulnerable participants • Population that bears the burdens of research also benefits from it
INFORMED CONSENT	• Participants make an informed choice about taking part in research OR • Criteria for waiver of consent are met
PRIVACY & CONFIDENTIALITY	• Adequate protections for participant privacy • Adequate protections for data confidentiality

- Defining Human Subjects Research
- Common Rule Definitions
    - Research: a systematic investigation including research development, testing and evaluation, designed to develop of contribute to generalizable knowledge
    - Human Subject: a living individual about whom an investigator conducting research obtains information or biospecimens through intervention or interaction with the individual or obtains, uses, studies, analyzes or generates identifiable private information or identifiable biospecimens
- What happens after approval?
    - Begin your study: Make sure to use/follow IRB approved documents
    - Changes of protocol: must have approval of the change before implementing the change
    - Reportable events: When something unexpected happens

Conclusions/action items:

In conclusion I was able to learn about the IRB review process.

Lecture 11: How Medical Product Research and Development Works in Industry

RENEE SOBANIA - Nov 19, 2025, 1:56 PM CST

Title: How Medical Product Research and Development Works in Industry

Date: November 19th, 2025

Content by: Renee Sobania

Present: BME 300

Goals: to learn about how research and development works in industry.

Content:

- Types of NPD Projects
  - Line extensions: addition of additional sizes and configurations
  - product improvements: Existing product change due to market feedback and/or new customer needs
  - New to company: Product line that is not new to market but is new for the company
  - New to world: Innovative products that create completely new markets
- Managing NPD: Stage-Gate Process
  - The Cloud)
    - Stage 0: ideation
  - The Funnell
    - Stage 1: Exploration
    - Stage 2: Concept Development
    - Stage 3: Design Development
  - The Tunnel
    - Stage 4: Design Confirmation
    - Stage 5: Design transfer and Commercialization
  - Post market surveillance
- Stage 0:
  - Choose area of opportunity
  - Review market trends and/or competitive threats
  - conduct primary and secondary market research
  - Identify customer unmet needs
  - Create high-level, "back of the napkin" ideas
- Stage 1:
  - Define problem to be solved and customer requirements
  - Review, refine and screen list of ideas from stage 0 for exploration
  - Create concepts for 8-10 ideas
  - Develop high-level business case (market size, value proposition, etc.)
- Defining the problem statement is arguably the most important step of the design process.
- Stage 2: Concept Definition
  - Based on customer interviews and use- case assessments, down select from 8-10, to 2-3, to 1 leading concept
  - Develop robust business case including market opportunity, initial forecast, and projected expenses
  - Conduct comprehensive IP examination \next gate review is go/no go business decision
- Stage 3: Design Development
  - Move to functional prototype
  - Continue iterative design process including initial testing and reviews with customers
  - Confirm regulatory pathway
  - begin formal design control documentation
  -

Conclusions/action items:

In conclusion, I was able to learn how R&D works in industry.

9/10 - Lec 1: Career Fair

EVELYN OJARD - Sep 24, 2025, 1:11 PM CDT

Title: Career Fair

Date: 9/10/2025

Content by: Evelyn Ojard

Present: N/A

Goals: Get ready for the career fair AND "job searching"

Content:

Tips:

- Keep track of what and where you apply
    - ECS tracking sheet (stay organized)
- Real site vs aggregator sites
    - Real = 2. Handshake, 3. LinkedIn, 1. the company website
    - aggregator = indeed, Google Jobs, etc.
- Connect BEFORE you are a candidate
- Follow-up is required
    - applying is just the first step, and then follow up with an actual person
        - Interacting with an actual human at places like the career fair gives you an opportunity to follow up
- connection makes the online application worthwhile
    - an alum or after the week of the career fair, and try to find a contact point
- don't online apply to things that are perfect
    - Experience is better than no experience, even if it is adjacent to what you want long-term

Resume Tips:

- It is a summary, the abstract, the overview of who you are
- Tailor your resume to the position - quick changes
    - put projects back on that might be more relevant
- Keywords are important
- Create nuance and uniqueness
- It's always under construction
- Use Word and don't use templates

Cover Letter Tips:

- Provides an opportunity to give more information about yourself
- Amplify your greatest selling points

    - combine experiences into packaging without it being all one experience
- What are the two or three things you want the company/employer to know
    - Intro: who you are, applying for, where you found it, and "thesis" statement
    - Paragraph all about A
    - Paragraph all about B
    - Why this employer/role + closing/next steps
- Address to person

The system is not that granular

Conclusions/action items: Go to drop in ECS resume review. And go through different search settings in Handshake.

9/17 - Lec 2: Leadership Styles

EVELYN OJARD - Sep 17, 2025, 2:07 PM CDT

Title: Leadership Styles by Angela Kita

Date: 9/17/2025

Content by: Evelyn Ojard

Present: N/A

Goals: Learn more about how I can lead better based on my CliftonStrengths Report.

Content:

1. Leadership

- important qualities: communication, confidence, listening, self-awareness, providing direction/purpose, and responsible
- people oriented skills
- bringing other people up by being an example
- you can be a leader at multiple different levels: personal, interpersonal, team, organizational
  - personal: self-awareness and management, competency, and goals
  - interpersonal: recognizing & responding to others' needs, active listening, building trust, engaging in difficult conversations
  - team: facilitate team interactions, support others' development, design and improve team processes, empower others
  - organizational: collaborate beyond the individual teams

2. Styles

- power model (leadership = power)
  - thought process: "someone has to take control here, and it should be me"
  - qualities:
    - "great man theory" & Trait theory - only certain people are born to lead
    - Being in control is the most important thing
  - hierarchy, authority, command
- servant (leadership = mutual service)
  - thought process: "it's not about me and my needs, the needs of my followers are most important
  - qualities:
    - being of service to others
    - sharing power
    - listening and understanding
  - empathetic, empowering, shared decision making
- authentic (leadership = authenticity)
  - thought process: "By being my genuine self, I will gain and build trust."
  - qualities
    - building self-esteem and self-awareness
    - emotional intelligence
    - creating authentic relationships
  - transparency, genuineness, honesty

3. Connect

- Leadership doesn't require a job title
  - you can develop your leadership skills regardless of your position, and this often leads to better outcomes for yourself and your teams
- self - assess: what motivates you and what drives you (values
- observe and reflect: where do you show up well and how do you get in your own way
- seek out feedback: others may be able to identifiy strengths and areas of improvements

4. Goal Setting

- start small, slow down
- focus on one element to practice
- look for mentors

Conclusions/action items: I would like to be the type of 300 that Kate was for me by building actual relationships with my teammates and making them feel comfortable asking me for help in future classes. I want to hang out with our group socially as well to make sure they know me as a person and not just as a 300/student

9/24 - Lec 3: Near Peer Mentoring

EVELYN OJARD - Sep 24, 2025, 2:09 PM CDT

Title: Near Peer Mentoring

Date: 9.24/2025

Content by: Evelyn Ojard

Present: N/A

Goals: Talk more about what it means to be a mentor

Content:

Why are we mentoring the 200s:

- leadership
- additional emotional and instructional support
- we are much more approachable compared to faculty (they feel more comfortable asking us questions)
- share expereinces
- increases belonging and makes BME a family
- learn how to convey knowledge and understand gaps in our own knowledge

transferrable skills (portable skills):

- leadership
- communication
- active listening
- study practices
- self awareness
- interpersonal skills

General Benefits of Mentoring:

- increased self-esteem/confidence
- increased patience
- build positive habits

what does it mean to be a "good mentor"?

- being communicative and organized
- building trust
- psychological safety (share w/o fear)
- reliability
- support/enthusiasm
- sharing my wealth of knowledge

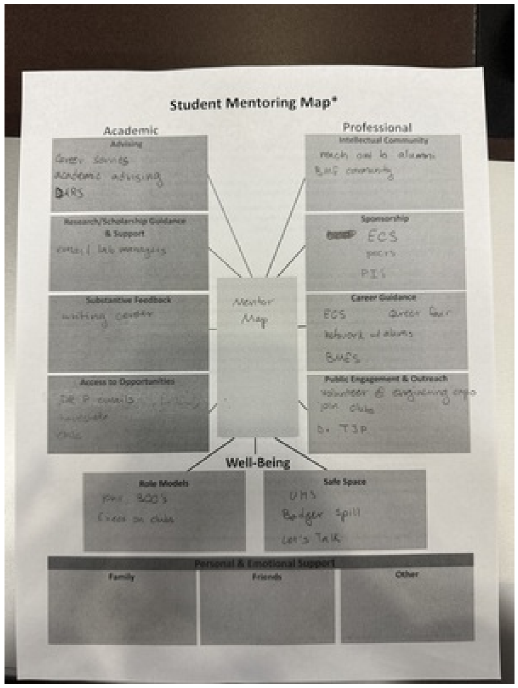
listening effectively:

- get rid of distractions
- stop talking
- act like you're interested
- look at the other person
- get the main idea
- ask questions
- check for understanding
- react to ideas, not to the person
- avoid hasty judgements

Make a mentor map

Conclusions/action items: Help provide more opportunities for my mentees.

EVELYN OJARD - Sep 24, 2025, 2:08 PM CDT



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10/1 - Lec 4: Sustainability in BME

EVELYN OJARD - Oct 01, 2025, 1:57 PM CDT

Title: Sustainability in BME

Date: 10/1/2025

Content by: Evelyn Ojard

Present: N/A

Goals: Learn more about how sustainability relates to BME

Content:

- Lifecycle assessment helps us to determine the most sustainable option
    - helps us answer questions without biases
- Agent-based modeling - what is the environmental impact of ...

Sometimes the decisions are both economically and sustainability motivated

Environmental payback periods -

- The break-even point is when both options are equal

Environmental impact is also dependent on how you make the product

So what do you do about these studies?

Environmental criteria are not the only factor to consider when making decisions, but they should be one of the primary ones.

How do we use these tools to engineer a more sustainable world?

- We look at the results to determine what options are both better for the world while also being safe and cost-effective

You are mapping your inputs and outputs into a system, and how does that correlate with sustainability\

Consider the amount of energy required to clean something if it is reusable versus disposable.

think about the lifetimes of a device. It might make more sense to have a higher initial investment if it's going to last significantly longer.

Conclusions/action items: When designing new products in healthcare, it's not just looking at what is most effective, but also looking at what is better for both my design and the environment.

10/8/25 - Lec 5: Patents and licensing with WARF

EVELYN OJARD - Oct 08, 2025, 2:07 PM CDT

Title: Lec 5: "Patents & licensing with WARF"

Date: 10/8/2025

Content by: Evelyn Ojard

Present: N/A

Goals: Learn more about WARF and IP

Content:

Moving research results from campus out into the market

Technology transfer examples:

- intellectual property licenses
- industry-sponsored research
- consulting arrangements
- fee for service

4 common IP types: patents, copyrights, trademarks, and trade secrets

Other WARF IP: biomaterials, technique, and know-how (support or backfill a company with some additional insight that the researchers or inventors have), data

Copyrights:

- Protection for creative works that are expressed in a tangible medium
- A wide range of subject matter, including software code

Trademarks

- Protection for names, marks, logos, dress, etc.
- requires use in commerce
- Source-identifying function

Trade Secrets

- can be used to protect anything of value
- protection is good so long as it

Patents GENERALLY:

- A patent is a property right granted by a governmental agency
  - eg., US Patent and Trademark Office (USPTO)
  - No global patent!
- Patent holder has the right to exclude others from making, using, selling, or importing the claimed invention
- There are three different types of U.S. patents:
  - Design (15-year term, limited to ornamental features)
  - Plant (new variety, 20-year term, asexually reproducing, non-tuber)
  - Utility
    - provisional (effectively a 1-year placeholder)
    - Non-provisional (20-year term, can claim priority to a provisional)

Utility (non-provisional) patents

- Issued for the invention of a new and useful process, machine, manufacture, or composition of matter

- also includes new and useful improvements thereof
- A quid pro quo with the USPTO and the public
  - applicant gets a time-limited monopoly on your invention (20 years from filing)
  - but, the applicant must teach others how to make and use the claimed invention
- Often takes 2-5 years to issue after filing (patent examination)
- Costs on average $30k - mostly attorney's fees
- ~90% of patents issued by USPTO are non-provisional utility patents

Requirements for patenting:

- Statutory requirements for patenting include:
  - 101 - eligible; cannot be a product of nature, abstract idea, or natural phenomenon
  - 102 - novel; it must be new
  - 103 - non-obvious; it cannot be a simple modification or combination of existing concepts
  - 112 - enabled and described; must provide enough detail to teach others how to make or use the invention
- ***Patent examiners*** are scientists hired and trained by the USPTO to review patent applications for these requirements

Value of Licensing

- **Benefits to the Company:**
  - Reduced R&D costs
  - Improved time to market
  - Opportunity to enter new markets and expand your company quickly
  - New features or products provide additional revenue opportunities
- **Determining the Value:**
  - Technology application
  - Key selling points/features/benefits
  - Technology trends
  - Market size, trend, competition
  - Industry standards/historical deals

AI and IP:

- Patents
  - Can AI invent? (no)
    - "inventor" = natural person, conception
  - Limited to US only? (no)
    - South Africa is the exception
  - Can AI assist in inventing?
    - Evolving, but likely <u>yes</u> under ***Pannu Factors***
- Copyright:
  - Original works of <u>human</u> authorship
  - AI must be incidental to conception and creation
  - Original conception by human master mind - Are prompts sufficient? (no)
  - Combinations of derivative works require more than de minimis contribution from human
  - traditional elements of authorship generated by AI? (no)

Conclusions/action items: Patents and IP are incredibly important to the manufacturing and development of all engineering areas.

10/15 - Lec 6: Valuation of Intellectual Property

EVELYN OJARD - Oct 15, 2025, 1:52 PM CDT

Title: Valuation of Intellectual Property

Date: 10/15

Content by: Evelyn Ojard

Present: N/A

Goals: Learn more about IP and its importance

Content:

- Biomedical engineers create life-changing solutions
- IP protection allows research to safely transfer into products, processes, and/or systems
    - medical device --> patent filing --> marketplace

- Building your IP Knowledge:
    - Legal career paths for biomedical engineers
    - protecting inventions and ownership
    - patent protection, searches & infringement
    - trademark, copyrights, & trade secret protection
    - counterfeit products in the biomedical industry

Legal Career Paths

- Technical advisor - STEM degree
- Patent agent - STEM degree + Patent Bar
- Patent Examiner - STEM degree (Patent Bar eventually)
- Patent Attorney - Law degree + Patent Bar
- Patent Litigator - Law degree (STEM degree + Patent Bar optional)
- IP License Attorney - Law degree (Stem degree + Patent Bar optional)
- Tech Transfer Manager - STEM degree preferred (Law degree optional)
- Engineer - STEM degree (work with IP lawyers to protect your inventions)

Skills from Engineering to IP

- Research --> determine if an invention is truly new
- Analytical reasoning --> claim drafting/infringement analysis
- Technical writing --> translate complex technical concepts into clear, precise language
- Communication --> explaining tech to non-experts and Patent Examiners
- Creativity --> problem-solving in patents/creating competitive products
- Collaboration --> cooperate with colleagues and external professionals
- Project Management --> manage resources, meet deadlines, and organize tasks (patent creation process from concept to product launch)

Conclusions/action items: Attend OH and look more into potential Patent Law Internships.

10/22 - Lec 7: Post Grad Discussion II

EVELYN OJARD - Oct 22, 2025, 1:58 PM CDT

Title: Fall Post Grad Planning

Date: 10/22

Content by: Evelyn

Present: N/A

Goals: Start thinking more about what I want for myself post grad

Content:

General Pointers:

Use your undergrad experience to "build a story"

- Gain experience while you can - easier while you are in school
- Tie them together - **Big Picture** of who you are/want to go/want to be
- Research = important for all post-degrees and helpful for industry

Do your homework - never too late

- What does your ideal career look like?
- What programs have the **opportunities** you are looking for?
- Location, career development, people, disease, research, courses

Think about letter writers or references early - 3 strong ones

School: Prepare for the MCAT or GRE - summer before senior year

Writing your story - better way

- General: Start with what you want to do - thesis statement
    - e.g. Cancer stem cells, role, etc.
    - Your narrow experience(S) and how that applies to your broad interest
    - Specific to each position or place to which you apply
- Personal statement: show a reasonable idea of what
    - You will achieve at University X
    - What you want to do afterwards
    - Name the faculty there who are in your field of interest
- Defend your plan with your life experiences - Most recent first
- CV to some extent in paragraph form - Be specific

Graduate school options

- Masters, MS
    - Stepping stone / change directions / gain depth / expand credentials for future
        - Medical School
        - PhD programs
    - Industry focused
    - Generally ONE YEAR!
- Doctoral, PhD
    - Desire to be an independent researcher
    - Write research grants
    - Work in academia
    - Lead projects in industry, startups, and consulting https://www.wisolve.org/

MS as a stepping stone for further education

- Reasons
    - Rewrite your story
    - MD: Need time to prep for MCAT or apply for Med Schools
    - PhD: Cannot find a fundeding
- MS will make you more desirable
    - Fill gaps in your resume
    - Higher level of skills - More lab time with less class time
    - More experiences - teaching, mentoring, research thesis
    - Older, more maturity
- Really powerful if you add in industry experience
- Reasons
    - Opens doors (credentials and experience)
    - Higher starting salary
    - Another opportunity for summer for internships
    - Can co-op during the MS as well (BME 702)
    - Time to find the dream job
- MS will make you more desirable (ditto)

Three MS options within BME - 24 credits for you

- **Research** (Typically 1.5-2 yrs)
    - For those continuing on for a PhD here
    - Can be funded as RA/TA/PA (tuition remission and stipend)
    - Thesis required (Must have a lab PI identified & willing to support before applying)
- **Accelerated Programs** (1 year)
    - Funding (TA only) stipend only (no tuition remission $1200/credit)
    - NO co-op allowed (internship is OK)
    - **Accelerated**
        - Coursework only
        - Independent study/research is allowed
    - **Biomedical Innovation, Design, and Entrepreneurship**
        - Project based - project required (BME Design project continuity)
        - Partnership with business school

Applying for BME Accelerated MS Programs

- Applying online, pay fee and submit - Fall and Spring start available http://www.grad.wisc.edu/
    - Statement of purpose: why you want to pursue further education in BME
    - Research MS only: List the PI who plans to support you
- Special for UW BME BS students
    - ~~Three letters of recommendation~~
        - You still need to input email addresses, use: Janna Pollock, (608)890-2756, and three addresses that go to her: janna.pollock@wisc.edu, tenbruggenca@wisc.edu, and bmegradadmission@engr.wisc.edu
        - Research MS ONLY - At least one from PI that has agreed to mentor you
    - ~~Official GRE (Quantitative section important) or MCAT scores~~
    - ~~Transcripts~~
    - Easy to meet deadline of 12/15 (some flexibility), spring entry allowed
    - Your application is reviewed separately, and we give special consideration to BME undergraduate students: Need at least a 3.0 overall / 3.0 in the last 60 credits

Research-Demonstrate skills outside classroom

- Convince them you can make the jump from textbooks to the real-world
- Utilize BME Design projects
- Build skill sets to get into labs
    - “I will do anything” has limited appeal and sounds desperate!

- "I know this, that, and this too" sounds arrogant!
- Instead: Show how the lab will help build on the skills on the skills you

- Previous research experience
  - Undergraduate research experience(s) – can continue into MS
  - Honors in research program
  - REU (research experience for undergraduates-summer)
- Publications (see how you could get included)

Conclusions/action items: Continue building relationships with professors and PI as well as figure out if it makes the most sense to go into a company like Foley and Lardner post grad or masters.

10/29 - Lec 8: Regulatory Pathways

EVELYN OJARD - Oct 29, 2025, 2:07 PM CDT

Title: Regulatory Pathways

Date: 10/29/2025

Content by: Evelyn Ojard

Present: N/A

Goals: Learn more about regulatory pathways and how they affect BME

Content:

Devices are different than drugs because a lot of things you want to know about drugs are the same.

Regulatory Pathway

- Class I
  - example is a tongue depressor
- Class II
  - moderate/controlled risk
  - 510k pathway or 510k de novo
  - 510k pathway
    - pushed for by industry
    - if you have approved 40 cardiac pacemakers then can you accept that if it is similar enough that you don't have to do all of the safety and efficacy testing
  - 510k de novo
    - no predicate device but can become a 510 predicate
    - predicates are often used for design revision
- Class III
  - high risk
  - PMA or HDE
    - HDE is a very special pathway for smaller markets
    - different risk vs benefit because they are for more specialized devices

clinicians have very little experience with the regulatory pathway

Drug Versus Device Regulatory Pathway

FDA Drug Path

- Phase 1 Trial
  - Healthy volunteers, determine side effects, how drug is metabolized and excreted. 20-80 patients, safety emphasis
- Phase 2 Trial
  - Begin if no toxicity in Phase 1. Emphasis on effectiveness. Preliminary data on whether drug works for condition. Safety also evaluated. Few dozen to 300 patients
- Phase 3 Trial
  - Begin if evidence of effectiveness in Phase 2. These studies gather more information about safety and effectiveness, studying different populations and different dosages and using the drug in combination with other drugs. Several hundred to about 3,000 people.

FDA Device Path

- Early Feasibility Trial
  - Limited clinical investigation of a device early in development, typically before the device design has been finalized. Evaluate the device design concept with respect to basic safety and device functionality in a small number of subjects (<10

initial subjects) when this information cannot be readily provided through additional nonclinical assessments or appropriate nonclinical tests are unavailable.

- Feasibility Trial
    - Capture preliminary safety and effectiveness information on a near-final or final device design to adequately plan an appropriate pivotal study. Patient numbers vary (1 patient to 100 patients)
- Pivotal Trial
    - Collect definitive evidence of the safety and effectiveness of a device for a specified intended use. Can be 15 patients or fewer to support PMA (FreeHand) or 300+ patients (CVRx).

FDA did not regulate medical devices until 1976

Conclusions/action items: The role of the regulatory pathway is very important, but also has many flaws. Many of the major issues that arise could not have been predicted based on current guidelines and regulations. No company is going to do a 15-year study to determine the safety because it is just not feasible, but that is often when major issues arise.

11/5 - Lec 9: "Bringing biologics to market"

EVELYN OJARD - Dec 10, 2025, 3:05 PM CST

Title: "Bringing biologics to market"

Date: 11/5/25

Content by: Evelyn Ojard

Present: N/A

Goals: Learning more about the process of bringing drug research and development into the marketable space

Content:

The Framework Guiding Advanced Therapeutic Product Development

A Beginners Toolkit of Regulatory Resources

- US regulations and also a bit of EU, Japan, etc.
- The FDA is similar to the regulations in other parts of the world

FDA Structure and Advanaced Therapeutics

- Device (CDRH)
  - PMA, 510 (k), IDE
- Drug (CDER)
  - NDA, IND
- Biologic (CBER)
  - BLA (biologics license applications), IND

U.S. Laws made by Congress --> Regulations (CFR Title 21) made by FDA based on laws --> FDA Guidance are made by FDA with help from the public to help industry and the public interpret regulations

The area we would interact more with is the FDA Guidance area

ex:

- 2015 - Design of Early Phase CGT Trials Guidance
- 2017 - Regenerative Medicine Framework:
  - Human Cell & Tissue Products
  - Same surgery expection
  - RMAT expedited programs
  - medical device use with products
- 2018 - CGT Therapy for Hemophilia Guidance
- 2020 CGT Framework:
  - Updated CGT Therapy for Hemophilia Guidance
  - CGT in Rare Disease Guidance
  - Long-term CGT trial follow-up
  - CGT manufacturing guidance
  - CGT "Sameness" for orphan drugs
- 2021 - CGT Manufacture During COVID

Dramatic Implications: 351 vs 361

a 361 product is generally taken from a patient and then put back into that patient, and doesn't get manipulated significantly (minimally manipulated)

- don't require much regulation, the surgeon can use their own discretion

homologous use is used for the same function even if it isn't the same type of cell a 351 product are human cell/tissue base products that are not homologous and have to go through a full regulation process

minimal manipulation means putting it in a centrifuge or putting it in a syringe and then injected back into the patient

Product Development Life Cycle

- extremely important to be able to distinguish between studies that are "**on the critical path**" vs "**good research projects**"!
- academia builds the approach and proof of concept but the critical path item is going to be safety tox

Defining the critical path is helped by using the Target Product Profile (TPP) like the PDS but for a therapeutic product

- Core
    - indication & patients, efficacy, safety, dose and regimen, route of adminstration, dose form
- Clinical Development Planning
    - Clinical pathway, regulatory pathway, timelines, cost, risk
- CMC (qTPP; Quality TPP)
    - Product attributes (purity, degradants, biocompatibility), storage, stability, container, and pharmacopoeial compliance

Conclusions/action items: Drug research comes to market differently.

11/7 - Lec 10: Tong Lecture

EVELYN OJARD - Dec 10, 2025, 3:06 PM CST

Title: Tong Lecture - "Building a Career of Impact"

Date: 11/7

Content by: Evelyn

Present: N/A

Goals: Learn from an alum about the impact we can make as a BME

Content:

The Foundation

- Solve tangible problems, work hard, add value

The Growth Curve

- Combine EQ with IQ to multiply impact & reach
- Chief of staff to CEO - If you work for a great leader it is a great opportunity to see a lot of diverse things

Build & Transform

- Drive system-level impact through innovation & scale
- We can have these amazing experiences in a lot of fields but in healthcare its different

Make the next best decision in the context of your life and what's happening around you

What does great look like?

- improved provider experience
- improved patient outcomes
- lower cost of care
- improved patient experience

50% of doctors would say they wouldn't make the choice to be a doctor again

We have a very archaic system that fundamentally that needs to change at the core of it

Underlying challenges:

- misaligned incentives
- fragmented financing & regulation (federal, state employer)
- Data silos & legacy IT
- Inequities (10-15yr gap between zip codes)

Healthcare needs better systems. And systems are what engineers build best

What's required to build a better healthcare system?

- Interoperable data infrastructure
  - seamless exchange of clinical, claims and social data across payers, providers and patients
- human centered design
  - care built around people, not processes - intuitive, empathetic, seamless
- aligned incentives and measurement
  - everyone rewarded for outcomes, not activity
  - performance is transparent and known to all
- connected care delivery platforms
  - integration of virtual, in-person, home, and community care

    - real-time data integration and feedback loops
- simplified and automated infrastructure

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, high-integrity people. They will shape who you become
- The 5 people you hold really close to you play a big role in the trajectory of your life

Know your values & protect them

- define what matters most - family/friends, health, career/impact, values - and make decisions that align

Embrace challenge & keep growing

- run towards hard problems. growth lives on the edge of discomfort - where big impact starts

Conclusions/action items: A lot of our futures depend on choosing paths and people that will help us grow.

11/12 - Lec 11 - An Introduction to Research and the IRB

EVELYN OJARD - Nov 12, 2025, 1:54 PM CST

Title: "An Introduction to Research and the IRB"

Date: 11/12

Content by: Evelyn

Present: N/A

Goals: Learn more about what the IRB does and how it conducts research

Content:

Historical problematic research

- US Public Health Service Untreated Syphilis Study at Tuskegee, 1932-1972
- WWII Nazi prisoner experiments, ~1941-1945
- US Public Health Service Guatemala syphilis experiments, 1946-1948
- Willowbrook State School hepatitis experiments,1956-1971

Overall they were using populations that did not have the ability to speak up about what was happening or decline

Ethical Research Frameworks

- Nuremberg Code, 1947
  - Emphasis on voluntary consent
- Declaration of Helsinki, 1964
  - Focus on medical research
- National Research Act, 1974
  - US response to US Public Health Service Untreated Syphilis Study at Tuskegee
  - Publication of the Belmont Report (1979) and creation of Institutional Review Boards (IRBs)

Belmont Report (3 Main Principles):

- Respect for Persons/Autonomy
  - “The principle of respect for persons thus divides into two separate moral requirements: the requirement to acknowledge autonomy and the requirement to protect those with diminished autonomy.”
- Beneficence
  - Maximize possible benefits and minimize possible harms
- Justice
  - “Who ought to receive the benefits of research and bear its burdens?”

Applying the Belmont principles

- 1991 Department of Health and Human Services (DHHS) 45 CFR 46
  - Common Rule
    - Criteria for approving research
    - Protections for vulnerable groups (specifically mentioned are pregnant ppl and fetuses, prisoners, newborns of questionable survivability, and children)
    - Requirements for IRB operations
- 2018 Revised Common Rule
  - Modifications to reduce administrative burden

IRB Composition

- Diversity of membership required
  - Race, gender, cultural backgrounds
  - Scientific expertise
    - MD, PhD, MPH

        - Faculty, clinicians
    - Non-scientists
        - Community members
        - IRB staff

IRB Purpose

- Protect rights and welfare of people enrolled in research
    - Participants/subjects
- IRBs review human research according to:
    - Ethical principles
        - Belmont Report
    - Federal regulations
        - Common Rule, HIPAA, FERPA
    - State laws
    - Institutional policies

IRB Review Requirements

- UW-Madison requires IRB review of all research involving human subjects, including exempt human subjects research.
- Research CANNOT begin until the IRB has reached a determination.
    - **No retrospective approval** of research that has already been done
    - It has to be approved before you can start your research

Common Rule Criteria (45 CFR 46)

RISKS	• No unnecessary risks; unavoidable risks as low as possible • Appropriate monitoring to prevent adverse effects or identify adverse outcomes as soon as possible
BENEFITS	• Potential direct benefits to participants, or scientific/societal benefits
RISK/BENEFIT RATIO	• Risks reasonable in relation to potential benefits of the research • Study design enables researchers to answer the research question, with appropriate procedures/data collection, appropriate number of participants
EQUITABLE SELECTION OF SUBJECTS	• Appropriate to answer the research question • Appropriate recruitment strategies • Justification and safeguards for vulnerable participants • Population that bears the burdens of research also benefits from it
INFORMED CONSENT	• Participants make an informed choice about taking part in research OR • Criteria for waiver of consent are met
PRIVACY & CONFIDENTIALITY	• Adequate protections for participant privacy • Adequate protections for data confidentiality

Defining Human Subjects Research

Common Rule Definitions:

- Research defined by the Common Rule as "a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge."
- Human subject defined under the Common Rule as a living individual about whom an investigator (whether professional or student) conducting research: (1) obtains information or biospecimens through intervention or interaction with the individual; or (2) obtains, uses, studies, analyzes, or generates identifiable private information or identifiable biospecimens

Examples of Applicable Research

A wide variety of activities, including studies of:

- Drugs, devices, or products developed through research in humans
- Data from surveys, interviews, and observation
- Employment information or records of earnings
- Medical records
- Bodily materials, such as cells, blood, urine, tissues, organs, hair, nail clippings, or DNA, when these are linked to specific individuals

Not Considered Research*

- QI/PE projects do not meet the definition of research
    - Project may not be performed systematically, or
    - Project may not be generalizable
- Common Themes for QI/PE Projects
    - Mandated by a clinic or department
    - Not investigator-initiated
    - Usually limited to a single institution/process

Conclusions/action items:

11/19 - Lec 12: "How medical product R&D works in industry"

EVELYN OJARD - Dec 10, 2025, 3:07 PM CST

Title: ""How medical product R&D works in industry"

Date: 11/19

Content by: Evelyn

Present: N/A

Goals: Learn more about medical device industry

Content:

Intro:

- NPD In the medical industry is
    - **Highly regulated**: FDA and other regulatory bodies have a significant impact
    - **Expensive**

Companies have a process when selecting and prioritizing projects

- Corporate Business Strategy
- Product Portfolio Review
- Product review
- Budgeting and resource allocation

Types of NPD Projects: Line extensions, product improvements, new-to-company, new-to-world

Managing NPD: Stage-Gate Process

- Stage 0 - ideation
- Stage 1 - exploration
- Stage 2 - concept development
- Stage 3 - design development
- Stage 4 - design confirmation
-

Conclusions/action items: R&D is a much longer process than it is during our design projects. You need to acquire a lot more funding and its a much longer process.

9/9/25 - Differing Approaches to Pain Management for Intrauterine Device Insertion and Maintenance: A Scoping Review

EVELYN OJARD - Sep 09, 2025, 4:09 PM CDT

Title: "Differing Approaches to Pain Management for Intrauterine Device Insertion and Maintenance: A Scoping Review"

Date: 9/9/2025

Content by: Evelyn Ojard

Present: N/A

Goals: Get a better understanding of current methods of pain management for IUD insertions

Search Term: Pubmed: Paracervical Block IUD

Citation: M. Rahman *et al.*, “Differing Approaches to Pain Management for Intrauterine Device Insertion and Maintenance: A Scoping Review,” *Cureus*, vol. 16, no. 3, p. e55785, doi: 10.7759/cureus.55785.

Link: https://pubmed.ncbi.nlm.nih.gov/38586685/

Content:

Current methods such as cold compress on abdomen and NSAI's (ibuprofen) are not effective in pain prevention

Paracervical blocks were useful in pain reduction during and five minutes after placement but did have the down side of pain during administration

"Multiple linear regression analysis demonstrated that 29.5% of the variability in the pain score was explained by nulligravid or women who had elective cesareans and difficulty at IUD insertion. Nulligravid women presented a higher mean pain score of 6.6 ± 2.0 when compared to women with elective cesarean delivery, 5.5 ± 2.1, and women with previous vaginal delivery, 3.9 ± 2.4 ($p < 0.001$)."

- Overall women who have not given birth (nulligravid) and women who had cesareans had higher pain scores than women who have had vaginal deliveries.

Non-pharmacological methods (i.e., "cough" method and "slow" placement): Did not prove to be effective in significantly lessening pain during placement and after

Pharmacological Methods:

Local Anesthetics (lidocaine) -

- Cervical gel and spray and intrauterine solution did NOT decrease pain
- Cervical spray/gel/cream and paracervical block's DID decrease pain
    - Paracervical blocks:
        - In Mody (2018) a randomized controlled trial they found that a "20-cc buffered 1% lidocaine paracervical block was able to decrease pain during the IUD placement, with uterine sounding, and 5 minutes after the placement. The overall perception of pain was lower when a block was administered compared to when no block was given at all."

▪

NSAIDs

- Oral Naproxen, IM ketorolac, and oral ibuprofen did NOT decrease pain
- Oral ketorolac did

Porstaglandin analogs

- Oral misoprostol did not
- Vaginal misoprostol and dinoprostone did

Found that a multifaceted approach using the cough method of placement, combined with the direct method of IUD insertion and accompanying it with a local anesthetic or prostaglandin analog might be optimal.

Found that lidocaine administration via paracervical block appeared to be the most effective when looking at significant pain decrease

Conclusion/Action Items: There is no current standard model to decrease pain, but increased knowledge and training in paracervical blocks will help to significantly decrease pain during insertion. Review other clinical guidelines and ongoing trials to determine best practices for incorporating paracervical block into standardized IUD pain management.

EVELYN OJARD - Sep 09, 2025, 4:10 PM CDT

Differing Approaches to Pain Management for Intrauterine Device Insertion and Maintenance: A Scoping Review

Abstract

Introduction And Background

Download

cureus-0016-00000055785.pdf (434 kB)

9/9/25 - Best practices for reducing pain associated with intrauterine device placement

EVELYN OJARD - Sep 09, 2025, 4:18 PM CDT

Title: "Best practices for reducing pain associated with intrauterine device placement"

Date: 9/9/2025

Content by: Evelyn Ojard

Present: N/A

Goals: Get a better understanding of current methods of pain management for IUD insertions

Search Term: Pubmed: Paracervical Block IUD

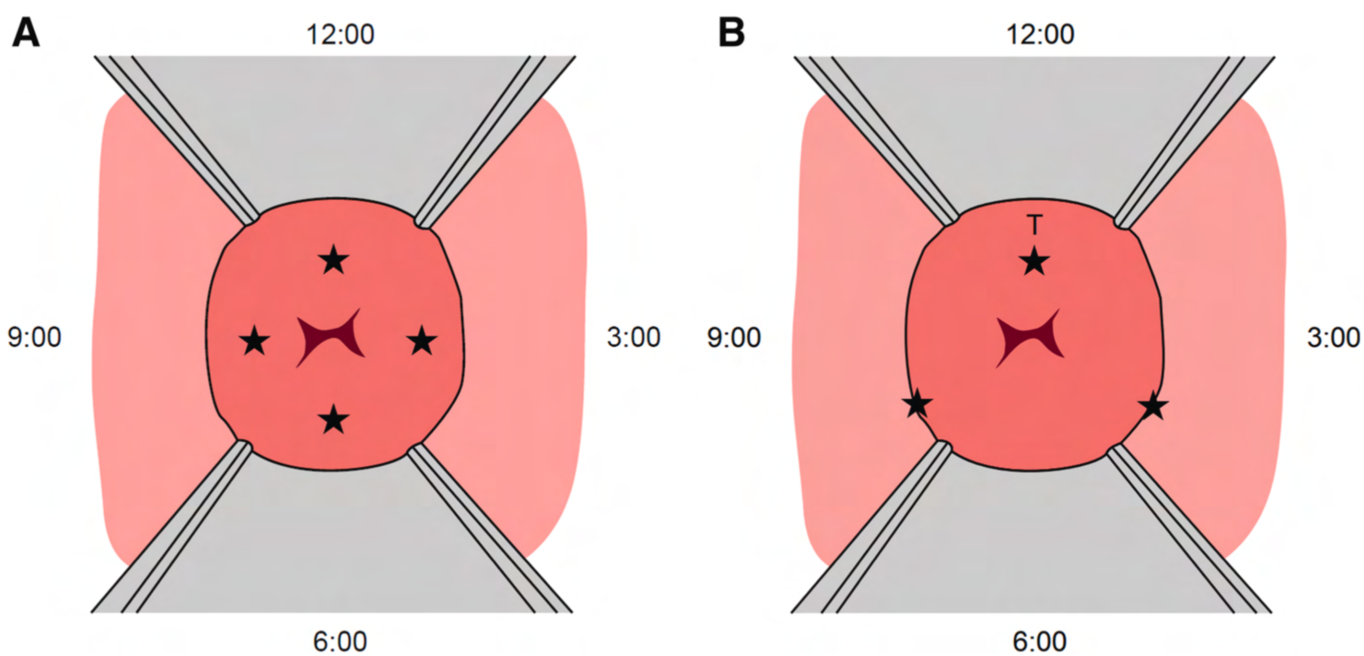
Citation: "Best practices for reducing pain associated with intrauterine device placement - ClinicalKey." Accessed: Sept. 09, 2025. [Online]. Available: https://www-clinicalkey-com.ezproxy.library.wisc.edu/#!/content/playContent/1-s2.0-S0002937825000729?scrollTo=%23hl0000369

Link: https://www-clinicalkey-com.ezproxy.library.wisc.edu/#!/content/playContent/1-s2.0-S0002937825000729?scrollTo=%23hl0000369

Content:

No current standard of care has been established specifically to manage pain with intrauterine device placement, resulting in wide variation in clinical practice.

Difference between intracervical block(A) and paracervical block (B)



"We recommend offering a PCB to nulliparous patients, others at increased risk for pain, and those patients concerned about pain (see Figure 4 , B for details of the procedure). PCB is also helpful for more challenging IUD placements, such as those requiring cervical dilation."

r

Conclusion/Action Items: There is no current standard model to decrease pain, but by improving pain management during IUD placement, we can promote a more positive patient experience and reduce the barriers to IUD uptake.

EVELYN OJARD - Sep 09, 2025, 4:19 PM CDT

[Download](#)

Best_practices_for_reducing_pain_associated_with_iud_placement_-_pdf.pdf (837 kB)

9/9/25 - How to do a Paracervical Block

EVELYN OJARD - Sep 09, 2025, 4:33 PM CDT

Title: "How to do a Paracervical Block"

Date: 9/9/2025

Content by: Evelyn Ojard

Present: N/A

Goals: Understand and watch a paracervical block insertion

Search Term: Google: exact detailing of a paracervical block procedure

Citation: IPAS, “How to do a Paracervical Block.” Accessed: Sept. 09, 2025. [Online]. Available: https://vimeo.com/690508206

Link: **https://vimeo.com/690508206**

Content:

1. Draw up either 20 ml of 1% lidocaine or 10 ml of 2% lidocaine
2. Clean the cervix with an antiseptic
3. Perform the paracervical block
    1. Inject 1-2 ml of lidocaine into the cervix @ the 12 o'clock position
    2. Pull back on the syringe so that you do not inject into the blood vessel
    3. Attach the tenaculum at that location
    4. The remaining lidocaine is injected in equal amounts (4.5 ml) at 2:00, 4:00, 8:00, and 10:00
    5. Starting at 2:00, pull the cervix a little to the side until you can see where the smooth cervix joins the vagina insert the needle deeply to give better pain relief
    6. Pull back on the syringe to avoid injecting into the blood vessel and inject the dose (4.5ml) of lidocaine
    7. continue and repeat around to 4,8, and 10 o'clock

Conclusion/Action Items: The process of a PCB may still result in cramping/pain but will be less than the placement of IUD insertion without it. Look further into the properties of the cervix.

EVELYN OJARD - Sep 09, 2025, 4:34 PM CDT

Download

how_to_do_a_paracervical_block_540p_.mp4 (15.3 MB)

9/16/25 - Mechanical and biochemical properties of human cervical tissue

EVELYN OJARD - Sep 16, 2025, 9:36 PM CDT

Title: Mechanical and biochemical properties of human cervical tissue

Date: 9/16/2025

Content by: Evelyn Ojard

Present: N/A

Search Term: "mechanical properties of cervical tissue"

Citation: K. M. Myers, A. P. Paskaleva, M. House, and S. Socrate, “Mechanical and biochemical properties of human cervical tissue,” Acta Biomater, vol. 4, no. 1, pp. 104–116, Jan. 2008, doi: 10.1016/j.actbio.2007.04.009.

Link: https://pubmed.ncbi.nlm.nih.gov/17904431/

Goals: Learn more about the mechanical strength of the human cervical tissue to use in finding the best material to use in modeling.

Content:

mechanical tests indicate that cervical stroma has a nonlinear, time-dependent stress response with varying degrees of conditioning and hysteresis depending on its obstetric background

NPND = Non-pregnant: no previous vaginal deliveries

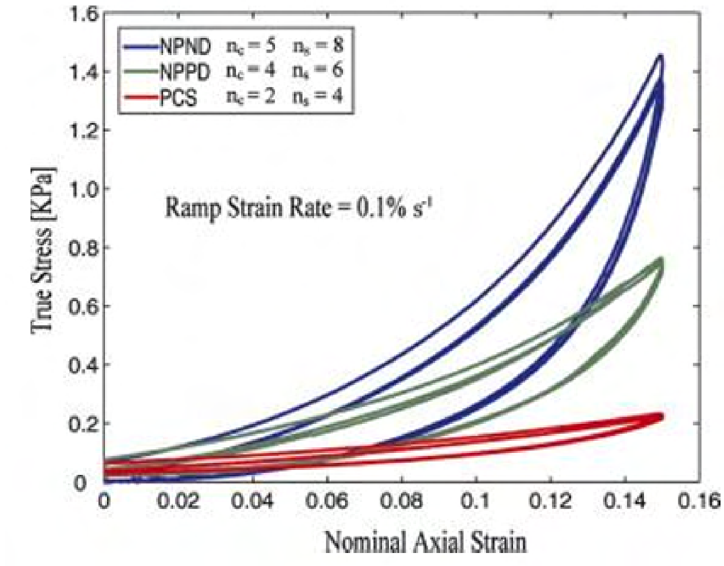
NPPD = Non-pregnant: previous vaginal deliveries

PCS = taken at time of cesarean section

All tests were conducted on a universal material testing machine (Zwick Z2.5/TS1S, Ulm, Germany) with the specimens immersed in a PBS bath in custom-designed acrylic fixtures (Fig. 3B). A 20 N load cell was used to collect compression data, and a 500 N load cell was used to collect tension data.

All tests were conducted on a universal material testing machine (Zwick Z2.5/TS1S, Ulm, Germany) with the specimens immersed in a PBS bath in custom-designed acrylic fixtures (Fig. 3B). A 20 N load cell was used to collect compression data, and a 500 N load cell was used to collect tension data.

Obstetric case	Nc	Ns	Standard variation in peak stress (kPa)
NPND	5	7	±1.2
NPPD	3	9	±0.4
PCS	2	3	±0.1



Peak and equilibrium stresses for confined compression

Obstetric case	Nc	Ns	5% Peak (kPa)	10% Peak (kPa)	15% Peak (kPa)	5% Peak Equilibrium (kPa)	10% Peak Equilibrium (kPa)	15% Peak Equilibrium (kPa)
NPND	5	9	1.8 ± 3.7	5.6 ± 9.4	14 ± 17	0.38 ± 0.57	0.99 ± 1.1	1.5 ± 1.4
NPPD	3	8	0.82 ± 2.0	2.9 ± 5.7	7.8 ± 13	0.23 ± 0.40	0.55 ± 0.78	1.1 ± 1.2
PCS	2	5	0.12 ± 0.07	0.17 ± 0.10	0.28 ± 0.18	0.07 ± 0.07	0.10 ± 0.08	0.12 ± 0.08

Conclusions/action items: I learned that cervical tissue doesn’t behave like a simple elastic material and that its properties change with physiological state, becoming softer in some conditions. For the PCBTM, that means aiming for materials and design features that feel realistic and allow some adjustability. Next, I should compare a few candidate materials and simple build options to see which best matches the general feel. I should also get feedback from users to make sure the model teaches the core skills effectively.

9/19/2025 - Images of Cervicovaginal Junction

EVELYN OJARD - Oct 02, 2025, 10:27 AM CDT

Title: A Guide to Paracervical and Intrauterine Fundal Block

Date: 9/19/2025

Content by: Evelyn

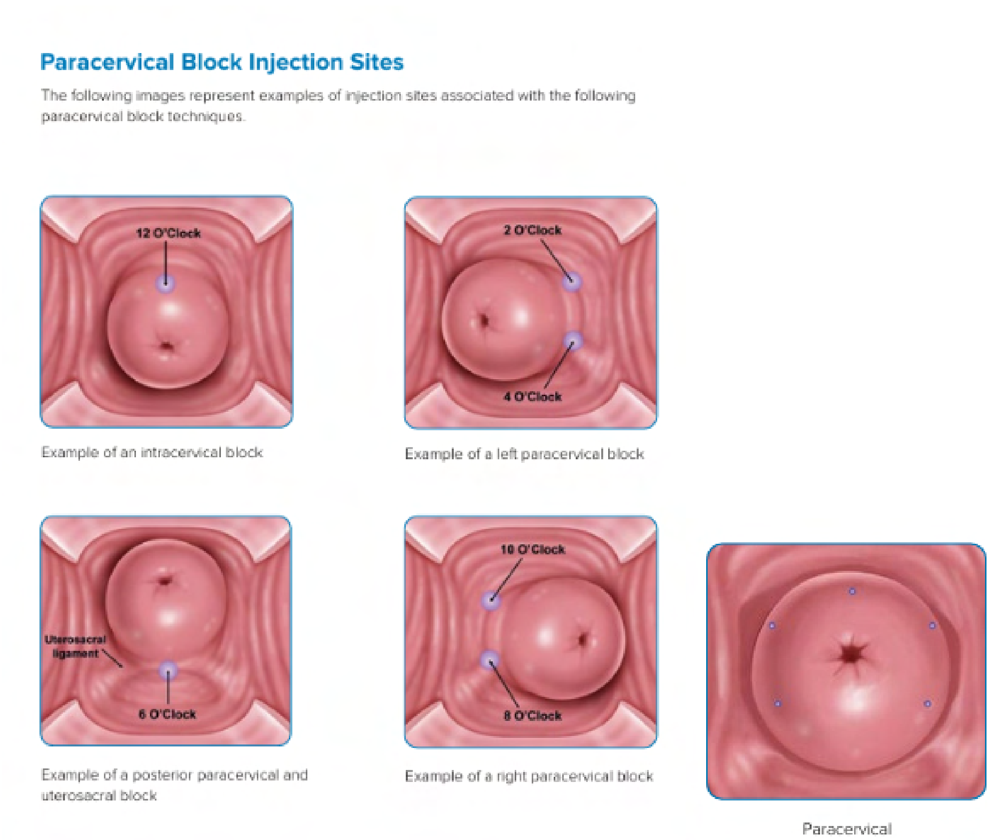
Present: N/A

Goals: Look at the images of a paracervical block and have a better understanding of what a cervicovaginal junction looks like for casting.

Citation: christian-albretsen, "A physician's guide to paracervical and intrauterine fundal block," Normedi Education. Accessed: Oct. 02, 2025. [Online]. Available: https://normedieducation.com/endometrial-ablation/a-physicians-guide-to-paracervical-and-intrauterine-fundal-block/

Link: https://normedieducation.com/endometrial-ablation/a-physicians-guide-to-paracervical-and-intrauterine-fundal-block/

Content:



Conclusions/action items: These images show the cervicovaginal junction. Use these images to understand how to solidworks the addition of a cervicovaginal junction.

9/16/2025 - "Healthcare Simulation Standards of Best PracticeTM Simulation Design"

EVELYN OJARD - Sep 19, 2025, 9:36 AM CDT

Title: "Healthcare Simulation Standards of Best Practice Simulation Design"

Date: 9/16/2025

Content by: Evelyn Ojard

Present: N/A

Citation: "Healthcare Simulation Standards of Best PracticeTM Simulation Design - Clinical Simulation In Nursing." Accessed: Sept. 19, 2025. [Online]. Available: https://www.nursingsimulation.org/article/S1876-1399(21)00096-7/fulltext"

Link: https://www.nursingsimulation.org/article/S1876-1399(21)00096-7/fulltext

Goals: Look further into what standards are required during a teaching simulation.

Content:

Key Design Criteria

1. **Consult Experts**
    - Collaborate with content experts (gynecology, pain management, simulation specialists).
    - Designers should have training in simulation pedagogy, ethics, and best practices
2. **Needs Assessment**
    - Gather evidence for simulation necessity (e.g., lack of PCB task trainers, gaps in resident training).
    - Use stakeholder surveys, root cause analysis, and patient safety goals to justify the model
3. **Measurable Objectives**
    - Create broad goals (improving access to pain-management training).
    - Develop specific learner objectives (correct identification of cervicovaginal junction landmarks, correct lidocaine injection sites)
4. **Alignment of Modality and Objectives**
    - Select task trainer modality with appropriate realism for PCB procedure.
    - Simulation should have a clear start, structured activities, and an endpoint
5. **Scenario/Case Design**
    - Include a backstory (patient requiring IUD insertion with PCB for pain management).
    - Develop cues, clinical progression, and standardized scripts for consistency
6. **Fidelity (Realism)**
    - Balance physical fidelity (accurate cervicovaginal anatomy, tissue feel),
conceptual fidelity (symptoms and responses consistent with anatomy),
and psychological fidelity (environment mimicking clinical distractions, time pressure)
7. **Learner-Centered Facilitation**
    - Facilitators should be trained in simulation pedagogy and debriefing.
    - Adapt involvement level to learners' experience (medical students vs. OB/GYN residents).
8. **Prebriefing**
    - Provide preparation materials (procedure background, learning objectives).

- Establish safe learning environment and shared mental model

9. **Debriefing/Feedback**
    - Conduct structured debriefing or guided reflection after practice.
    - Use feedback to improve learner technique and reinforce objectives
10. **Evaluation Plan**
    - Define assessment methods (checklists, peer feedback, objective structured assessment).
    - Use results for continuous quality improvement of PCB-TM
11. **Pilot Testing**
    - Pilot test with representative learners before full rollout.
    - Adjust for missing elements or confusing design features

Conclusions/action items: These standards highlight that PCB-TM should not just replicate anatomy, but also be embedded in a learning design: clear objectives, preparation, scenario realism, and guided reflection.

9/25 - Equilibrium mechanical properties of the human uterus in tension and compression

EVELYN OJARD - Sep 25, 2025, 1:18 PM CDT

Title: Equilibrium mechanical properties of the human uterus in tension and compression

Date: 9/25

Content by: Evelyn

Present: N/A

Goals: Learn more about the mechanical strengths of uterine tissue for molding

Citation: S. Fang *et al.*, "Equilibrium mechanical properties of the human uterus in tension and compression," *Acta Biomaterialia*, vol. 194, pp. 219–232, Mar. 2025, doi: 10.1016/j.actbio.2025.01.033.

Link: https://www.sciencedirect.com/science/article/pii/S1742706125000431?via%3Dihub#d1e1051

Content:

- Bulk modulus κ (kPa, matrix/compression-dominated):
  NP: 4.51 ± 4.82   PG: 3.11 ± 2.02 → no significant difference; similar compressive stiffness.
- Locking stretch ζ (–, fiber extensibility in tension):
  NP: 2.43 ± 0.48   PG: 2.82 ± 0.32 → PG higher ⇒ more extensible under tension.
- Initial fiber stiffness ξ (kPa, small-strain tension):
  NP: 30.0 ± 21.7   PG: 24.7 ± 12.9 → no significant difference at small strain.
- Fiber concentration/dispersion b (0–1, larger = more aligned):
  NP: 0.79 ± 0.47   PG: 0.56 ± 0.27 → NP more aligned, PG more dispersed

Conclusions/action items: Look into finding materials that will match these properties.

10/7/2025 - "Standard Guide for Silicone Elastomers, Gels, and Foams Used in Medical Applications Part I—Formulations and Uncured Materials"

EVELYN OJARD - Oct 10, 2025, 11:43 AM CDT

Title: "Standard Guide for Silicone Elastomers, Gels, and Foams Used in Medical Applications Part I—Formulations and Uncured Materials"

Date: 10/7/2025

Content by: Evelyn Ojard

Present: N/A

Citation: "Standard Guide for Silicone Elastomers, Gels, and Foams Used in Medical Applications Part I—Formulations and Uncured Materials." Accessed: Oct. 10, 2025. [Online]. Available: https://store.astm.org/f2038-18.html

Link: https://store.astm.org/f2038-18.html

Goals: Learn more about ASTM standards for future testing protocols

Content:

- covers medical-grade silicone formulations before cure (HCR, LSR, gels, foams) and the controls needed to keep them consistent and safe for later device use.
- Reference tests for later:
  - Tensile/elongation/modulus (ASTM D412), tear (ASTM D624), hardness (ASTM D2240), compression set (ASTM D395), specific gravity (ASTM D792), fluid/chemical resistance (ASTM D471).

Conclusions/action items: Start writing Testing protocol for down the road.

10/7/2025 - "Anatomy of the uterine cervix and the transformation zone"

EVELYN OJARD - Oct 30, 2025, 12:56 PM CDT

Title: "Anatomy of the uterine cervix and the transformation zone"

Date: 10/7/2025

Content by: Evelyn Ojard

Present: N/A

Goals: Determine the exact landmarks for the cervicovaginal junction for deliverables and understanding

Content:

- **General Anatomy**
  - Cervix: fibromuscular organ, ~4 cm long, ~3 cm diameter.
  - Parous cervix > nulliparous cervix; reproductive-age cervix > postmenopausal cervix.
  - Intravaginal part (lower half) in vagina; supravaginal part (upper half) in pelvis.
  - Neighbors: bladder anterior, bowel posterior, ureters lateral, uterine arteries superior-lateral.
  - Most uteri anteverted (cervix enters vaginal vault posteriorly); retroverted uterus alters position.
- **Epithelial Linings**
  - **Squamous epithelium (ectocervix & vagina)**: stratified, non-keratinized, glycogenated, estrogen-dependent.
  - **Columnar epithelium (endocervical canal)**: single layer, tall cells, papillary folds, crypts (glands).
  - **Squamocolumnar junction (SCJ):** dynamic meeting point of squamous & columnar epithelia.
  - **Transformation zone (TZ):** region between original SCJ and new SCJ formed via squamous metaplasia.
- **Tissue Constituents**
  - **Stroma:** dense fibromuscular tissue with blood, lymph, and nerve plexuses.
    - Blood supply: uterine artery branches at 3 & 9 o'clock.
    - Drainage: hypogastric venous plexus.
    - Lymph: iliac, obturator, parametrial nodes.
    - Nerve: hypogastric plexus; endocervix = sensitive, ectocervix = few sensory nerves.
  - **Nerve implications:** biopsies & cryotherapy tolerated; dilatation may trigger vasovagal response.
- **Squamous Epithelium**
  - Basal → parabasal → intermediate → superficial layers (maturation ↑, nuclear size ↓).
  - Glycogenation signals normal maturation; absent after menopause (atrophic, fragile epithelium).
  - Appears pink normally, bluish in pregnancy (vascular).
- **Columnar Epithelium**
  - Appears reddish (thin, vascular background).
  - Forms folds & crypts (5–6 mm deep).
  - Can form polyps (reddish mass at os), lined with columnar or partly squamous epithelium.
  - No glycogen; does not stain with Lugol's iodine.
- **SCJ & Metaplasia**

- Original SCJ: at or near external os pre-puberty.
- After puberty/pregnancy: eversion of columnar cells → ectropion/ectopy (reddish cervix).
- Metaplasia: columnar cells replaced by squamous cells via reserve cell hyperplasia → immature → mature squamous epithelium.
- Metaplasia is irreversible.
- Nabothian cysts: mucus-filled retention cysts when crypts covered by squamous epithelium.

- **Transformation Zone (TZ)**
  - Forms when columnar epithelium everts and undergoes squamous metaplasia.
  - Most common site for squamous cervical cancer and HPV-related changes.
  - Congenital TZ: rare (<5%); due to incomplete intrauterine epithelialization.
  - Types of TZ (based on visibility and location): most reproductive-age women = type 1 (visible on ectocervix).
- **Pathophysiological Relevance**
  - TZ = most vulnerable to HPV infection during active metaplasia.
  - Oncogenic HPV infects basal/metaplastic cells → dysplasia → potential CIN/invasive cancer.
  - Majority of HPV infections clear spontaneously.

Conclusions/action items:

- The cervicovaginal junction is defined by the dynamic SCJ and TZ, landmarks shift with age, hormones, parity, and menopause.
- Deliverables should emphasize:
  - Differentiation between ectocervix (squamous), endocervix (columnar), and TZ (metaplastic).
  - Clinical relevance: TZ as primary site of precancerous and cancerous change.
  - Anatomical context for procedures (biopsy, colposcopy, IUD placement, paracervical block).

Comments

Randolph Ashton Oct 30, 2025, 10:27 AM CDT

This entry is empty?

10/30 - Anatomy, Abdomen and Pelvis: Uterus

EVELYN OJARD - Dec 10, 2025, 3:11 PM CST

Title: Anatomy, Abdomen and Pelvis: Uterus

Date: 11/30

Content by: evelyn

Present: n/a

Citation: M. A. Ameer and D. C. Peterson, “Anatomy, Abdomen and Pelvis: Uterus,” in *StatPearls*, Treasure Island (FL): StatPearls Publishing, 2025. Accessed: Oct. 01, 2025. [Online]. Available: http://www.ncbi.nlm.nih.gov/books/NBK470297/

Search Term: anatomy of the uterus

Goals: learn more about the anatomical uterus

Content:

The Uterus is a hollow, pear-shaped organ in the pelvis — located behind the bladder and in front of the rectum.

It consists of four main segments (from top to bottom): the fundus, corpus (body), isthmus, and cervix.

The uterine wall has three layers: the inner lining (endometrium), the thick muscular middle (myometrium), and an outer serous layer (perimetrium). The endometrium undergoes cyclic changes and shedding (menstruation) in response to hormones.

Blood is supplied mainly via uterine and ovarian arteries; lymphatic drainage and autonomic innervation follow defined pathways.

The uterus can vary in position (e.g., anteverted, retroverted) and orientation between individuals; such differences can affect symptoms (e.g. pelvic pain, urinary issues) or complicate pregnancy (e.g. risk of uterine incarceration).

Conclusions/action items: Implement this into the new uterus design.

9/9/2025 - The Papaya Workshop: A Simulation to Teach Intrauterine Gynecologic Procedures

EVELYN OJARD - Dec 10, 2025, 3:14 PM CST

Title: "The Papaya Workshop: A Simulation to Teach Intrauterine Gynecologic Procedures"

Date: 9/9/2025

Content by: Evelyn Ojard

Search Term: Google: how to train clincians on paracervical block

Citation: M. Paul and K. Nobel, “Papaya: a simulation model for training in uterine aspiration,” *Fam Med*, vol. 37, no. 4, pp. 242–244, Apr. 2005.

Link: https://pubmed.ncbi.nlm.nih.gov/15812688/

Present: N/A

Goals: Learn more about current models

Content:

The papaya is an excellent uterine model because it is the shape and size of a uterus, has a stem end that resembles a cervix, and has an interior texture similar to endometrium.

This workshop has been taught in clinical and pre-clinical settings by faculty at UCSF and elsewhere, to medical students, advanced-practice clinicians, and physicians, in many countries including Vietnam and South Africa.

The fruit model, while sharing many characteristics of a uterus, does not mimic some anatomical features such as the tone of the cervical os or the attachments to the uterus.

Conclusions/action items: the mechanical properties of a papaya are very similar.

9/16/2025 - “21 CFR Part 870 -- Cardiovascular Devices.”

EVELYN OJARD - Sep 19, 2025, 9:31 AM CDT

Title: 21 CFR Part 870 -- Cardiovascular Devices

Date: 9/16/2025

Content by: Evelyn Ojard

Present: n/a

Citation: “21 CFR Part 870 -- Cardiovascular Devices.” Accessed: Sept. 16, 2025. [Online]. Available: https://www.ecfr.gov/current/title-21/part-870

Link: www.ecfr.gov/current/title-21/part-870

Goals: Go through current standards to see what is most applicable to our PCBTM.

Content:

This model is expected to be categorized as Class I for general controls and Class II for specific controls based upon subpart F of 870 of Title 21 of the Code of Federal Regulations by the FDA. These are the guidelines that apply to CPR mannequins used in a teaching environment which is similar to that of the PCBTM.

This model is exempt from the premarket notification procedures due subpart E of 807 of Title 21 of the Code of Federal Regulation by the FDA.

The training model does not need to be biocompatible by Use of International Standard ISO 10993-1.

Conclusions/action items: Using standards that are similar to that of a CPR training dummy is accurate in the sense that it is a model that is outside of the body (i.e. does not need to be biocompatible). However, I want to look further into simulation standards used for nursing simulations as well.

9/25/25 - Ecoflex 00-20

EVELYN OJARD - Sep 25, 2025, 1:06 PM CDT

Title: Ecoflex 00-20

Date: 9/25/2025

Content by: Evelyn Ojard

Present: N/A

Citation: "Ecoflex™ 00-20 Product Information," Smooth-On, Inc. Accessed: Sept. 25, 2025. [Online]. Available: https://www.smooth-on.com/products/ecoflex-00-20/

Link: https://www.smooth-on.com/products/ecoflex-00-20/

Goals: Determine materials that could match that of cervical tissue

Content:

The material properties we need to match are needle insertion resistance of 1.09N and elasticity of 1.94 kPa/mm

Ecoflex 00-20 has:

Tensile Strength 160 psi
100% Modulus 8 psi
Elongation @ Break 845 %

It was also the same material used in the task trainer that our client gave us to model our design after.

Conclusions/action items: Ecoflex 00-20 could be a good option but more reserach is needed. Pros are that it is very cheap and it would be easy for them to recast more after eventual wear and tear.

10/2/25 - A synthetic cervix model and the impact of softness on cerclage integrity

EVELYN OJARD - Oct 03, 2025, 11:51 AM CDT

Title: "A synthetic cervix model and the impact of softness on cerclage integrity"

Date: 10/2/25

Content by: Evelyn

Present: NA

Citation: A. Baumer, A. C. Gimovsky, M. Gallagher, and M. C. Leftwich, "A synthetic cervix model and the impact of softness on cerclage integrity," *Interface Focus*, vol. 9, no. 5, p. 20190009, Oct. 2019, doi: 10.1098/rsfs.2019.0009.

Goals: Learn more about the properties of the cervix and what materials they used

Content:

- paper goal: understand how cervical softness (material stiffness) affects cerclage strength → they built a synthetic cervix and mechanically tested it. relevance: I can copy their "feel → numbers → iterate" loop for my paracervical block trainer.
- geometry: they derived a generalized cervix shape from ultrasound, not just eyeballing anatomy. for my model, ultrasound- or MRI-based contours would make the os/fornices more realistic.
- materials: used silicone rubber; clinicians first judged tactile realism, then they ran stress–strain tests to quantify modulus. do the same: quick OB/GYN "feel check," then benchtop curves.
- tuning softness: adding silicone thinner ↓ modulus (they plot modulus vs thinner%). I can pick "Soft/Med/Firm" cores by recipe %, but label them by measured modulus.
- molding approach: two-piece inner/outer mold → assemble, cure, demold. this suggests a swap-able cervical core so the puncture zone can be replaced after repeated injections.
- suture/technique context: they model a McDonald cerclage path; even though I'm training paracervical block/IUD, it flags stress concentration near the external os → I should reinforce that ring so the model survives many needle passes.
- test rig idea to copy: stitched cervix constrained in a capsule; a conical steel insert on a 5 kN load cell pushes until rupture. for my trainer, standardize a holder and constant-rate needle insertion to get comparable force curves.

Conclusions/action items: softer material → lower rupture force (they show averaged traces + rupture force vs elasticity). for training, learners should feel that "soft cervix" deforms easier and offers different resistance; so I should offer multiple softness levels. We need to figure out our exact benchmarks for testing before we proceed. What is allowable limits for the MTS testing.

Comments

Randolph Ashton Oct 30, 2025, 10:31 AM CDT

Good find. Continue to document contributions to the final prototype/devices.

9/19/25 - Preliminary Design

EVELYN OJARD - Sep 19, 2025, 3:56 PM CDT

Title: Initial Design

Date: 9/19/2025

Content by: Evelyn Ojard

Present: N/A

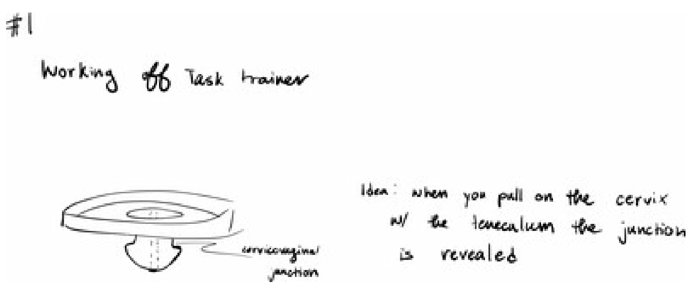
Goals: Create my first potential design ideas to present to the group

Content:

Based off of the task trainer the client sent to us. Altered the cervical component to include the cervicovaginal junction but kept the rest of the model the same.

Conclusions/action items: Figure out a better model that would allow for iud insertion to more closely mimic that of uterus. Not just a circular ball

EVELYN OJARD - Sep 19, 2025, 3:56 PM CDT



Download

IMG_0352.jpeg (137 kB)

9/19/2025 - Secondary Design

EVELYN OJARD - Sep 19, 2025, 3:58 PM CDT

Title: Second Design

Date: 9/19/2025

Content by: Evelyn Ojard

Present: N/A

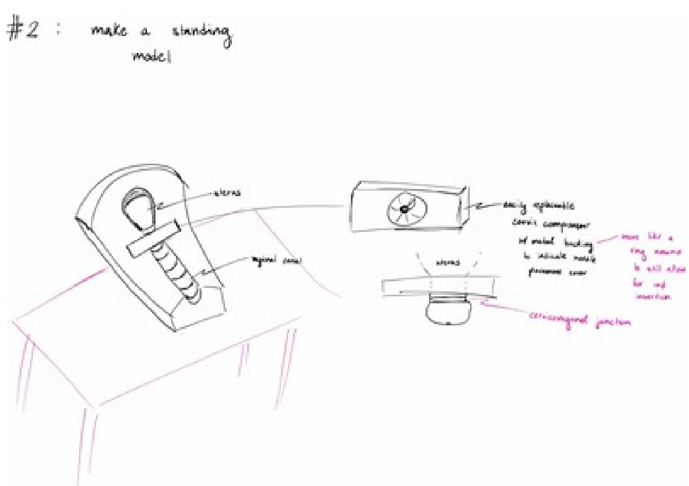
Goals: Create a second design that is different than the original task trainer. Have a design that has a more accurate and realistic uterus

Content:

Based off of current IUD insertion models but instead of having it as one piece, the cervix and cervicovaginal junction are able to removed and replaced. Allows IUD insertion to be more realistic and would be more stable as it has a wider base.

Conclusions/action items: Go through designs with other team members and discuss, combine/create new ideas for the design matrix.

EVELYN OJARD - Sep 19, 2025, 3:59 PM CDT



Download

IMG_0351.jpeg (101 kB)

10/28 - MTS Testing Mold

EVELYN OJARD - Nov 05, 2025, 4:33 PM CST

Title: MTS Testing Mold

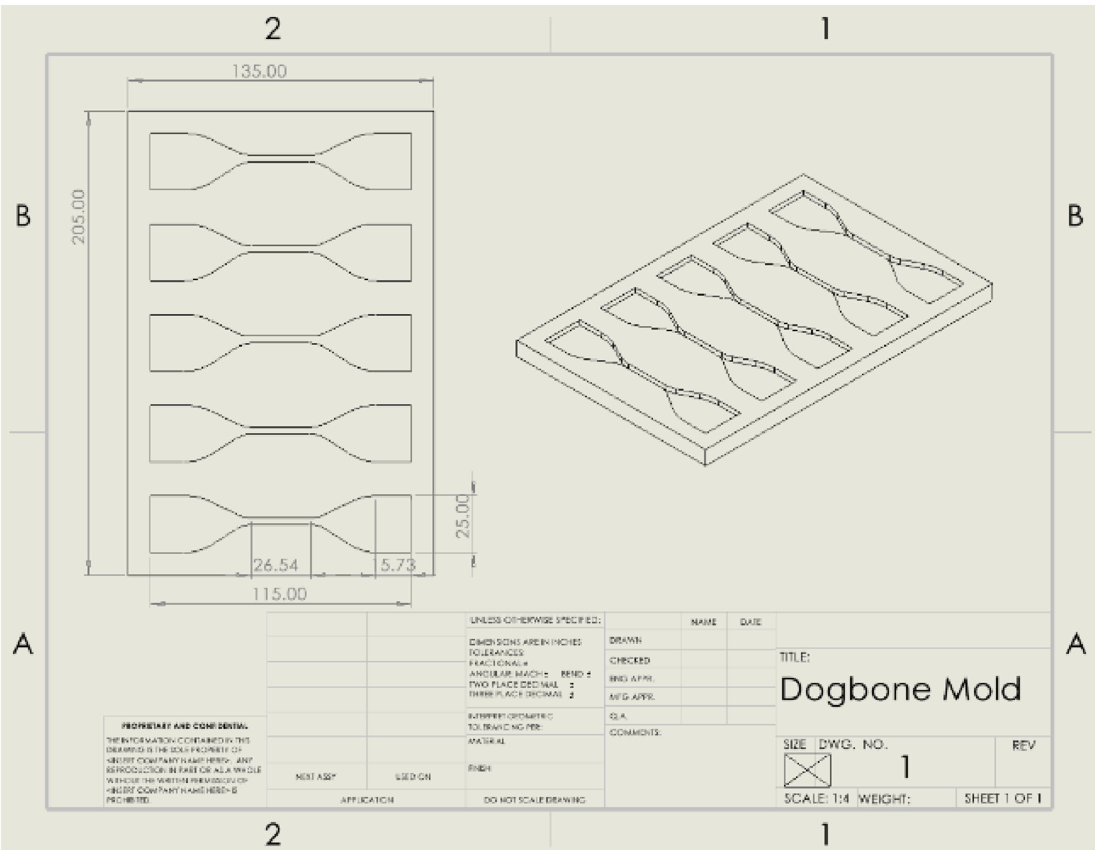
Date: 10/28/2025

Content by: Evelyn Ojard

Present: All

Goals: Make and teach the sophomores how to create a part in solidworks

Content:



Conclusions/action items: Taught the sophomores how to make a part for MTS testing. Taught how to make a sketch, dimension, and then making a drawing for display.

10/29 - Compression Testing Mold

EVELYN OJARD - Nov 05, 2025, 4:58 PM CST

Title: Compression Testing Mold

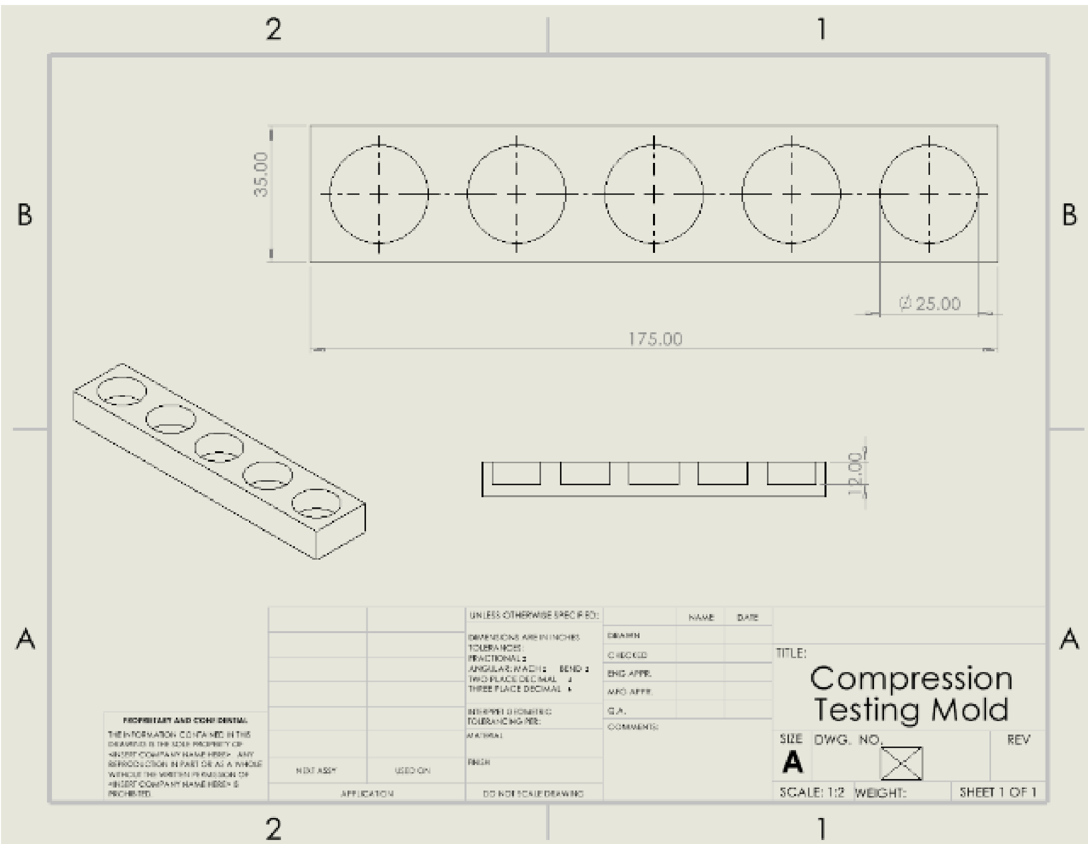
Date: 10/28

Content by: Evelyn Ojard

Present: N/A

Goals: Make a mold for the ecoflex to complete compression testing to verify our material choice

Content:



Mold for compression testing of the ecoflex

Conclusions/action items: Complete compression testing after casting ecoflex

11/5 - Modified Cervix Design

EVELYN OJARD - Nov 05, 2025, 5:01 PM CST

Title: Modified Cervix Desing

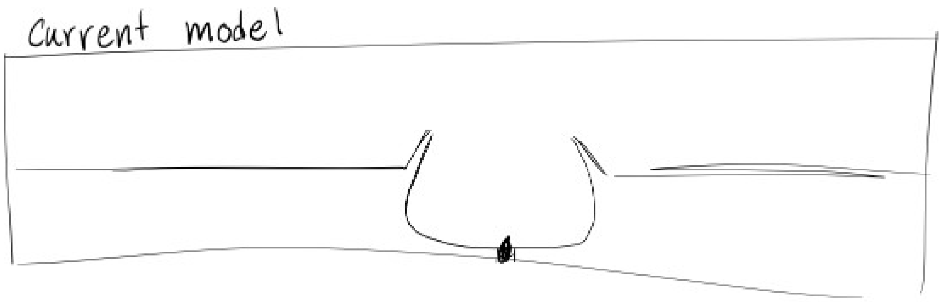
Date: 11/5

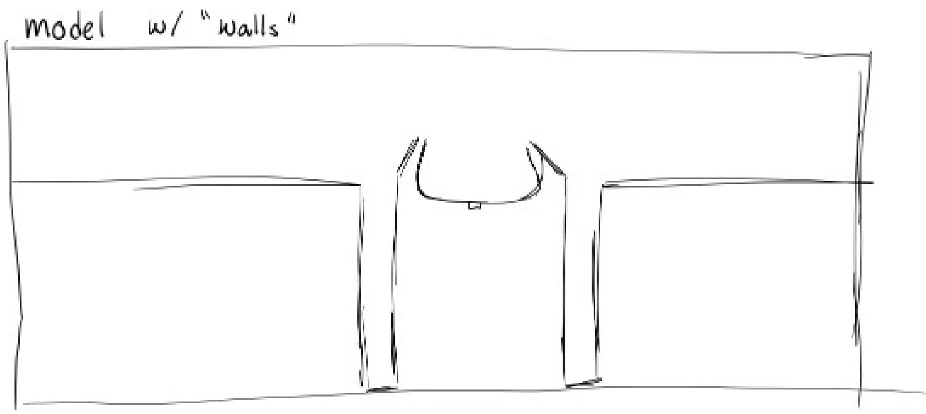
Content by: Evelyn Ojard

Present: N/A

Goals: Make a design that has closer vaginal walls to simulate how the cervix is nestled and not just a flat plate

Content:





Conclusions/action items: Make a more formal sketch and talk with Jesse Darley to discuss feasability

11/7 - SolidWorks Drawing of Modified Cervix

EVELYN OJARD - Nov 07, 2025, 3:00 PM CST

Title: SolidWorks Drawing of Modified Cervix

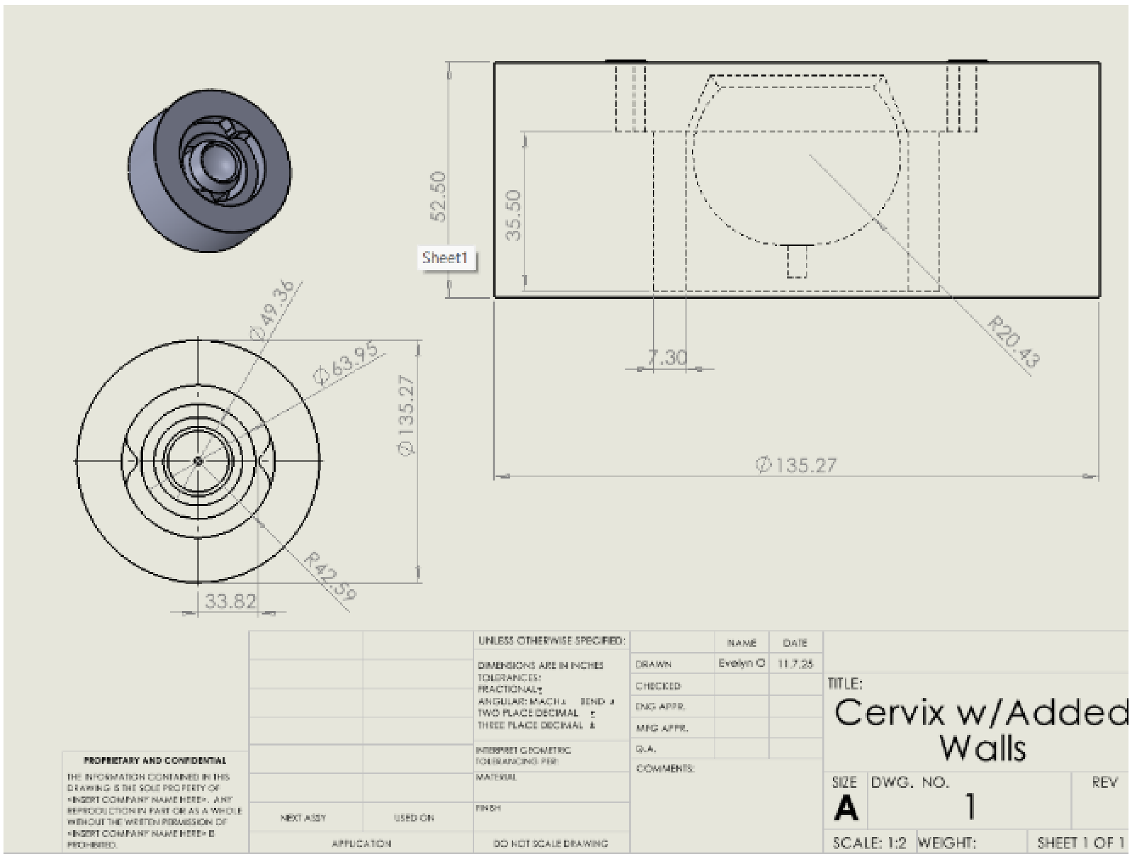
Date: 11/7

Content by: Evelyn Ojard

Present: N/A

Goals: Make a formal SolidWorks drawing of modified cervix based on comments from our client

Content:



Extended walls from the base of the cervicovaginal junction to allow for a more "nestled" effect on the cervix which is more anatomically accurate. In the human body, the cervicovaginal junction is not visible and the tenaculum must be used to expose it. When we just had the "plate" the junction was very easily visible and would not be as accurate for the residents to learn on. Extending the walls allows the residents to learn the correct movement and force required to visualize the junction and inject the paracervical block.

Conclusions/action items: Have our client set up a purchasing account at the makerspace and print the new mold and then cast using ecoflex.

EVELYN OJARD - Nov 07, 2025, 3:03 PM CST

Download

STL_File_-_Modified_Cervix_added_walls_.STL (151 kB)

11/22 - Solidworks drawings of modified Cervix, Vagina, and Uterus

EVELYN OJARD - Dec 10, 2025, 3:14 PM CST

Title: Solidworks drawings of modified Cervix, Vagina, and Uterus

Date: 11/22

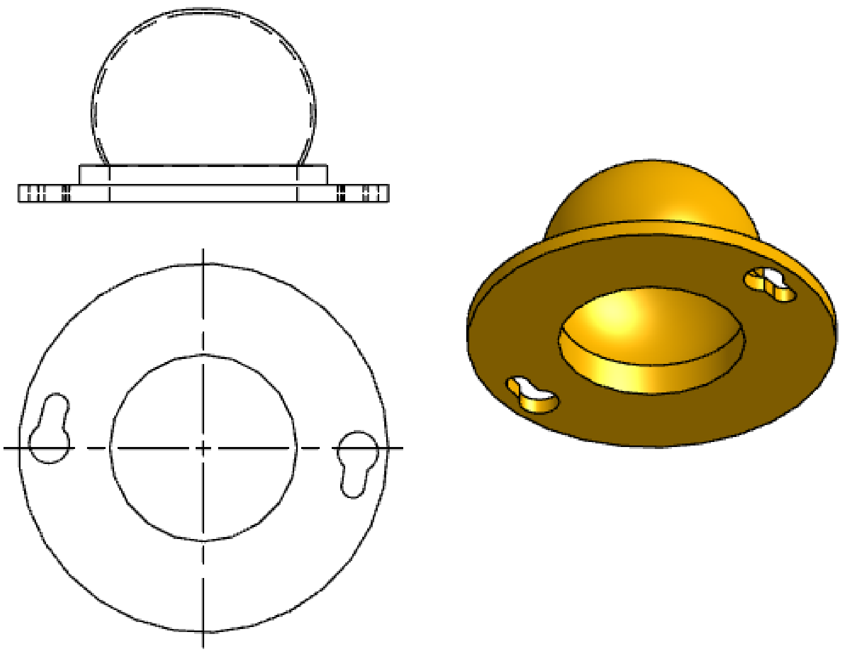
Content by: Evelyn

Present: N/A

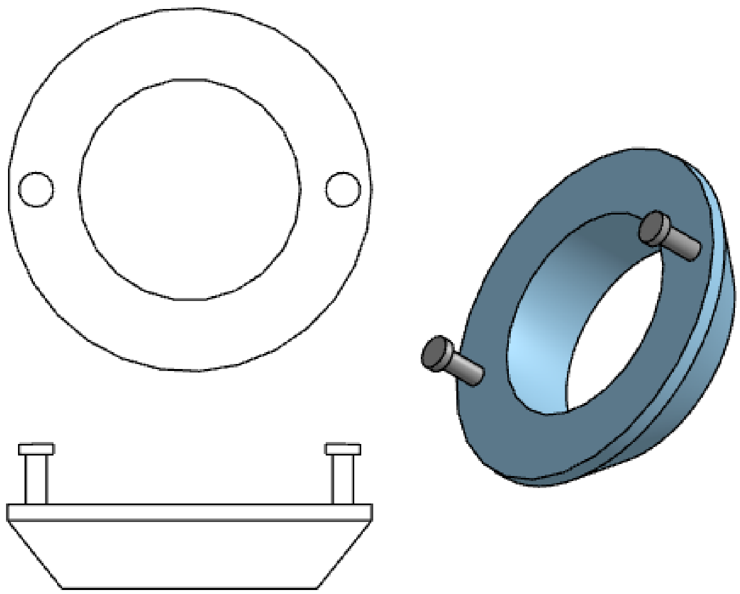
Goals: Make modifications to current solidworks designs

Content:

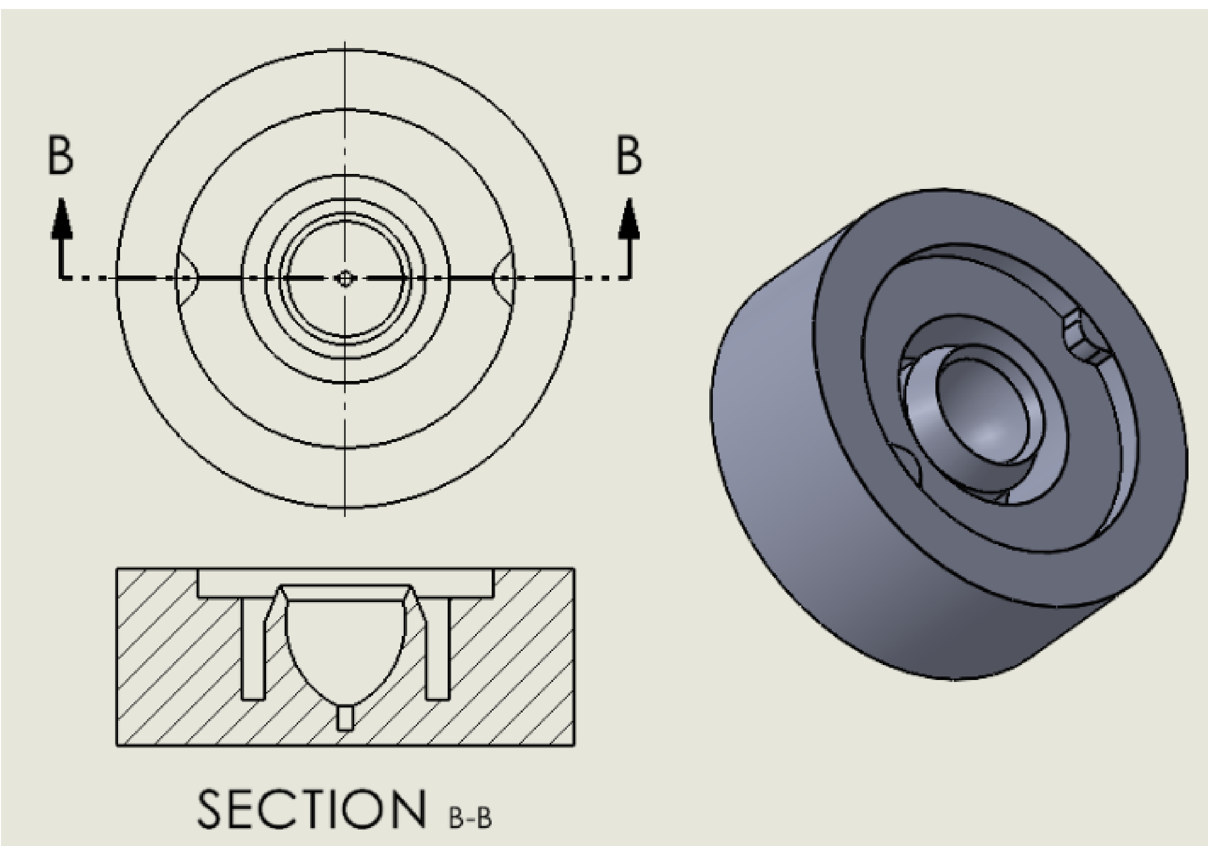
Cervix:



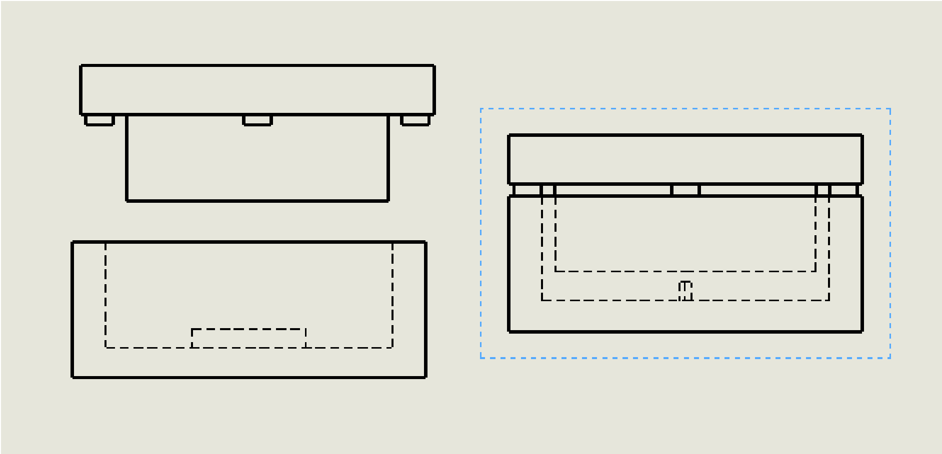
Connecting Piece:



Cervix Mold:



Vaginal Mold:



Conclusions/action items: 3D Print and cast these molds to deliver to our client for final approval.

09/10/2025 Lecture

ELLINORE LETTS - Sep 10, 2025, 2:00 PM CDT

Title: BME Career Prep Lecture Notes

Date: 09/10/2025

Content by: Ellinore Letts

Present:

Goals: Prepare for job searches and career fair.

Content:

Make notes of what you do via ECS tracking sheet, connect before you apply.

Don't use third party hiring sites, use connections.

Follow up after application, 2 to 3 weeks.

Tailor resume to position by making quick changes. Integrate key words that are listed in the job description.

Design projects without years or semesters.

Jobs - org, location, position, location, title and dates.

Cover Letter- always based on the job posting, custom, selling points

- adress to person

-Intro: Who you are, applying for, where you found it + thesis statement. "Based on my experience in A and B, I believe I would be able to make a difference in X role at Y company

- Paragraph about A and paragraph about B

- Why and next steps

Conclusions/action items:

Review resume, cover letter and sign up for career fair. Look into different employers. Look for summer 2026 Internships.

09/17/2025 Lecture

ELLINORE LETTS - Sep 17, 2025, 2:00 PM CDT

Title: Leadership Lecture Notes

Date: 09/17/2025

Content by: Ellinore Letts

Present: N/A

Goals: Learn about leadership styles, effective team dynamics and how to be a better team member.

Content:

Self awareness is critical to leadership quality. Personal components, intrapersonal, and group assesment can allow you to determine strengths as a leader.

Quizzes such as Myers Briggs, DiSC and Clifton Strengths can allow you to determine what your best qualities as a leader are.

Power Model, Servant Model and Authentic Model.

Power Model

- Centered around control, the idea that power channels up to one leader.

Servant Leadership

- Being of service for others

People, Process, or Thought Oriented

Conclusions/action items:

My leadership goals are to become more comfortable communicating ideas and creating a space where everyone feels open to sharing thoughts. I think that I want to be a more inclusive leader, and I think this can come from developing the skills needed to better include others and encourage their actions.

09/24/2025 Lecture

ELLINORE LETTS - Sep 24, 2025, 3:54 PM CDT

Title: Mentor Lecture Notes

Date: 09/17/2025

Content by: Ellinore Letts

Present: N/A

Goals: Learn about the benefits to mentoring BME 200 students, and what skills are important to help teach BME 200s.

Good Mentorship emphasizes sharing knowledge, and connecting with others.

- Can extend beyond BME

- Listen to your mentee, and be an effective listener.

-Learn from the student you are mentoring, ask questions.

-React to ideas, not the person

-Avoid Judgment

What to Share with Mentee I wish I would have known:

- Madgrade

- DARS

Conclusions/action items:

Fill out mentor map, and spend time getting to know BME 200 students. Reach out to BME 200's to schedule meeting time.

ELLINORE LETTS - Sep 24, 2025, 3:55 PM CDT

Download

Mentor_Map.HEIC (2.07 MB) Mentor Map as Created in BME 300 Lecture.

10/01/2025 Lecture

ELLINORE LETTS - Oct 01, 2025, 2:00 PM CDT

Title: Sustainability

Date: 10/01/2025

Content by: Ellinore Letts

Present: N/A

Goals: Learn about environmental impacts, and sustainability in biomedical design.

Circular economy - allows for items to be kept in the economy, reducing the production of waste.

How can you balance economic and environmental assessment?

- Considering operation and development waste.

How do we use these tools to engineer a more sustainable world?

- Consider resources, people, time.

- Mechanical vs human powered.

Conclusions/action items: By making our design more sustainable we can improve out biomedical design skills and make our product better.

ELLINORE LETTS - Oct 01, 2025, 1:25 PM CDT

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Mentor_Map.HEIC (2.07 MB) Mentor Map as Created in BME 300 Lecture.

10/08/2025 Lecture

ELLINORE LETTS - Oct 08, 2025, 1:42 PM CDT

Title: Patents + Licensing

Date: 10/08/2025

Content by: Ellinore Letts

Present: N/A

Goals: Patents and Licensing

Conclusions/action items: Learn more about patents and IP as it can apply to BME design.

Technology Transfer - intellectual property licensing, industry sponsored research, consulting, fee for service.

IP: Patents, Copyrights ,Trademarks, Trade Secrets.

Copyright - Creative works, includes software

Trademarks - Names, marks, logo, dress

Trade Secret - Unknown information

Patents - USPTO gives time limited monopoly over claimed invention

1. Design (15 yr)

2. Plant (new variety, 20 yr)

3. Utility (1 yr provisional, no-provisional 20 yr)

Must be eligible, novel, non-obvious, enabled and described.

Learn about how patents can possibly be relavent towards our BME project, see where this colud be a fit.

ELLINORE LETTS - Oct 08, 2025, 1:22 PM CDT

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Mentor_Map.HEIC (2.07 MB) Mentor Map as Created in BME 300 Lecture.

10/15/2025 Lecture

ELLINORE LETTS - Oct 15, 2025, 1:38 PM CDT

Title: Bioengineer it. Protect It.

Date: 10/15/2025

Content by: Ellinore Letts

Present: N/A

Goals: Learn about protecting biomedical designs, patent law, application to BME.

Content:

IP allows research to safely transfer into products, processes, and/or systems.

1. Legal Career Paths for Biomedical Engineers

2. Protecting Inventions and Ownership

3. Patent Protection, Searches and Infringement

4. Trademark, Copyright and Trade Secret

5. Counterfit

Conclusions/action items: Learn about how this can apply to our project.

10/22/2025 Lecture

ELLINORE LETTS - Dec 10, 2025, 3:16 PM CST

Title: BME Advising

Date: 10/22/2025

Content by: Ellinore Letts

Present: N/A

Goals: Learn about postgraduate options.

Content:

Make sure the story that you write is clear to someone who is not you, and use it to determine where you want to go to.

MS - 1 year, build experience and credentials.

UW Madison research masters

- Stipend, 1 year, requires sponsor and approval from research mentor.

Need 3.0 overall, deadline for fall and spring entry

MD - take classes

Conclusion: Consider how these options shape what I want to do as a BME.

10/29/2025 Lecture

ELLINORE LETTS - Dec 10, 2025, 3:16 PM CST

Title: Regulatory Pathways

Date: 10/29/2025

Content by: Ellinore Letts

Present: N/A

Goals:

Content: Learn about the history of healthcare regulation, the FDA and the importance of healtchare regulation.

Regulatory pathways - Welle/Krauthamer, begins device regulation until 1976

Class 1 - Low Risk

Class 2 - Moderate / Controlled Risk

Class 3 - High Risk

Different Devices have different associated risks, and key regulatory steps that must be met when brining a device to market.

Conclusion: Consider how these apply to BME industry.

11/05/2025 Lecture

ELLINORE LETTS - Dec 10, 2025, 3:17 PM CST

Title: Regulatory Strategy

Date: 11/05/2025

Content by: Ellinore Letts

Present: N/A

Goals:

Content: Learn about the overall structure of the FDA, how they guide product development and a "quality" mindset.

Device - CDRH

- PMA, 510(k), IDE

Drug - CDER

- NDA, IND

Biologic - CBER

- BLA, IND

351 vs 361 regulatory paths

361 - generally taken from a patient and put back into patient (homologous use)

- minimally manipulated

351

- Intended use combined

Conclusion: Consider how these impact the timing and regulatory pathways of BME projects.

11/7/2025 Tong Lecture

ELLINORE LETTS - Nov 12, 2025, 1:22 PM CST

Title: Tong Lecture

Date: November 7th, 2025

Content by:

Present: BME Design

Goals: To learn about why healthcare needs more engineers and why we are so important in healthcare.

Content:

- Chapter 1: The Foundation
  - Solve tangible problems, work hard
- Chapter 2: Climb the Growth Curve
  - Combine EQ with IQ to multiply impact and reach
    - Her first part of her career was about her and proving what she could do
    - The second part was working with a team and helping other people
- Chapter 3: Build & Transform
  - Drive system-level impact through innovation & scale
    - How can you change access to healthcare
    - How does anyone have a chance if they can't get access to healthcare
    - How do we make healthcare affordable, accessible and have good outcomes
- 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
  - Improved provider experience: only 50% of physicians 15 years out from residency said they would study it again if they had the choice
    - You want to deliver patient care
- Improved patient outcomes
- How much do we spend on healthcare in the US ($$ and % of GDP)
- How much do we spend per person on healthcare vs. other OECD countries
- How do we measure on outcomes, cost, quality and provide experience
  - US ranked last on equity, access and outcomes
- Why's it so complicated
  - >900 insurers
  - > 100 EHRS
- Underlying challenges
  - Misaligned incentives
  - Fragmented financing and regulation (federal, state, employer)
  - Data silos & legacy IT
  - Inequities (10-15 year gap between zip codes)
- 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
- What is required to build a better healthcare system?
  - Human centered design.
  - Clinicians be rewarded for outcomes not activity

- 1. Work hard and build range: take on the hardest projects, classes and experiences you can find. Effort and range are your foundation.
  - once you are in a professional job you have a much easier time getting a job afterwards
- 2. Seek diverse exposure: explore different sectors, teams and geographies. Gain perspective and learn how systems connect, not just how parts work.
  - range of living in different places and doing different jobs helps get experience and helps you find out what you like and what you want to do.
  - Use your resources and make connections with people
- 3. Choose your people wisely
  - Surround yourself with curious, driven, high-integrity people. They will shape who you become.
- 4. Know your values & protect them
  - Define what matters most - family/friends, health, career/impact, values and make decisions that align
- 5. Embrace challenge and keep growing
  - Run towards hard problems. Growth lives on the edge of discomfort - where big impact starts
  - acknowledged how hard you have worked to get where you are

Conclusions/action items:

Research and development is so important to design devices that will improve people's health yes, but also to design devices that are affordable and accessible to people. What good is healthcare if people don't have access. It is so important as an R&D to help develop a product that actually helps people and isn't just a money grab. Human centered design is important: build around people, not processes

11/12/2025 Lecture

ELLINORE LETTS - Dec 10, 2025, 3:17 PM CST

Title:An introduction to Research and the IRB

Date: 11/12/2025

Content by: Ellinore Letts

Present: N/A

Goals: Learn about the IRB.

Content:

Ethical Research Frameworks

Belmont Report - respect for persons and autonomy

HIPAA resources for researchers

• UW HIPAA website

• https://compliance.wisc.edu/hipaa/

• Policies, FAQs, training, research guide

• Contact information for Privacy or Security Officers and

local IT

• De-Identification policy

• https://policy.wisc.edu/library/UW-114

• U.S. Department of Health and Human Services

website

• http://privacyruleandresearch.nih.gov/

Conclusion: Consider how these impact the timing and regulatory pathways of BME projects.

11/19/2025 Lecture

ELLINORE LETTS - Dec 10, 2025, 3:17 PM CST

Title: How NPD works in the Medical Device Industry

Date: 11/19/2025

Content by: Ellinore Letts

Present: N/A

Goals: Learn about medical device innovation, systems, and product development.

Content:

Selecting and Prioritizing Projects

Types of NPD

Line extensions - addition of additional sizes, etc.

Product Improvements - product change due to market feedback and or customer needs

New to Company - new for a company, not the market

New to World - create new markets

NPD Stage-Gate Process

Stage 0 - Ideation

Stage 1 - Exploration

Stage 2 - Concept Development (Go/NoGo)

Stage 3 - Design Development

Stage 4 - Design Confirmation (Design Freeze)

Stage 5 - Design Transfer and Commercialization (Launch)

+ Post Market Surveillance

Conclusion: Consider how these impact the timing and regulatory pathways of BME projects.

09/08/25 Paracervical Block Research

ELLINORE LETTS - Sep 08, 2025, 1:32 PM CDT

Title: Paracervical Block Existing Models

Date: 09/08/2025

Content by: Ellinore Letts

Present: N/A

Goals: Goal of this entry is to understand existing methods, materials, and techniques in a paracervial block to gain a better understanding of what this project will entail.

Content:

Paracervical Block

- **Definition:** A local anesthesia technique where anesthetic (e.g., lidocaine) is injected around the cervix to numb cervical and lower uterine tissue.
- **Purpose:**
  - Reduce pain during gynecologic and obstetric procedures such as:
    - IUD insertion or removal
    - Endometrial biopsy
    - Dilation and curettage (D&C)
    - First-trimester abortion
    - Cervical dilation for other procedures
    - Occasionally used in obstetrics for assisted delivery
- **Mechanism:**
  - Local anesthetic is injected into tissue around the cervix (commonly at the 4 and 8 o'clock positions, sometimes more).
  - Blocks pain transmission from cervical and uterine nerves.
  - Numbs cervix but does not fully block uterine cramping.
- **Effects:**
  - Provides localized pain relief in cervix and lower uterus.
  - Patients may still feel uterine contractions or cramping.
- **Risks/Complications:**
  - Vasovagal reaction (dizziness, fainting)
  - Rare systemic anesthetic toxicity (if injected into a vessel)
  - Local bleeding or infection (rare)

Conclusions/action items:

A paracervical block is a local anesthesia technique where anesthetic is injected around the cervix to reduce pain during gynecologic and some obstetric procedures. It provides effective cervical pain relief but does not fully eliminate uterine cramping. Next steps in researching include reviewing its effectiveness compared to other pain control methods, learning specific injection sites, and understanding contraindications and complication management.

Conclusions/action items:

Satalich, James R., et al. "Cementation in Total Hip Arthroplasty: History, Principles, and Technique." *EFORT Open Reviews*, U.S. National Library of Medicine, 7 Dec. 2022, www.ncbi.nlm.nih.gov/pmc/articles/PMC9780613/.

09/12/25 Paracervical Block Research

ELLINORE LETTS - Sep 12, 2025, 11:45 AM CDT

Title: Paracervical Block Existing Models

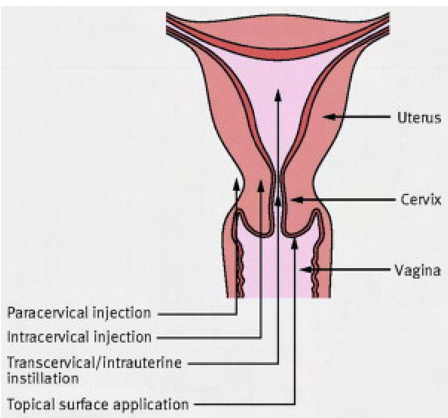
Date: 09/12/2025

Content by: Ellinore Letts

Present: N/A

Goals: The goal of this project is to develop a more thought through understanding of a cervical block procedure. This will also allow for a better understanding of the biological components involved in the procedure.

Content:



Paracervical Block (PCB)

Purpose

-
- Routine pain management for uterine aspiration in awake or moderately sedated patients.
- Targets nerve bundles at **3 and 9 o'clock** + uterosacral ligaments.
- Reduces pain with **cervical manipulation/dilation**, less effect on uterine pain.

Pain Levels

-
- Paracervical block + NSAIDs → Moderate pain (5–7/10 scale).

Evidence & Techniques

-
- Systematic reviews show mixed efficacy due to lack of sham comparisons.
- Techniques associated with decreased pain:
  - Carbonated lidocaine.
  - Deep injection (3 cm).
  - 4-site injection.

- Slow injection over 60 sec.
- Wait 3 min between block and dilation.

Conclusions/action items:

A paracervical block is a local anesthesia technique where anesthetic is injected around the cervix to reduce pain during gynecologic and some obstetric procedures. It involves both the cervix and the uterus. It should be determined the material properties of these body parts to properly model them.

Conclusions/action items:

"Paracervical Block," *ScienceDirect Topics: Medicine and Dentistry*. Available: https://www.sciencedirect.com/topics/medicine-and-dentistry/paracervical-block [Accessed: Sep. 12, 2025].

09/12/25 Cervix Research

ELLINORE LETTS - Sep 12, 2025, 12:03 PM CDT

Title: Cervix General Research

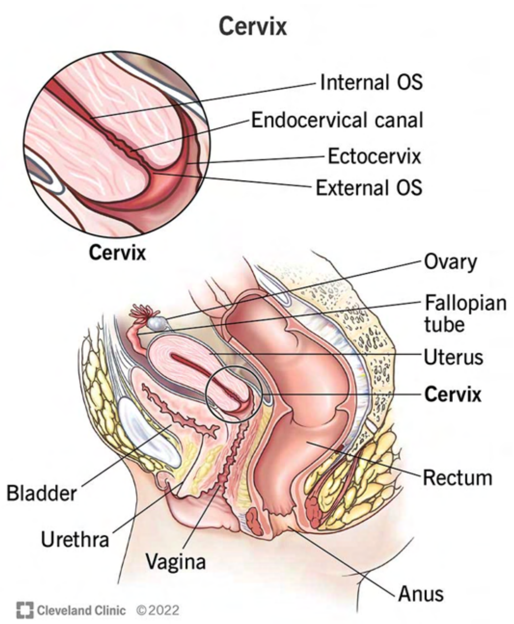
Date: 09/12/2025

Content by: Ellinore Letts

Present: N/A

Goals: The goal of this entry is to understand the function, biology, and material properties of the cervix. The cervix is opened during a paracervical block, which leads to the uterus.

Content:



Main Purpose

-
- Connects uterus and vagina; lets fluids pass in and out.
- Acts as a gatekeeper during pregnancy and childbirth.

Functions

-
- **Menstruation:** Period blood leaves the uterus through the cervix to the vagina.
- **Pregnancy:** Sperm must pass through the cervix to reach the uterus and fallopian tubes.
- **Fertility:** Around ovulation, cervical mucus becomes thinner and less acidic, making it easier for sperm to travel.
- **Childbirth:**
  - During pregnancy a mucus plug seals the uterus.
  - Before birth, the plug dissolves; the cervix softens, thins, and dilates so the baby can pass.
  - Dilation is used to estimate how soon delivery will happen.
- **Protection:** Keeps objects like tampons or diaphragms from entering the uterus.

Location

-
- Sits inside the pelvic cavity, about 3–6 inches inside the vaginal canal.
- Starts at the base of the uterus and extends into the top of the vagina (ectocervix).
- Located behind the bladder/urethra and in front of the rectum/anus.

Structure

-
- Cylinder/tube-shaped, like a neck connecting uterus to vagina.
- **Parts:**
    - **Internal os:** Opening to the uterus.
    - **Endocervical canal:** Tunnel from internal os to ectocervix.
    - **Ectocervix:** Portion projecting into the vagina.
    - **External os:** Opening to the vagina.
    - **Transformation zone (TZ):** Where cell changes happen most often (site of dysplasia or cancer).

Size & Feel

-
- Average length about 1 inch (varies with age, childbirth, and menopause).
- Shortens significantly during labor.
- Can be felt with a clean finger; texture and position change with menstrual cycle — softer and higher during ovulation.

Tissue Composition

-

- Strong fibromuscular tissue.
- **Glandular cells:** Line the endocervical canal.
- **Squamous cells:** Cover the ectocervix and vagina.
- These meet at the transformation zone (important for Pap smears and cervical cancer screening).

Conclusions/action items:

This gave a general background the the biological layout and function of the cervix. Next, research on the size, material properties and function will be needed to determine how this can best be modeled.

Conclusions/action items:

"Cervix: Anatomy, Function, Changes & Conditions," *Cleveland Clinic Health Library*. [Online]. Available: https://my.clevelandclinic.org/health/body/23279-cervix. [Accessed: Sep. 12, 2025].

09/12/25 Uterus Research

ELLINORE LETTS - Sep 12, 2025, 12:17 PM CDT

Title: Uterus General Research

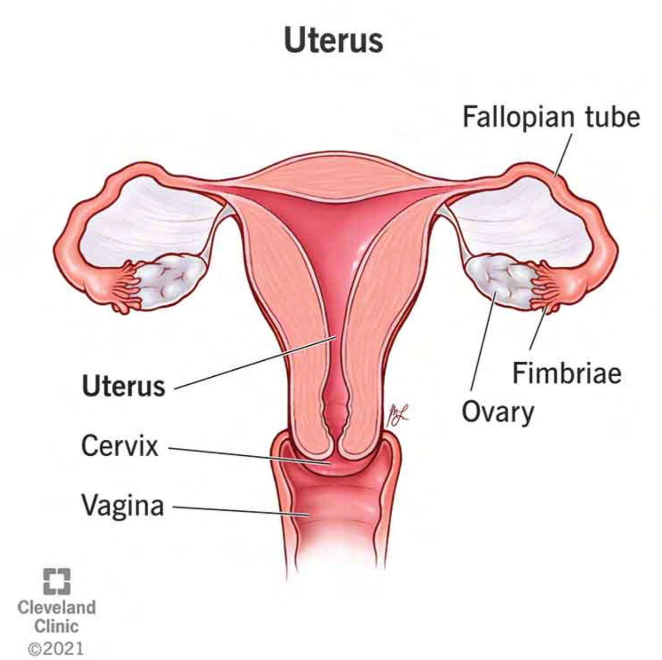
Date: 09/12/2025

Content by: Ellinore Letts

Present: N/A

Goals: The goal of this entry is to understand the function, biology, and material properties of the female uterus. The uterus is connected to the cervix and is opened during a paracervical block.

Content:



Uterus – Notes

Main Functions

-
- **Pregnancy:**
    - Uterus stretches to support and grow a baby.
    - Contracts during labor to push the baby out.
- **Fertility:**
    - Site where a fertilized egg implants and develops.
- **Menstrual Cycle:**
    - Uterine lining (endometrium) thickens each cycle.
    - If no pregnancy, lining sheds (menstruation).

Menstrual Cycle Changes

-
- Endometrial lining becomes thick and blood-rich before ovulation.
- If no fertilization: lining sheds (period).
- If fertilization: blastocyst implants into endometrium → pregnancy begins.

During Pregnancy

-

- Fertilized egg implants into uterine lining.
- Uterus grows and stretches dramatically (from lemon to watermelon size).
- Contracts in labor and returns to near-pre-pregnancy size after about 6 weeks (involution).

Anatomy & Structure

-
- Shape: light bulb / upside-down pear.
- Size: about fist-sized (3 inches top to bottom, 2 inches wide).
- Positioned in pelvis between bladder and rectum.
- Supported by pelvic floor muscles, ligaments, and perineal body.

Sections of the Uterus

-
- **Fundus:** Uppermost, widest part connecting to fallopian tubes.
- **Corpus (Body):** Main part where implantation occurs.
- **Isthmus:** Narrowing area between corpus and cervix.
- **Cervix:** Lower part opening into the vagina.

Layers of the Uterus

-
- **Perimetrium:** Outer protective layer.
- **Myometrium:** Thick muscular middle layer (expands in pregnancy, contracts in labor).
- **Endometrium:** Inner lining (sheds during menstruation, nourishes embryo if pregnancy).

Size & Growth

- Non-pregnant: ~3 in × 2 in × 1 in, ~1 oz weight.
- Pregnant: up to 2 pounds; expands to hold a full-term baby.

Positions of the Uterus

- **Anteverted (common):** Tilts forward toward abdomen.
- **Retroverted (tipped/tilted):** Tilts backward toward spine.
- **Anteflexed:** Bent forward sharply.
- **Retroflexed:** Bent backward sharply.

Conclusions/action items:

Determine the mateiral properties of each layer of the uterus, and their connection. Think of ways this could be replicated and assembled relative to the cervix, and in relation to the patients body.

Conclusions/action items:

Cleveland Clinic, "Uterus: Anatomy, Function, Size, Position & Conditions," *Cleveland Clinic Health Library*. [Online]. Available: https://my.clevelandclinic.org/health/body/22467-uterus. [Accessed: Sep. 12, 2025].

09/12/25 Material Properties of the Uterine Layers

ELLINORE LETTS - Sep 12, 2025, 12:30 PM CDT

Title: Uterus General Research

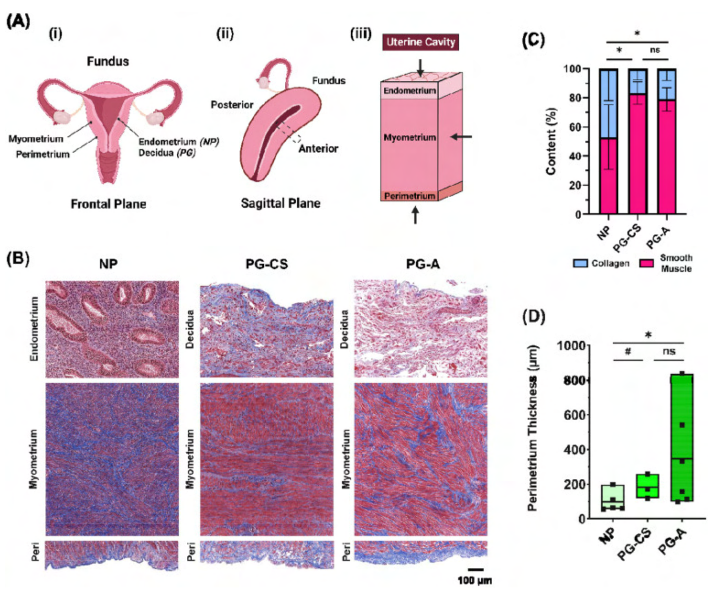
Date: 09/12/2025

Content by: Ellinore Letts

Present: N/A

Goals: The goal of this entry is to understand what qualities exist within each layer of the uterus, how these relate to the overall uterine function.

Content:



Histological and Compositional Properties

-

- **Endometrium (nonpregnant, NP):**
  - Glandular epithelium + stromal cells in a collagen-rich ECM.
  - Structure varies with menstrual cycle stage.
- **Decidua (pregnant, PG):**
  - Mostly decidualized stromal cells in a collagenous matrix.
  - Glandular epithelium is thin or absent.
  - No difference between decidua parietalis in PG-CS and PG-A.
- **Myometrium:**
  - PG myometrium has larger smooth muscle fibers and less collagen than NP.
  - No structural difference between PG-CS and PG-A.
- **Perimetrium:**
  - Thin, collagen-rich layer.

- Thickens during pregnancy with greater variability in PG-A.

Stiffness (Elastic Modulus,)

-
- **Range:** ~10^2–10^3 Pa, with spatial heterogeneity.
- **Layer differences (NP):**
  - Myometrium > Endometrium (significant).
  - Myometrium ≥ Perimetrium (in most patients).
  - Perimetrium slightly softer than myometrium.
- **Layer differences (PG):**
  -
  - PG-CS myometrium > PG-CS decidua (significant).
  - PG-A myometrium > PG-A decidua (trend).
  - No significant difference between myometrium and perimetrium in PG.
- **Pregnancy effects:**
  - Decidua stiffer than NP endometrium in third trimester.
  - Myometrium stiffness unchanged from NP.
  - Perimetrium stiffness unchanged, but PG-A shows extreme high points.

Regional Variations

-
- Stiffness varies across anterior, posterior, and fundus regions for all layers.
- No consistent correlation between stiffness and proximity to placentation.

Viscoelasticity

-
- **Viscoelastic ratio (∞/ 0):** 0.4–0.6 across layers → uterus is both solid and liquid at the microscale.
- **Layer-specific trends:**
    - Endometrium-decidua ratio increases in pregnancy → becomes less viscous.
    - NP endometrium and PG-CS decidua are less viscoelastic than myometrium/perimetrium.
    - Trend not observed in PG-A tissues.

- NP uterus: stiff myometrium, softer endometrium, thin perimetrium.
- PG uterus: myometrium larger fibers, decidua stiffer, perimetrium thickened, uterus behaves viscoelastically (~halfway between solid and fluid).
- High spatial and patient-to-patient variability, especially in PG-A.

Conclusions/action items:

The uterus is divided into distinct layers, with different stiffnesses, visoelastic properties and variations dependant on a womens menstural cycle. By determining different materials that we can work with to best model these layers, we can create a realistic model of the uterus.

Conclusions/action items:

D. M. Fodera, S. R. Russell, J. L. Lund-Jackson, S. Fang, X. Chen, J.-S. Y. Vink, M. L. Oyen, and K. M. Myers, "Material Properties of Nonpregnant and Pregnant Human Uterine Layers," *bioRxiv*, 2023. [Online]. Available: https://doi.org/10.1101/2023.08.07.551726. [Accessed: 12-Sep-2025].

09/16/25 Biomechanics of the Vagina

ELLINORE LETTS - Sep 16, 2025, 1:49 PM CDT

Title: Biomechanics of the Vagina

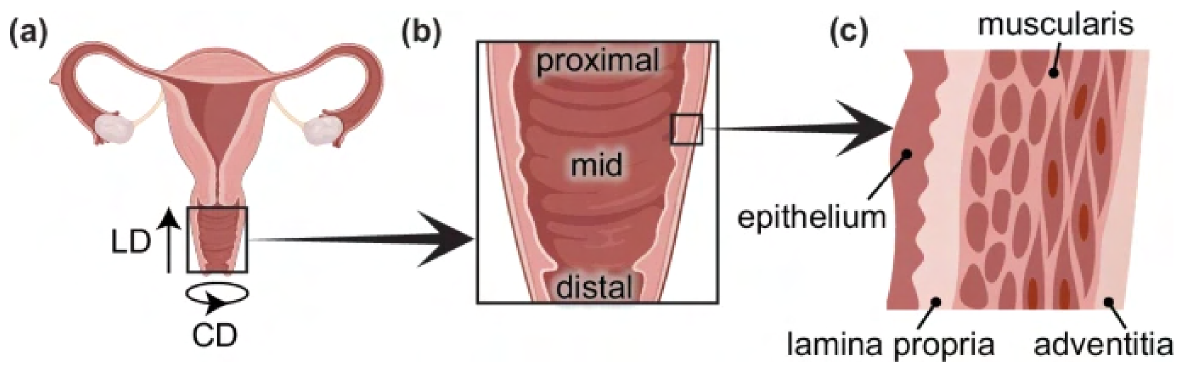
Date: 09/16/2025

Content by: Ellinore Letts

Present: N/A

Goals: The goal of this research is to understand the mechanical properties, function, and relationship between the uterus, vaginal canal, and cervix.

Content:



- The vagina is a fibromuscular tubular organ with four structural layers (epithelium, subepithelium, muscularis, adventitia), each contributing differently to its strength and function.
- Mechanical properties support menstruation, sexual activity, pregnancy, childbirth, and pelvic organ support.
- During childbirth, the vagina undergoes extreme remodeling and stretch (diameter from ~2.5 cm to ~10 cm).
- ~80% of vaginal deliveries cause some trauma; 30% of women post-delivery develop pelvic floor disorders versus 11% in nulliparous women.
- Vaginal biomechanics are linked to pelvic organ prolapse and other disorders; understanding these properties is key to prevention and treatment.
- Research uses both **in vivo** and **ex vivo** methods; animal models fill gaps due to ethical constraints but can't fully replicate human tissue properties.
- Variability among individuals and testing protocols leads to inconsistent data, emphasizing the need for standardization.
- Identifying mechanical trends across age, pregnancy, parity, menopause, and injury can guide clinical interventions and device design.
- The field is underdeveloped relative to its clinical importance; this review consolidates fragmented data to guide future studies.

Conclusions/action items:

It will be important to determine strength, flexibility, YM, and stress strain relationships for the individual components. This information laid a good background for further research.

Conclusions/action items:

Dubik, J., Alperin, M., & De Vita, R., “The biomechanics of the vagina: a complete review of incomplete data,” *npj Women’s Health*, vol. 3, Art. no. 4, Jan. 27, 2025.

09/16/25 Compression Testing, Mechanical Testing of Womens Reproductive Systems

ELLINORE LETTS - Sep 16, 2025, 1:59 PM CDT

Title: Compression Testing, Mechanical Testing of Women's Reproductive Systems

Date: 09/16/2025

Content by: Ellinore Letts

Present: N/A

Goals: The goal of this entry is to determine the general mechanical properties and compile testing data on individual components that can be used to determine material selection for out model.

Content:

Cervix

- **Early pregnancy:** Young's modulus ≈ **13 kPa** (in vivo elastography).
- **Mid pregnancy:** Young's modulus ≈ **7.5 kPa**.
- **Late pregnancy (term):** Young's modulus ≈ **4.4 kPa** (marked softening).
- **Pressure–strain elastic modulus (EP_{max}):** Early pregnancy ≈ **243 kPa** (median); term ≈ **5 kPa** (median).
- **Flexibility:** Dramatic increase in compliance (softening) from early to late pregnancy.

Vagina

- YM ≈ **6–10 MPa** at high strains in cadaver/excised tissue (represents full wall stiffness under load).
- **Soft region (in vivo low-strain behavior):** Much more compliant; initial "toe" region before collagen recruitment (kPa range, though data vary).
- **Stress–strain behavior:** Nonlinear; low stiffness at small strain, steep rise after collagen fibers align; large extensibility to accommodate childbirth.

Uterus

- **Nonpregnant tissue (compression/indentation tests):** Equilibrium stress ≈ **9.9 kPa**; bulk modulus ≈ **4.4 kPa**.
- **Pregnant tissue:** Equilibrium stress drops to ≈ **3.7 kPa**; bulk modulus ≈ **3.9 kPa**, indicating greater extensibility.
- **Anisotropy:** Mechanical response varies by layer and loading direction (myometrium vs. other layers).
- **Flexibility:** The pregnant uterus is substantially more compliant than the nonpregnant uterus, reflecting remodeling and fiber alignment changes.

Notes

- Both cervix and vagina show nonlinear stress–strain curves with a compliant toe region followed by a stiffer linear region.
- Cervix shows the largest stiffness change over pregnancy; vagina maintains extensibility but collagen recruitment makes it stiff under large strain.
- **Uterus** also softens and becomes more extensible during pregnancy but retains directional differences in stiffness across its layers.
- **Design implication:** For anatomical models, soft elastomers (low Shore A) for cervix, vaginal canal, and uterus at rest but allow for nonlinear stiffening or reinforced layers to simulate higher loads.

Conclusions/action items:

This information can be translated into material selection for our model. It will be important the materials we choose for our model match this information to ensure it is anatomically as accurate as possible. Looking into soft elastomers that can be 3D printed will be key in determining how to design out model.

Conclusions/action items:

1. P. Massó et al., "In Vivo Measurement of Cervical Elasticity on Pregnant Women by Torsional Wave Technique: A Preliminary Study," *Sensors*, vol. 19, no. 15, p. 3249, Aug. 2019. [Online]. Available: https://www.mdpi.com/1424-8220/19/15/3249
2. P. Hu et al., "Quantification of Cervical Elasticity During Pregnancy Using Shear Wave Elastography," *IEEE Trans. Biomed. Eng.*, vol. 71, no. 3, pp. 1124–1133, Mar. 2024. [Online]. Available: https://coilab.caltech.edu/documents/29093/Hu-2024-IEEE-TBME1.pdf

- J. Dubik et al., "The Biomechanics of the Vagina: A Complete Review of Incomplete Data," *npj Women's Health*, vol. 5, no. 1, p. 47, Apr. 2025. [Online]. Available: https://www.nature.com/articles/s44294-024-00047-7
- M. Cosson et al., "A Biomechanical Study of the Strength of Vaginal Tissues," *J. Biomech.*, vol. 37, no. 8, pp. 1279–1285, Aug. 2004. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0301211503003336
- S. Fang et al., "Anisotropic Mechanical Properties of the Human Uterus," *J. Mech. Behav. Biomed. Mater.*, vol. 100, pp. 1–11, Mar. 2020. [Online]. Available: https://pmc.ncbi.nlm.nih.gov/articles/PMC8376808/

09/29/25 Casting and Molding

ELLINORE LETTS - Sep 29, 2025, 4:04 PM CDT

Title: Overview of Casting and Molding

Date: 09/29/2025

Content by: Ellinore Letts

Present: N/A

Goals: Depending on the materials we decide to base our design around, we are going to need to 3D print a mold that can be used to develop our model. The goal of this entry is to gain a better understanding of high level casting techniques, and corresponding materials.

Content:

1. Overview of Casting

-
- **Casting** is pouring a liquid material into a mold where it solidifies or cures to form a specific shape.
- Used widely for anatomical models, prosthetics, training devices, and prototypes.
- Two main types in your context: **silicone casting** (soft, flexible) and **plastic casting** (rigid, durable).

---

2. Silicone Casting

Properties

-
- **Soft, flexible, tear-resistant**
- **High fidelity** for fine detail
- **Biocompatible** (if medical-grade platinum-cure silicone is used)
- Durometer ranges from **ultra-soft (Shore 00)** to **firm (Shore A 60+)**
- Excellent chemical and temperature stability

Common Uses

-
- Replicating **soft tissues** or making flexible molds
- Creating gaskets, seals, medical models

Materials

-
- **Platinum-cure silicone (addition-cure)** — preferred for biocompatibility and low shrinkage
- **Tin-cure silicone (condensation-cure)** — less expensive, but releases by-products, not as biocompatible

Steps

1.
2. **Prepare mold** — clean, apply mold release (especially silicone-on-silicone).
3. **Measure & mix** silicone parts A and B by weight.
4. **Degas** under vacuum to remove bubbles.
5. **Pour slowly** into mold from one side to minimize air entrapment.
6. **Cure** at room temp or slightly elevated temp per manufacturer's specs.
7. **Demold carefully** to avoid tearing soft parts.
8. **Post-cure (optional)** for maximum mechanical stability and reduced leachables.

Tips

-
- **Adjust softness** by blending silicones or adding silicone oils.
- **Colorants** can be added during mixing.
- **Reinforcement** (mesh or fabric) can increase tear strength.

---

3. Plastic Casting

Properties

-
- **Rigid, strong, and dimensionally stable**
- Good for **molds, shells, or support structures**
- Can be transparent or opaque
- Typically higher hardness than silicone

Common Materials

-
- **Urethane resins** (fast-curing, low viscosity, many hardness options)
- **Epoxy resins** (durable, slower cure, good adhesion)
- **Thermoplastics** (ABS, PLA, PETG) — usually 3D printed, then used as molds
- **Acrylics or polyesters** for rigid, clear parts

Steps

1.
2. **Prepare mold** — rigid silicone or another release-coated material.
3. **Measure & mix** resin and hardener/catalyst carefully.
4. **Pour** into mold slowly to reduce bubbles.
5. **Degas or pressure-cast** if clarity or fine detail is important.
6. **Allow full cure** — plastics often exotherm (generate heat) during curing.
7. **Demold** once fully hardened.

Tips

-
- **Thin resins** capture fine details but are more brittle.
- **Fillers** (glass fibers, metal powders) can change properties.
- Use **mold release** to protect molds and ease demolding.
- Post-processing: sanding, polishing, painting, drilling.

---

4. Combining Silicone and Plastic Casting

-

- Make a **rigid plastic mold** → cast soft silicone part inside.
- Make a **soft silicone mold** → cast rigid plastic part inside.
- Often you'll have a **t**wo-part mold (male/female halves) to create an enclosed cavity for casting.
- For anatomical models: rigid outer mold for durability, soft inner silicone for realistic tissue feel.

---

5. Safety & Quality

-

- Work in a **well-ventilated area** (especially urethanes/epoxies).
- Wear **gloves and eye protection**.
- Measure accurately — incorrect ratios cause soft or uncured parts.
- Record **batch numbers** and curing conditions for repeatability.

- **Silicone** = soft, flexible, biocompatible → great for anatomical parts or flexible molds.
- **Plastics (resins)** = rigid, durable → great for molds, shells, and supports.
- **Shore hardness** is critical for matching tissue feel.
- Always **test small batches** to confirm properties before full-scale casting.

M. Carbone, S. Condino, L. Mattei, P. Forte, G. Ferrari, F. Cutolo and V. Ferrari, “Anthropomorphic ultrasound elastography phantoms — characterization of silicone materials to build breast elastography phantoms,” *Proc. Annu. Int. Conf. IEEE Eng. Med. Biol. Soc.* (EMBC), pp. 492–495, Aug. 2012, doi: 10.1109/EMBC.2012.6345975.

Conclusions/action items:

We are going to need to find shore hardness materials that can match what our model requires, and determine if we need a hard or soft mold. From there, we can develop our model, 3D print the mold, and determine what that will require.

10/01/25 - Ecoflex Research

ELLINORE LETTS - Oct 01, 2025, 12:35 PM CDT

Title: Ecoflex Material Research

Date: 10/01/25

Content by: Ellinore Letts

Present: N/A

Goals: As we have decided on our preliminary design, we must now begin to consider the different materials that we can use for our model. As we have decided to make a negative mold, and make our components a soft polymer, this research is on using Ecoflex.

Content: on Ecoflex 00-10

Shore Hardness Scales

- **Shore 00:** Very soft rubbers and gels.
- **Shore A:** Flexible rubbers (soft → medium → hard). High end can include semi-rigid plastics.
- **Shore D:** Hard rubbers, semi-rigid and hard plastics.
- **Note:** Scales overlap (e.g., 95A ≈ 45D).
- **Measurement:** Done with a Shore hardness gauge — needle indentation resistance gives the hardness value.

Ecoflex™ 00-10 Overview

- **Type:** Platinum-cure silicone, mixed 1A:1B by weight/volume.
- **Properties:** Very soft, stretchy, strong, rebounds without distortion. Slightly tacky surface when cured.
- **Appearance:** Translucent, can be pigmented.
- **Modifiers:**
    - *Silicone Thinner™* → lowers viscosity (but reduces strength).
    - *THI-VEX™* → thickens for brush-on applications.
    - ## Silc Pig™ for coloring

Instructions & Use

- **Safety:** Use in ventilated area, wear eye/skin protection. Avoid latex gloves (inhibits cure).
- **Mixing:** Pre-mix Part B, then mix A+B for ~3 minutes, scrape sides/bottom. Vacuum degas recommended.
- **Pouring:** Pour in one spot to minimize bubbles; maintain at least 0.5 in (1.3 cm) over highest point.
- **Curing:** Room temp cure (73°F/23°C). Post-cure optional (176°F/80°C for 2 hr + 212°F/100°C for 1 hr) for max strength.
- **Release agents:** Not always needed, but Ease Release™ 200 helps with complex surfaces.
- **Storage:** Keep molds clean, dry, and assembled; lifespan depends on usage (abrasive casts reduce life).

Material Properties:

Technical Data

Data At-A-Glance

Mix Ratio By Volume	1A:1B
Mix Ratio By Weight	1A:1B
Pot Life	30 minutes
Cure Time	4 hours
Shore Hardness	00-10
Specific Gravity	1.04 g/cc
Specific Volume	26.6 cu. in./lb.
Tensile Strength	120 psi
100% Modulus	8 psi
Elongation @ Break	800 %
Die B Tear Strength	22 pli
Color	Translucent
Useful Temperature (min)	-65 °F
Useful Temperature (max)	450 °F
Shrinkage	<.001 in. / in.
Mixed Viscosity	14,000 cps

Conclusions/action items: Compare different ecoflex mixtures to see what should be ordered for each part of the mold. Ecoflex 00-10 was used as an example, but may be too soft for out desired project.

"EcoflexTM Series, Super-Soft, addition cure silicone rubbers," Smooth, https://www.smooth-on.com/product-line/ecoflex/ (accessed Oct. 1, 2025).

10/01/25 - Shore Hardness + Casting

ELLINORE LETTS - Oct 01, 2025, 12:44 PM CDT

Title: Shore hardness + casting

Date: 10/01/25

Content by: Ellinore Letts

Present: N/A

Goals: By determining what the shore hardness should be of our desired components, we can determine what products to buy to fill our negative cast.

Anatomical Structure	Mechanical Property (Young's modulus / kPa)	Approx. Shore Hardness (for silicone simulation)	Notes
Uterus (body)	~1.7 kPa	**Shore 00-10**	Very soft, spongy; compressible tissue
Cervix	0.9–15 kPa	**Shore 00-30**	Firmer than canal; outer layer can be slightly stiffer
Vaginal Canal	— literature surrogate used silicone Shore A ~18	**Shore 00-20**	Soft, stretchy, deformable walls
Vaginal Opening / Introitus	Slightly firmer than canal to simulate dilation resistance	**Shore 00-30**	Needs more durability; can be reinforced with mesh or thicker rim

	Ecoflex™ 00-30
Product Type	Silicone Rubber - Platinum Cure Skin Safe FX Materials
Mixed Viscosity	3,000 cps
Mix Ratio By Volume	1A:1B
Mix Ratio By Weight	1A:1B
Pot Life	45 minutes
Cure Time	4 hours
Shore A Hardness	00-30
Specific Gravity	1.07 g/cc
Specific Volume	26.0 cu. in./lb.
Color	Translucent
Die B Tear Strength	38 pli
Tensile Strength	200 psi
Elongation @ Break	900 %
100% Modulus	10 psi

	Ecoflex™ 00-30
Shrinkage	<.001 in. / in.
Useful Temperature (min)	-65 °F
Useful Temperature (max)	450 °F

Product Description

Ecoflex™ 00-30

Ecoflex™ rubbers are platinum-catalyzed silicones that are versatile and easy to use. Ecoflex™ rubbers are mixed 1A:1B by weight or volume and cured at room temperature with negligible shrinkage. Low viscosity ensures easy mixing and de-airing. Cured rubber is very soft, very strong and very "stretchy", stretching many times its original size without tearing and will rebound to its original form without distortion.

Certified Skin Safe - Cured Ecoflex™ 00-30 is skin safe and certified by an independent laboratory.

Conclusions/action items: I believe our group should stick with the Ecoflex 00-30 as it is adaptable to each part of our model. By supplementing with additional products, we will be able to make an anatomically accurate model, that matches the hardness and elastic properties we desire.

Item	Quantity / Size	Purpose	Estimated Price
Ecoflex™ 00-30 Silicone Rubber	1 gallon	Main material for uterine, cervical, and vaginal structures	$74.16
Silicone Thinner™	1 pint	To soften Ecoflex for vaginal canal and uterus	$11.76
Ecoflex™ Gel Silicone Rubber	Trial unit	For very soft layers (vaginal canal or cervix inner core)	$36.72
THI-VEX™ Silicone Thickener	Dropper	For brush-on layers and thickened edges (vaginal opening rim)	$4.08
Silc-Pig™ Silicone Pigments	Starter set / assorted colors	For realistic tissue colors (pink, red, flesh)	$32–40

"EcoflexTM Series, Super-Soft, addition cure silicone rubbers," Smooth, https://www.smooth-on.com/product-line/ecoflex/ (accessed Oct. 1, 2025).

10/08/25 Material Strength Testing

ELLINORE LETTS - Oct 08, 2025, 2:00 PM CDT

Title: Material Strength

Date: 10/08/25

Content by: Ellinore Letts

Present: N/A

Goals: Learn about testing methods to determine the strength and Young's Modulus of our chosen materials. Learn about compressive vs tensile testing methods.

Refer to PDF on how to generate stress and strain curves from compression and tensile testing.

https://www.mee-inc.com/files/3814/2118/3301/HAMM_2014-TensionAndCompressionTesting.pdf

By testing out materials in compression, we will be able to generate a Young's Modulus and determine the stiffness of our material. This can be used as a tool in collaboration with other forms of testing to measure the anatomical accuracy of our design.

[1] “Tension and compression testing,” Tension and Compression Testing | Tension and Compression Failure Analysis | Tension and Compression Material Analysis | ToF-SIMS, https://www.mee-inc.com/hamm/tension-and-compression-testing/ (accessed Oct. 8, 2025).

10/16/25 Tensile Testing + YM

ELLINORE LETTS - Oct 16, 2025, 4:25 PM CDT

Title: Tensile Testing and Young Modulus

Date: 10/16/25

Content by: Ellinore Letts

Present: N/A

Goals: Prepare protocol for mechanical testing for ecoflex materials.

Mechanical Properties of Ecoflex Silicone Elastomers

Ecoflex is a family of platinum-catalyzed, addition-cure silicone rubbers known for their low modulus, high elongation, and biocompatibility. These properties make Ecoflex suitable for applications such as prosthetics, soft robotics, and wearable sensors.

Tensile Properties

- **Young's Modulus**: Ecoflex elastomers exhibit a low elastic modulus, typically between 100 kPa and 125 kPa, indicating their soft and flexible nature
- **Ultimate Tensile Strength**: The tensile strength of Ecoflex 00-30 is approximately 200 psi (1.38 MPa), with an elongation at break of about 900%
- **Strain Rate Sensitivity**: The mechanical behavior of Ecoflex is influenced by strain rate, with variations observed in stress-strain curves under different loading rates

Compressive Properties

- **Elastic Modulus**: In compression, Ecoflex demonstrates a low modulus, typically between 100 kPa and 125 kPa, similar to its tensile properties
- **Compression Testing Standards**: ASTM D575 provides standardized methods for determining the compression-deflection characteristics of rubber compounds, applicable to Ecoflex elastomers l

Testing Protocols

Tensile Testing

1. **Specimen Preparation**: Prepare dumbbell-shaped specimens according to ASTM D412 standards.
2. **Test Setup**: Mount the specimen in the grips of the MTS Universal Testing Machine.
3. **Testing Conditions**: Conduct tests at a strain rate of 0.1–0.5 mm/min and room temperature (20–25°C).
4. **Data Acquisition**: Record force and displacement data throughout the test.
5. **Analysis**: Determine the Young's modulus, ultimate tensile strength, and elongation at break from the stress-strain curve.

Compression Testing

1. **Specimen Preparation**: Prepare cylindrical or cuboid specimens with dimensions suitable for the testing machine.
2. **Lubrication**: Apply a thin layer of lubricant to the compression plates to minimize friction.
3. **Test Setup**: Place the specimen between the compression plates of the testing machine.
4. **Testing Conditions**: Apply compressive load at a rate of 0.1–0.5 mm/min and room temperature (20–25°C).
5. **Data Acquisition**: Record force and displacement data throughout the test.
6. **Analysis**: Determine the compressive modulus and analyze the stress-strain behavior.

Conclusions and Action Items: Create testing protocol for ecoflex materials.

- D. R. Darby, Z. Cai, C. R. Mason, and J. T. Pham, "Modulus and adhesion of Sylgard 184, Solaris, and Ecoflex 00-30 silicone elastomers," *J. Mater. Sci. Mater. Electron.*, vol. 30, no. 4, pp. 3616–3623, 2019.
- ASTM International, "ASTM D575-91: Standard Test Methods for Rubber Properties in Compression," ASTM International, West Conshohocken, PA, 2001.
- Y. Liu, L. Zhang, and Z. Zhang, "Strain rate, temperature and deformation state effect on Ecoflex 00-50 silicone mechanical behaviour," *J. Mater. Sci. Technol.*, vol. 35, no. 6, pp. 1079–1085, 2019.
- ASTM International, "ASTM D412-16: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension," ASTM International, West Conshohocken, PA, 2016.

Comments

Randolph Ashton Oct 30, 2025, 10:33 AM CDT

Good research on material properties and testing procedures!

09/08/25 3D Task Trainer for GYN Procedures

ELLINORE LETTS - Sep 08, 2025, 1:50 PM CDT

Title: 3D Printed Task Trainer for OBGYN Procedures

Date: 09/08/2025

Content by: Ellinore Letts

Present: N/A

Goals: The Goal of this entry is to learn about existing task trainers that are used in OBGYN procedures and potentially during a cervical block.

Content:

Introduction

- Medical simulation is key for educating students and residents, especially for gynecologic procedures.
- Low-cost 3D-printed task trainers allow realistic, deliberate practice, improving clinical skills, decision-making, and patient care.
- High-fidelity simulators exist but are costly; low-cost realistic gynecologic models are limited.
- Previous models used fruit or PVC with racquetballs; limited realism and durability.
- Digital simulator design and 3D printing allow economical creation of complex, realistic models.
- The new 3D-printed task trainer received positive informal feedback, prompting formal evaluation.

Methods

- Uterus and cervix designed in Tinkercad, printed in 3D; silicone cervix created (3 cm x 3.8 cm).
- Adult nongravid uterus modeled at 8 cm; cervix held between uterus and connecting ring.
- Task trainer: wooden base, PVC tubing, PVC “T” connector, 3D-printed uterus/cervix, hook-and-loop tape.
- Gel inside uterus simulates tissue for procedures (endometrial biopsy, manual vacuum aspiration).
- Low-cost: ~$15.38 per model.
- Study approved by IRB; mixed methods: surveys + qualitative feedback.
- Participants: 177 learners, including medical students, residents, OB-GYN clinicians, nurse practitioners, midwives.
- Procedures practiced: Pap smear, cervical polyp removal, uterine sounding, endometrial biopsy, IUD insertion/removal, cervical dilation, manual vacuum aspiration.

Task Trainer Evaluation Responses

- Six key evaluation questions (Likert scale 1–5):
    1. Realistic simulation of internal female pelvic anatomy
    2. Successful completion of procedures using the simulator

3. Increased preparedness for real-life procedures
4. Enhanced overall learning
5. Realistic opportunity to identify/use medical tools
6. Repetitive practice improves comfort and patient communication

- Average score: 4.5; standard deviation: 0.53–0.74 → strong consensus and low variability.
- Manual vacuum aspiration subset (23 learners, 3 additional questions): average 4.8, SD 0.3–0.5 → very high agreement.
- Qualitative feedback highlighted realism, ability to aspirate tissue, practice with IUDs, tenaculum use, and cost-effectiveness.
- Constructive feedback: adding cervicovaginal junction for paracervical blocks, silicone lining for PVC pipe, limited mobility of uterus.

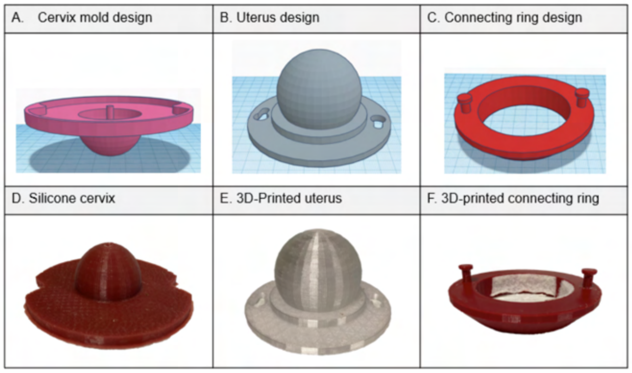
Results

- Simulation effectively mirrored real-life procedures, enhanced learning, increased comfort with instruments, and improved potential patient communication.
- Task trainer most suitable for early learners: 78% indicated medical/nurse practitioner students; 66% indicated first-year residents.

Discussion

- Novel 3D-printed task trainer paired with PVC components; tabletop, reusable, easy to clean.
- Components used for multiple sessions; silicone cervix durable (~18 uses per model).
- Survey was anonymous, efficient, and yielded broad perspectives.
- Facilitated deliberate practice, skill refinement, confidence-building, and safe learning environment.
- Supported interprofessional and multidisciplinary training (OB-GYN, family medicine, nurse practitioners).
- Enhances real-life preparation, reduces performance anxiety, and allows learners to focus on skill development

Figure 1: 3D-Printed Plastic and Silicone Components
The cervix mold (A), uterus (B), and connecting ring (C) were created using 3D design software. The cervix was created by pouring a dyed silicone mixture into the cervix mold (D), and the uterus (E) and connecting ring (F) were printed with a 3D printer.



Link to 3D Printing Instructions as used in this example: https://digitalcommons.unmc.edu/com_obgyn_pres/1/

Conclusions/action items:

The study successfully developed and tested a low-cost 3D-printed gynecological task trainer. It allows learners to efficiently practice multiple gynecological procedures in group settings. The trainer is realistic, simple, and cost-effective, enhancing both procedural skills and confidence in patient communication.

Conclusions/action items:

. Steinauer J, Preskill F, Robertson P. Training medical students in intrauterineprocedures using papayas. Med Educ. 2007;41(11):1099-100.2. Hellier S, Ramponi D, Wrynn A, Garofalo S. An innovative approach: using simulation toteach primary care gynecologic procedures.

Simul Healthc. 2017;12(4):268-73.3. Lichtenberger JP, Tatum PS, Gada S, Wyn M, Ho VB, Liacouras P. Using 3D printing(additive manufacturing) to produce low-cost simulation models for medical training. Mil Med.2018;183(suppl_1):73-7

09/08/25 3D Printed OBGYN Trainer Procedure

ELLINORE LETTS - Sep 08, 2025, 2:03 PM CDT

Title: 3D Printed OBGYN Task Trainer Procedures

Date: 09/08/2025

Content by: Ellinore Letts

Present: N/A

Goals: The Goal of this entry is to understand the methods, materials and procedure used in this 3D printed training model.

Content:

Table 1: Gynecological Task Trainer Equipment Supply List and Costs
This list contains the items needed to create the gynecological task trainer. These costs were obtained from online retailers on 11/09/2023.

Item	Cost total	Cost each
Wood shelf board or similar, 72 inch length x 12 inch depth (cut to 12 x 12 inch, yield 6 bases)	$17.98	$3.00
PVC pipe 1.5 inch x 24 inch (cut into 6" lengths, yield 4 pieces)	$4.21	$1.05
Charlotte pipe 1.5" x 2" PVC SWV Hub x Hub Increaser/Reducer Coupling, 1 piece	$2.24	$2.24
Charlotte pipe 2" x 2" x 1.5" PVC DWV sanitary tee, 1 piece	$3.54	$3.07
Silicone and dye 3 ounces of silicone per cervix Very small amount of dye per cervix	Ecoflex 00-20 – cost depends on the unit purchased Silc Pig Blood 4 oz $35.59	$3.00
Filament for 3D printed items: Solid and translucent polyactic acid (PLA) costs about $0.65/ounce 3D-printed cervix mold 1.34 ounces/38g of PLA		$0.87
3D-printed uterus 1.69 ounces/48g of translucent PLA		$1.10
3D-printed outer ring 1.24 ounces/35g of PLA		$0.79
Thick-It, water thickening agent to make the gel that is placed in the uterus to represent tissue Red food coloring	Thick-It 10 oz container $9.93, use approximately 0.25 oz per uterus. Cost per uterus: $0.25. Red food coloring 1 oz container $2.30, very small amount of food coloring; just enough to make the gel pink. Cost per uterus: $0.01	$0.26
	Total cost for one model:	$15.38

Uterus and cervix designed in Tinkercad, printed in 3D; silicone cervix created (3 cm x 3.8 cm).

- Adult nongravid uterus modeled at 8 cm; cervix held between uterus and connecting ring.
- Task trainer: wooden base, PVC tubing, PVC "T" connector, 3D-printed uterus/cervix, hook-and-loop tape.
- Gel inside uterus simulates tissue for procedures (endometrial biopsy, manual vacuum aspiration).
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Figure 1: 3D-Printed Plastic and Silicone Components
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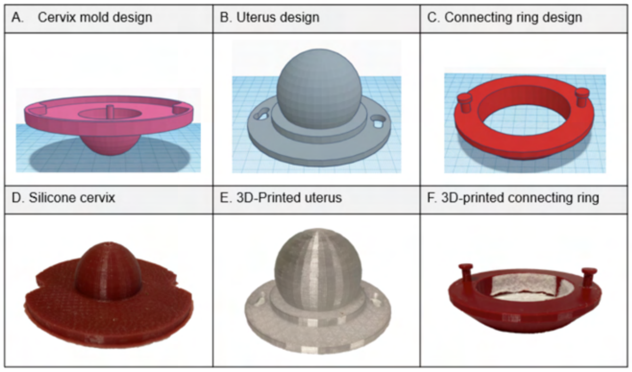
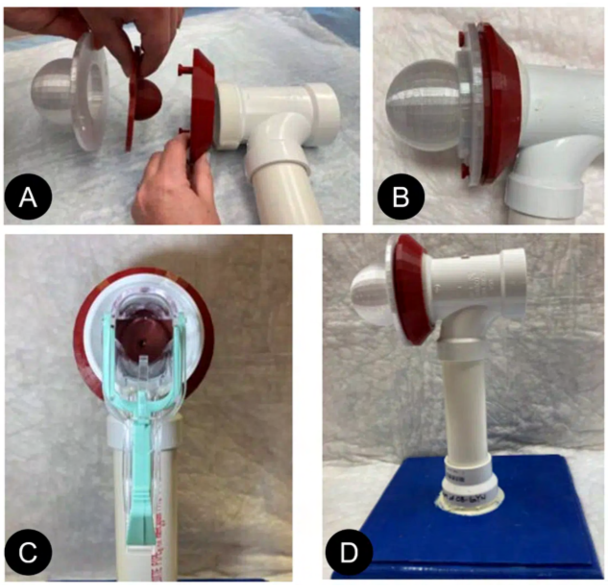




Link to 3D Printing Instructions as used in this example: https://digitalcommons.unmc.edu/com_obgyn_pres/1/

Link to Entire Document: https://www.unmc.edu/obgyn/_documents/monico_and_carlson_evaluation_of_3d-printed_gynecological_task_trainer.pdf

Conclusions/action items:

This has outlined the methods and materials used in developing this 3D printed task trainer, with outlined costs, ordered materials, and 3D instructions. It will be crucial to continue to research different models that have been used and compare methods, costs, and success of the studies.

Conclusions/action items:

Monico, J. E., & Carlson, K. S. (2024). *Evaluation of a novel 3D-printed task trainer for the simulation of gynecological procedures at a medical academic center*. University of Nebraska Medical Center. Retrieved from https://www.unmc.edu/obgyn/_documents/monico_and_carlson_evaluation_of_3d-printed_gynecological_task_trainer.pdf

09/16/25 Procedure for 3D printed task trainer

ELLINORE LETTS - Sep 16, 2025, 1:40 PM CDT

Title: Procedure for 3D printed task trainer

Date: 09/16/2025

Content by: Ellinore Letts

Present: N/A

Goals: The goal of this is to understand the step by step task trainer fabrication, materials and process of development.

Content:

Task Trainer Base1. Wood base, approximately ¾” x 10” x 10”2. Charlotte pipe coupling 1.5” x 2” PVC DWV Hub x Hub increaser/reducer3. PVC pipe 1.5-inch diameter x 6-inch length4. PVC DWV All Hub Sanitary Reducing Tee 2 x 2 x 1.5 inches5. Gorilla construction adhesive – 1 tube6. Hook and loop tape with adhesive - white, ¾ inch, approximately 5” per task trainer3D-Printed ItemsAccess to a 3D printerFilament for 3D printing: For each task trainer, create one uterus and one connecting ring. Create at least one 3D-printed cervix mold – mix and pour silicone intothe mold to create the cervix. The links to the 3D print files (.stl file format) are below.a) Uterus - print with translucent PLA or other hard plastic, 48 grams. File: https://webmedia.unmc.edu/medicine/OBGYN/3D/uterus.stlb) Connecting ring - print with red PLA or other hard plastic, 35 grams. File: https://webmedia.unmc.edu/medicine/OBGYN/3D/connecting-ring.stlc) Cervix mold - print in any color of PLA or other hard plastic, 38 grams. File: https://webmedia.unmc.edu/medicine/OBGYN/3D/cervix.stlSilicone Cervix1. Ecoflex 00-20 Super Soft Shore Platinum Silicone Rubber Compounda) Approximately 3 ounces per cervix (part A 1.5 oz and part B 1.5 oz)b) Silicone ease release, 1 can2. Silc Pig Silicone Pigments – “blood” color3. Stir sticks4. 3 disposable plastic cups, 12-16 ounces5. Painter’s plastic or plastic wrap – to cover the work surface when creating the silicone cervixPolyps1. Red pipe cleaners –approximately 2 inches for each polypGel – to simulate uterine tissue/contents1. Thick-It liquid thickener2. Red food coloring3. Water

Conclusions/action items:

This has outlined the methods and materials used in developing this 3D printed task trainer, with outlined costs, ordered materials, and 3D instructions. It will be crucial to continue to research different models that have been used and compare methods, costs, and success of the studies.

Conclusions/action items:

Monico, J. E., & Carlson, K. S. (2024). *Evaluation of a novel 3D-printed task trainer for the simulation of gynecological procedures at a medical academic center*. University of Nebraska Medical Center. Retrieved from https://www.unmc.edu/obgyn/_documents/monico_and_carlson_evaluation_of_3d-printed_gynecological_task_trainer.pdf

09/24/25 OBGYN Training Observations

ELLINORE LETTS - Sep 24, 2025, 2:03 PM CDT

Title: OBGYN Training Observations

Date: 09/24/2025

Content by: Ellinore Letts

Present: Entire Team

Goals: The goal of attending the training session with Dr. Dalby was to observe the current training model, speak with residents and learn what is working and not working.

Content:

- Dr. Dalby used the roma tomato training model to teach family medicine and OBGYN residents how to perform paracervial blocks, and different gynelogical procedures. Upon talking to the other resident trainers, they stated their current design doesn't properly replicate the mechanical properties, looks or stability of an ideal model.

Our model should include:

- Something that can be easily broken down, and can by easily assembled.

- A uterus that can be added and removed.

- Something that can be easily made using typical clinical supplies.

Conclusions/action items:

Use this feedback to create design matrix and work on design ideas. Create three design to model and score on design matrix. Send to client for feedback.

11/30/25 ASTM Standards

ELLINORE LETTS - Dec 04, 2025, 2:10 PM CST

Title: ASTM Standards

Date: 12/30/25

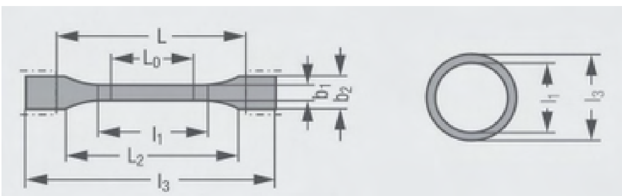
Content by: Ellinore Letts

Present: N/A

Goals: Determine ASTM standards for testing Ecoflex 00-20 in tension and compression.

Content:

Tensile Testing - Dogbone Model



Standard	Type	Note	l3 mm	l1 mm	b2 mm	b1 mm	h mm	L0 mm	Shape
ASTM D412	C	Preferred specimen	≥115	33	25±1	6+0.05	1.3 ... 3.3	25±0.25	Dumbbell specimen

Thickness: 3mm

Compression Testing - Cylinder Model

Standard	Type	Note	h mm	Dia mm	Shape
ASTM D575	C	Preferred specimen	12	25±0.25	Cylinder

Conclusions/action items: Pour Ecoflex samples. Perform testing and analyze data.

11/30/25 MTS Protocol Research

ELLINORE LETTS - Nov 30, 2025, 12:42 PM CST

Title: MTS Protocol

Date: 11/30/25

Content by: Ellinore Letts

Present: N/A

Goals: Create Protocol for MTS testing of Ecoflex 00-20 samples in compression and tension.

Content:

MTS Tensile Testing Protocol – ASTM D412 Type C

Objective:
To evaluate the tensile properties (stress–strain behavior, Young's modulus, ultimate tensile strength) of Ecoflex 00-20 using standardized dumbbell-shaped specimens.

Materials and Equipment:

- Ecoflex 00-20 silicone elastomer
- ASTM D412 Type C dumbbell molds (6 mm × 3 mm cross-sectional area, 33 mm gauge length)
- MTS uniaxial testing machine with 100 N load cell
- Digital caliper or micrometer
- Data acquisition software (MATLAB or MTS proprietary software)
- Timer/stopwatch

Procedure:

Sample Preparation:
a. Mix Ecoflex 00-20 according to manufacturer instructions.
b. Pour into Type C dumbbell molds and cure at room temperature overnight.
c. Remove samples from molds.
d. Measure gauge length, width, and thickness with a caliper to calculate cross-sectional area.

MTS Setup:
a. Install a 100 N load cell on the MTS machine.
b. Set crosshead speed according to ASTM D412 recommendations.

Testing:
a. Secure the specimen in the grips, aligning it so the gauge section is centered and straight.
b. Begin the tensile test, recording force and extension continuously.
c. Continue the test until specimen failure.

Data Acquisition:
a. Record force (N) and displacement (mm) throughout the test.
b. Calculate engineering stress.
c. Calculate engineering strain.

Data Analysis:

a. Plot stress–strain curves for each sample and average.
b. Determine Young's modulus from the slope of the linear elastic region.
c. Determine ultimate tensile strength and elongation at break.
d. Analyze at least six replicate samples to assess reproducibility.

Reporting:

a. Report average Young's modulus, ultimate tensile strength, and standard deviations.

Conclusions/action items: Pour Ecoflex samples. Perform testing and analyze data.

ELLINORE LETTS - Nov 30, 2025, 12:40 PM CST

DATA

Download

Cervical_Block_TM_Design.HEIC (1.93 MB)

12/06/25 Patent Research

ELLINORE LETTS - Dec 06, 2025, 4:09 PM CST

Date: 12/06/25

Content by: Ellinore Letts

Present: NA

Goals: Learn about patent filing and prepare for WARF meeting.

Content:

WARF manages the patenting process on behalf of principal investigators, providing expertise in patent strategy, licensing, and legal protection, and covering the substantial costs associated with patent filings. They leverage their industry network to identify potential licensing partners—companies or startups with the resources to bring new inventions to market for public benefit.

To begin the process, innovators submit an innovation disclosure, which initiates WARF's internal review to assess patentability and gather the technical details needed for drafting a patent application. Innovators then participate in a confidential disclosure meeting to discuss the invention, its functions, and potential applications in greater depth.

A decision committee evaluates the disclosure based on factors such as patentability, market landscape, licensing prospects, public benefit, and WARF's ability to add value. The invention then undergoes an equity review by the Office of the Vice Chancellor for Research and Graduate Education to identify any funding sources or contractual obligations that may affect intellectual property rights.

For inventions that move forward, innovators enter into a memorandum agreement with WARF. This agreement establishes the legal relationship, assigns ownership of the invention to WARF, and ensures that inventors will share in any royalty income. WARF then proceeds with the patent application, collaborating with experienced intellectual property professionals—including registered patent agents and patent attorneys—to prepare and file the patent.

-
    1.

Conclusions/action items:

Complete meeting with WARF and learn next steps.

12/06/25 Womens Health Funding

ELLINORE LETTS - Dec 06, 2025, 4:13 PM CST

Date: 12/06/25

Content by: Ellinore Letts

Present: NA

Goals: Learn about how funding in womens health creates a demand for OBGYN procedure training models.

Growing investment in women’s health has increased attention on gaps in clinical training, particularly for OB/GYN procedures. Expanded federal, industry, and philanthropic funding streams have accelerated research and innovation, highlighting the need for accurate, accessible, and anatomically realistic models to support clinician training. As resources flow into developing better tools for diagnosing and treating women’s health conditions, the demand for high-fidelity training models continues to rise. This demand is fueled by the need to improve procedural competency, ensure patient safety, support early-career clinicians, and standardize techniques across diverse healthcare settings

Conclusions/action items:

There is an increasing demand for effective training models as womens health and experiences gain attention.

09/24/25 Preliminary Design Ideas

ELLINORE LETTS - Sep 25, 2025, 11:08 AM CDT

Title: Ellinore Letts Preliminary Design

Date: 09/24/25

Content by: Ellinore Letts

Present: N/A

Goals: Based on information from research and from meetings with our client, decide on some preliminary design ideas.

Content:

See drawing attached below.

Conclusions/action items: Meet with group to discuss ideas, create a design matrix and create three collective designs to score. Receive feedback on current drawing, begin to consider dimensions, materials, and other fabrication considerations.

ELLINORE LETTS - Sep 24, 2025, 3:51 PM CDT

DATA

Download

Cervical_Block_TM_Design.HEIC (1.93 MB)

09/25/25 Design Matrix

ELLINORE LETTS - Sep 25, 2025, 11:07 AM CDT

Title: Design Matrix

Date: 09/24/25

Content by: Ellinore Letts

Present: N/A

Goals: Create Design Matrix and decide on scoring criteria for top three designs. Draw, describe and score ideas.

Content:

Criteria (Weight)	Modified Task Trainer		Shoebox Design		Modified Venus Design	
Realistic (25)	5/5	25	4/5	20	2/5	10
Ease of Fabrication (25)	5/5	25	1/5	5	1/5	5
Anatomical Accuracy (20)	4/5	16	2/5	8	3/5	12
Cost (15)	5/5	15	3/5	9	4/5	12
Portability (10)	3/5	9	3/5	9	4/5	12
Safety (5)	4/5	1	5/5	5	5/5	5
Total (100)		91		56		56

Design 1: Modified Task Trainer

The current model with the stand is very close to being ideal, but lacking in a few areas. Specifically that of the shape of the cervix and the shape and mechanical properties of the uterus. We plan to alter the task trainer by modifying the mold for the cervix by creating a more accurate and visual cervicovaginal junction. We would also modify the shape of the uterus to make one that is more accurate (a t-shape) and pre-coat it in silicon to better mimic that of the uterine lining. We would also place threads on the PVC tubing so that the design can be easily taken apart and taken to different locations for trainer training.

Design 2: Shoebox Design

This design is a small box that would house a vaginal canal and uterus with a removable/replaceable cervix. We would use a PVC tube to cast the vaginal canal, a small rectangular box to cast the removable cervix, and a lightbulb to cast the shape of the uterus. We would cast using spray foam insulation and then remove the materials and coat the areas in silicon. The cervix would be created by modifying the task trainer design by including the cervicovaginal junction and changing the base shape to be that of a rectangle. The uterus would also be created by 3D printing a mold and then casting it with ecoflex.

Design 3: Modified Venus Design

This design is a simple table top design that includes a simplified vaginal opening, cervix, and the inclusion of the uterus. The current design only includes the vaginal opening and cervix but does not include a uterus. This design places the uterus behind the cervix in a ball shape configuration.

Realistic (25): This category assesses the models to simulate paracervical block procedure. The Modified Task Trainer received a 5/5 because this design is also the only one with a stand to better simulate the height clinicians would be at when performing the paracervical block procedure. The Shoebox design received a 4/5. Similar to the Modified Task Trainer, the materials used, ecoflex, are similar to that of the gynecological properties. However, the reason it received a lower score is because the height at which the procedure is performed is much lower than the clinician would actually expect. The Modified Venus Design, received a 2/5 because it is again performed at a lower angle than one would actually perform a paracervical block as well as having the uterus at an angle that is not accurate causing students when learning the procedure to unreliable estimate where to place the needle.

Ease of Fabrication (25): Ease of fabrication was weighted at 25/100, as it was one of the client’s priorities to have something simple to replicate as needed. Due to the client’s busy schedule, the replaceable parts of the product need to be easy and fast to recreate in between training sessions once worn out, and should not require extra time and research to reproduce. The Modified Task Trainer received a score of 5/5, because the client is already familiar with and has used former versions of the Task Trainer. The PVC tubing and stand can be easily assembled, and presence of the threads makes the device quick to disassemble as necessary when replacing pieces. The Shoebox Design scored a 1/5, because the building process requires multiple steps, including casting and 3D printing for the uterus, and would require substantial effort on the client’s part to recreate. Similarly, the Modified Venus Design also scored a 1/5, as replicating its assembly would not be intuitive and low-effort when compared to the Modified Task Trainer. It would require learning and understanding how the uterus attaches to the cervix in the particular model, as our client would not be familiar with the new layout and materials.

Anatomical Accuracy (20): Anatomical accuracy was weighted at 20/100, as it is critical for a task trainer to visually replicate the anatomy it models. The model’s ability to differentiate the vaginal canal, cervix, and uterus is essential to provide medical students with the most realistic training experience possible. The modified task trainer received a score of 4/5 because its attachments can be adjusted to meet various anatomical training needs, while its base structure remains unchanged. This model also incorporates the design of cervical folds, which are distinctive anatomical features that help differentiate the uterus from the cervix.The shoebox design scored 2/5 due to its poor visual representation of the uterus, cervix, and vaginal canal, despite maintaining basic biomechanical function. The modified Venus design received a score of 3/5, while it is also interchangeable and reflects the general appearance of uterine, cervical, and vaginal structures, it does not accurately represent the junctional angles between the cervix and uterus.

Portability (15): The portability of each design is weighted to be 15/100, since the final training model should be easily transported. This is an important aspect to consider when designing as the client needs to be able to transport ten task trainers to and from storage and training areas, and even hopefully between buildings in order to train providers in many locations. For all three designs, none of their sizes are prohibitively large, meaning that they are all adequate and relatively mobile. The Modified Task Trainer was rated a 3/5 as it does have a flat base, making it easy to set, store, and transport, however the unusual shape prohibits it from being packed efficiently together. On the other hand, the Shoebox Design’s small, rectangular box shape makes it ideal for packing together and being easily transported in a box, car, or more. However, the replaceable cervix component is hard to transport comfortably. For these reasons, the Shoebox Design received a 3/5. The Modified Venus Design can be easily transported due to its flat base and simple, table-top design which allows it to safely stand up during transportation. The relatively simple and durable components also make it easily portable, thus giving the Modified Venus Design a score of 4/5.

Cost (15): The cost effectiveness of our design was weighted to be 15/100, this is due to the fact that this model will need to be made in larger quantities. This is an important factor for our client and our designing process because the client aims to use this product for classes/presentations. During these presentations she hopes to be able to hand out multiple of our trainers to the students so they can practice independently. Given that we have a $500 budget, each model will need to be produced at a cost effective rate, nearly $50 each. The modified task trainer receives a 5/5 on cost effectiveness because its pieces are easily accessible and purchased at a low cost, additionally it only requires a couple components, ultimately greatly reducing the cost to construct. The shoebox design receives a 3/5. This score arises because the design is the most complicated from a manufacturing standpoint, containing more molded components which are made of more expensive materials like silicone. Lastly, the modified venus design received a 4/5, this middle ground score makes sense because as previously stated the venus design is relatively simple to construct and purchase components for, but possesses more complexity than the simple modified task trainer.

Safety (5): This category ranks the relative safety of each design. All designs essentially have the same level of safety which is why all designs received high scores. The Modified Task Trainer received a 4/5 because it is the only design that is elevated and puts it at a slightly higher risk of tipping. Both the Shoebox Design and the Modified Venus Design received a 5/5 because they have a lower center of mass on the table and have a very small risk of falling.

Conclusions/action items: Discuss design matrix with client and advisor. Decide on final design and begin to think about prototyping, materials, and methods.

ELLINORE LETTS - Sep 25, 2025, 11:04 AM CDT

Download

Cervical_Block_TM_Design.HEIC (1.93 MB)

10/16/25 Material Testing Protocol

ELLINORE LETTS - Oct 16, 2025, 4:28 PM CDT

Title: Material Testing

Date: 10/16/25

Content by: Ellinore Letts

Present: N/A

Goals: Create a procedure for material testing in compression and tension of ecoflex material as it pertains to our design.

Content:

Ecoflex Mechanical Testing Protocol (

Objective: Determine tensile and compressive mechanical properties of Ecoflex (stress-strain behavior, Young's modulus, ultimate strength, failure modes).

Equipment & Materials:

- Ecoflex specimens (dumbbell for tension, cylindrical/cuboid for compression)
- MTS Universal Testing Machine with grips/fixtures
- Appropriate load cell (500 N – 5 kN)
- Lubricant (talc or silicone grease) for compression plates
- Calipers
- Data acquisition system/software

1. Preparation

Tensile:

1. Cast/cut dumbbell specimens (ASTM D412: 25 mm gauge length × 5 mm width).
2. Mix and cure Ecoflex thoroughly.
3. Inspect for defects or air bubbles.

Compression:

1. Cast cylindrical (10 mm × 20 mm) or cuboid specimens.
2. Ensure flat and parallel surfaces.
3. Lightly coat top/bottom surfaces with lubricant.

2. Test Setup

Tensile Test:

1. Mount specimen in tensile grips; ensure alignment to prevent bending.

Compression Test:

1. Place specimen between parallel compression plates.

General:

1. Select suitable load cell.
2. Set room temperature (20–25°C).
3. Confirm data acquisition is ready.

3. Test Parameters

- **Strain Rate:** 0.1–0.5 mm/min
- **Control Mode:** Displacement control
- **Data:** Force, displacement, time

4. Test Execution

Tensile:

1. Start test; elongate specimen until failure.
2. Observe failure mode (necking, tearing).
3. Record maximum force and elongation.

Compression:

1. Apply compressive load until failure or predetermined strain.
2. Observe deformation (buckling, shear, crushing).
3. Record load and displacement throughout.

5. Post-Test Analysis

1. Calculate stress ($\sigma=F/A$) and strain ($\varepsilon=\Delta L/L0$)
2. Plot stress-strain curves.
3. Determine:
    - Young’s modulus
    - Ultimate strength

    - Elongation or compression at failure

4. Document failure modes.

6. Reporting

Include:

- Specimen dimensions, curing method
- Test type and conditions (strain rate, temperature)
- Stress-strain curves and mechanical properties
- Observed failure modes

ELLINORE LETTS - Oct 16, 2025, 4:26 PM CDT

Download

Cervical_Block_TM_Design.HEIC (1.93 MB)

10/23/25 MTS

ELLINORE LETTS - Oct 23, 2025, 3:33 PM CDT

Title: Material Testing

Date: 10/23/25

Content by: Ellinore Letts

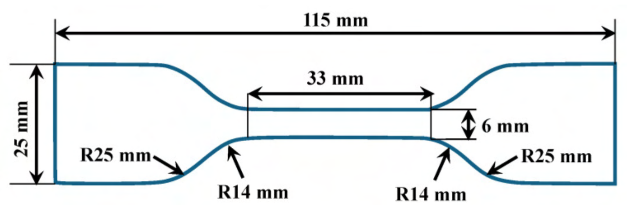
Present: N/A

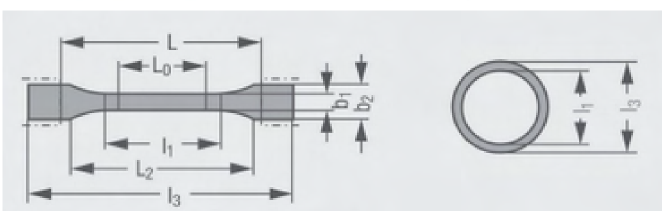
Goals: Refer to ASTM standards to determine the proper dimensions, max loads for MTS testing.

Content:

Dogbone Mold (Tensile Test)

Max Force : 19.8N





Standard	Type	Note	l_3 mm	l_1 mm	b_2 mm	b_1 mm	h mm	L_0 mm	Shape
ASTM D412	C	Preferred specimen	≥115	33	25±1	6+0.05	1.3 ... 3.3	25±0.25	Dumbbell specimen

Notes:

- For Ecoflex 00-20, **2–3 mm thickness** is recommended.
- Keep the backing flat to avoid gripping issues.
- The width and thickness directly impact max load.

2. Compression Testing

- For compression, ASTM D575 (“Rubber – Compression Set”) is often used to measure compression behavior. But for **full stress-strain compression testing**, you can use **ASTM D695** (compressive properties of rigid plastics) adapted for soft elastomers. For Ecoflex, the main concern is staying in the **linear elastic region**.

Cylinder Mold (Compression Test)

- **At 100% strain (linear modulus): 6.2N**
- **Estimated ultimate compression (~2× modulus): 12.4N**

Standard	Type	Note	h mm	Dia mm	Shape
ASTM D575	C	Preferred specimen	12	25±0.25	Cylinder

Notes:

- Keep **height ≤ diameter** to reduce barreling and friction effects
- Use **lubricated platens** to reduce friction.

For low-stiffness Ecoflex, you will need **sensitive load cells** (~50 N max for compression).

Conclusion: Create molds in Solid works and 3D print. Schedule time to pour ecoflex and test.

Sources:

[1] CCSI Inc., “ASTM Specimen Dies,” *CCSI Inc.*, [Online]. Available: https://www.ccsi-inc.com/product-category/test-prep-equipment/astm-specimen-dies/. [Accessed: 23-Oct-2025].

[2] ZwickRoell, “ASTM D412 Tensile Test for Elastomers,” *ZwickRoell*, [Online]. Available: https://www.zwickroell.com/industries/plastics/plastics-testing-standards/astm-d412-tensile-test-elastomers/. [Accessed: 23-Oct-2025].

ELLINORE LETTS - Oct 23, 2025, 3:28 PM CDT

Download

Cervical_Block_TM_Design.HEIC (1.93 MB)

10/20/25 CITI Training

ELLINORE LETTS - Nov 05, 2025, 1:32 PM CST

Title: CITI Training

Date: 10/20/25

Content by: Ellinore

Present: Ellinore

Goals: Complete BME 300 training requirements.

Content:

citiCompletionReport_15037454_73347095.pdf

Conclusions/action items: I have completed my required BME 300 trainings

11/30/25 ASTM Standards

ELLINORE LETTS - Nov 30, 2025, 12:46 PM CST

Title: ASTM Standards

Date: 12/30/25

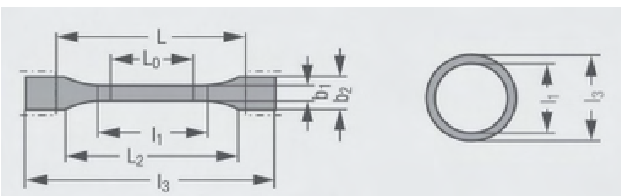
Content by: Ellinore Letts

Present: N/A

Goals: Determine ASTM standards for testing Ecoflex 00-20 in tension and compression.

Content:

Tensile Testing - Dogbone Model



Standard	Type	Note	l3 mm	l1 mm	b2 mm	b1 mm	h mm	L0 mm	Shape
ASTM D412	C	Preferred specimen	≥115	33	25±1	6+0.05	1.3 ... 3.3	25±0.25	Dumbbell specimen

Thickness: 3mm

Compression Testing - Cylinder Model

Standard	Type	Note	h mm	Dia mm	Shape
ASTM D575	C	Preferred specimen	12	25±0.25	Cylinder

Conclusions/action items: Pour Ecoflex samples. Perform testing and analyze data.

11/30/25 MTS Tensile Data

ELLINORE LETTS - Nov 30, 2025, 12:50 PM CST

Title: MTS Tensile Data

Date: 12/30/25

Content by: Ellinore Letts

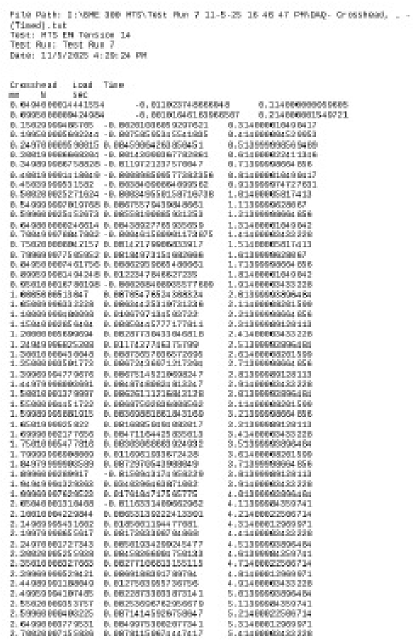
Present: N/A

Goals: Store MTS raw data.

Content: Attatched.

Action Items: Write MATLAB Code to determine graph and youngs modulus.

ELLINORE LETTS - Nov 30, 2025, 12:50 PM CST

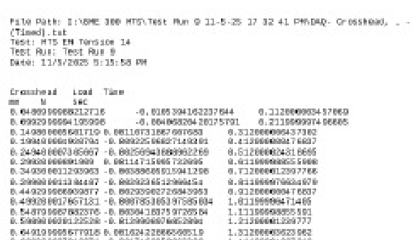

File Path: I:\BME 300 MTS\Test Run 7 11-5-25 16 46 47 PM\DAQ- Crosshead, . - (Timed).txt
Test: MTS EM Tensile 14
Test Run: Test Run 7
Date: 11/5/2025 4:28:24 PM

Crosshead Load Time
mm N sec

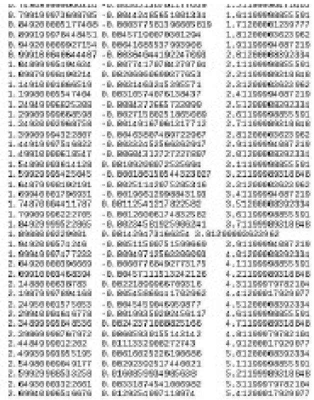
Download

Sample6.txt (488 kB)

ELLINORE LETTS - Nov 30, 2025, 12:50 PM CST


File Path: I:\BME 300 MTS\Test Run 9 11-5-25 17 32 41 PM\DAQ- Crosshead, . - (Timed).txt
Test: MTS EM Tensile 14
Test Run: Test Run 9
Date: 11/5/2025 5:15:58 PM

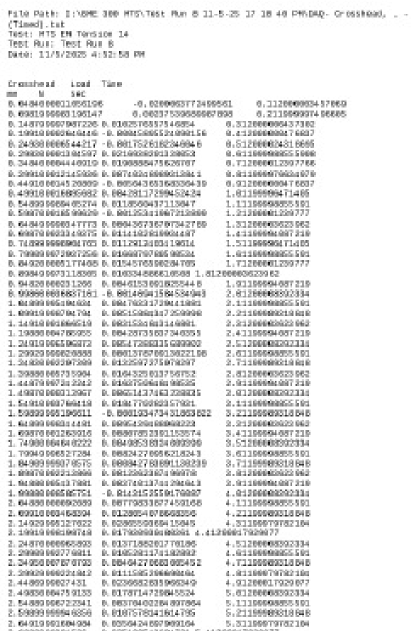
Crosshead Load Time
mm N sec



Download

Sample4.txt (482 kB)

ELLINORE LETTS - Nov 30, 2025, 12:50 PM CST



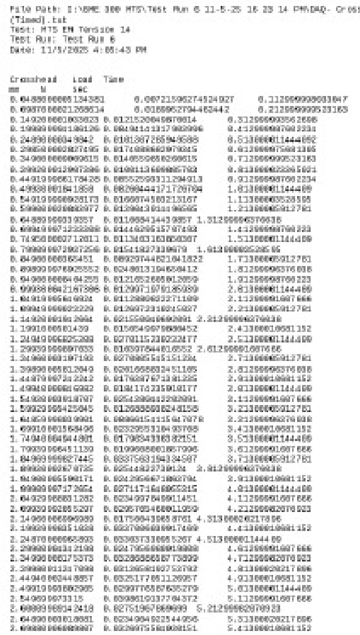
File Path: I:\BME 300 MTS\Test Run 8 11-5-25 17 18 40 PM\DAQ- Crosshead, . . - (Timed).txt
Test: MTS EM Tension 14
Test Run: Test Run 8
Date: 11/5/2025 4:52:58 PM

Crosshead Load Time
mm N sec

Download

Sample5.txt (509 kB)

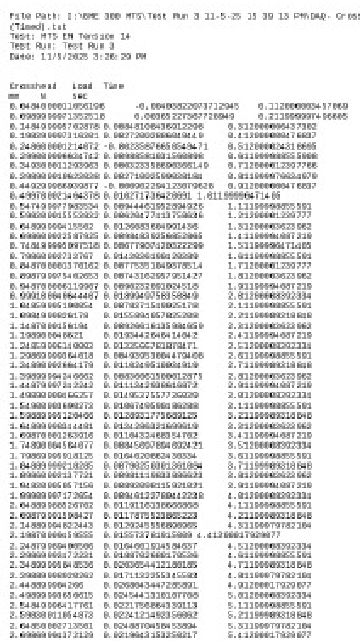
ELLINORE LETTS - Nov 30, 2025, 12:50 PM CST



Download

Sample1.txt (494 kB)

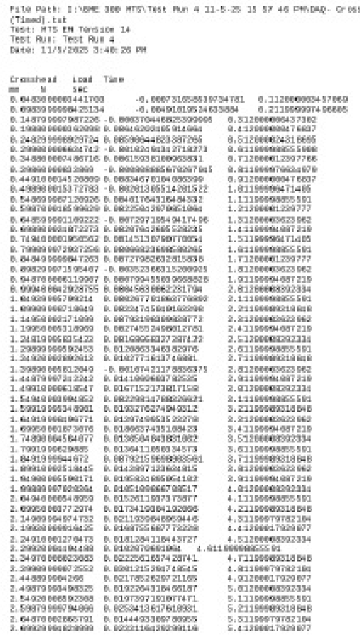
ELLINORE LETTS - Nov 30, 2025, 12:50 PM CST



Download

Sample2.txt (297 kB)

ELLINORE LETTS - Nov 30, 2025, 12:50 PM CST



Download

Sample3.txt (492 kB)

11/30/25 MATLAB Code

ELLINORE LETTS - Nov 30, 2025, 12:51 PM CST

ELLINORE LETTS - Nov 30, 2025, 12:53 PM CST

Title: MATLAB Code

Date: 12/30/25

Content by: Ellinore Letts

Present: N/A

Goals: Write MATLAB Script to analyze MTS Data.

Content:

```
%% Load data
filename = 'BME300MTStension.txt';
data = readmatrix(filename); % use readtable if header exists
% Assume columns: 1 = time (s), 2 = displacement (mm), 3 = force (N)
time = data(:,1);
displacement = data(:,2); % mm
force = data(:,3);        % N
%% Sample geometry
L0 = 33;  % mm, gauge length
A = 18;   % mm^2, cross-sectional area
%% Calculate stress and strain
strain = displacement / L0;       % strain
stress = force / A;               % stress in N/mm^2 (MPa)
%% Plot stress-strain curve
figure;
plot(strain, stress, 'LineWidth', 2);
xlabel('Strain (mm/mm)');
ylabel('Stress (MPa)');
title('Stress-Strain Curve');
grid on;
%% Optional: calculate Young's modulus (linear region)
linear_region = strain < 0.1; % adjust range as needed
p = polyfit(strain(linear_region), stress(linear_region), 1);
E = p(1); % Young's modulus
disp(['Young''s modulus = ', num2str(E), ' MPa']);
```

Action Items: Repeat for Compressive testing.

12/02/25 MTS Compressive Data

ELLINORE LETTS - Dec 02, 2025, 1:03 PM CST

Title: MTS Compressive Data

Date: 12/02/25

Content by: Ellinore Letts

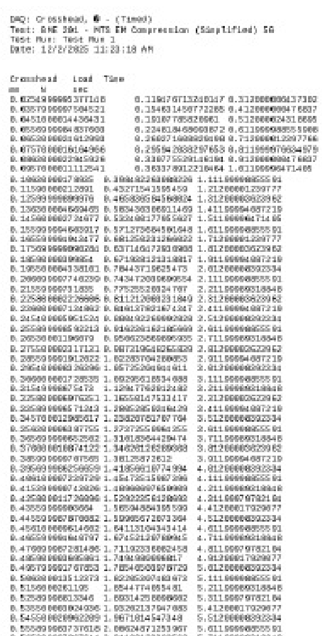
Present: N/A

Goals: Store MTS raw data.

Content: Attatched.

Action Items: Write MATLAB Code to determine graph and youngs modulus.

ELLINORE LETTS - Dec 02, 2025, 1:03 PM CST



DAQ: Crosshead, - (Timed)

Test Run: Test Run 1

Date: 12/2/2025 11:20:18 AM

Crosshead Load Time

mm N sec

Download

PBTM_MTS_comp.txt (31.3 kB)

12/02/25 MATLAB Code

ELLINORE LETTS - Dec 02, 2025, 1:05 PM CST

Title: MATLAB Code

Date: 12/30/25

Content by: Ellinore Letts

Present: N/A

Goals: Write MATLAB Code to Analyze MTS Compressive data.

Content:

```
%% MATLAB Script for Compression Testing

% Title: Compression Test Analysis

% Date: 12/30/25

% Author: Ellinore Letts

% Purpose: Analyze MTS compression data and plot stress-strain curve


%% Load data

filename = 'PBTM MTS comp.txt'; % change filename for compression data

data = readmatrix(filename); % use readtable if header exists


% Assume columns: 1 = time (s), 2 = displacement (mm), 3 = force (N)

time = data(:,1);

displacement = data(:,2); % mm

force = data(:,3); % N


% Ensure compression is positive

%force = -force; % flip sign if MTS records compression as negative


%% Sample geometry
```

```
L0 = 12; % mm, initial height for ASTM D575 cylinder

d = 25; % mm, diameter

A = pi*(d/2)^2; % cross-sectional area in mm^2


%% Calculate stress and strain

strain = displacement / L0; % engineering strain (mm/mm)

stress = force / A; % stress in N/mm^2 = MPa


%% Plot stress-strain curve

figure;

plot(strain, stress, 'LineWidth', 2);

xlabel('Strain (mm/mm)');

ylabel('Stress (MPa)');

title('Compression Stress-Strain Curve');

grid on;


%% Optional: calculate Young's modulus (linear region)

linear_region = strain < 0.1; % adjust as needed (e.g., 0–10% strain)

p = polyfit(strain(linear_region), stress(linear_region), 1);

E = p(1); % Young's modulus

disp(['Young''s modulus (linear region) = ', num2str(E), ' MPa']);


%% Optional: save stress-strain data

 csvwrite('compression_stress_strain.csv',[strain, stress]);
```

Action Items: Analyze testing results.

9/9/25 Paracervical Block for Intrauterine Device Placement Among Nulliparous Women

NORA LORENTZ - Sep 09, 2025, 11:26 AM CDT

Title: Paracervical Block for Intrauterine Device Placement Among Nulliparous Women

Date: 9/9/25

Content by: Nora

Present: Nora

Goals: The goal of this research is to find if a 20-mL buffered 1% lidocaine paracervical block helps to decrease pain during IUD insertion.

Content:

- The trial was randomized, single-blind, and placebo-controlled.

- 64 women were enrolled in the trial, 33 with paracervical blocks and 31 without.

- The primary outcome was pain with IUD insertion measured along a 100-mm visual analog scale.

- The secondary outcome included pain with speculum placement, paracervical block administration, tenaculum placement, 5 minutes post-procedure, and overall pain perception.

- Women with the paracervical block reported significantly less pain with IUD placement, uterine sounding, 5 minutes post-procedure, and with overall IUD insertion.

- Women who received the block reported significantly more pain during block administration than those in the placebo group did.

- No pain difference reported for speculum insertion of tenaculum placement.

Mody, Sheila K. MD, MPH; Farala, John Paul MD; Jimenez, Berenice MD; Nishikawa, Moena; Ngo, Lynn L. MD, MPH. Paracervical Block for Intrauterine Device Placement Among Nulliparous Women: A Randomized Controlled Trial. Obstetrics & Gynecology 132(3):p 575-582, September 2018. | DOI: 10.1097/AOG.0000000000002790

Conclusions/action items:

It was found that 20-ml of buffered 1% lidocaine paracervical block did significantly lower pain during several aspects of the IUD placement process, as well as with overall IUD placement. However, the administration of the paracervical block was found to be painful. Regardless, the overall experience of IUD placement was still less painful, even with the pain of the block administration.

- Must research further about current training models used/available

- Must research further about what training models require to be useful, and what can be improved in these current models

9/17/25 How to do a Paracervical Block

NORA LORENTZ - Sep 18, 2025, 4:32 PM CDT

Title: Paracervical Block Technique

Date: 9/17

Content by: Nora

Present: Nora

Goals: To learn the very basics of how a paracervical block is typically done.

Content:

- Image/visual of the procedure, includes visual of the injection site for tenaculum and for the PCB itself.

- Visual of the clock to show the 2, 4, 8, 10 o'clock strategies. As well as the 12 o'clock tenaculum injection site

- Step-by-step procedure including: preparation and description of the lidocaine syringe, placement of speculum and cervical antiseptic prep, lidocaine injection, cervix grasp, and remaining lidocaine injection prior to beginning procedure.

- Practice tips are also given, they can be summed up as: max lidocaine dosage is 200mg total, substitute of 10ml of 2% lidocaine can be used with two-point technique, deep injection has more effective pain relief than superficial, aspirate before injecting, side-effects, midlevel providers with proper training are similar in safety and efficacy as physicians, adverse effects from PCB are rare.

IPAS, “How to do a Paracervical Block.” Accessed: Sept. 09, 2025. [Online]. Available: https://vimeo.com/690508206

Conclusions/action items:

This source was highly effective for giving a concise, well-rounded idea of a typical paracervical block administration procedure. It included good technique advice and enough detail to closely describe the procedure. From the step-by-step instructions, I can more accurately predict what features our training model must include in order to properly represent a procedure.

- Continue research

- Consult this info as needed

9/17/25 Thermal comfort in hospitals – A literature review

NORA LORENTZ - Sep 18, 2025, 4:46 PM CDT

Title: Thermal Comfort in Hospitals - A literature review

Date: 9/17/25

Content by: Nora

Present: Nora

Goals: To learn more about the average temperatures in hospitals in order to accurately predict the conditions our model will be exposed to while in storage or being used for training.

Content:

- Hygiene and safety are the main current parameters that determine temperature within hospitals

- Established standards for thermal comfort were based on normal groups of occupants, such as patients and hospital personnel

- Statistics relayed on different data points like humidity, air circulation, air pressure, etc.

- Condensation risk is a major factor, especially in surgery rooms

- Each end of the spectrum has pros and cons, for example low temperature can lead to patients' skin drying, while high temperatures can lead to growth and transfer of bacteria.

- This source examples and references many studies spanning multiple countries

- 20-24 degrees celcius appears to be the average temperature range

- Thermal conditions within hospitals may contribute to the healing process of patients

- Thermal comfort can vary based on patient condition, staff activities, and types and number of equipment.

- The source writes that further research in this area can help with the design process of how to design hospital buildings and systems.

Conclusions/action items:

Because this source referenced such a wide range of studies, I have a pretty well-rounded, average idea of how temperature conditions within our client's hospital will be. My group now will be able to operate under the assumption that our model only needs to be able to endure temperatures of 20-24 degrees Celsius. Additionally, humidity, pressure, etc. will all be very mild.

- We can move forward by designing models that will exist under these aforementioned thermal conditions.

9/24/25 Paracervical Block Video

NORA LORENTZ - Oct 01, 2025, 5:25 PM CDT

Title: Paracervical Block Video

Date: 9/24

Content by: Nora

Present: Nora

Goals:

Content:

- PCB's are designed to block the pain fibers leading to the uterus

- Lidocaine is most commonly used. Marcaine is less commonly used (takes longer to achieve, lasts longer)

- Patient's pain perception is mostly due to impulses passing by sensory pathways down cervix's lateral and posterior portions into area of cardinal and uterosacral nerves

- PCB injects to block impulses leaving uterus at this junction

- Protocols should/can be adjusted for every patient

- Bulk of medicine is typically injected into uterosacral region. More complex: component of block in intracervical injection as well

- 4 quadrant technique common

- Source included a very useful video demonstration, accompanied by detailed voiceover. Included demonstration of speculum, tenaculum, aspiration of syringe, and the injections

- Significant benefits have been shown to result from PCB

- Be very careful during PCB procedure to not introduce medications into vascular tree. Aspiration of needly prior to injection ensures this.

- When determining amount of medication, consider your patient's body mass.

- Necessary to have certain safety equipment in room (ex. blood pressure and pulse monitor, crash cart, etc.) and proper resuscitation methods

- Techniques differ based on patient and practice

Hologic, Inc.. *Paracervical block video - Animation*. (Nov. 4, 2015). Accessed: Sept. 24, 2025. [Online Video]. Available: https://www.youtube.com/watch?v=m0EyyHouT00

Conclusions/action items:

This source was instrumental in helping me correctly visualize the paracervical block procedure as it included a highly detailed and helpful animated video. As I move forwards in the design process, I should continue to reference this video as needed. The video also stressed that PCB techniques differ based on a variety of factors, so it is important that we keep in mind our client's specific techniques in order to design our training model according to these specifications. The source also described a variety of details and context surrounding the procedure, tips and tricks, and certain techniques necessary for patient safety.

- Reference this video when needed for anatomy, procedure visualization, procedure steps, and more

9/24/25 Paracervical Block (sample)

NORA LORENTZ - Sep 24, 2025, 11:52 PM CDT

Title: Paravcervical Block (sample) - www.proceduresconsult.com

Date: 9/24/2025

Content by: Nora

Present: Nora

Goals: To watch a real (non-animated, so real anatomy) video of the procedure to obtain more information of what realistic anatomy is.

Content:

- The video was very short and to the point, being only 39 seconds.

- The video showed an overlay of different hours on a clock, to provide a visual of where to inject around the cervix

- Showed the placement of the needle in anatomy, and aspiration

- Showed the injections at every site and in the correct procedural order

- The video was able to show me how the tissues and cervix reacted upon injection (ex. movement, mechanics, perceived firmness/give)

ProceduresConsult. *Paracervical Block (sample) - www.proceduresconsult.com*. (Apr. 19, 2009). Accessed: Sept. 24, 2025. [Online Video]. Available: https://www.youtube.com/watch?v=xst2_QbVDGI&rco=1

Conclusions/action items:

This video was very brief but very informative. It offered me a look at real anatomy during the paracervical block, something none of my previous sources have done. This will be very useful as I move into designing a task trainer. I can use this source to observe anatomy, tissues, materials, and the PCB administration procedure itself.

- Look back at video to reference anatomy and procedure

10/1/25 Advances in vaginal bioengineering

NORA LORENTZ - Oct 01, 2025, 5:41 PM CDT

Title: Advances in vaginal bioengineering: Applications, techniques, and needs

Date: 10/1/25

Content by: Nora

Present: Nora

Goals: Currently, there is limited knowledge on female anatomy and physiology. This source aims to look into advances in the field.

Content:

- Vagina is fibromuscular canal that connects uterine cervix to vulva. Unique functions and properties (i.e. dental delivery, passage of menstrual fluid, arousal, etc.)

- "The mechanical properties of the vagina are imbued by microstructural components (such as elastic fibers, collagen fibers, and smooth muscle cells) of the subepithelium and muscularis."

- Lots of information in the source about vaginal microbiome - however this isn't relevant to our project so will not be listing in LabArchives.

- Information about hormonal changes

- Information about aging

- Information about animal models. Animal models are useful, but are held back from full effectiveness due to factors like size.

- computational models are commonly used for labor and delivery, this is a very useful tool.

- Biomaterial and tissue engineering utilize many strategies. "Combinations of biocompatible polymers, cells, and cell culture conditions are the subject of ongoing and future research, which attempts to capture and emulate the relevant features and nuances of native tissue." Nothing in the source discussed biomaterials/replicas that are used for training models, so most of the information was valuable for learning about anatomical accuracy, but not very applicable to our design project.

Buchanan, Lily M, et al. “Advances in Vaginal Bioengineering: Applications, Techniques, and Needs.” *Current Research in Physiology*, vol. 6, 1 Jan. 2023, pp. 100111–100111, pmc.ncbi.nlm.nih.gov/articles/PMC10724214/#sec10, https://doi.org/10.1016/j.crphys.2023.100111. Accessed 1 Oct. 2025.

Conclusions/action items:

This source contained a huge deal of material about the tissues and properties of female reproductive anatomy. It discussed changes due to hormones, disease, aging, health factors, etc. at great length. It also contained information about tissue engineering and models (like animals or on the computer), but none was very applicable to us designing a training model.

- Research more specifically into materials used for training models

10/1/25 Biomechanically Compliant Gynecologic Training Simulator

NORA LORENTZ - Oct 01, 2025, 5:58 PM CDT

Title: Biomechanically Compliant Gynecologic Training Simulator

Date: 10/1/25

Content by: Nora

Present: Nora

Goals: The goal of this source was to use finite element analysis to see what materials most accurately simulate the biomechanical properties of pelvic tissues for gynecological training simulators.

Content:

- Materials were used to fabricate vagina and cervix model using a hybrid technique of fused deposition modeling and molding

- 5 materials were compared: RTV615, Dragon Skin 10, Dragon Skin 30, Dragon Skin FX-Pro, Eco Flex 00-30-. The control was a pelvic tissue model

- 2 FEA (finite element analysis) modules were used

- Structural mechanics module simulated speculum insertion and opening, where horizontal opening and peak von Mises stress and anterior of vagina were measures, as well as posterior walls of vagina obtained.

- Explicit dynamics module estimated fracture stress during punch biopsies and the maximum perpendicular deformation of the cervix before the break.

- Results of FEA showed Dragon Skin 10 was the most accurate material.

- A simulator from this material was successfully made using hybrid technique.

Buchanan, Lily M, et al. “Advances in Vaginal Bioengineering: Applications, Techniques, and Needs.” *Current Research in Physiology*, vol. 6, 1 Jan. 2023, pp. 100111–100111, pmc.ncbi.nlm.nih.gov/articles/PMC10724214/#sec10, https://doi.org/10.1016/j.crphys.2023.100111. Accessed 1 Oct. 2025.

Conclusions/action items:

This source was very helpful and applicable to our project. We were previously considering eco-flex, so it will be interesting to look into the pros and cons of Dragon Skin 10 versus ecoflex. It was interesting to hear about the testing metrics used in the FEA modules, especially when considering that, while their metrics were important to us, a big concern is also the biomechanics of injections.

- Look into Dragon Skin 10 compared to Eco-Flex

- Look into injecting into Dragon Skin 10

10/16/25 MTS Insight Machine

NORA LORENTZ - Oct 16, 2025, 4:39 PM CDT

Title: MTS Insight Machine

Date: 10/16/25

Content by: Nora

Present: Nora

Goals: Look into the MTS insight machine in order to further research how we will test our own task trainer.

Content:

ISO 527-4: Tensile Properties - Isotropic & Orthotropic FRP Composites

- Tensile testing is used to determine mechanical material property data

- During tensile testing, uniaxial tensile force is applied to a flat specimen to look into stress/strain behavior and critical materials properties including: tensile modulus, tensile strength, elongation at break, and Poisson's Ratio.

- During tensile testing, the specimen is placed in a servohydraulic or electromechanical testing machine subjecting the specimen to controlled tension load until failure.

- Response can be measured with contracting or non-contracting extensometer or strain gages

- There are many options listed in the link

Conclusions/action items:

My group will likely end up using the MTS Insight - Model 5kN. We will need to begin to write a procedure to perform testing. It is important that we do testing on our task trainer so we know that it is sufficient for the client's use and meets their needs.

- Continue researching testing methods

- Apply testing methods once we are finished with the fabrication process

10/23/25 Dog Bone Tensile Test

NORA LORENTZ - Oct 23, 2025, 8:28 PM CDT

Title: Dog Bone Tensile Test: What, Why, Who, and How

Date: 10/23/25

Content by: Nora

Present: Nora

Goals: I want to learn more about testing, and I am interested in why we are supposed to use a "dogbone" shape.

Content:

- Dog bone tensile test is the industry standard for testing material strength

- Pull a standardized specimen until it breaks, thereby determining key mechanical properties

- Most important mechanical properties: yield point, elongation, tensile strength

- Shape is "dogbone" because: narrow middle (gauge) with wider ends that can fit into the testing grips. The shape ensures that the resulting data will be accurate and repeatable across all tests.

- Some of the key sectors that rely on tensile testing: plastics and polymers, rubbers and elastomers, automotive and aerospace, medical manufacturing, material supplies and R&D labs.

- Specifically, regarding medical manufacturing: used to ensure durability, flexibility, and patient safety.

- ELASTIC MODULUS: stiffness/flexibility

- YEILD POINT: where material begins to deform permanently

- ULTIMATE TENSILE STRENGTH: maximum stress material can endure

- ELONGATION AT BREAK: how long material can stretch before snapping

[1] G. Abdoo, “Dog Bone Tensile Test: What, Why, Who, and How,” *Fremont Cutting Dies*, May 25, 2025. https://fremontcuttingdies.com/dog-bone-tensile-test-what-why-who-and-how/

[Dog Bone Tensile Test: What, Why, Who, and How - Fremont Cutting Dies]

Conclusions/action items:

I was able to learn a lot about tensile testing through this test, specifically regarding the dog bone shape. I was interested in focusing on this shape as I know my team is using it as part of our testing procedure. I was able to understand a lot more clearly what information my team will be able to gain from dog bone testing, and how to interpret this information.

- Use this information as we develop and enact our testing plans

Comments

Randolph Ashton Oct 30, 2025, 10:39 AM CDT

Lots of good research. Continue to document how the research is translating into your design contributions.

11/13/25 Mechanical Responses of Ecoflex

NORA LORENTZ - Nov 13, 2025, 5:10 PM CST

Title: Mechanical responses of Ecoflex silicone rubber: Compressible and incompressible behaviors

Date: 11/13/25

Content by: Nora

Present: Nora

Goals: To learn more about how Ecoflex reacts to certain situations, in order to better understand how it should perform in our model and during testing

Content:

- Silicone rubbers typically have highly nonlinear responses

- Currently, there are Several well-established nonlinear elastic constitutive models (ex. Ogden, Yeoh, etc.)

- This article examines compressibility and incompressibility constraints

- Uniaxial tensile tests conducted on dogbone specimens

- Lots of details about how tests were carried out and constitutive models

- "The five models are shown to be capable of capturing the nonlinear elastic response of Ecoflex from the uniaxial test, under both compressible and incompressible constraints."

- Decrease in radial stretch with increase in circumferential stretch

- Circumferential stretch increases with higher inner pressure

- Both compressible and incompressible behaviors show a similar trend

- Higher area of well creates higher internal pressure

- "The Ecoflex samples show limiting stretch behaviors in both axial and lateral directions and slight compressibility, and up to an axial stretch ratio of 4, they exhibit elastic response with a negligible hysteretic area."

[1] D. Steck, J. Qu, S. B. Kordmahale, D. Tscharnuter, A. Muliana, and J. Kameoka, “Mechanical responses of Ecoflex silicone rubber: Compressible and incompressible behaviors,” *Journal of Applied Polymer Science*, vol. 136, no. 5, p. 47025, Aug. 2018, doi: https://doi.org/10.1002/app.47025.

Conclusions/action items:

I was able to learn a lot about the article's testing methods and methods of data interpretation, which was helpful for me to better understand how to draw conclusions from my team's MTS testing. Additionally, the information was useful to better understand ecoflex's performance. I now know more about both testing methods and ecoflex, which was be useful as I continue with the project.

- Continue MTS testing our ecoflex

12/6/25 What is the Young's Modulus of Silicon?

NORA LORENTZ - Dec 06, 2025, 6:29 PM CST

Title: What is the Young's Modulus of Silicon?

Date: 12/6/25

Content by: Nora

Present: Nora

Goals: To learn more about the Young's modulus and be better able to interpret testing results.

Content:

- Young's modulus quantifies elastic behavior of a material

- possible values for Young's modulus range from 130-188 GPa

- Poisson's ratio range from 0.048 to 0.40

- Crystal orientation of the silicon in a silicon wafer has significant effects on the microfabrication properties of the wafer, so it is important to be mindful or orientation/specification

- Orthotropic elasticity is also important to keep in mind

- Elastic constants of silicon, values for 298 K: listed in table 12 in paper

- Temperature also has notable effects on the elasticity of silicon

- "For design calculations and analytic expressions where a single isotropic elasticity value is called for, the choice depends on the orientation and loading of the structure."

- "For finite-element calculations, the use of the full anisotropic description of elasticity can have significant benefits for the accuracy of the results, particularly for more complex designs with off-axis orientations or nonrectilinear structures, and there is no reason not to use the complete elastic matric when doing computer calculations."

- Silicon is a very popular material and also very important for the economy, and thus has been highly studied. The information on it is very accessible and applicable to the work of specialists and non-specialists.

[1] M. A. Hopcroft, W. D. Nix, and T. W. Kenny, “What is the Young’s Modulus of Silicon?,” *Journal of Microelectromechanical Systems*, vol. 19, no. 2, pp. 229–238, Apr. 2010, doi: https://doi.org/10.1109/jmems.2009.2039697.

Conclusions/action items:

I was able to learn a lot about what the Young's modulus and testing means in general. I also learned a lot about how this information applies to silicon specifically. Since our project highly focuses on silicon (we use Eceflex 00-20), it was good to be able to understand all of this. I can now better interpret the information we gathered in our MTS testing of the material.

- Examine MTS testing results.

12/9/25 Health Literacy and Women's Reproductive Health: A Sytematic Review

NORA LORENTZ - Dec 09, 2025, 4:16 PM CST

Title: Health Literacy and Women's Reproductive Health: A Systematic Review

Date: 12/9/2025

Content by: Nora

Present: Nora

Goals: Objective of the study was to identify and examine the relationship between health literacy and women's reproductive health knowledge, behaviors, and outcomes.

Content:

- Health literacy: "capacity to obtain, process, and understand basic health information and services needed to make appropriate decisions"

- 90 million Americans have difficulty understanding and acting upon health information, resulting in negative impacts on health and well-being

- It is important for women to be aware of knowledge around contraception, safe sex practices, healthy pregnancy, preventative care, etc.

- Articles in the review included those who measured health literacy, provided evidence on relationship, had study population of women less than or equal to 45 years old (reproductive age), et.

- Low health literacy was observed to be correlated with less knowledge "regarding the meaning, mechanism of action, and risks of oral contraception"

- Found that women with lower health literacy were more likely to city inadequate knowledge as a barrier to correct contraception use

- Higher proportion of women with low health literacy were found among users of long-term forms of birth control (ex. IUD or implant) or less efficacious forms (ex. douching or rhythm) compared to proportion using methods liked diaphragm, oral contraceptive, etc.

- Women with low health literacy reported lower mean age at first intercourse (15.5 vs 15.8 years) and were less likely to have protected intercourse during first sexual encounter and more likely to have two or more sexual partners in the last six months

- More information on cervical cancer, pregnancy, prenatal care, postpartum outcomes. Deemed unnecessary to recount due to contraception-focused nature of this project.

[1] K. A. Kilfoyle, "Health Literacy and Women's Reproductive Health: A Systematic Review," *Journal of Women's Health*, vol. 25, no. 12, pp. 1237–1255, Dec. 2016, doi: https://doi.org/10.1089/jwh.2016.5810.

Conclusions/action items:

This source was very useful for showing me how health literacy impacted various areas of women's health. Specifically, within contraception, it showed me that IUDs are very popular among less health literate women. Thus, I have a greater understanding of how important it is to have accessible, comfortable birth control options such as an IUD. Since our final report does touch on issues within women's health care, extra information on this area is very important for my team.

- Use this information to further emphasize the importance of contraception (i.e. IUDS with proper pain management) accessibility within female health in the final report

12/9/25 Trends and determinants of IUD use in the USA, 2002-2012

NORA LORENTZ - Dec 09, 2025, 4:39 PM CST

Title: Trends and determinants of IUD use in the USA, 2002-2012

Date: 12/9/2025

Content by: Nora

Present: Nora

Goals: The study wanted to look into which factors and subgroups have pushed the recent increase in the USA's IUD usage.

Content:

- The increase in IUD use from 2002 to 2012 (1.8 to 9.5%) was driven largely by an increase from parous women who intended to have more children

- Data was drawn from surveys on women 15-44 years old, in in-person interviews that averaged 80 min, sample included 7643 completed interviews in 2002 and 5601 interviews from 2011-2013.

- Study included women who were sexually active in the past 3 months, excluding those who were currently pregnant, trying to conceive, or sterile

- Parous women's rates were 4.2% in 2002 and 19.3% in 2012. This suggests that IUDs are more likely to be used for spacing purposes rather than ending childbearing in the USA.

- Dissatisfaction with a previous method were also common for IUD users.

- Method of birth controls that are long-acting and reversible (such as an IUD) are the most cost-effective and reversible option to prevent unintended pregnancy.

- LARCs also have other positives, like no daily user compliance which improves method adherence, effectiveness, and continuation

- IUDs account for over 90% of LARC use in the USA

- Increase in IUD use does not seem to affect proportion of women at risk of unintended pregnancy who use no method at all. This level remained stable at about 10% throughout the decade.

- IUD use increase was significant in every observed racial and ethnic group. Highest use in study found in foreign-born Hispanic women.

- Strong, significant increase in IUD use in all education groups.

- Little variation across education and income. However, IUDs do have a high cost, making it important for programs like Title X and Medicaid to exist.

[1] W. D. Mosher, C. Moreau, and H. Lantos, "Trends and determinants of IUD use in the USA, 2002–2012," *Human Reproduction*, vol. 31, no. 8, pp. 1696–1702, May 2016, doi: https://doi.org/10.1093/humrep/dew117.

Conclusions/action items:

This source was very helpful to show me how IUDs are being used in the United States, and who is using them. It is evident that IUDs are a very important, and effective, method of birth control that is being used across many demographic dividers. This method is becoming more and more popular as time passes. Therefore, with this rise in IUD use, it becomes even more valuable for providers to be properly trained on IUD administration.

- Use this information while writing about the importance of IUD administration, and therefore proper training through our team's training models.

12/9/25 What is it about intrauterine devices that women find unnaceptable?

NORA LORENTZ - Dec 09, 2025, 4:52 PM CST

Title: What is it about intrauterine devices that women find unacceptable? Factors that make women non-users: a qualitative study

Date: 12/9/2025

Content by: Nora

Present: Nora

Goals: Study aims to explore how non-users of IUDs beliefs and perceptions lead to them rejecting the birth control method.

Content:

- One-on-one semi-structured interviews of 10 women of varying ages and parity.

- Study done in UK.

- None of the women interviewed had used IUDs but all had used contraception in the past 6 months.

- Five major themes found: lack of objective information on IUDs, reported side-effects, anxieties about process of receiving an IUD, IUD infection risk, and lack of personal control once fitted

- Prominent worries about "mess and embarrassment" during fitting

- Some of the identified themes closely mirrored themed found in studies on user attitudes and experiences while getting IUDs

- IUDs were seen as associated with "hidden nature of the fitted device and unreliability"

- Study focused on perceptions related to copper IUDs

[1] C. Asker, H. Stokes-Lampard, J. Beavan, and S. Wilson, “What is it about intrauterine devices that women find unacceptable? Factors that make women non-users: a qualitative study,” *Journal of Family Planning and Reproductive Health Care*, vol. 32, no. 2, pp. 89–94, Apr. 2006, doi: https://doi.org/10.1783/147118906776276170.

Conclusions/action items:

This source observed the main drawbacks that discouraged UK women from receiving an IUD. One of the major factors for those interviewed was the IUD administration process itself. Women were worried about discomfort, pain, embossment, etc. during IUD insertion. It appears that there is a demand for making the IUD insertion process more seamless, which can be done through wider access/training on paracervical blocks.

- In final report, emphasize that making the IUD administration process easier/more painless will encourage more women to receive IUDs.

12/10/25 Anatomy of the Uterus

NORA LORENTZ - Dec 10, 2025, 12:32 PM CST

Title: Anatomy of the Uterus

Date: 12/10/2025

Content by: Nora

Present: Nora

Goals: I needed this source to get a few final citations for the final report, on very specific anatomy that needed evidence.

Content:

- Anteverted angle between cervix and uterus

- This angle is about 170 degrees. Differs slightly between women and based on age, parity, etc.

- Fallopian tube enters at superolateral angle

- Uterine body is flexed on the cervix, which is anteflexion

- The whole uterus is tipped forward, which is anteversion

- "Variations of these positions, termed retroflexion and retroversion, may occur in normal anatomy as well under pathological circumstances."

- Cervical os is circular but becomes a transverse slit in the parous woman.

- Body of the uterus is covered with peritoneum, except anteriorly onto the bladder at the level of the uterine isthmus, and laterally at the broad ligaments

- Information about vascular supply and lymphatic drainage.

[15] H. Ellis, "Anatomy of the uterus," *Anaesth. Intensive Care Med.*, vol. 12, no. 3, pp. 99–101, Mar. 2011, doi: 10.1016/j.mpaic.2010.11.005.

Conclusions/action items:

From this source I was able to gather a few key pieces of information needed for the final report. For example, I needed to know the precise angle between the cervix and uterus, in order to write about it for some of the initial designs. The source gave a lot of valuable, highly detailed information about the intricacies of the uterus. For example, the source provided many details about the functions and anatomy of the uterus.

- Cite and use this evidence in the final report

9/11/25 Evaluation of a Novel 3D-Printed Task Trainer for the Simulation of Gynecological Procedures at a Medical Academic Center

NORA LORENTZ - Sep 24, 2025, 6:17 PM CDT

Title: Evaluation of a Novel 3D-Printed Task Trainer for the Simulation of Gynecological Procedures at a Medical Academic Center

Date: 9/11/25

Content by: Nora

Present: Nora

Goals: The paper wanted to assess the effectiveness and success of a new type of gynecological task trainer.

Content:

- The trainer was created with 3D-printed plastic, silicone, and a tabletop base.

- Learners did simulations of gynecological tasks with the trainers. The learners used a five point Likert scale to evaluate.

- Researchers used the Tinkercad 3D design program and approximately $15.38 per-model

- The task trainer was made of a wooden base, PVC tubing, and a PVC sanitary connector piece shaped like a "T". There was a cervix mold, uterus, and connecting ring made with 3D design software.

- The task trainer was used for many procedure, including pap smear collection, cervical polyp removal, uterine sounding, endometrial biopsy, insertion and removal of intrauterine device, cervical dilation, and manual vacuum aspiration.

- Learners responded with overwhelmingly positive reactions, however some criticism included: "It would be nice to have a cervicovaginal junction to practice paracervical blocks before the procedure." “If the PVC pipe simulating the vaginal vault had a silicone lining, it would help keep the speculum from slipping out.” “The simulator does not have vaginal walls + uterus is immobile plastic,”

J. Monico and K. Carlson, “Evaluation of a Novel 3D-Printed Task Trainer for the Simulation of Gynecological Procedures at a Medical Academic Center ,” *University of Nebraska Medical Center*, [Online]. Available: https://www.unmc.edu/obgyn/_documents/monico_and_carlson_evaluation_of_3d-printed_gynecological_task_trainer.pdf

Conclusions/action items:

The task trainer was successfully found to help give beginner-level learners increased comfort with the procedure and was very realistic. The task trainer facilitated skill development while minimizing patient risks and overall had a positive impact on the learners studied. However, researchers/practitioners are always searching for lower-cost and improved models.

- Look more into task trainers

9/24/25 Simulation and Training of Gynecological Skills

Title: Simulation and Training of Gynecological Skills

Date: 9/24

Content by: Nora

Present: Nora

Goals: The traditional apprentice-tutor model is no longer sufficient for ensuring proper knowledge and skills of a procedure prior to entering the operating r
considering cost, construction, and more.

Content:

- There is a recommendation by "six leading professional organisations in gynaecology, the ESGE, EBCOG, EAGS, ENTOG, ACOG and AAGL" for hospita

- Having proper training models ensures more safety within the operating room, as patients experience benefits like more experienced providers and lower

- "This knowledge acquisition can be further supported by one or more group-based sessions and should always be followed by an official assessment of th

- Some models the source described include: a foam rubber tube, tubular balloons to represent the ureters and tubes, cloths for practicing suturing and kno

- Practical methods should be taught in tandem with validated methods and training tools, for maximum effectiveness.

- Described and cited an easily reproducible abdominal hysterectomy by laparotomy task trainer

- A vaginal hysterectomy model was described and cited. It is inexpensive and anatomically representative. Its cost, construction, and utility can be found w

- Described the advised dry lab setup for training laparoscopic skills. This includes a pelvic trainer, training models for psychomotor and suturing skills, and

H. Ferreira *et al.*, “Simulation and Training of Gynaecological Skills,” *Facts Views Vis Obgyn*, vol. 1
no. 1, pp. 21–27, Accessed: Sep. 24, 2025. [Online]. Available:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6260672/

Conclusions/action items:

This source clearly outlined the benefits of using training models for practicing gynecological procedures. In fact, I learned that task trainers are essentially a
positive, but not make-or-break, opportunity. This connects to my project as it allows me to further better understand the benefits my product can have. Add
gynecological task trainers, which I will be sure to take into account.

- Keep in mind necessary aspects of task trainers as I design

10/8/25 Reconstructing the female reproductive system using 3D bioprinting in tissue engineering

NORA LORENTZ - Oct 08, 2025, 11:53 PM CDT

Title: Reconstructing the female reproductive system using 3D bioprinting in tissue engineering

Date: 10/8/25

Content by: Nora

Present: Nora

Goals: My goal is to learn how bioprinted systems of female reproductive anatomy are created and used within the healthcare system.

Content:

- The source begins by describing the various female reproductive organs and their roles (ex. vagina serves as birthing canal, for sperm deposition, etc.)

- Animal models often fail to replicate anatomy correctly

- 2D models cannot capture complexity of living tissues

- 3D bioprinting: new, evolving tech that combines living tissues with biomaterials. Combats the limitations of the other methods above.

- "This technology has rapidly evolved, incorporating methods such as extrusion-based, inkjet-based, laser-assisted and Vat-polymerization-based bioprinting to improve precision and cell viability"

- Successful bioprinting requires consideration of: hormonal responsiveness, vascularization, matrix composition, multi-cellularity, and mechanical properties.

- "The core principle of bioprinting involves the layer-by-layer deposition of bioinks to fabricate tissue structures based on digital designs"

- This technology can be applied to: study reproductive processes, evaluate infertility treatments, and develop regenerative therapies.

- This method remains challenging for many reasons, like the complexity of the tissue and compromised cell viability

[1] H. Yi *et al.*, “Reconstructing the female reproductive system using 3D bioprinting in tissue engineering,” *Materials Today Bio*, vol. 34, p. 102127, Jul. 2025, doi: https://doi.org/10.1016/j.mtbio.2025.102127.

Conclusions/action items:

This source was very interesting as it gave me an insight into the newest, most-advanced technology regarding replications of the female reproductive system. It taught me more about the complexities and details of this field. However, the methods used are obviously far beyond our scope and expertise. For this reason, I will have to continue to research more basic methods.

- Continue researching how other teams are replicating the female reproductive system

10/8/25 Comparing Task Trainers to Standardized Patients for Gynecologic Assessment Skills

NORA LORENTZ - Oct 09, 2025, 12:09 AM CDT

Title: Comparing Task Trainers to Standardized Patients for Gynecologic Assessment Skills

Date: 10/8/25

Content by: Nora

Present: Nora

Goals: To study task trainers used for nurse practitioner students to practice gynecologic exams.

Content:

- Use of standardized patients helps practitioners apply techniques and adapt them to individual persons

- Barries such as cost and continued training will need to be addressed in future projects

- Biggest disadvantage of task trainers is that users can't practice communicating with patients

- Activity was done in women's health clinic on campus

- Results:

"In evaluating students' ability to obtain a history, 59% agreed or strongly agreed and 41% disagreed or strongly disagreed that introductions and hand hygiene were done with low-fidelity trainers, and 81% strongly agreed and 19% agreed that this was more easily accomplished with SPs. Therapeutic communication and trauma-informed care were provided with 48% agreeing or strongly agreeing with task trainers, and 33% agreed and 67% strongly agreed that this was done with the SPs. Seventy-six percent of students agreed or strongly agreed that they were able to discuss procedural indications and contraindications with the task trainer, whereas 91% strongly agreed or agreed when doing so with the SPs. Forty percent agreed or strongly agreed with the ability to adapt the exam based on patient age, menstrual status, or history of trauma when working on a task trainer, whereas 92% strongly agreed or agreed that this could be done in person with SPs."

- 96% strong agreed that they could do a speculum exam with a task trainer

- Seemed to build confidence, be very helpful, and a comforting learning experience

- In order for best training experience: Initial training needed, as well as engaging with live humans after.

[1] K. Ford, A. Weltin, and K. Knox, "Comparing Task Trainers to Standardized Patients for Gynecologic Assessment Skills," *The Journal for Nurse Practitioners*, Oct. 2022, doi: https://doi.org/10.1016/j.nurpra.2022.09.010.

Conclusions/action items:

This source was very helpful for giving me evidence that task trainers have a positive impact on the practitioners who use them. I would like to see what their task trainer looks like, so I can see how the criticisms apple to their model (and thus can be applied/unapplied from our design). It was interesting to hear that task trainers can also be used for breast exams.

- Continue researching task trainers

- Look into/try to get an image of the pelvic task trainer used in this source

12/6/25 - Comparing Task Trainers to Standardized Patients for Gynecologic Assessment Skills

NORA LORENTZ - Dec 06, 2025, 6:43 PM CST

Title: Comparing Task Trainers to Standardized Patients for Gynecologic Assessment Skills

Date: 12/6/25

Content by: Nora

Present: Nora

Goals: To learn how students interact and benefit from the use to task trainers verses real patients.

Content:

- Low-fidelity models allow students to become familiar with procedure and/or techniques

- Standardized patients allow students to apply techniques and adapt them to individual persons

- Barriers to standardized patients include cost and availability of standardized patients

- Study focused on seeing which method of learning (manikins or standardized patients), NP students preferred

- An SP is defined as a person who has been coached to simulate an actual patient in “realistic and repeatable ways

- Focused on breast and pelvic exams, spring of 2022 with 30 students

- Introduction and hand-hygiene rate far lower with trainers than SPs

- Therapeutic communication and trauma-informed care also lower in trainer than in SP

- "students improved gynecological exam performance; self-reported improved knowledge, preparation, and confidence6; and improved student comfort levels with male genitourinary exams7 when using manikins before interacting with SPs."

[1] K. Ford, A. Weltin, and K. Knox, “Comparing Task Trainers to Standardized Patients for Gynecologic Assessment Skills,” *The Journal for Nurse Practitioners*, Oct. 2022, doi: https://doi.org/10.1016/j.nurpra.2022.09.010.

Conclusions/action items:

This study was useful for showing me how students interact with task trainers versus real patients. I learned that both methods have certain benefits over the other. Ultimately, I believe that both serve a role in providing students with a well-rounded, complete education. Task trainers (manikins) are very useful when becoming familiar with the more basic elements of a procedure, while standardized patients allow for refinement of certain people-skills (like trauma-informed care) and other procedural details.

- Continue to work on project

12/7/25 Effectiveness of different numbers of simulation training models on medical students' cervical examination performance

NORA LORENTZ - Dec 07, 2025, 1:55 PM CST

Title: Effectiveness of different numbers of simulation training models of medical students' cervical examination performance

Date: 12/7/2025

Content by: Nora

Present: Nora

Goals: To see how different numbers of simulation training models affect medical student's performance during cervical examinations

Content:

- Study was done at Peking Union Medical College Hospital, Beijing, China between August 1 2016 and April 30 2017. Fifth year medical students with no obstetric experience were randomly assigned to the large or small number training groups.

- Large group performed cervical examinations on ten dilation models, nine effacement/consistency models

- Small group practiced on four dilation models and three effacement/consistency models

- For the examination, both groups evaluated ten models in the same order and reporter their findings

- Conclusion: "A small number of simulation training models was sufficient to improve students' accuracy and confidence in assessing cervical dilation, although a large number was needed to improve accuracy in cervical effacement and consistency."
- Simulation helps replicate real patients, anatomic regions, or clinical tasks. Also improves patient safety, promotes teamwork and effective communication, and assesses performance of healthcare professionals.

- Regarding use of models, must find balance between improving simulation outcomes for medical students in cervical examination and reducing educational costs of the resources

- Silicon models used in study. Dilation ranged from 1 to 10 cm. 9 combinations of effacement (0.5, 1, 2) and consistency (soft, intermediate, hard).

- No difference between the groups in assessment of cervical dilation. Thus, small number of models is sufficient to achieve the goal

- A large number of training models was found to improve students accuracy in the assessment of cervical effacement and consistency.

[1] W. Lin and Y. Song, "Effectiveness of different numbers of simulation training models on medical students' cervical examination performance," *International Journal of Gynecology & Obstetrics*, vol. 141, no. 2, pp. 255–260, Dec. 2017, doi: https://doi.org/10.1002/ijgo.12404.

Conclusions/action items:

The study here was very helpful in showing how simulation models can benefit students. Although their model focused more on obstetrics rather than gynecology, learning about their model still showed me how models can be used to simulate procedures in women's reproductive anatomy. I can now understand better how our model will aid those learning at our client's training sessions. Also, I learned more about the general limitations of simulation models.

- Apply these findings as we create our own simulatio models

9/23/25 Initial Design Ideas

NORA LORENTZ - Oct 12, 2025, 4:48 PM CDT

Title: Design Ideas

Date: 9/23/25

Content by: Nora

Present: Nora

Goals: The goal is to come up with a few design ideas or even concepts/facts that will help my team design task trainer models that meet our client's specifications.

Content:

Document attached below

Conclusions/action items:

The designs I came up with are very basic as I don't know a lot yet about materials and the details of fabrication. Hopefully, I can confer with my team and use the 300's expertise to help us fully realize several design options. In order to make up for my lack of in-depth knowledge, I was hoping that some of my research on depth of injection, speculum sizes, etc, would help the team.

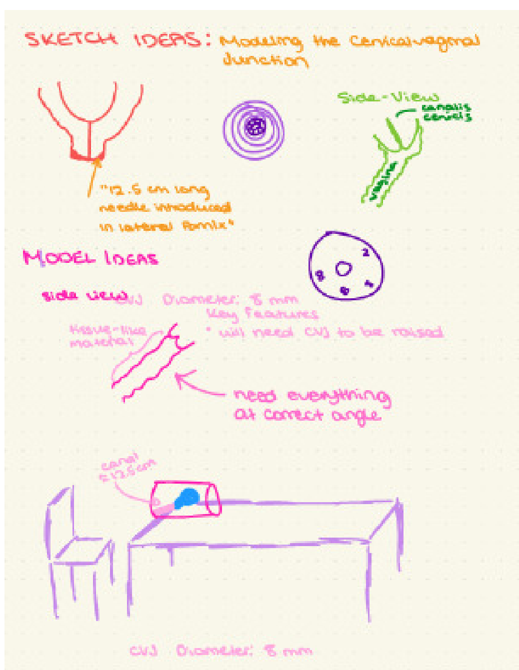
- Share my designs with the team

- Learn about teammates design ideas

- Begin thinking of several design options for our task trainer

Note: the attached document was completes on 9/23, however the entry on LabArchives was input later.

NORA LORENTZ - Oct 12, 2025, 4:44 PM CDT



Download

Idea_Sketch.pdf (506 kB)

10/29/25 SolidWorks Dogbone

NORA LORENTZ - Oct 29, 2025, 6:43 PM CDT

Title: SolidWorks Dogbone

Date: 10/29/25

Content by: Nora

Present: Nora

Goals: To create a dog bone mold in SolidWorks.

Content:

- Was able to create a dog bone mold in SolidWorks.

- Included accurate measurements and dimensions.

Screenshot of dog bone in SolidWorks attached below!

Conclusions/action items:

By making this dog bone in SolidWorks I was able to gain a lot of valuable knowledge and gain comfort with using this software. Additionally, the dog bone mold will be very useful for MTS testing. We can cast into this mold with our silicon/ecoflex and test the materials' properties to make sure they are satisfactory for our design.

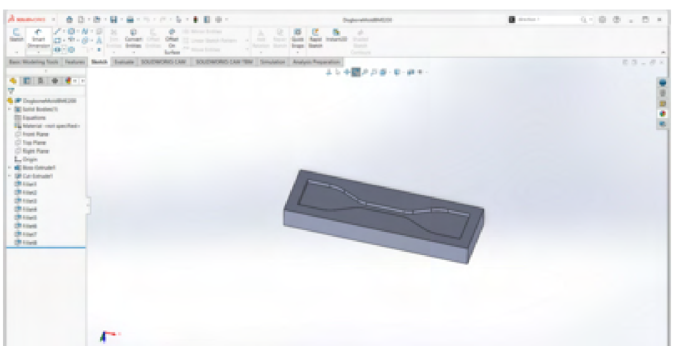
- 3D print mold and cast in it

Comments

Randolph Ashton Oct 30, 2025, 10:36 AM CDT

Great! Glad that you're working in Solid Works!

NORA LORENTZ - Oct 29, 2025, 6:42 PM CDT



Download

Screenshot_2025-10-29_183923.png (280 kB)

11/3/25 Clear Uterus Design

NORA LORENTZ - Nov 03, 2025, 7:56 PM CST

Title: Clear Uterus Design - Formlabs BioMed Clear

Date: 11/3/25

Content by: Nora

Present: Nora

Goals: To convert the previous uterus design, using Renee's SolidWorks, into a clear uterus design. My goal is to research the material Formlabs BioMed Clear.

Content:

- Biomed Clear Resin by Formlabs was designed with medical applications. It is medical-grade material.

- Wear resistance and low water absorption over time.

- Parts printed with this material are compatible with sterilization methods.

- "Transparent, hard, and strong"

- Suitable for pharmaceutical and drug delivery

- "for biocompatible applications requiring long-term skin (>30 days), breathing gas pathways, and mucosal membrane contact (>30 hours) or short-term bone, tissue, and dentin (<24 hours)."

- Transparent and allows light to pass through.

- Young's Modulus 2080 MPa

- Ultimate tensile strength 52 MPa

- Elongation 12%

- Flexural Strength 84 MPa

- Flexural Modulus 2300 MPa

- Hardness Shore D 78 D

- Notched Izod 35 J/m

- Image from the source attached below for reference of what the material looks like.

[1] "BioMed Clear Resin," *Formlabs*. https://formlabs.com/store/materials/biomed-clear-resin/

Conclusions/action items:

Using the research I gathered above, I have determined that the material listed is sufficient for our new clear uterus design. Formlabs BioMed Clear appears to meet all of our desired standards and needs for this part of our design. It is transparent and has sufficient hardness and durability. Thus, I will continue to move forward in the fabrication process and print out our uterus with this.

- Use Renee's SolidWorks to print uterus in this material

11/5/25 Updated Cervix Ideas

NORA LORENTZ - Nov 13, 2025, 5:14 PM CST

Title: Updated Cervix Ideas

Date: 11/5

Content by: Nora

Present: Nora

Goals: Sketch new cervix designs to collaborate with the team and design a new cervix that better fits the client's requests.

Content:

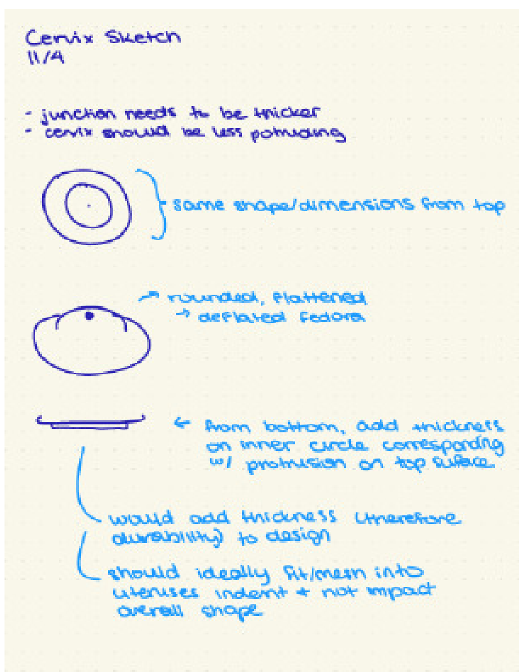
Attached below.

Conclusions/action items:

Although my sketch was very rough, I was still able to share it with the team. We discussed all of our design ideas and settled on a new cervix design to move forward with. We will fabricate that model and show it to the client.

- Fabricate new cervix

NORA LORENTZ - Nov 13, 2025, 5:14 PM CST



Download

11_4_Cervix_Sketch.pdf (247 kB)

10/23/25 Intro to Machining

NORA LORENTZ - Oct 29, 2025, 6:32 PM CDT


NORA LORENTZ

Eligibility: CoE Students

Profile

Program Registrations

My Memberships

Membership Type	Start Date	Expiry Date	Renew	Card Info
Machining	Wed, Aug 20 2025	Permanent	Not Renewable	N/A
Shop Tools	Wed, Feb 12 2025	Permanent	Not Renewable	N/A
Shop Tools	Tue, Aug 20 2024	Thu, Jan 2 3000	Not Renewable	N/A
Laser Cutter	Tue, Aug 20 2024	Thu, Jan 2 3000	Not Renewable	N/A
Lab Orientation	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Renewable	N/A
Laser Cutter - Training Eligible	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Renewable	N/A

Download

Screenshot_2025-10-29_183233.png (116 kB)

NORA LORENTZ - Oct 29, 2025, 6:36 PM CDT

Title: Intro To Machining

Date: 10/23/25

Content by: Nora

Present: Nora

Goals: To complete my intro to machining via sessions on the lathe and mill.

Content:

Screenshot of proof attached.

Conclusions/action items: I have completed my Intro To Machining Requirement

10/20/25 Chemical Safety Training: The OSHA Lab Standard

NORA LORENTZ - Oct 29, 2025, 6:33 PM CDT

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

This certifies that Nora Lorentz has completed training for the following course(s):

Course	Assignment	Completion	Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024-2025	10/20/2025	10/20/2028
Chemical Safety: The OSHA Lab Standard	Final Quiz	10/20/2025	

Data Last Imported: 10/29/2025 06:24 PM

Download

Screenshot_2025-10-29_183220.png (75.3 kB)

NORA LORENTZ - Oct 29, 2025, 6:37 PM CDT

Title: Chemical Safety Training: The OSHA Lab Standard

Date: 10/20/25

Content by: Nora

Present: Nora

Goals: To complete my chemical safety training.

Content:

Screenshot of proof attached.

Conclusions/action items: I have completed my chemical safety training.

10/20/25 Biosafety Required Training

NORA LORENTZ - Oct 29, 2025, 6:33 PM CDT

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

This certifies that Nora Lorentz has completed training for the following course(s):

Course	Assignment	Completion	Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024-2025	10/20/2025	10/20/2028
Chemical Safety: The OSHA Lab Standard	Final Quiz	10/20/2025	

Data Last Imported: 10/29/2025 06:24 PM

[Download]

Screenshot_2025-10-29_183220.png (75.3 kB)

NORA LORENTZ - Oct 29, 2025, 6:38 PM CDT

Title: Biosafety Required Training

Date: 10/20/25

Content by: Nora

Present: Nora

Goals: To complete the required Biosafety Required Training.

Content:

Screenshot of proof attached.

Conclusions/action items: I have completed the Biosafety Required Training.

9/10/2025 Standard practice for pain management during IUD insertion.

Cadence SEYMOUR - Dec 10, 2025, 10:22 AM CST

Title: Standard practice for pain management during IUD insertion

Date: 09/10/2025

Content by: Cadence Seymour

Present: N/A

Goals: Gain a better understanding of the current most common recommendations for pain management during IUD insertion, as well as to gather information about how often the pain is being reported and at what severity level.

Search Term: Standard pain management approaches to IUD insertion, Paracervical block.

Citation:

[1] M. Rahman *et al.*, "Differing Approaches to Pain Management for Intrauterine Device Insertion and Maintenance: A Scoping Review," *Cureus*, vol. 16, no. 3, Mar. 2024, doi: https://doi.org/10.7759/cureus.55785.

Link: https://www.cureus.com/articles/229842-differing-approaches-to-pain-management-for-intrauterine-device-insertion-and-maintenance-a-scoping-review#!/

Content:

-The article intended to come to a consensus within the medical community about the proper techniques for IUD insertion and the resulting pain management practices.

-Within the articles from which they received their data, they noted that the women with previous vaginal deliveries/births noticed the least amount of pain during insertion, and the nulligravid (never pregnant) women had reported the most amount of pain.

- It was found that the non-pharmacological methods of pain management, such as different insertion techniques, tools, and the use of a cold compress, did not play a role in the pain metrics determined by patients. However, as far as pharmacological methods, such as lidocaine gel, lidocaine Paracervical block, and lidocaine combined with either diclofenac or prilocaine, were said to decrease the pain levels, but at differing times during the procedure.

-For social context, they also recognized the increased amount of IUDs being used/implanted since the overturning of Roe V wade in 2022.

-During the actual insertion, the most painful portion is inserting a hysterometer, which is where the pain prevention research is/should be most focused. The hysterometer is used to determine the depth of the uterus upon insertion.

- NSAIDs were unsuccessful in reducing pain during insertion in comparison with the placebo groups.

-The practices that improved pain during the insertion processes of the hysterometer, IUD, and tenaculum usage were tramadol, mixing local anesthetics like lidocaine and prilocaine in cream form, and using 10% lidocaine spray on the area.

-The method of a paracervical block was deemed helpful in reducing pain; however, it added pain from its own insertion in most test groups.

-The article intended to simplify the lack of consistency within the medical field on how to best address IUD pain during insertion, but in doing so, realized all the different results and data proved to be clinically insignificant.

Conclusions/action items: There are no clear conclusions on the best practices for IUD insertion; however, continuing to research and build data trends on pain reduction with different methods will greatly improve the process for future patients. Additionally, devising a standard practice for IUD insertion will provide emotional comfort for the patients, rather than the mixed reviews on the pain scale currently.

9/10/2025 IUD Insertion Current Procedure

Cadence SEYMOUR - Oct 01, 2025, 7:37 PM CDT

Title: IUD insertion Current Procedure

Date: 09/10/2025

Content by: Cadence Seymour

Present: N/A

Goals: To get a clear, concise definition of each step in the current IUD implanting process and the pain associated with it along the way.

Citation:

[1] E. L. Lanzola and K. Ketvertis, "Intrauterine Device Placement and Removal," *PubMed*, 2023. https://www.ncbi.nlm.nih.gov/books/NBK557403/

Link: https://www.ncbi.nlm.nih.gov/books/NBK557403/

Content:

IUD insertion process:

-Before the actual insertion, the doctor will ask the patient to take a pregnancy test to confirm a negative.

-Then they will get consent, both written and verbal, and consequently have the patient lie in the dorsal lithotomy position.

-Next, the doctor will perform bimanual examinations, determining the tilt of the uterus (antiverted - tilted forward, normal tilt, or retroverted - tilted backwards, abnormal tilt).

-From there, they will then insert the speculum into the vagina.

-Then the doctor will cleanse the cervix and vaginal fornices with an antiseptic solution.

-This would now be the time for the patient to consider and receive a paracervical block before insertion

-Then, using a single tooth tenaculum, they will hold the anterior lip of the cervix and pull the cervix so it is slightly elongated.

-Next, using a sterile uterine sound, they will measure the depth of the uterine cavity.

-Then they will follow the manufacturer's instructions on actual insertion of the intrauterine device.

-Lastly, they will cut the string on the IUD to about 3 or 4cm and then remove the tenaculum from the cervix, ending the procedure.

-Patients typically experience the most pain during the tenaculum grasp and the placement of the device.

Conclusions/action items: From this article, I have created a better understanding of the general process of IUD insertion and where the pain is most often experienced. With this information, studies can be conducted to further investigate the best pain management techniques.

Comments

Randolph Ashton Sep 19, 2025, 11:41 AM CDT

Improper reference citation format. Primary reference like books or published articles don't need a website.

9/13/2025 More About Paracervical Block Process and Pain Related Biology

Cadence SEYMOUR - Dec 10, 2025, 10:22 AM CST

Title: More About Paracervical Block Process and Pain Related Biology

Date: 09/13/2025

Content by: Cadence

Present: N/a

Goals: My goals for this topic were to get a better idea of the Paracervical block process and different methods for administering it.

Citation:

[1] Hologic, Inc., “Paracervical block video - Animation,” *YouTube*, Nov. 04, 2015. https://www.youtube.com/watch?v=m0EyyHouT00

Link: https://www.youtube.com/watch?v=m0EyyHouT00

Content:

-A Paracervical block is essentially the introduction of an anasthetic at the base of the uterus near the cervix. This procedure's goal is to block the pain fibers leaving and surrounding the uterus.

-There are many different medications used for anesthesia in the procedure, the most common of which are: lidocaine, which is very rapid to start working; however, because of that, it is also very quick to wear off; or Marcaine, which is the inverse, takes longer to start the proper pain block, but the effects are much longer acting.

-Because of the medications' differences, most physicians who use the paracervical block administer a combination of both lidocaine and Marcaine to achieve fast and long-lasting pain relief.

-The sensation of pain that occurs from this process stems from impulses passing through the lateral and posterior portions of the cervix and into the area near the uterus.

-The paracervical block inserts that pain medication into the region of most pain near the cervix and base of the uterus to block the impulses.

-There are multiple different variations to medication placement depending on the physician administering it; some of the most common techniques are (in clock terms) 4 & 8, or 2, 4, 8, & 12, or just 3 & 9. In the video, they showed the process at 2, 4, 8, and 12.

-Before injecting the anesthetic, they aspirate the syringe to make sure that they aren't in the intravascular space.

-Additionally, they can administer a single shot at the 12 O'clock position to aid with the pain of tenaculum placement.

-The physician can also go back in for a second round of numbing and do positions of 3, 9, 5, 7, once the cervix has been properly numbed. Approximately 20-25 CC's will be administered throughout this process.

-The patient will then sit at rest for 5-10 minutes before proceeding with the IUD insertion process or other procedure.

Conclusions/action items: After watching this video, I am more familiar with the paracervical block process as well as the visual landmarks associated with the insertion of the needle. From here, I aim to find more information about competing designs of training models for this process and build my own preliminary design with these basic concepts.

9/13/2025 Materials for Training Model Part One

Cadence SEYMOUR - Oct 01, 2025, 7:36 PM CDT

Title: Materials for Training Model Part One

Date: 09/13/2025

Content by: Cadence

Present: N/A

Goals: My goals for this research session were to determine which materials would have similar characteristics to either the vaginal wall or the cervix, so we can design our model most human-like. I wanted to compare aspects such as density, elasticity, response to puncturing, as well as visual appearance, during this process.

Citation:

[1] Q. Chai, Y. Jiao, and X. Yu, "Hydrogels for Biomedical Applications: Their Characteristics and the Mechanisms behind Them," *Gels*, vol. 3, no. 1, p. 6, Jan. 2017, doi: https://doi.org/10.3390/gels3010006.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC6318667/

Content:

-From a more financial perspective, it seems like silicone is a good alternative to any more complex material to mimic the inside of the vagina.

-Alternatively, in the medical field right now, especially in biomedical engineering, there is an increase in materials like hydrogels for imitating more internal and soft tissues.

- According to the National Library of Medicine, "Hydrogels, crosslinked 3D networks of hydrophilic polymer chains, are capable of holding large amounts of water due to their hydrophilic structure." This property of hydrogels makes them extremely applicable for use in our project.

-These materials have low mechanical strength, dependent on water percentage, and are also porous, similar to the vaginal wall that we are trying to imitate.

-Hydrogels can also be responsive to different environments like pH, temperature, light, chemicals, and moisture.

The material, all in all, doesn't seem to fit the requirement for our product; however was good to look into for more background information about

Conclusions/action items: The material, all in all, doesn't seem to fit the requirement for our product; however, it was good to look into for more background information about material mechanics relative to the human application. From here I know now that I want to look more into firmer products more similar ot silicone.

Comments

Randolph Ashton Sep 19, 2025, 11:43 AM CDT

Incorrect citation format for a primary source.

09/30/2025 IUD impact

Cadence SEYMOUR - Oct 02, 2025, 11:55 PM CDT

Title: IUD impact

Date: 09/30/2025

Content by: Cadence Seymour

Present: N/a

Goals: My goals for this research session were to gather information about how the IUD impacts women, specifically how many women currently have one, and the relative availability of the procedure. Additionally, it would be nice to better understand the effect that pain management techniques and proper training have on the fluidity of this process.

Citation:

[1] CDC, “FastStats - Contraceptive Use,” *Centers for Disease Control and Prevention*, 2019. https://www.cdc.gov/nchs/fastats/contraceptive.htm

Content:

-From this research, I learned that according to the CDC, "Percent of women ages 15–49 currently using long-acting reversible contraception (Intrauterine device or contraceptive implant) 10.4%."

- This number is relatively low if you consider the other methods, such as female sterilization or the pill, which had the same age range and produced nearly 20% of women.

-This relatively low intensity of people having to use the device could be for several reasons, one of which could be the pain associated with the procedure due to a lack of training or no paracervical blocks. [1]

-Without the paracervical block, the tenaculum placement portion of the procedure is one of the most noticeable sources of pain, second being the actual IUD implantation through the cervix.

Conclusions/action items: This research was really helpful in understanding the impact that our project might have on the accessibility of IUD procedures, as well as pain management effectiveness. If done correctly, an IUD is an extremely smart plan against pregnancy. From here, I want to continue to research the impact of Paracervical blocks upon insertion.

10/02/2025 IUD impact pt. 2

Cadence SEYMOUR - Oct 03, 2025, 12:00 AM CDT

Title: IUD impact

Date: 10/02/2025

Content by: Cadence Seymour

Present: N/a

Goals: My goals for this research entry were to continue to learn about the impact that the IUD has on the general population of people who have it. I wanted to explore the relative rates of people who have it in comparison with other forms of birth control.

Citation:

[1] Planned Parenthood, "What are the benefits & advantages of the IUD?," *www.plannedparenthood.org*, 2019. https://www.plannedparenthood.org/learn/birth-control/iud/what-are-the-benefits-of-iuds

Content:

- Additionally, IUDs are extremely effective, over 99%.

-IUDs can also lighten period symptoms, such as cramping or bleeding, or make it go away altogether.

-IUDs also serve as emergency contraception.

- If you get one placed within 5 days of unprotected sex, you are almost guaranteed not to be pregnant and still protected for up to 12 years, depending on the brand of IUD you get.

-The effectiveness of an IUD is independent of which brand or kind it is, as well. For example, hormonal vs copper IUDs have almost the same rate of effectiveness.

-The IUD is also one of the most long-term solutions for birth control, being that it can last anywhere from 4-12 years, only needing to be removed prior if it is not staying in place or if the patient's body is rejecting it.

Conclusions/action items: From this session, I was able to get a better understanding of why the accessibility of the IUD as birth control is so important in our youth and protection against unwanted pregnancies. I was also able to better understand the need for paracervical blocks as a procedure preceding the IUD implantation to make the whole process go smoother. From here, I believe my next research should focus on the forces involved during the procedure, as well as the materials that we could use in our mold to best mimic the material properties of the actual human.

10/02/2025 Material Properties of vagina

Cadence SEYMOUR - Oct 03, 2025, 12:18 AM CDT

Title: Material Properties of Vagina

Date: 10/02/2025

Content by: Cadence Seymour

Present: N/a

Goals: My goals for this research session were to research more information about the material properties, such as Young's modulus of the uterus and cervix. With this information, I can better help my group determine the material best suited for emulating the human vagina in our design.

Citation:

[1] A. Baah-Dwomoh, J. McGuire, T. Tan, and R. De Vita, "Mechanical Properties of Female Reproductive Organs and Supporting Connective Tissues: A Review of the Current State of Knowledge," *Applied Mechanics Reviews*, vol. 68, no. 6, Sep. 2016, doi: https://doi.org/10.1115/1.4034442.

Content:

- One of the first points this article makes is that the female anatomy has to undergo an extreme amount of mechanical deformation and remain remarkably strong during processes like birth or other things taking place in the vaginal canal.

-From there, they go on to mention the cervix being able to dilate 10cm during labor, and the female tendons and ligaments stretching up to three times their length during pregnancy due to increased weight.

-After reading just that initial section is very clear that we are going to be looking for a material that is both flexible and very strong.

- They determined the mechanical properties of the female anatomy through in vivo tests, which are a series of uniaxial loading stress tests in both tension and compression, and many more.

-They begin the information section with the uterus, where they describe it as being "typically pear-shaped and approximately 7.6cm long, 4.5 cm wide and 3.0cm thick." After performing several tests on many different uteri, they found that the material it is made of is extremely viscoelastic. As a result of their testing method I mentioned earlier they mentioned the follownig mechnical calculations, "the uterine tissue exhibited a peak true stress of 500 ± 219 kPa with a corresponding peak true strain of 0.30 ± 0.09 in the circumferential direction and a peak true stress of 320 ± 176 kPa with a corresponding peak true strain of 0.30 ± 0.09 in the longitudinal direction."

Conclusions/action items: From this research session, I now have a numerical understanding of the material properties of the cervix and vagina. From here, what I can do is compare these numbers to our contending product materials to pick the most accurate in human representation. I want to additionally research some of these materials myself and look for a number that best matches the ones found and given above.

10/03/2025 Youngs modulus of the Uterus

Cadence SEYMOUR - Oct 03, 2025, 11:14 AM CDT

Title: Young's Modulus of the Uterus

Date: 10/03/2025

Content by: Cadence Seymour

Present: N/a

Goals: My goals for this research session were to quantify the mechanical strength of the female uterus. Additionally, I wanted to better understand the role the stage of the hormone cycle plays in the material properties of the uterus tissue.

Citation:

[1] R. Franko *et al.*, “Mechanical properties of native and decellularized reproductive tissues: insights for tissue engineering strategies,” *Scientific Reports*, vol. 14, no. 1, Mar. 2024, doi: https://doi.org/10.1038/s41598-024-57867-5.

Content:

- This study evaluated both female and male reproductive tissues on concepts like Young's modulus in hopes of increasing the ability for biomedical engineers to manufacture prosthetic reproductive tissues for future engineering work. The information most relevant to our project would be specifically the Young's modulus of the female anatomy, specifically the cervix and uterus.

-To begin with, actual numerical data, they tested the Young's Modulus of the cervix and uterus during the luteal and follicular phases of women. The direct data that I am using to anaylize and work off of is, "An increase in the YM was observed in decellularized compared to native tissues only at luteal phase, in both contralateral (9.24 ± 5.22 *vs* 2.75 ± 3.6 kPa, $p = 0.00837$) and ipsilateral horns (16.25 ± 9.69 *vs* 2.51 ± 1.55 kPa, $p < 0.0001$), but not at follicular phase, neither in contralateral (7.51 ± 6.40 *vs* 2.75 ± 3.6 kPa, decellularized and native, respectively, $p > 0.05$) nor ipsilateral (4.22 ± 1.65 *vs* 2.13 ± 1.62, decellularized and native, respectively, $p > 0.05$)."

-From this bit of data, I can conclude, as well as the source, that there is an increase in the Young's modulus during the luteal phase compared with the follicular phase.

-The explicitly stated Young's modulus range for the cervix and uterus near that portion of the anatomy is 19.5 kPa to 243 kPa.

-Their study continues about the material properties at different stages during pregnancy, but we are doing a general non-pregnant women's model trainer for now so that information is not extremely relevant right now.

Conclusions/action items: From this source, I now have a numerical gauge for the mechanical properties of the cervix and the uterus, so we can move on to comparing that to other materials we could use in the mold for our kit. I want to explore next the material properties of silicon and EcoFlex and ensure that they match up from a mathematical standpoint before selecting them for our project. I also want to bring this information to my group and come to a group decision about what material would be best for replicating the uterus.

10/09/2025 Eco-Flex

Cadence SEYMOUR - Oct 09, 2025, 10:34 AM CDT

Title: Mechanical Properties of Eco-Flex

Date: 10/09/2025

Content by: Cadence Seymour

Present: N/a

Goals: My goals for this research session were to gain an understanding of the mechanical properties of EcoFlex as well as how they compare to my previously determined qualities of the uterus.

Citation:

[1] R. Janardhana, F. Akram, Z. Guler, A. Adaval, and N. Jackson, "A Comprehensive Experimental, Simulation, and Characterization Mechanical Analysis of Ecoflex and Its Formulation Under Uniaxial Testing," *Materials*, vol. 18, no. 13, p. 3037, Jun. 2025, doi: https://doi.org/10.3390/ma18133037.

Content:

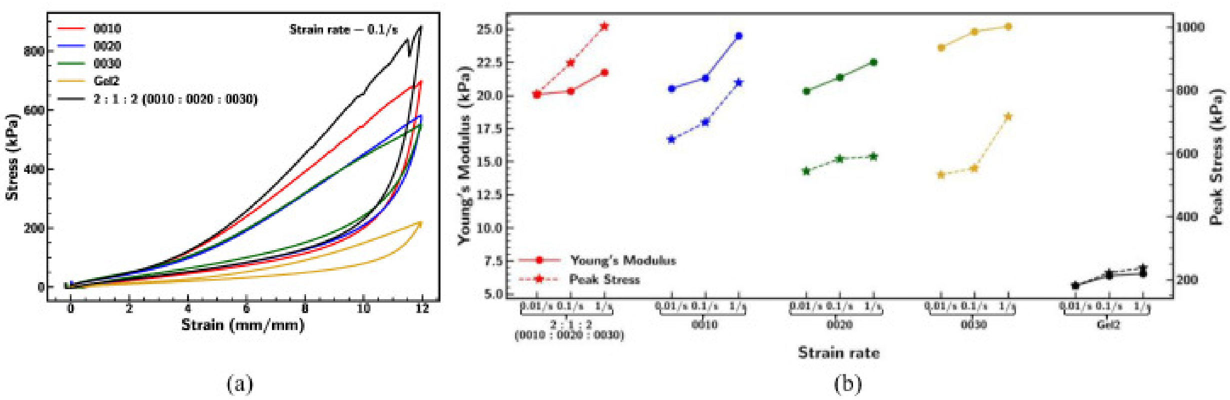
-Eco Flex is a material commonly used for human tissue imitation in things like training models or suture kits. [1]

-Ecoflex, by definition, is a flexible silicone elastomer with low stiffness and high flexibility (5-80kpa). This is what makes it so suitable to be used in designs for human tissues and skin. [1]

-They have done some testing on its properties and qualities when combined with other materials, which showed, "the excellent tunability properties of EcoFlex have been demonstrated to improve the softness and stretchability when combined with other elastomers such as Slyguard184, Slyguard 186, and Solaris." Upon looking into these additional materials, it seems they would add too much complexity to our project to implement, and we should continue on the thought process of just EcoFlex or EcoFlex with thinners for different portions of the anatomy.[1]

-They evaluated the Young's modulus of the EcoFlex at 100% strain for five cycles of on and off tension to this degree, and each of the different concentrations of EcoFlex withstood this testing and returned to the original state without deformation. This will be a helpful quality in our project as we need the material to be flexible like human tissues and resistant to tearing, as our human tissues are. [1]

-They created a stress-strain curve for this material, and it is inserted below [1]



-ultimately, this study is examining the different strengths of different relative sample concentrations of the EcoFlex, but all of them are flexible and durable enough to withstand the purpose of our project.

Conclusions/action items: After reading this study, I feel confident in saying the EcoFlex material would be a good match for our model trainer kit, as it possesses similar mechanical properties to those of a vagina and cervix, and has flexibility in concentration and consequently stiffness. From here, I will continue to research more materials similarly to make sure we're making the best selection.

10/09/2025 Silicone

Cadence SEYMOUR - Oct 09, 2025, 3:33 PM CDT

Title: 10/09/2025 silicone

Date: 10/09/2025

Content by: Cadence Seymour

Present: N/a

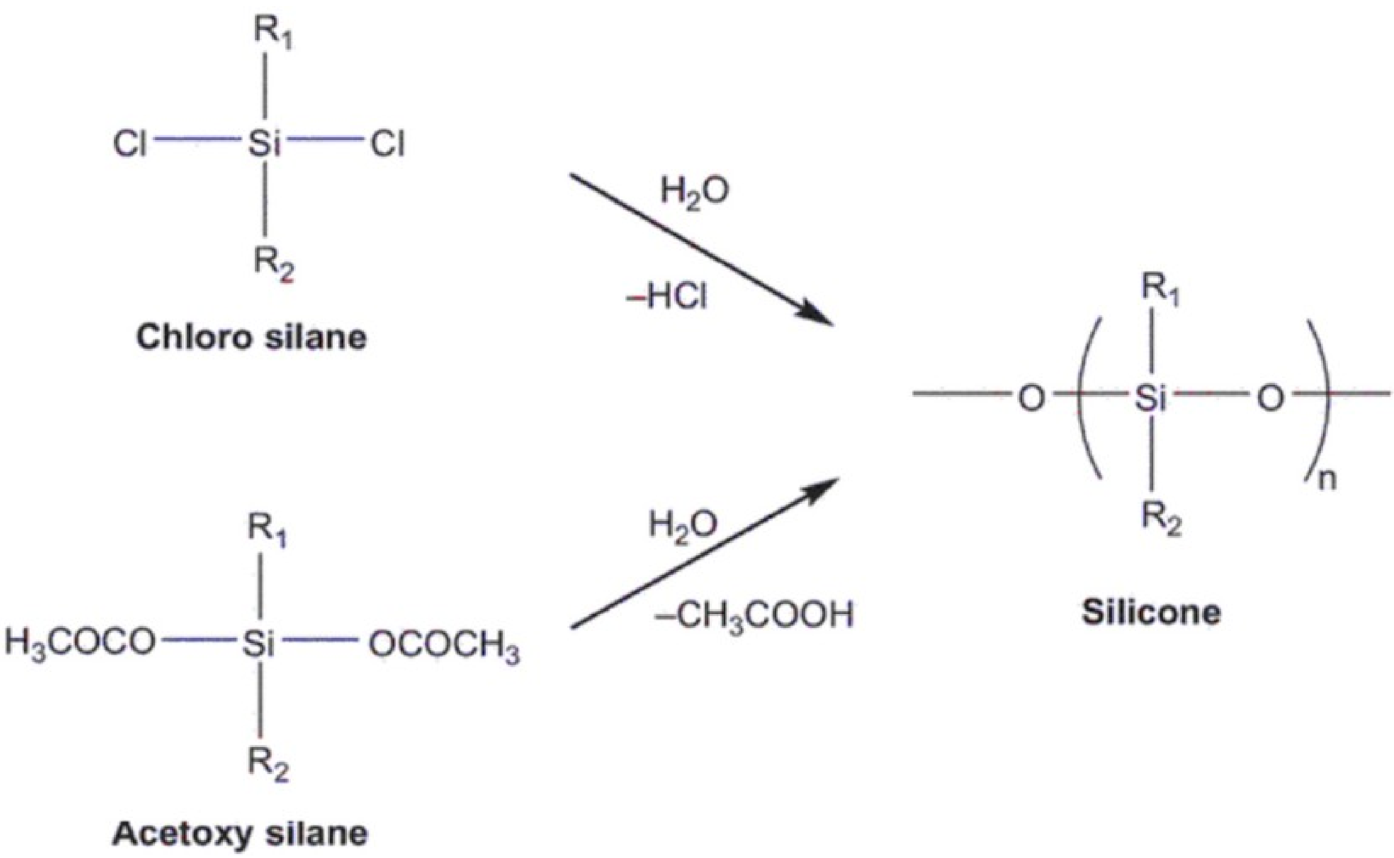
Goals: My goals for this research session were to learn more about silicone as a base material to better understand its subcategories, like EcoFlex or Solaris. I wanted to learn all the information about chemical processes, as well as previous functions and mechanical properties.

Citation:

[1] M. Zare, E. R. Ghomi, P. D. Venkatraman, and S. Ramakrishna, "Silicone-based biomaterials for biomedical applications: Antimicrobial strategies and 3D printing technologies," *Journal of Applied Polymer Science*, vol. 138, no. 38, p. 50969, May 2021, doi: https://doi.org/10.1002/app.50969.

Content:

-This study initially talks about the chemical process of making silicone, which is shown below in an image. This explains and gives rise to its many physical properties, like stretch and elasticity.



-They define silicone as, "Silicone or polysiloxane is a synthetic polymer widely used in biomedical applications. It is made up of silicon, oxygen, carbon, and hydrogen. The material is a mixture of semi-inorganic polymeric molecules consisting of an array of polydimethylsiloxane [(CH3)2-SiO] monomer chains of different lengths." Because of these strong bonds, it is a material with great strength and resistance to deformation.

-They also have a very helpful chart of the different silicone types and consequent applications, which would be good to return to upon selection for our project trainer.

-The most common uses for silicone in biomedical engineering are:

1) Coating, treatment, or assembly of various medical devices

2) Inserts and implants to replace various body parts

2) Catheters, drains, and shunts, used for medical treatment and short-term placement.

3) Aesthetic implants

4) Specialty contact lenses.

They also then list the most important traits of silicone as:

1. Silicone elastomers are relatively firm and flexible.

2. Form stability under a wide range of temperature and chemical conditions.

3. Hemocompatibility due to its hydrophobicity, thus retaining blood properties.

4. Silicone has a high permeability to gases, including oxygen, carbon dioxide and moisture.

5. It is inert, nontoxic, and nonbiodegradable.

-These qualities greatly align with the qualities of the vagina and cervix, and make silicone a top contender for our project.

Conclusions/action items: From this session, I am able to conclude that our original thought that mechanically silicone could be a good fit holds true. Now I have data from both the EcoFlex subcategory and silicone as a whole that support its similarities to the human vagina. From here, I am going to research some alternative materials to see if they have different advantages, possibly from existing designs.

10/16/2025 Testing methods Part One

Cadence SEYMOUR - Oct 16, 2025, 5:52 PM CDT

Title: Testing Methods Part One

Date: 10/16/2025

Content by: Cadence

Present: N/a

Goals: My goals for this research session were to get a better idea of a specific testing process my team plans to use in our fabrication stage. We want to use MTS in the makerspace, so I would like to understand how it works and what it displays more clearly. If nothing else, starting today, I want to understand the machine we are going to be using, then I can focus on what it shows later.

Citation:

[1] "Mark-10," *Mark-10 Force and Torque Measurement*, 2025. https://mark-10.com/products/configuring-a-system/tensile-testers/?gclsrc=aw.ds&gad_source=1&gad_campaignid=964245355&gbraid=0AAAAAD_tlOfzb8COSD0e9tZtSI9QHgyyj&gclid=CjwKCAjwr8LHBhBKEiwAy47uUgMVHyg-bA46i37_F_sEuYtsHnr6MmwhUvN8-q6ZcwF7i_OpiFBjQxoC4mwQAvD_BwE (accessed Oct. 16, 2025).

Content:

Above is pictured a very advanced MTS machine that we will not be using this exact model of. However, it can definitely be used to get a better idea of how this testing process works, as well as how the machine works and what it shows us as the testers.

The larger vertical portion numbered 1 is called the testing frame, and it is used to generate the force necessary to pull on our material to test its tensile strength.

Then the next portion number 2 is used to create and run tests, manage and view results, graphically see results, as well as manually change the force the machine is using to induce the tensile stress.

The number 3 is the force sensor, is measures the force the machine is putting onto the object, and can measure both compression and tensile forces.

Lastly, number 4 are the grips and mounting pieces. Their job is to hold to material being tested in place.

They have the capability in this model to switch out the pieces for mounting and grip in order to test different materials and objects using the same machine and force.

The pieces that our machine will have will be very similar in function; however will look a little different.

Additionally, we will not have the screen presentation of the forces administered in such a fancy way. But it seems the silicone will be stretched similarly, so we can see what force it can withstand.

Conclusions/action items: After this, I better understand the process of MTS or tensile stress testing. I want to move from here onto researching how we might test how many times the cervical silicone can be perforated before it becomes denatured and no longer serves its function. That way, I can talk to my group and make a plan on how to tackle that.

10/16/2025 Testing methods part two (Perforation)

Cadence SEYMOUR - Oct 17, 2025, 9:48 AM CDT

Title: Testing methods part two (perforation)

Date: 10/16/2025

Content by: Cadence

Present: N/a

Goals: My goals for this study session were to research and come up with good ideas about how we might test our silicone product in terms of perforation. It will be used with a needle several times, and we need to know exactly how many times it can withstand that force.

Citation:

[1] “Understand the Importance of Perforation Strength Testing,” *prestogroup*, 2023. https://www.prestogroup.com/articles/understand-the-importance-of-perforation-strength-testing/ (accessed Oct. 16, 2025).

Content:

This is a standard machine some people use to do perforation testing in materials, but I'm not sure if we have access to one of these.

This source claims that perforation testing is one of the most important steps of mechanical strength testing for materials before use, to truly know the strength of the material you are using.

They describe their product as a machine that can "be used to quantify the material's ability to get separated easily when tensile force is applied to it."

We could greatly use testing of this type.

Conclusions/action items: From here, I want to share this information with my group and see if we have access to a machine of this type. Also, I want to stress to them that this type of testing seems important and we should try to implement it.

10/24/2025 EcoFlex Properties

Cadence SEYMOUR - Oct 24, 2025, 11:51 AM CDT

Title: EcoFlex Chemistry and information

Date: 10/24/2025

Content by: Cadence Seymour

Present: N/a

Goals: My goals for this research session were to understand how EcoFlex works so that I can explain it to my group. We were talking about it last week, and I wanted to research it to get more information about how it congeals helpfully and elastically from a chemical standpoint.

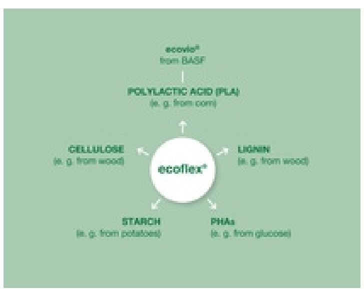
Citation:

[1] "Ecoflex® (PBAT)," *Basf.com*, 2022. https://plastics-rubber.basf.com/global/en/performance_polymers/products/ecoflex

Content:

-Ecoflex is considered a biopolymer and was created in 1998 as the first biodegradable and certified compostable plastic by BASF on a fossil basis.

-Its decomposable nature makes it part of a very circular lifecycle. It is used and recycled so that it can be remade again from the original components.



-Ecoflex is made of many polymers together that give it its characteristic elasticity

-This resource states that, "EcoFlex is an ideal blend component for the production of plastics from renewable raw materials like polyactic acid (PLA), making many applications actually possible in the first place. Thus, Ecoflex provides the bio-based and certified compostable BASF biopolymer ecovio with special material properties such as flexibility and toughness."

-This flexibility and toughness are what allow it to properly replicate the human anatomy and vagina and cervix in different concentrations.

-They go on to say, "Mechanical characteristics such as stiffness or puncture resistance can be varied and specifically adjusted." Again, this is a property of Eco Flex we will be implementing in our design because it will be crucial that our cervix can withstand puncture. We can add thinner or thickening agents to change this composition and material properties.

Conclusions/action items: From here, I now know more about EcoFlex as a product, and the company that it sells from. I also know specifically the way we can go about changing the mechanical properties of the material in order to best replicate the cervix. I plan to continue to research this and share the information I found with my group members.

10/24/2025 EcoFlex best practices

Cadence SEYMOUR - Oct 24, 2025, 12:17 PM CDT

Title: EcoFlex best practices.

Date: 10/24/2025

Content by: Cadence Seymour

Present: N/a

Goals: The goals for this research session were to continue to gather information about how EcoFlex works and the advantages of using it as our primary material. Specifically, I want to learn more about how the Ecoflex parts combine to form their elastic shape hours later.

Citation:

[1] "Ecoflex™ GEL Product Information," *Smooth-On, Inc.* https://www.smooth-on.com/products/ecoflex-gel/

Content:

- The first bit of information i found important when researching EcoFlex is that the brand SmoothOn (its primary seller), recommends some releasing agent to be present when molding. They recommend something like Ease Release™ 200, which is another one of their products, that just increases the simplicity of the release form, whatever mold you are using. This is something I plan to share with my group and potentially advocate to implement in our design based on how our first mold comes out and the ease of removal.

-The Ecoflex elastiomer consists of two portions, of two individual elastomers, that when mixed in an almost perfect 1:1 ratio, congeal to form the flexible rubber-like material that is skin safe and used for a lot of medical applications.

-They recommend that both portions of the mixture be mixed extremely well before combining to ensure the best product mixture texture and result.

-Additionally, they want you to mix the two portions very thoroughly as well. This part is crucial in making sure the product turns out the way that you want; otherwise, the uncombined mixture won't release the way you intend and can get stuck in the mold. They even go as far as to say that it is best practice to "double mix," which just means mix it in one container thoroughly, scrape the sides, and transfer to a different container, then mix in the second container just as thoroughly, also scraping the sides there, then continuing to pouring.

-Lastly, you need to wait several hours to make sure the material is fully set before use. After 2 hours at room temperature (23 degrees Celsius), they consider the mixture completely set and ready to be released from the mold and used. Although I think our group should continue to let it rest overnight to make sure it is completely ready for use.

Conclusions/action items: From here, I can now share this information with my group members as we start to mold our products and do material testing on the EcoFlex. Specifically, I want to bring up with my group members their thoughts on the releasing agent and see if it is something we will be implementing into our design for ease of use for the client.

Comments

Randolph Ashton Oct 30, 2025, 10:40 AM CDT

Great research. Continue to document how this translates into design ideas and contributions to the final prototype.

12/06/2025 WARF Process

Cadence SEYMOUR - Dec 06, 2025, 4:48 PM CST

Title: 12/06/2025 WARF Process

Date: 12/06/2025

Content by: Cadence Seymour

Present: N/A

Goals: The goals for my research session today were to look into the WARF process a little more, after just having our meeting with them on Friday. I want to understand what to expect in the far future and the couple of weeks to come.

Link: https://www.warf.org/

Citation:

[1] "WARF - Wisconsin Alumni Research Foundation," *WARF*. https://www.warf.org/

Content:

-We know from meeting with the WARF representative on Friday that we start by meeting with him to explain our idea and fill in any gaps they might have in understanding of the purpose of our project.

-We had explained to him the basics of the design and demand in the market right now for our product, as well as specifically how our design varies from other existing designs on the market.

-The main points we hit with him were that we explained the need for the cervicovaginal junction, a piece our model kit has that others don't, as well as the overall cost being lower than $50 to create keeps this much better in the reasonable range for physicians than the existing designs on the market.

-From reading the website, we can see that they are a nonprofit organization that invests in people's designs, and requires the inventor to sign over the intellectual property of the design and agree to receive 20% of the future potential revenue.

-They invest about $200 million into new ideas each year, with each patent being 10 to 25k to maintain.

-Once they have the patent, they will then search for people to license the idea and try to sell it for the revenue to be returned to the organization to reinvest in the future of research.

Conclusions/action items: From here, I now know how the patenting process works through WARF. My group met with them on Friday and we will know if we are offered a patent by the 20th of December, which is their next group meeting.

12/06/2025 Patenting Not Through WARF Process

Cadence SEYMOUR - Dec 06, 2025, 5:08 PM CST

Title: Patenting Not Through WARF Process

Date: 12/06/2025

Content by: Cadence Seymour

Present: N/A

Goals: My goals for this research session were to understand what the process might be like if we didn't patent through WARF, and how much it might cost the group to do so.

Link: https://www.uspto.gov/patents/basics/essentials#questions

Citation:

[1] United States Patent and Trademark Office, "Patent Essentials," *www.uspto.gov*. https://www.uspto.gov/patents/basics/essentials#questions

Content:

- Directly from the website above, I found this quote explaining exactly what a patent is, "A U.S. patent gives you, the inventor, the right to "exclude others from making, using, offering for sale, or selling" an invention or "importing" it into the U.S. A plant patent gives you additional rights on the "parts" of plants (e.g., a plant patent on an apple variety would include rights on the apples from the plant variety)" [1].

-We would want from a patent the ability to pursue our own business and try to sell the product we have made, based on what we perceive to be a great demand for it.

-A patent we would apply for would be a design patent, a design patent is good for 15 years.

-They state the criteria of what deserves a patent is...

"So, for a patent to be issued, your invention must meet four conditions:

1. Able to be used (the invention must work and cannot just be a theory)
2. A clear description of how to make and use the invention
3. New, or "novel" (something not done before)
4. "Not obvious," as related to a change to something already invented" [1].

-As inventors, we are allowed to patent not through an additional party like WARF; however, we have to pay the 10-25k for the patent as discussed in the previous research entry.

Conclusions/action items: In conclusion, it doesn't sound like we as a team are going to be applying for the patent on our own due to the cost constraints. We will discuss it more as a group and conclude once we hear from the WARF team on the 20th. Ideally, we get the WARF patent and don't need to worry about it.

12/06/2025 IUD Market Demand

Cadence SEYMOUR - Dec 06, 2025, 5:26 PM CST

Title: 12/06/2025 IUD Market Demand

Date: 12/06/2025

Content by: Cadence Seymour

Present: N/A

Goals: My goals for this research session were to figure out if there is a large increase in IUD interest in the younger population. We have seen statistics in the past to support this idea, but I would love to find some more empirical evidence to send to the WARF team.

Link: https://wcorlando.com/why-the-iud-has-increased-in-popularity/

Citation:

[1] ss_admin, “Why the IUD Has Increased in Popularity,” *The Women’s Center*, Nov. 29, 2018. https://wcorlando.com/why-the-iud-has-increased-in-popularity/ (accessed Dec. 06, 2025).

Content:

-One of the more compelling comments I've seen from this website was the following: "For women who are looking for a cost-effective, long-acting form of birth control that requires no day-to-day effort, works more than 99% of the time, and is completely reversible, nothing compares to the intrauterine device (IUD)" [1].

-The website says that 1% of women possessed the IUD in the mid-1990s; now it accounts for at least 10% of women.

-Another incredibly important piece of information when considering their demand right now is their effectiveness. More now than ever, people do not want to have kids, so the effectiveness would be greatly considered amongst that population (This is backed statistically in a different research tab.) To touch on this point to validate the previous, the source says, "IUDs are also 20 times more effective over time than the pill, patch, and ring, largely because they take the user out of the equation. With an IUD, you don’t have to remember to change your patch on time or take a pill at the same time every day. IUDs are so effective, in fact, that only two other forms of birth control have higher rates of effectiveness: permanent sterilization, which is 99.9% effective, and abstinence, which is 100% effective" [1].

- They also say that one of the things that makes IUD the best form of birth control is that they are completely reversible where whereas the competing methods in effectiveness are not, such as sterilization.

Conclusions/action items: Because I claimed that people are now more than ever trying to have fewer and fewer kids, I need to go find some data to back up that statement. Additionally, I want to research how the PCB plays into this demand for IUDs.

12/06/2025 Declining birth rate in the early 2000's

Cadence SEYMOUR - Dec 06, 2025, 5:35 PM CST

Title: Declining birth rate in the early 2000s.

Date: 12/06/2025

Content by: Cadence Seymour

Present: N/A

Goals: As I previously stated in the conclusion of the prior document, for this research session, I want to find some statistics to back up my statement about people wanting to have fewer and fewer kids nowadays.

Link: https://www.cbsnews.com/news/us-birth-rate-all-time-low-cdc-data/

Citation:

[1] "U.S. birth rate hits all-time low, CDC data shows," *Cbsnews.com*, Jul. 24, 2025. https://www.cbsnews.com/news/us-birth-rate-all-time-low-cdc-data/

Content:

-The US birth rate has his an all-time low this past year in 2024, of fewer than 1.6 children being born to each woman this year.

-I was using this fact to support the increase in IUD demand; however, this website seems very concerned for the future of the US, and a potentially harmful increase in IUD desire could result. They said, "The U.S. was once among only a few developed countries with a rate that ensured each generation had enough children to replace itself — about 2.1 kids per woman. But it has been sliding in America for close to two decades as more women are waiting longer to have children or never taking that step at all" [1].

-Later in the article, they defined this decrease because of the increase in the general population, and they consider the low birth rate to be a delay, and we, as a country, just need to be patient and wait for this reality to change.

Conclusions/action items: From this, I mostly just wanted to make sure my claims were all statistically backed, and they are by federal data, so there is no further research needed on this topic.

12/06/2025 Effectiveness of Paracervical block procedure for IUD insertion

Cadence SEYMOUR - Dec 06, 2025, 6:00 PM CST

Title: Effectiveness of Paracervical Block Procedure for IUD insertion

Date: 12/06/2025

Content by: Cadence Seymour

Present: N/A

Goals: my goals for this research session were to get a better understanding and factual data to show that the PCB makes a huge difference in the IUD insertion process to strengthen our claim for WARF patent.

link: https://www.acog.org/clinical/clinical-guidance/clinical-consensus/articles/2025/05/pain-management-for-in-office-uterine-and-cervical-procedures

Citation:

[1] "Pain Management for In-Office Uterine and Cervical Procedures," *Acog.org*, 2025. https://www.acog.org/clinical/clinical-guidance/clinical-consensus/articles/2025/05/pain-management-for-in-office-uterine-and-cervical-procedures

Content:

-One of our biggest points as a team for the demand for our product is that there is a new light being shone on the pain that women endure during gynecological procedures. This light is going to increase the demand for pain management techniques as a result. If we can prove that the paracervical block is one of, if not the most, effective form of pain management for IUD insertion, we would greatly increase our chances of selling this as a product.

-It is comments like this, "Historically, Black patients have received less analgesics than White patients, and women have received less attention to their pain than men undergoing similar procedures," that make me think there is a new light being shone on women's pain management [1].

-Even if the reader chooses to ignore the physical need for better pain management techniques, "Higher levels of preprocedural anxiety or of expectations of pain are associated with higher levels of patient-reported pain with office procedures," as a fact, prevents you from denying the impact having them would have on the mental aspect of the procedure [1].

- Lastly, in their conclusion section, they state plainly two facts from the studies they ran that I think are extremely relevant to this topic: "There is sufficient high-quality evidence to recommend local injected anesthesia," and "Paracervical blocks decrease procedural pain for uterine aspiration" [1].

Conclusions/action items: From this, we now have a source with empirical data to represent the need for the paracervical block or any pain management techniques for women's gynecological procedures.

12/06/2025 Effectiveness of Paracervical block procedure for IUD insertion

Cadence SEYMOUR - Dec 06, 2025, 6:12 PM CST

Title: Effectiveness of Paracervical Block Procedure for IUD insertion

Date: 12/06/2025

Content by: Cadence Seymour

Present: N/A

Goals: The goal for this research session is the same as the previous, to get a better understanding and factual data to show that the PCB makes a huge difference in the IUD insertion process to strengthen our claim for WARF patent.

link: https://pmc.ncbi.nlm.nih.gov/articles/PMC6438819/

Citation:

[1] S. K. Mody, J. P. Farala, B. Jimenez, M. Nishikawa, and L. L. Ngo, “Paracervical Block for Intrauterine Device Placement Among Nulliparous Women,” *Obstetrics & Gynecology*, vol. 132, no. 3, pp. 575–582, Sep. 2018, doi: https://doi.org/10.1097/aog.0000000000002790.

Content:

-From a National Library of Medicine study, they concluded based on a study of 64 women with no baseline differences, "A 20 cc buffered 1% lidocaine paracervical block decreases pain with IUD placement (primary outcome), uterine sounding (secondary outcome), and 5 minutes after placement (secondary outcome). While paracervical block administration can be painful, perception of pain for the overall IUD placement procedure is lower compared to no block" [1].

- The design of the study was as follows: "In a randomized, single-blind, placebo-controlled trial, women were assigned to receive either 20 cc buffered 1% lidocaine paracervical block or no block prior to IUD placement. The primary outcome was pain with IUD placement measured on a 100 mm visual analog score (VAS)" [1].

-The biggest takeaway from this study is that the women with a PCB notice a significant decrease in pain with IUD insertion than those who did not receive one.

-This data helps us to support the claim that the Paracervical block training model kit would be of use in a clinical setting and will likely become more popular or in demand.

-if you put together the fact that more people are getting IUDs with the fact that a PCB is one of the most effective forms of pain management, you can conclude that the demand for our product is going to be increasing as well.

Conclusions/action items: This is all the relevant information I want to share with our WARF partner throughout this process.

9/13/2025 Existing Designs

Cadence SEYMOUR - Sep 17, 2025, 5:51 PM CDT

Title: Existing Designs

Date: 09/13/2025

Content by: Cadence

Present: N/A

Goals: My goals for this read were to figure out what designs already exist for paracervical block training. Additionally, I want to come up with some flaws in each of these designs, as well as things I think they're accomplishing well. From here, we might be able to get a better idea of the form our project will take in many ways, such as materials, size, height, multiple pieces, and many other factors.

Citation: Laerdal Medical. (n.d.). Clinical female pelvic trainer Mk 3 - advanced. Retrieved from https://laerdal.com/sg/item/LIM-60905?srsltid=AfmBOopxy-Hzw_5m4IDeoT9h4MKxwSqWjWS0RD6GK79pZ1I5UBHhrUbz

Link: https://laerdal.com/sg/item/LIM-60905?srsltid=AfmBOopxy-Hzw_5m4IDeoT9h4MKxwSqWjWS0RD6GK79pZ1I5UBHhrUbz

Content:

-From this website, I was able to see one of the current models on the market.

-It did not explicitly say that this could be used for paracervical block training; however, the model contains the correct anatomy to do so: cervix and vagina.

-Additionally, this product has an easily removable stomach area to see into the internal portion of the kit.

-It has partial thighs as well as correct outside anatomy to mimic the speculum insertion process of any procedure as well.

-There are detachable "modules" for different training sessions to help the physician focus on one specialized goal.

-The price range here, however, is much higher than we are given, but each model kit possesses a level of complexity that our models will not have due to our more focused design.

-These products are made of a material similar to silicone and latex.

Conclusions/action items: From researching other model kits on the market, I have realized now that ours will be more focused on one procedure, the Paracervical block, and because of that, it will be much simpler and cost-effective. I also have gained information about the materials these types of simulators are made of, and I will use that new knowledge to brainstorm ideas for our design.

10/09/2025 Competing Designs Materials

Cadence SEYMOUR - Oct 09, 2025, 3:47 PM CDT

Title: Competing Designs Materials

Date: 10/09/2025

Content by: Cadence Seymour

Present: N/a

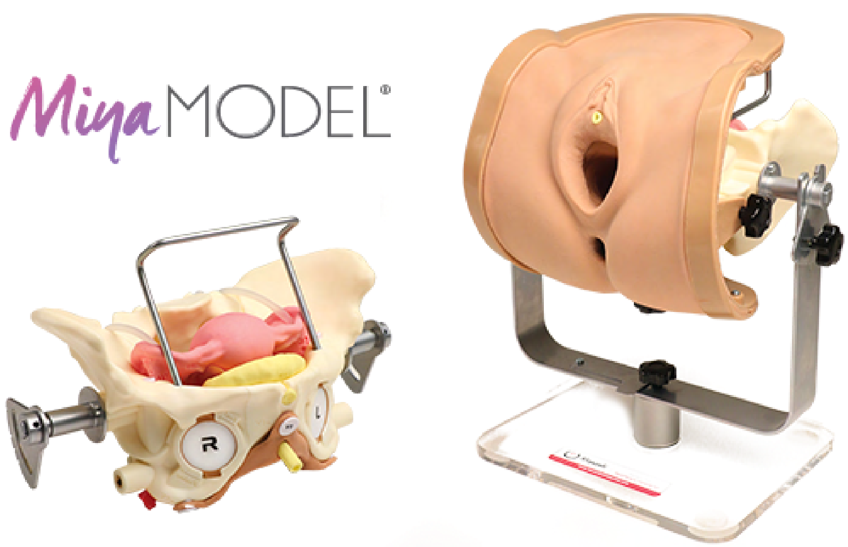
Goals: My goals for this research session were to get a good idea of what other trainer kits that we are basing off of are made of. From there, we can base some material/make-up ideas for our project.

Citation:

[1] "The Miya Model – Miyazaki Enterprises," *Miyazakienterprises.com*, 2024. https://miyazakienterprises.com/miya-model/

Content:

Taken directly from the Miya model website and team, they describe the trainer as, "The Miya Model consists of a pelvic frame and multiple replaceable anatomic cartridges, designed with specific surgical procedures in mind. The model incorporates several features to simulate real surgical experiences, including lifelike skin and life-size organs, realistic cutting and puncturing tensions, palpable surgical landmarks, a pressurized vascular system that can simulate bleeding due to inadequate technique, and an inflatable bladder that leaks water if damaged."



-The Miya Model (pictured above) is one of our most common comparisons when it comes to basic ideas. We like the idea of the physical appearance accuracy within the design, as well as the rotational capabilities in the design, so that it can properly imitate the tilt of a true vagina during the gynecological processes.

-The parts of the design we won't be implementing are the buttox in the back of the design and the general complexity and price point. For our project, we need to stay closer to $50 per design, and this training kit is much more expensive and out of this range.

-The Miya model, however, like I said, imitates the anatomy mechanically in a similar manner that we would like to, so I wanted to look into the materials it was made out of to gather insight on what we could construct our similar portions out of.

-The model's cervix and vagina (the pieces we will also be implementing) are made out of medical-grade silicone. Medical-grade silicone is the material we were previously planning to use in our design, so seeing it in a real published design is reassuring for our team.

Conclusions/action items: From here, I plan to discuss with my team the specific material we think is best and begin manufacturing the mold for this process. We also have to consider our clients' access to the material we chose, so I will bring that up with them in the discussion.

11/10/2025 Competing Design Uterus Simulation Model

Cadence SEYMOUR - Dec 06, 2025, 4:21 PM CST

Title: Competing Design Uterus Simulation Model

Date: 11/10/2025

Content by: Cadence Seymour

Present: N/A

Goals: My goals for this were to get a better understanding of what other ideas already exist with the same premise of design.

Link: https://www.granvillebiomedical.ca/products/venus-trio

Citation:

[1] “Venus Diversity Trio - Pelvic Health Educational Models,” *Granville Biomedical Inc.*, 2020. https://www.granvillebiomedical.ca/products/venus-trio

Content:

-This Venus design is different from most because it is very small and portable.

-The design costs $388 for three identical models (aside from the color of the skin like exterior), making the unit price roughly $129. The goal for our product is to be $50 a piece to produce.

-This design also uses a medical-grade silicone type of material, the same as we do; however, we use the EcoFlex 00-20.

-The outer vaginal opening is a feature I really like in this design, and it adds a lot of anatomical realism to the design we should also try to emulate.

-These models can be used in clinical settings or to show patients the procedure.

-To clean these models, you just use mild soap and water

-The company recommends that you use minimal force on the model kit, as it is fragile.

Conclusions/action items: In conclusion, this design still doesn't possess reusability, the way our design should. As I have mentioned before, this kit requires minimal force with use; our kit will be more durable.

09/24/2025 Design ideas

Cadence SEYMOUR - Sep 24, 2025, 6:23 PM CDT

Title: Design idea 1

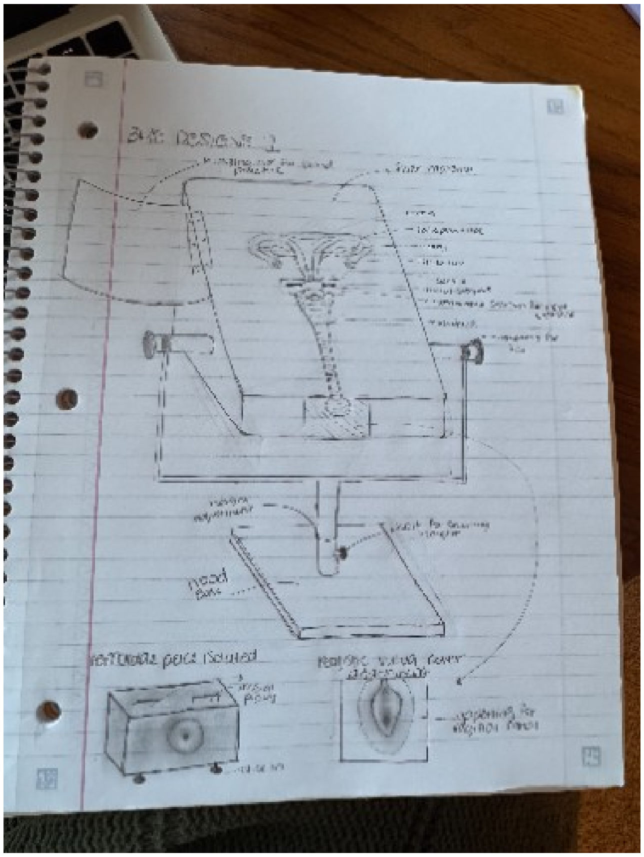
Date: 09/24/2025

Content by: Cadence Seymour

Present: N/a

Goals: The goals for this entry are to draw out my initial design ideas to get a better idea of where I can improve the idea or design.

Content:



-This is my initial drawing for how our design might look

<u>Some of the key components of this design are</u>

-The ability to raise up or rotate forward or backwards for eye-level practice.

-Additionally, we have a removable cervix portion that we change out when the silicone becomes too perforated to maintain accurate pressure.

-The realistic vaginal opening for speculum insertion

-The box has a cover for "blind" or unguided practicing without depth advice from visual landmarks.

Conclusions/action items: After drawing this out, I think I could work to better simplify the design and make the price range for production more realistic to our budget. I plan to explore these ideas with input from the clinic we attend and advice from the residents who are learning there.

10/29/2025 Solid works dog bone MTS testing design

Cadence SEYMOUR - Oct 29, 2025, 6:36 PM CDT

Title: solid works dog bone MTS testing design

Date: 10/29/2025

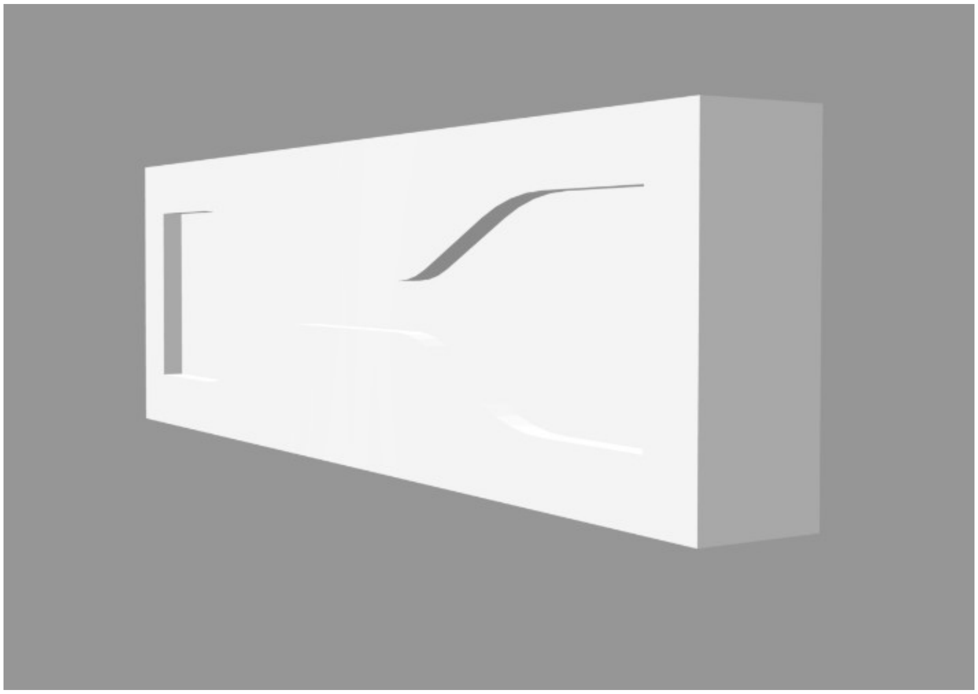
Content by: Cadence Seymour

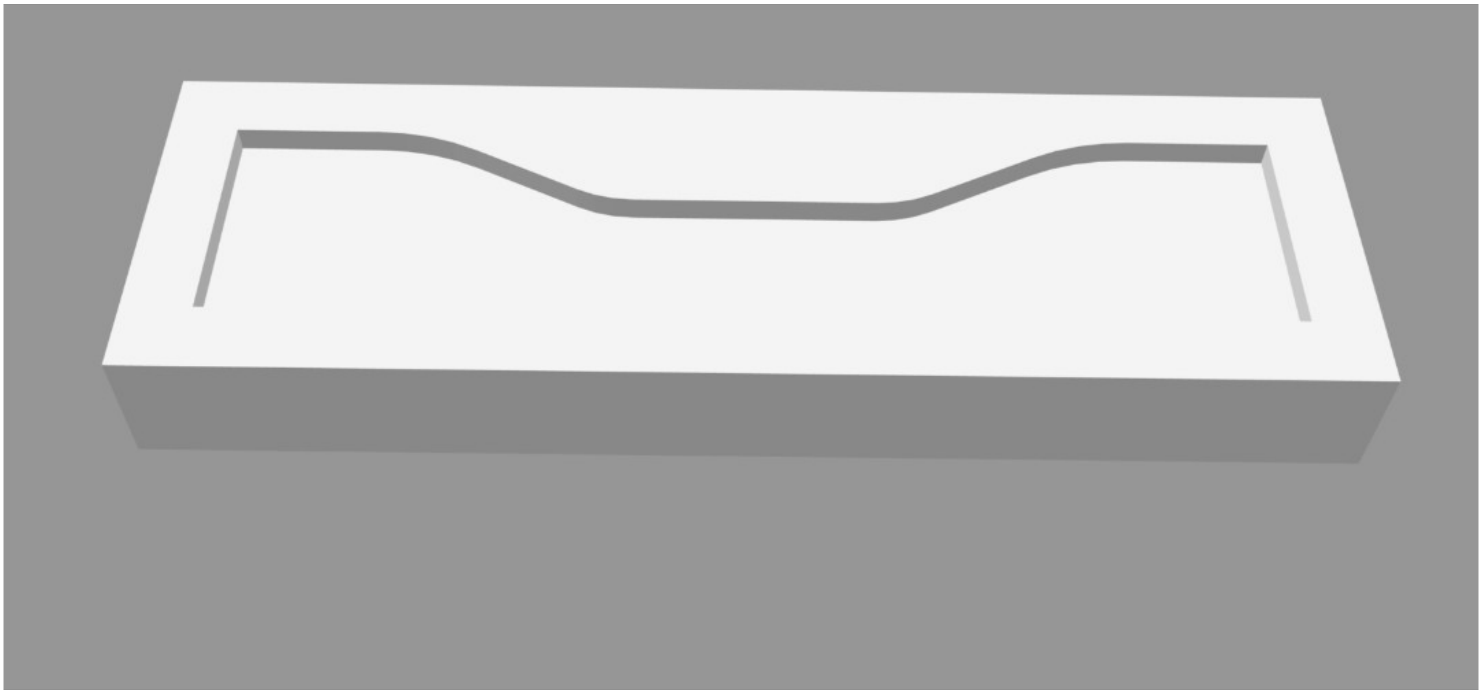
Present: N/a

Goals: My goals for this design were to plan out and create a mold for the dog bone for our MTS testing we will be doing next week. I wanted to collaborate with my 300's and get some advice on how to best use SolidWorks and familiarize myself with the program.

Content:

I made this dog bone mold with the 300s to be used to create the bone for MTS testing next week. The imaging is weird; being white, it is hard to see the hole in the mold.





Conclusions/action items: After doing this we now all have this mold made for use next week during our MTS testing. I also now know the basics of how to use solid works and can use it more in the future for more projects.

10/29/2025 Designs for uterus/cervix connection

Cadence SEYMOUR - Oct 29, 2025, 7:09 PM CDT

Title: Designs for Uterus-Cervix Connection

Date: 10/29/2025

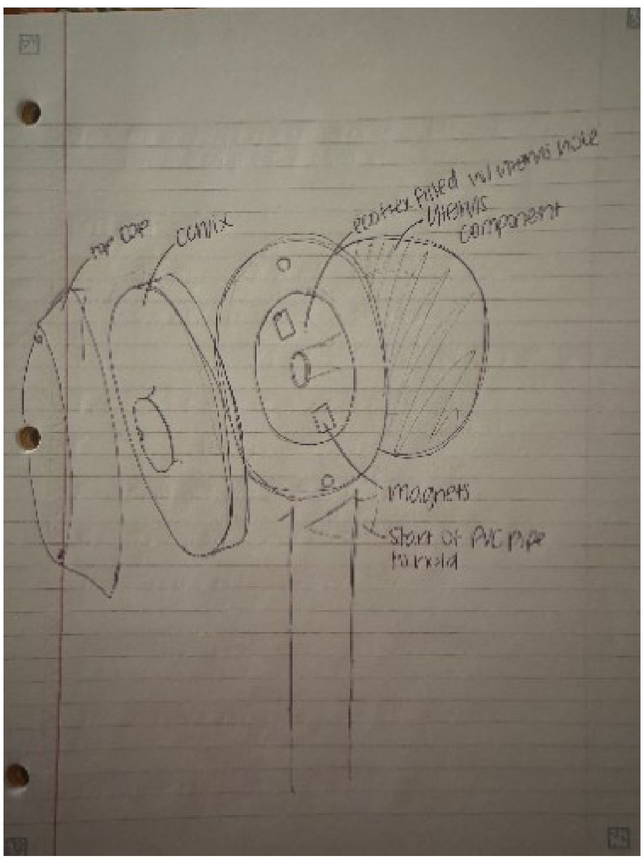
Content by: Cadence Seymour

Present: N/a

Goals: My goals for this session were to brainstorm some ideas about how we might connect the uterus and cervix portions of our trainer, even though they are separate components. This is crucial not only because it is anatomically accurate, but because it is something our client has stressed as a priority of hers as well.

Content:

When I was thinking about how we might connect the two portions of the design so that when you pull on the tenaculum, you are actually stretching out the uterus portion of the trianer, as you do in the real procedure, I came up with a couple of ideas. The best idea I came up with was adding magnets to the inside of the design, on the inner face of the uterus portion, as illustrated below. In doing this, we would also add the corresponding magnets on the back side of the cervix portion on the trainer as well. When they are connected, they would pull with one another so that when the tenaculum adds force, it stretches out the uterus's eco flex portion. This would also act as our "stopper" part of the design, to show how far the needle has been inserted and teach proper depth. All of this can be visualized below.



Conclusions/action items: from here, I want to explain these ideas to my group members and get their input to hopefully improve the ideas further and best suit our final product. I really want to continue brainstorming additional ideas as well.

11/05/2025 New Cervicovaginal junction design

Cadence SEYMOUR - Nov 05, 2025, 5:00 PM CST

Title: Connecting piece new design

Date: 11/05/2025

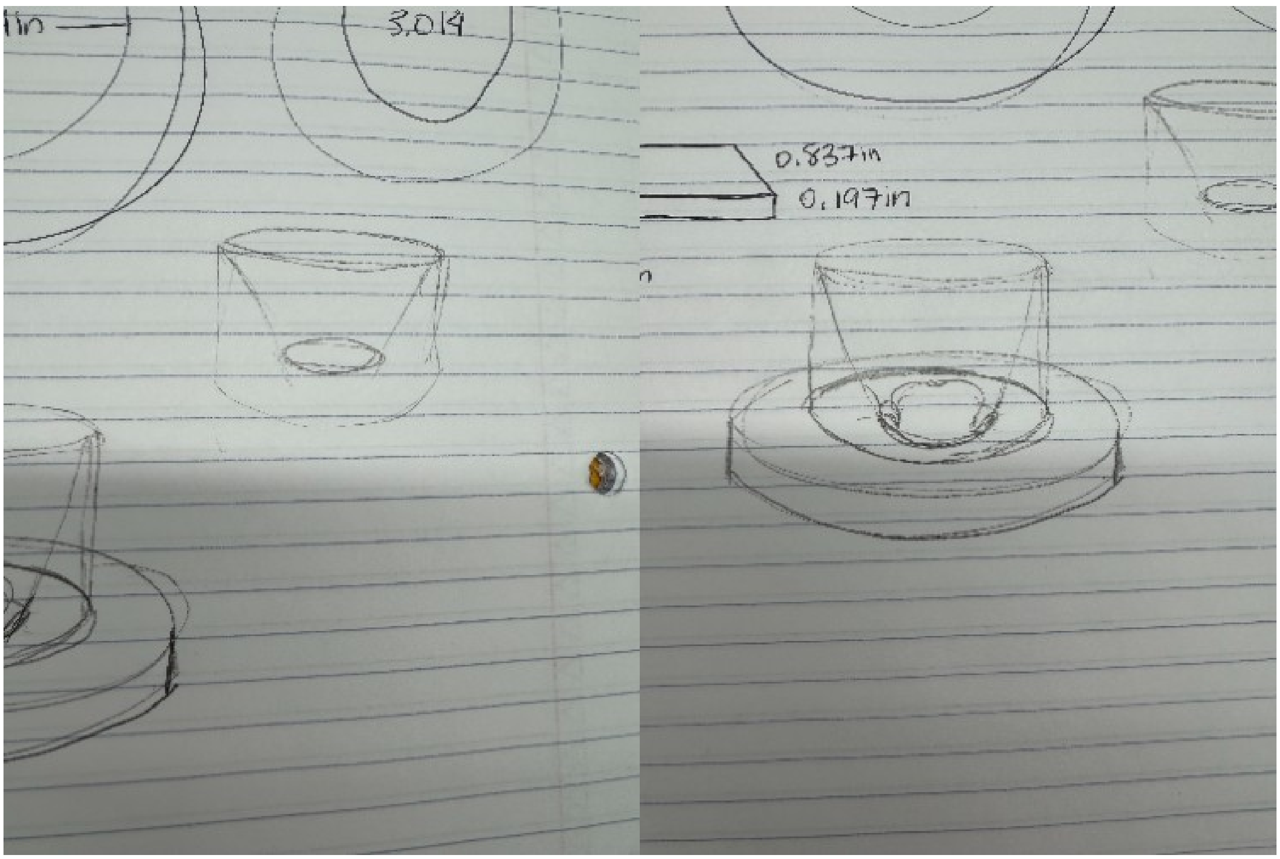
Content by: Cadence Seymour

Present: N/a

Goals: my goals for this session were to design out some ideas for the cervicovaginal junction being too thin, as well as there being no vaginal wall to surround the cervix. Once I get these ideas, I am going to share them with my group to hopefully fully resolve the problem.

Content:

I drew this idea of including a new inner lining on the inside of the design for the PVC pipe to encapsulate. This will provide new friction in the design that would improve the adhesion of the individual pieces as well. I think this is a good addition and would cost us virtually nothing to manufacture and implement into our existing design without having to make further alterations.



Conclusions/action items: From here I have a solid idea to present to my group how I want to go about fixing the two existing problems out client identified. I will show them later tonight and hopefully result the issue with the team and see their ideas as well.

11/05/2025 New connecting piece design

Cadence SEYMOUR - Nov 05, 2025, 5:04 PM CST

Title: New connecting piece design

Date: 11/05/2025

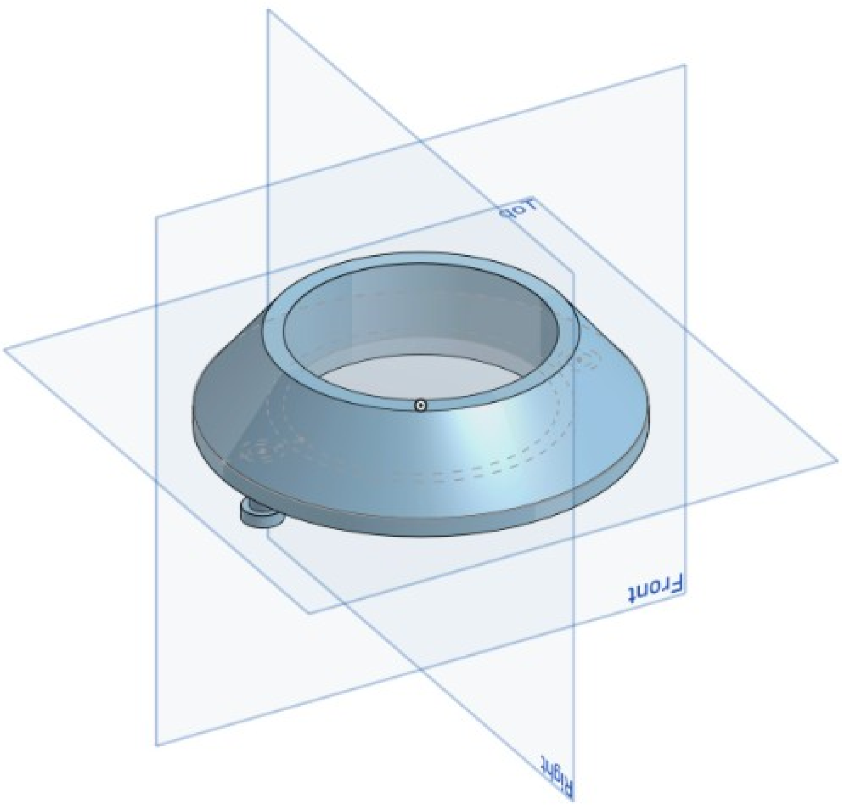
Content by: Cadence Seymour

Present: N/a

Goals: My goals for this session were to redesign the connecting piece of our design with the correct dimensions so that it properly fits within the PVC pipe we just received in the mail.

Content:

I designed the new piece with an inner dimension of 2.7in, rather than 3.014in in the previous design, to account for the new diameter measurements we have on the real PVC pipe. I created this in Onshape by making a sketch and selectively extruding, mirroring, and rotating it until the piece was virtually identical, just with different dimensions. You can see the piece I made down below, as well as in the final design.



Conclusions/action items: Now I have the final piece we need for the design adn from here we will measure the new cervix and alter it if need be. Lastly I need to change the design and reprint it for the final product.

11/05/2025 Mold for new cervix

Cadence SEYMOUR - Nov 05, 2025, 5:17 PM CST

Title: Mold for new cervix

Date: 11/05/2025

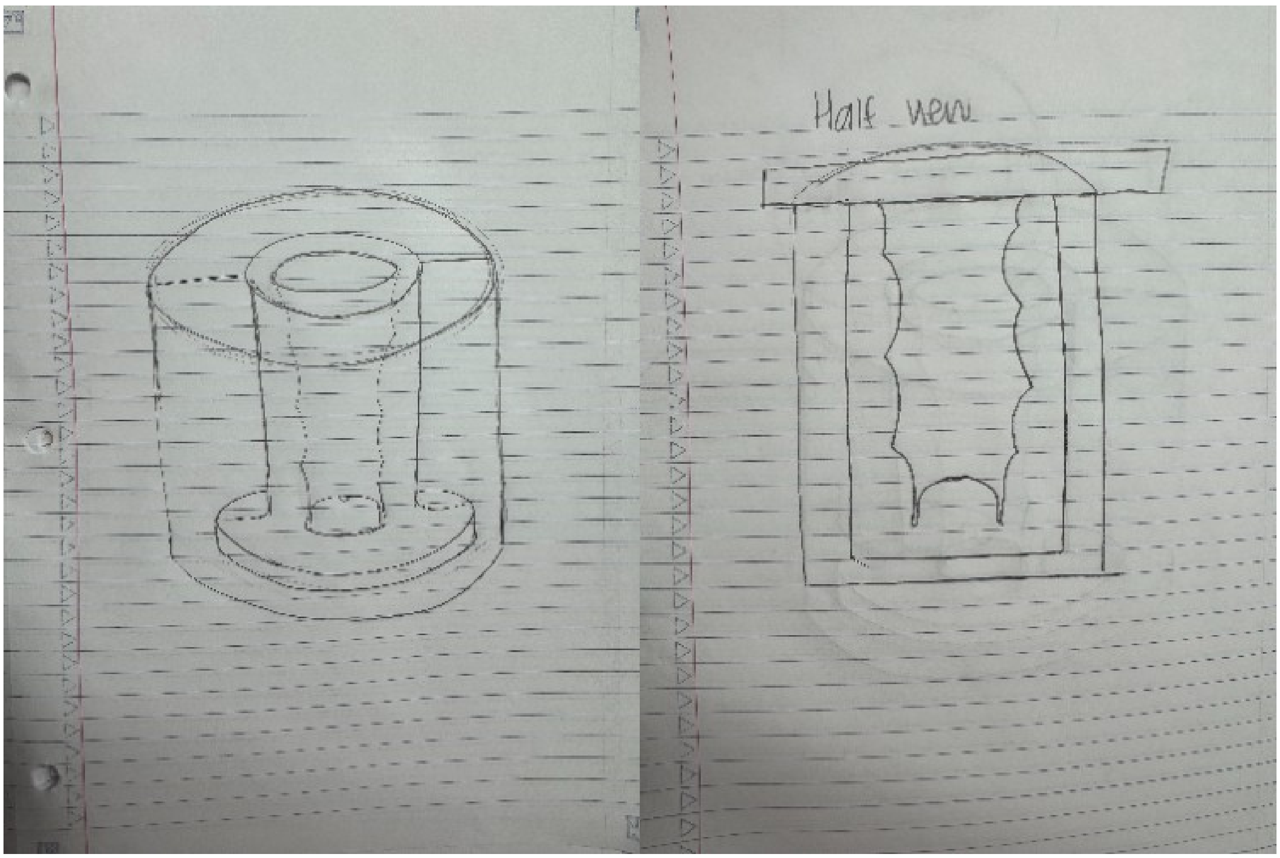
Content by: Cadence Seymour

Present: N/a

Goals: My goals for this research session were to create a rough sketch for the mold pieces we might need to accommodate my silicone design(also in LA, just a few entries back). This will help me get a better idea of how reasonable this design would be to produce as well.

Content:

This is the design I came up with to fill the mold with EcoFlex until it resembles the necessities of the trainer we didn't previously have.



Conclusions/action items: From here, I want to show this piece to my group and hopefully resolve some of the problems our client pointed out.

11/12/2025 Final New connecting piece

Cadence SEYMOUR - Nov 12, 2025, 8:22 PM C

Title: Final New Connecting Piece

Date: 11/12/2025

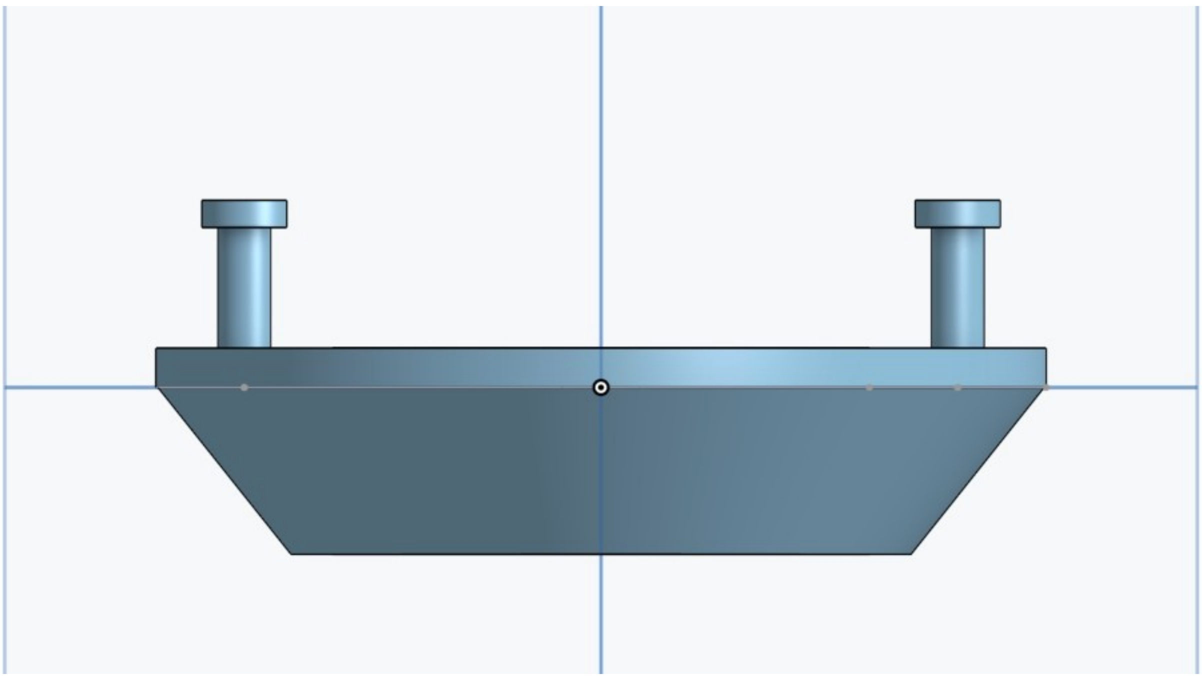
Content by: Cadence Seymour

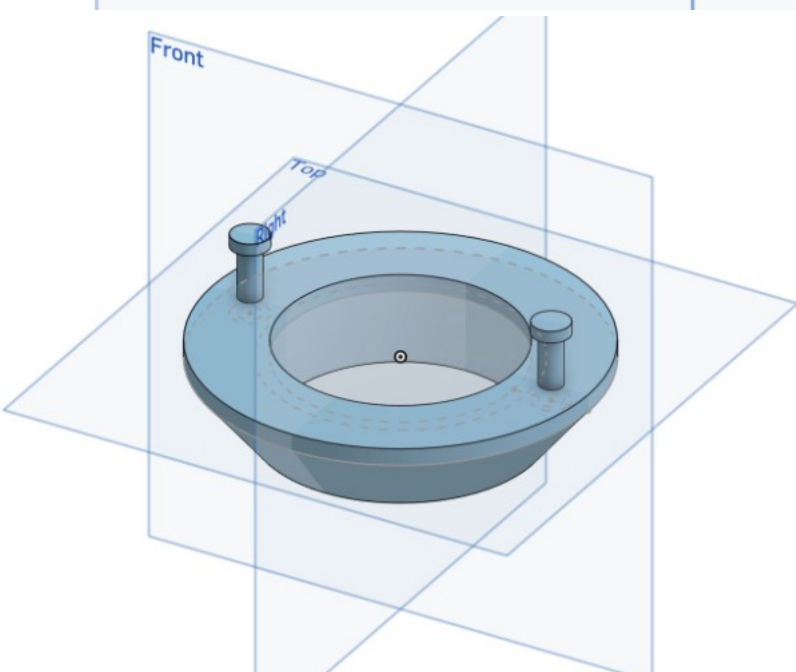
Present: N/A

Goals: My goals for this session were to finalize the new connecting piece design. it needed new peg dimensions to allow for both higher than higher-than-anticipated height, as well as the new components we added to the whole design.

Content:

Attached below is an image of the finalized design for our cervix connecting piece. It has longer pegs to adjust for the longer-than-anticipated cervix piece; additionally, it better fits PVC pipe we purchased more snugly. Overall, these improvements will greatly impact the design for the better.





Conclusions/action items: from here, I want to send this file over to my group members who are free later in the week so that we can get this piece printed. after it is printed we will start out assembly/

11/12/2025 MTS testing results

Cadence SEYMOUR - Nov 12, 2025, 8:36 PM CST

Title: MTS Testing Results

Date: 11/12/2025

Content by: Cadence Seymour

Present: N/A

Goals: The team went to MTS testing this past week to see if the material we have selected is strong enough to withstand the tension of the MTS machine, because it will surely be greater than the force required by the doctor to pull on the cervix with the tenaculum.

Content:

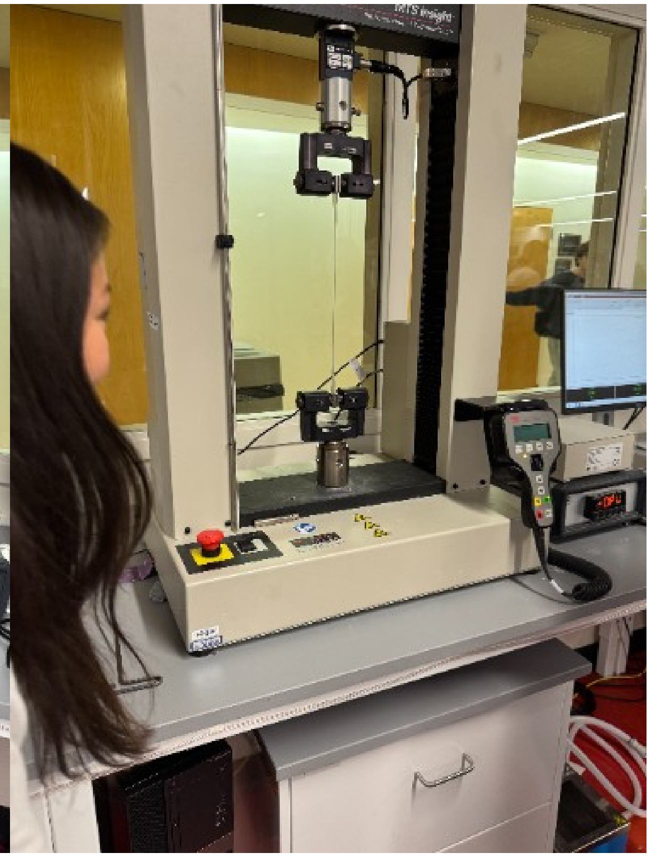
In the week before last, we printed the dog bone shape mold and filled them with our material for the cervix.

After this, we let them sit for 24 hours minimum.

We then took these ASTM standardized bones to the MTS machine in ECB and tested them under tensile load to get information like their Young's modulus and modulus of rigidity, as well as the ultimate strength.

Below, I have attached some of the pictures from the testing day to show how stretchy the EcoFlex 00-20 is.

We observed the max tensile stress to be around 5-6N of force, which is much higher than the anticipated range of 2-5N.



Conclusions/action items: From here, we have already spent 3 hours at the MTS machine in ECB, and we did not have time to complete the tension and compressive tests. We need to return and complete these tests as a team sometime next week, but for now, we are extremely pleased with the results we did observe.

12/06/2025 Schematic for final design

Cadence SEYMOUR - Dec 06, 2025, 4:38 PM CST

Title: Schematic for final design

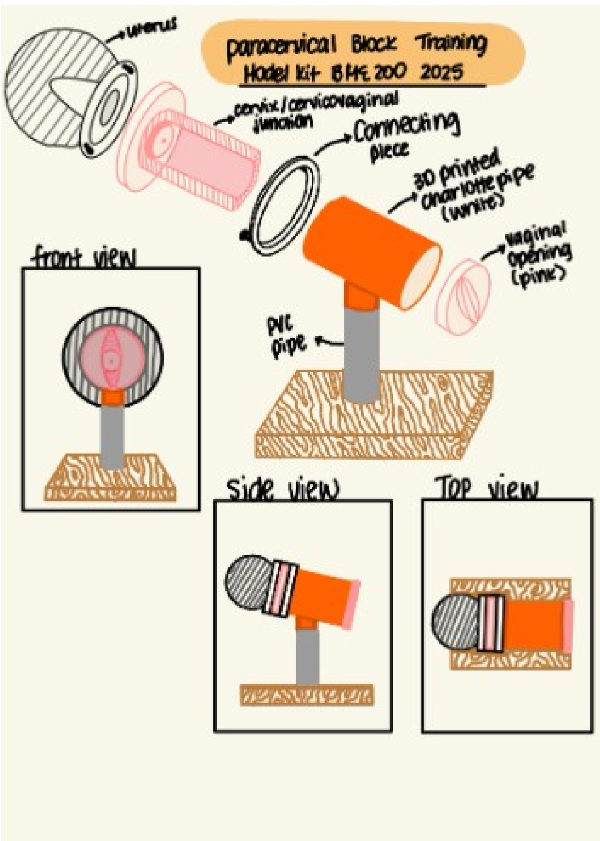
Date: 12/06/2025

Content by: Cadence Seymour

Present: N/A

Goals: My goal for this session was to create a clear schematic to add/show people in reference to our design.

Content:



Conclusions/action items: In conclusion, we have since changed the uterus design to no longer contain the inner portion for accuracy because of 3D printing limitations. This gives a clear image of the way our design is aiming to look, as well as some future work items worked in, such as the pelvic tilt.

10/24/2025 Intro to Machining

Cadence SEYMOUR - Nov 21, 2025, 10:15 AM CST

Title: Intro to Machining

Date: 10/24/2025

Content by: Cadence Seymour

Present: N/a

Content:

CADENCE SEYMOUR

ID Number: 9086776979

Eligibility: CoE Students

Profile

Program Registrations

Bookings

Memberships

Orders

Invoices

My Memberships

Membership Type	Start Date	Expiry Date	Renew	Card Info
Machining	Wed, Aug 20 2025	Permanent	Not Renewable	N/A
Machining - Training Eligible	Wed, Aug 20 2025	Wed, Dec 31 3000	Not Renewable	N/A
Shop Tools	Tue, Aug 20 2024	Thu, Jan 2 3000	Not Renewable	N/A
Laser Cutter	Tue, Aug 20 2024	Thu, Jan 2 3000	Not Renewable	N/A
Lab Orientation	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Renewable	N/A
Shop Tools - Training Eligible	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Renewable	N/A
Laser Cutter - Training Eligible	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Renewable	N/A

Conclusions/action items: I after this step continued and did my chemical safety courses.

10/28/2025 Chemical Safety Training

Cadence SEYMOUR - Nov 21, 2025, 10:20 AM (

Title: Chemical Safety Training

Date: 10/28/2025

Content by: Cadence Seymour

Present: N/a

Content:

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

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

This certifies that Cadence Seymour has completed training for the following course(s):

Course	Assignment	Completion	Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024-2025	10/29/2025	10/29/2028
Chemical Safety: The OSHA Lab Standard	Final Quiz	10/29/2025	

Data Last Imported: 10/31/2025 11:24 AM

Conclusions/action items: From here I will do my biosafety module too.

10/28/2025 BioSafety Training

Cadence SEYMOUR - Nov 21, 2025, 10:21 AM (

Title: BioSafety Training

Date: 10/28/2025

Content by: Cadence Seymour

Present: N/a

Content:

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

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

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Biosafety Required Training	Biosafety Required Training Quiz 2024-2025	10/29/2025	10/29/2028
Chemical Safety: The OSHA Lab Standard	Final Quiz	10/29/2025	

Data Last Imported: 10/31/2025 11:24 AM

Conclusions/action items: Now I have completed the required training for this course.

2025/09/11 - Paracervical Block Procedure

ABIGAYLE CHAPMAN - Sep 24, 2025, 6:52 PM CDT

Title: Paracervical Block and its effect on pain

Date: 09/11/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Gain a deeper understanding of what a Paracervical Block is, how it is administered and performed, and how it can be useful for IUD insertion.

Content:

Reference: https://www.sciencedirect.com/topics/medicine-and-dentistry/paracervical-block

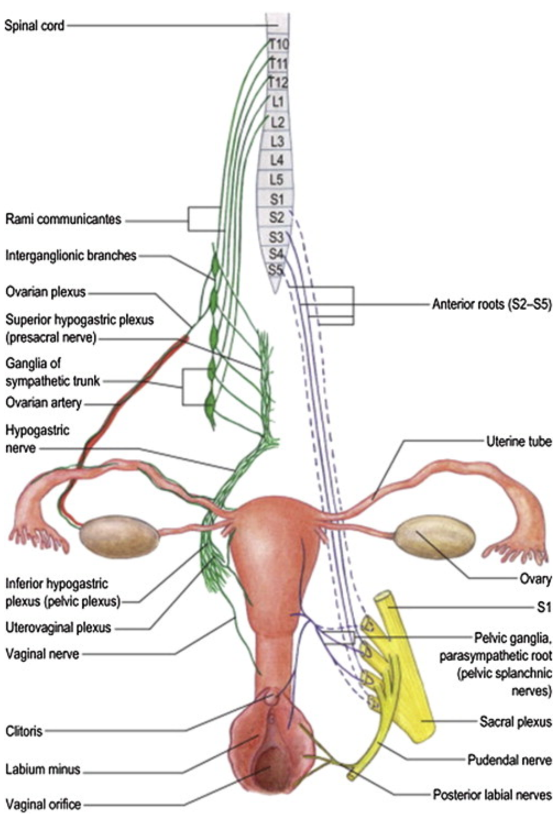
Citation:

Allen, Rebecca H., et al. “Pain relief for obstetric and gynecologic ambulatory procedures.” *Obstetrics and Gynecology Clinics of North America*, vol. 40, no. 4, Dec. 2013, pp. 625–645, https://doi.org/10.1016/j.ogc.2013.08.005.

-A paracervical block involves anesthetizing nerve bundles lateral to the cervix at 3 and 9 o'clock, and nerve bundles within the uterosacral ligaments.

-The pain reduction occurs due to cervical manipulation and dilation, but affects uterine pain levels to a lesser extent.

-Female reproductive organs have two main nerve pathways through which pain is perceived. The fundus of the uterus has sympathetic fibers from T10 to L2 (pictured below), which enter through the inferior hypogastric plexus. The cervix, upper vagina, and lower uterine segment have parasympathetic fibers going from S2 to S4 (pictured below) which enter the cervix with uterine blood vessels at 3 and 9 o'clock. The pudendal nerve connects with the lower vagina and vulva.



-Perceived pain on the patient's part can also be influenced by a patient's anticipation of pain and their anxiety levels. Regardless of procedures or precautions undertaken, overall pain reduction can also be achieved by enforcing a safe and comfortable setting.

Reference:https://pmc.ncbi.nlm.nih.gov/articles/PMC6438819/

Citation:

Mody, Sheila K., John Paul Farala, Berenice Jimenez, Moena Nishikawa, and Lynn L Ngo. “Paracervical Block for Intrauterine Device Placement Among Nulliparous Women: A Randomized Controlled Trial.” *September 2018*, September 1, 2019, 575–82. PubMed Central. https://doi.org/10.1097/AOG.0000000000002790

-Women who have never had children experience more pain during IUD insertion than women who have given birth previously. There is no current pain management standard for women who haven't had children undergoing IUD insertion, and most randomized trials of oral and local anesthetics have not seen a reduction in pain with IUD placement.

-According to results of the study, which looked at two groups and administered to one group the paracervical block while giving the other a placebo, those in the paracervical block group reported lower pain. This implies the block is useful for pain reduction.

Conclusions/action items: In conclusion, there are specific nerve bundles a paracervical block serves to numb in order to decrease sensation during a procedure such as an IUD placement. In general, the block can be a helpful tool in reducing discomfort, and patients report less pain with the block rather than without, so this product has the potential to make a positive impact by serving as a training device for the particular procedure. However, reducing pain during IUD placement involves more than just a competent and efficient administering of a paracervical block. It's also important to prioritize mental wellbeing of a patient and ensuring a safe and relaxing environment during the procedure, as well as eliminating any possible misconceptions for women undergoing IUD placement.

Comments

Randolph Ashton Sep 19, 2025, 11:45 AM CDT

Science Direct is a website not a publisher. Please use the publisher's name.

2025/09/18 - Cervix/Vaginal Anatomy

ABIGAYLE CHAPMAN - Sep 18, 2025, 7:44 PM CDT

Title: Cervix and vaginal anatomy

Date: 9/18/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Develop a more full understanding of the cervix and vagina.

Content:

Source: https://www.ncbi.nlm.nih.gov/books/NBK568392/.

Citation:

Prendiville, Walter, and Rengaswamy Sankaranarayanan. “Anatomy of the Uterine Cervix and the Transformation Zone.” In *Colposcopy and Treatment of Cervical Precancer*. International Agency for Research on Cancer, 2017. https://www.ncbi.nlm.nih.gov/books/NBK568392/.

Notes:

- Cervix is approximately 3 cm in diameter and 4 cm in length.

- Cervix has several linings: endocervical canal is lined with glandular epithelium, and the ectocervix is lined with squamous epithelium.

-A speculum tends to alter cervical positioning when properly placed. When a speculum is opened, the cervix generally is brought more centrally into view, into line with the longitudinal axis of the vagina.

-The intravaginal part of the cervix is at the top of the vagina and surrounded by vaginal fornices.

-Lateral, posterior, and anterior fornices are part of the vagina, frame the cervix. They are arched areas surrounding the cervix.

-Stroma of the cervix is dense, fibromuscular tissue. Vascular, lymphatic, and nerve supplies to the cervix pass through the stroma.

-The endocervix has many intricate sensory nerve endings, though there are only a few in the ectocervix

Source: https://doi.org/10.1007/s00192-011-1592-z.

Citation:

Egorov, Vladimir, Heather van Raalte, and Vincent Lucente. “Quantifying Vaginal Tissue Elasticity under Normal and Prolapse Conditions by Tactile Imaging.” *International Urogynecology Journal* 23, no. 4 (2012): 459–66. https://doi.org/10.1007/s00192-011-1592-z.

Notes:

-Regarding vaginal walls under normal conditions, average values for tissue elasticity for the anterior and posterior compartments were 7.4±4.3 kPa and 6.2±3.1 kPa respectively

Conclusions/action items: I now have a better understanding of cervix length and size, as well as the overall anatomy of this body part. The connectivity of the cervix to the vagina is also more clear to me. Additionally, I now have numbers to associate with the resistance of vaginal wall tissue, which will help us figure out what material to use for our model when considering the 'realistic feel' of vaginal tissue that our client has requested.

2025/09/18 - IUD insertion process

ABIGAYLE CHAPMAN - Sep 18, 2025, 9:33 PM CDT

Title: IUD Insertion Process

Date: 09/18/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Gain a more complete understanding of IUD insertion and how it works. Understand the steps somebody practicing insertion would perform in order to understand what features we may need our model to include.

Content:

Source: https://www.aafp.org/pubs/afp/issues/2005/0101/p95.html

Citation:

B. A. Johnson, "Insertion and Removal of Intrauterine Devices," *Am. Fam. Physician*, vol. 71, no. 1, pp. 95–102, Jan. 2005.

Notes:

-First, a sterile sounding device is used to check uterine cavity depth (between 6 and 9 cm in order to safely place an IUD)

-A flange is aligned with the IUD arms and set to the distance the uterus was sounded at

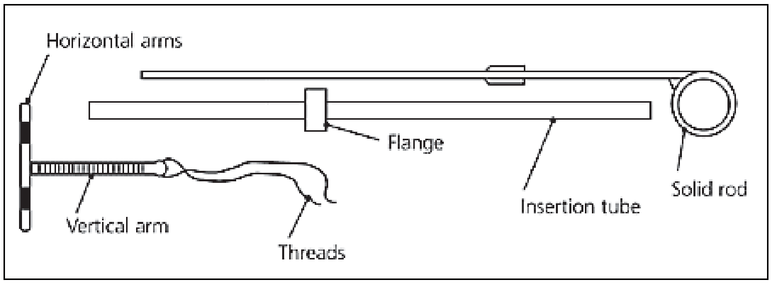
-Clear inserter rod is placed into the insertion tube, at the end opposite the arms of the IUD

-IUD is inserted until the flange is against the cervical os

-Tube will be pulled back by 2 cm so IUD arms are able to expand to their spread T-shape, and then slowly moved forward for positioning purposes.

-The insertion rod is removed by holding the insertion tube still and removing the tube and tenaculum.

-Lastly, the threads will be cut to a length of 3 cm, and sometimes are tucked away.



Conclusions/action items: Our model's uterine cavity should be at least 6 cm in depth, which is the minimum requirement for IUD insertion to be performed. It will also need to be T-shaped to allow for proper placement of an IUD, and to allow a user of the model to check for the proper placement of the device.

2025/09/25 - Materials mimicking vagina/uterus/cervix

ABIGAYLE CHAPMAN - Sep 25, 2025, 11:40 AM CDT

Title: Materials mimicking vaginal/uterine/cervical tissue

Date: 09/25/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Find potential candidates for materials for our model that closely mimic the feel of the vagina, uterus, and cervix in order to create a realistic experience for those using the paracervical block model for training purposes.

Content:

Source: https://www.brachyjournal.com/article/S1538-4721(14)00023-3/abstract

Citation:

Nattagh, Khashayar, Timmy Siauw, Jean Pouliot, I.-Chow Hsu, and J. Adam Cunha. “A Training Phantom for Ultrasound-Guided Needle Insertion and Suturing.” *Brachytherapy* 13, no. 4 (2014): 413–19. https://doi.org/10.1016/j.brachy.2014.01.003.

Notes:

-Physicians training for suturing and image-guided needle insertions (specifically for gynecologic brachytherapy (BT)) ideally need to be able to practice these scenarios prior to the operating room.

-A team created a low cost, realistic and disposable gynecologic phantom for this purpose. This model in particular was made for practicing image-guided BT needle insertion, placing a suture on the vaginal wall, and suturing the cervical lip.

-Phantom included a vaginal cavity, uterus, uterine canal, and cervix within a gelatin matrix.

-Uterus was made of gelatin and then coated with rubber to mimic soft tissue.

-Material costs were under $200 for the first phantom, and the total time the device was actively being practiced on was 3 hours before replacement became necessary. Following the first, future phantoms cost under $20 when accounting for only needing to replace parts, and these held up for 1 hour of active participation on the device.

-The elasticity of the gelatin was based on the speed of sound on the gelatin (1495 to 1506 m/s), which was determined using pulse echo measurements.

Conclusions/action items: While not specifically for paracervical block training, a training phantom for BT purposes created the uterus from gelatin, and then coated it with rubber in order to simulate a tissue-like interior. Gelatin may be a good option for us, because it can create a similar feel to tissue while remaining relatively cheap. It is also valuable information to know the phantom held up for at least one hour while undergoing sutures and needle insertion. While our device doesn't need to withstand repeated sutures, it will need to be injected with a needle multiple times for each paracervical block, and the cervix must be grasped and pulled by a tenaculum, which will put considerable strain on any flesh-like materials we use over time. Knowing the time frame for BT training may help us gauge how long gelatin might work for our device, if we choose to use it.

2025/09/25 - Part 2: Materials mimicking vagina/uterus/cervix

ABIGAYLE CHAPMAN - Sep 25, 2025, 12:04 PM CDT

Title: Part 2: Materials mimicking vaginal/cervical/uterine tissue

Date: 09/25/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Assess potential materials for their realism in recreating the feel of vaginal/cervical/uterine tissue.

Content:

Source: https://pmc.ncbi.nlm.nih.gov/articles/PMC11699912/

Citation:

Coggeshall, Hannah, Brian Brost, Tara Chettiar, and Lindsay Nordwald. “Innovative Intrauterine Device Training Model as Dynamic New Teaching Tool.” *Kansas Journal of Medicine* 17, no. Suppl 2 (2024): 10. https://doi.org/10.17161/kjm.vol17.22687.

Notes:

-A team created realistic training models for IUD insertion.

-Ballistic gelatin was used to create 3D models of a uterus and cervix. These models could be positioned in anterograde/retrograde flexion, and also could simulate uterine perforation (which is when the IUD pushes through the uterine wall and into surrounding tissue, and is a serious complication and may require surgical removal of the IUD).

-Residents practiced on these models in workshops, using various IUD types. These models were compared to device manufacturer supplied trainers, which are made of hard plastic and not accurate to variations in anatomy.

-Surveys of the experience were performed.

-Device parameters were ranked on a scale of 1 (Low) to 5 (High).

-Average results of the gelatin model:

Realistic feel (4.6)

Adaptability (4.0)

Ability to grasp the cervix (3.6)

Realistic teaching tool (4.5)

Useful in teaching (4.6)

-Manufactured (hard plastic) models were considered useful for residents who considered themselves to be of a 'Novice' skill level, but individuals of higher skill felt they benefitted less. The gelatin model ranked 88% and above in usefulness regardless of skill level.

-On average, the gelatin model ranked above other IUD trainers regarding personal practice, teaching, and competency based on surveys.

Conclusions/action items: In general, ballistics gelatin receives positive feedback from users practicing procedures involving IUD placement, which is something our device will allow for. It is considered more useful and realistic than hard plastic, and surveys of users rate the material fairly well on simulating grasping the cervix and the realistic feel of the material. Ballistics gelatin is one option to consider for our device.

2025/10/1 - Uterus dimesions and anatomy

ABIGAYLE CHAPMAN - Oct 01, 2025, 9:59 AM CDT

Title: Uterus dimensions and anatomy

Date: 10/1/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Find measurements and gather information to develop a better understanding of the anatomically accurate uterus, which can then be used to help ensure accuracy in our training model for IUD insertion.

Content:

Source:https://www.ncbi.nlm.nih.gov/books/NBK470297/

Citation:

Ameer, Muhammad Atif, and Diana C. Peterson. “Anatomy, Abdomen and Pelvis: Uterus.” In *StatPearls*. StatPearls Publishing, 2025. http://www.ncbi.nlm.nih.gov/books/NBK470297/.

Notes:

-Uterus lies between the urinary bladder anteriorly and the rectum posteriorly.

-Average uterine dimensions: approximately 8 cm in length, 5 cm in width, 4 cm in thickness.

-Uterine cavity volume on average ranges from 80 mL to 200 mL.

-Uterus divides into 3 main segments: the body, cervix, and fundus.

-Wall of the uterus consists of 3 distinct layers:

Endometrium forms the inner lining, including a superficial functional layer that responds to reproductive hormones and a deeper basal layer.

Myometrium, made up of smooth muscle cells, forms the middle muscular layer.

Serosa or perimetrium is the outermost layer, and consists of a thin layer of epithelial cells.

-Uterus orientation:

The long axis of the cervix often does not align with the long axis of the uterine body.

Usually, the body of the uterus tilts forward over the cervix, a position known as anteflexion. Conversely, retroflexion refers to a backward tilt at this junction.

In 80% of women, the uterus lies at a right angle to the vagina with a forward tilt. This is called anteversion.

In 20% of women, the uterus tilts backward over the vagina, which is known as as retroversion.

Uterine orientation within the pelvis varies among individuals.

-Anomalies in uterine cavities can occur, including heart-shaped uterine cavities, multiple uterine cavities, ect.

Conclusions/action items: While the accuracy of the uterus may not be the most important piece of our training device, maintaining a somewhat realistic shape, size, and texture in order to accurately simulate IUD insertion would be ideal for our model. Knowing the dimensions of the uterus and volume of the uterine cavity will allow us to construct a uterus that is to-scale, and understanding the 3 layers of the wall of the uterus may give us insight as to how to replicate the texture and elasticity of the uterus during the procedure.

2025/10/1 - IUD Insertion Perforation Force

ABIGAYLE CHAPMAN - Oct 01, 2025, 11:06 AM CDT

Title: IUD Insertion Perforation Force

Date: 10/1/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Find out what could go wrong during an IUD insertion in order to understand how our model might simulate these failures.

Content:

Source: https://pmc.ncbi.nlm.nih.gov/articles/PMC5683155/

Citation:

Rowlands, Sam, Emeka Oloto, and David H Horwell. "Intrauterine Devices and Risk of Uterine Perforation: Current Perspectives." *Open Access Journal of Contraception* 7 (March 2016): 19–32. https://doi.org/10.2147/OAJC.S85546.

Notes:

-Perforation, in which an IUD becomes embedded in the uterine wall, is rare but can occur during insertion. It can cause pain, bleeding, and organ damage in rare cases.

-It is more likely that perforation may occur with a less experienced inserter, and most perforations are not detected at time of insertion.

-Risk is higher in those who are breastfeeding, as uterine lining is thinner at this time. Other causes of thinner lining include uterine atrophy (eg, due to long-term use of injectable progestins).

-The forces required to insert an IUD increase with increasing inserter tube diameter.

-The force required to insert an IUD is on average 1.5–6.5 N.

-Forces generated physiologically (for instance, contractions) within the uterus have been estimated to be potentially as high as 50 N. These forces are known to be sufficient to produce uterine perforation.

-Forces required to cause perforation are significantly higher than the forces needed to simply insert an IUD.

Source:https://pmc.ncbi.nlm.nih.gov/articles/PMC4132253/

Citation:

Goldstuck, Norman D, and Dirk Wildemeersch. "Role of Uterine Forces in Intrauterine Device Embedment, Perforation, and Expulsion." *International Journal of Women's Health* 6 (August 2014): 735–44. https://doi.org/10.2147/IJWH.S63167.

Notes:

-Perforation may occur after insertion, due to a mismatch in size of the uterus and IUD.

-IUD insertion forces range from 1.5 N to 6.5 N.

-The forces acting against the insertion of an IUD come from obstruction of passage of the device in the cervical canal, and frictional force resisting passage of the device.

-Removal forces range from 1 N to 5.8 N.

-Fracture forces (the force required to break an IUD) range from 8.7 N to 30 N depending upon device. A fractured IUD during insertion is very uncommon, as the forces required to break the IUD are higher than that needed for simple insertion.

-Measured perforation forces are from 20 N to 54 N, and calculations show the uterus can generate up to 50 N of myometrial force depending on internal pressure and surface area.

-Perforation of the uterus at the time of IUD insertion may be dependent on the inserter, and may be more likely if the uterus is acutely anteflexed or retroflexed and is not properly straightened before insertion

-Use of a tenaculum with 2 N of force can reduce the uterocervical angle from 75 degrees to 10 degrees by applying traction and straightening the uterine axis. This can help prevent lower uterine perforation.

Conclusions/action items: Overall, though rare, perforation is a potential risk factor during IUD insertion. It's important for training medical students to understand the risks, and our model could provide a way to train to prevent this issue. Our uterus should be able to be measured for the IUD size, as is consistent with a normal procedure, in order to prevent future perforations. In general, perforation during insertion is very rare, and the amount of force required for this to occur is high, but it may be helpful for our model to provide feedback if a 20N threshold (the danger zone for perforation or IUD fracture) is reached during the insertion process.

2025/10/06 - Uterine Wall properties

ABIGAYLE CHAPMAN - Oct 06, 2025, 8:09 PM CDT

Title: Uterine Wall properties

Date: 10/6/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Gain a better understanding of the texture, thickness, and elasticity of the uterine wall, to ensure realism while assembling our design.

Content:

Source:https://pmc.ncbi.nlm.nih.gov/articles/PMC8376808/

Citation:

Fang, Shuyang, James McLean, Lei Shi, Joy-Sarah Y. Vink, Christine P. Hendon, and Kristin M. Myers. “Anisotropic Mechanical Properties of the Human Uterus Measured by Spherical Indentation.” *Annals of Biomedical Engineering* 49, no. 8 (2021): 1923–42. https://doi.org/10.1007/s10439-021-02769-0.

Notes:

-The uterus has very complex stress distributions.

-The study took mechanical testing data, creating an initial 3-D anisotropic (a property with differing values based on direction or location) constitutive modeling framework by incorporating quantitative tissue fiber architecture.

-Using spherical indentation to allow for material property mapping and to preserve tissue architecture, in this study researchers performed a follow-up tensile testing of the tissue sample. This test was performed on both pregnant and non-pregnant women.

-Thickness of the uterus, on average, for non-pregnant women, ranged from 4.84±0.61 mm.

-Average length: 23.07±2.40 mm

-Average width: 20.41 ±2.91mm

-In pregnant women, tissue dimensions are slightly larger.

-During pregnancy, the uterus grows upward, developing out of the pelvic region starting at 12 weeks. This means the uterine fibers become more longitudinally aligned to bear strain, but the actual stiffness of tissue does not vary notably.

-Both pregnant and non-pregnant women showed heterogeneous material properties of the uterus. This means the uterus varies greatly in terms of the resistance in different places.

Conclusions/action items: We now have numbers for a general tissue thickness and uterine size to go off of when creating and modifying our design. While we are not designing this device specifically to emulate the uterus of a pregnant woman, it is helpful to keep the greater variations of uterine size and tissue thickness in mind. In general, stiffness of the uterine tissue remains similar regardless of the pregnancy status of the woman, and this will not be an issue to consider for modeling the paracervical block procedure. We can also be sure now that the uterus varies greatly in stiffness across varying anatomical locations, as is confirmed by this study, and would be very complex to properly replicate. Going based off of our client's feedback when choosing a silicon concentration for the uterus wall will likely be our best choice for preserving realism.

2025/10/07 - Ecoflex durability

ABIGAYLE CHAPMAN - Oct 08, 2025, 11:08 AM CDT

Title: Ecoflex 00-20 Durability

Date: 10/07/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Understand the durability of the ecoflex we intend to use for the silicon molds of our cervicovaginal junction and the cervix, so we know how many repeated needle uses the device can realistically hold up under.

Content:

Source: https://www.sciencedirect.com/science/article/pii/S0020740321003581

Citation:

Liao, Zisheng, Jie Yang, Mokarram Hossain, Gregory Chagnon, Lin Jing, and Xiaohu Yao. "On the Stress Recovery Behaviour of Ecoflex Silicone Rubbers." *International Journal of Mechanical Sciences* 206 (September 2021): 106624. https://doi.org/10.1016/j.ijmecsci.2021.106624.

Notes:

-To explore the durability and lasting capabilities of silicon and dig deeper into the material's mechanical abilities, experiments were performed.

-These included loading-unloading cyclic experiments with varied time gaps between the first cycle and second cycle to demonstrate stress recovery behavior after stress softening.

-Stress softening refers to reduced stiffness in substances like silicon after deformations and reloading. This can occur due to needle punctures.

More in-depth exploration of stress softening:

- The Mullins effect (also known stress softening) occurs in materials like silicone elastomers (used in sensors and energy devices) when they withstand repeated cyclic loads.
- It causes the material's stress during reloading cycles to be notably lower than the stress measured during the initial loading at the same strain.
- This stress softening is not permanent; the original stiffness can be recovered by letting the material rest in a stress-free state at room temperature or by annealing (heating and then allowing it to cool) it at a higher temperature.
- The continuous change in mechanical behavior (softening and recovery) influences device performance, so thorough investigation of this effect is necessary
- Following Mullins' work in 1948, the phenomenon has been extensively studied through both experimental research and the creation of mathematical models.

-Performing these experiments with a gap between the first and second cycle allowed researchers to see the stress recovery capabilities of the silicon after the first cycle of stress softening.

-Three different modes of deformations were selected for the experiment:

1. Uniaxial tension

2. Planar tension

3. Equibiaxial tension tests

-Researchers also considered Shore hardness dependence with different strain levels.

Ecoflex overview:

-Ecoflex polymers are two-component platinum-catalysed silicones. They are cured at room temperature, and feature negligible shrinkage and a comparatively short curing time (few minutes to several hours).

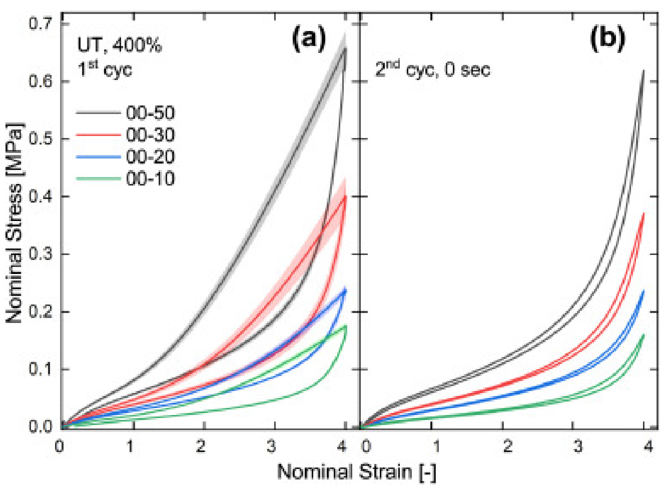
-Characteristics of Ecoflex include high stretchability and durability, making it capable of resembling human skin in certain models, while also serving as cushioning, wearable strain sensors, and more.

-Investigation of the stress recovery from the stress softening is somewhat rare, but important.

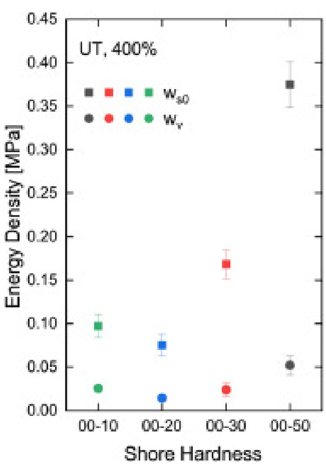
Ultimately, the study considered:

- **Recovery Time** (from 0 seconds up to 1 year).
- **Strain Level** (from 160% to 400%).
- **Deformation Modes** (Uniaxial, Planar, and Equibiaxial Tension).
- **Shore Hardness** (00-10, 00-20, 00-30, and 00-50).

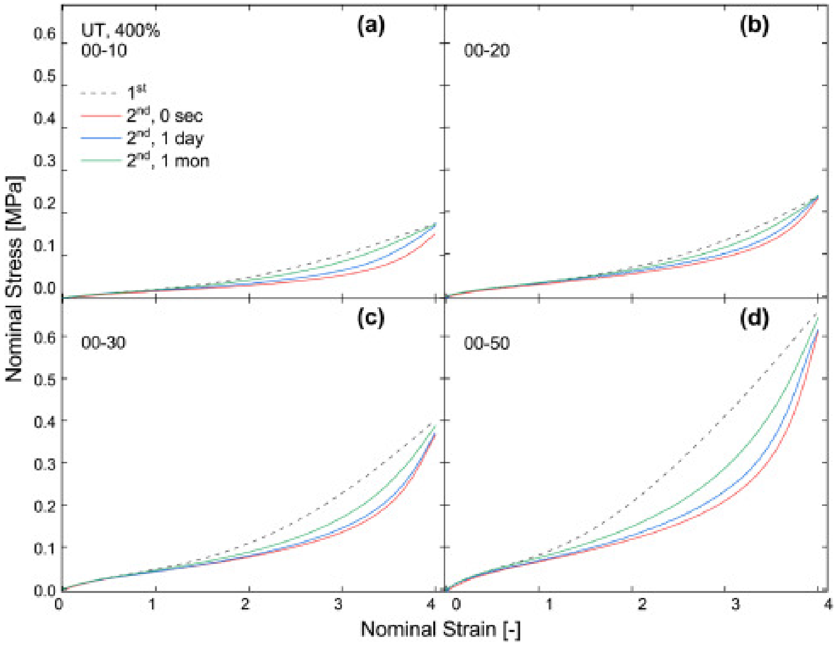
Graphs (descriptions directly quoted):



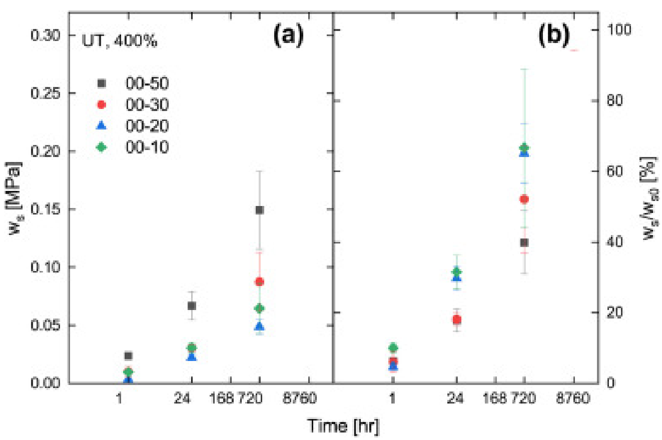
Above: Stress-strain response of the two-cycle uniaxial tension tests at strains of 400% for four Shore hardnesses 00-10, 00-20, 00-30, 00-50. (a) The first cycles with error bands, (b) the second cycles applied 0 second after the first cycle.



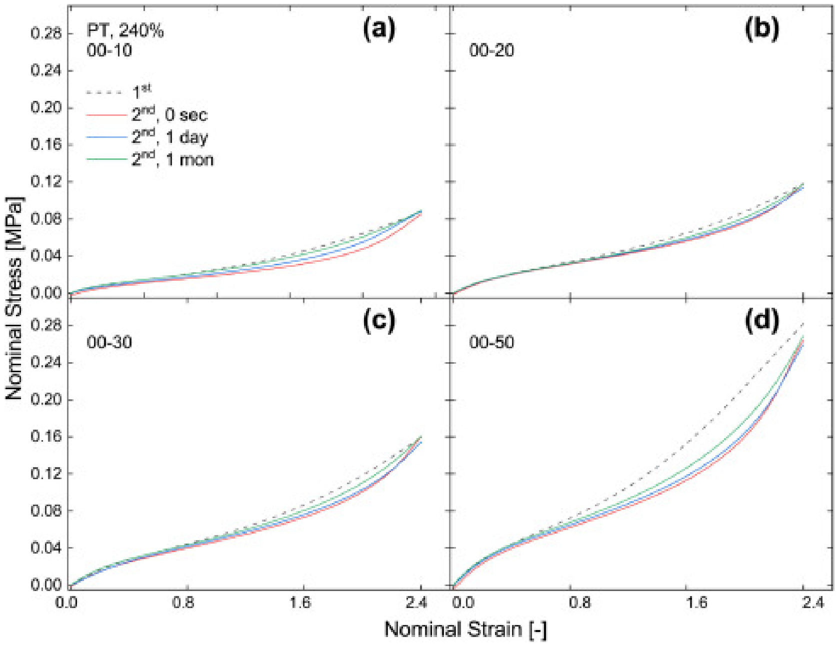
Above: The initial softening dissipation energy density (black dots) and viscoelastic dissipation energy density (red dots) of uniaxial tension tests at strains of 400% for different Shore hardnesses.



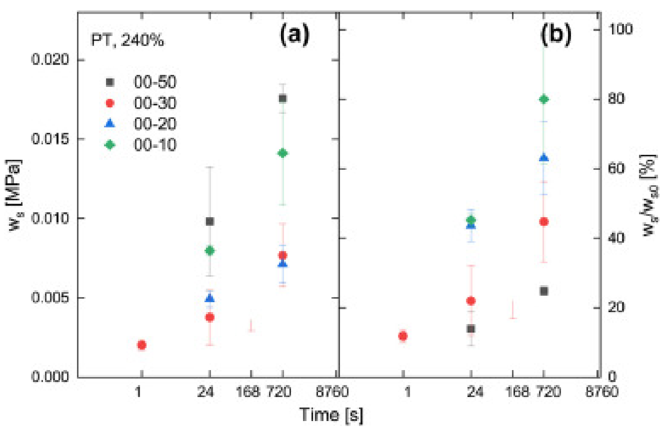
Above: Time dependence of the stress recovery under a uniaxial tension mode at strains of 400% for different Shore hardnesses. The second loading paths with recovery times of 0 second, 1 day, and 1 month (solid lines) compared with the first loading path (dash line) for Shore hardnesses (a) 00-10, (b) 00-20, (c) 00-30, (d) 00-50, are presented, respectively.



Above: The time dependence of the dissipation during the second cycles of uniaxial tension tests at strains of 400% for different Shore hardnesses. (a) The subsequent softening dissipation energy density, (b) the softening dissipation ratio between the subsequent and initial softening dissipation energy density.



Above: Time dependence of the stress recovery under a planar tension mode at strains of 240% for different Shore hardnesses. The second loading paths with recovery times of 0 second, 1 day, and 1 month (solid lines) compared with the first loading paths (dash line) for Shore hardnesses (a) 00-10, (b) 00-20, (c) 00-30, (d) 00-50, are presented, respectively.



Above: The time dependence of the dissipation during the second cycles of planar tension tests at strains of 240% for Shore hardnesses 00-10, 00-20, 00-30, 00-50. (a) The subsequent softening dissipation energy density, (b) the softening dissipation ratio between the subsequent and initial softening dissipation energy density

Key results of stress recovery rate:

Experimental results focused primarily on Ecoflex 00-30.

Results show:

- **Stress Recovery with Time:** The stress response of the second loading path progressively increases and moves closer to the initial (first) loading path as the recovery time increases.
- **Strain Dependence:** The stress recovery is slower at higher applied strains (e.g., 400%) compared to lower strains (e.g., 200%). This suggests that the higher energy threshold required for dissociation at large strains also makes the later re-connection of filler-rubber links "tougher," thus retarding the recovery rate.

- **Consistency across Modes:** The recovery behavior (stress increasing with time) is qualitatively confirmed across all three deformation modes tested: uniaxial, planar, and equibiaxial tension.

Authors researched other Shore hardnesses (including 00-20) and found that all these materials share similar mechanical behavior, including the stress softening and the stress recovery behavior.

-Ecoflex 00-20 in particular is slightly softer than 00-30, so it may be more flexible overall, but exhibits similar softening and stress recovery.

-Ultimately, results showed that stress softening could recover significantly with time in Ecoflex.

Conclusions/action items: Stress softening of silicon has relevance to our model's ability to withstand multiple training sessions, as it can occur with repeated needle use. The researchers even tested the particular Ecoflex Shore hardness we plan to use, Ecoflex 00-20. However, I cannot directly infer from this data how many needle uses a model made of Ecoflex 00-20 could handle before needing replacement. What I can take away from my readings is that the model's resistance to stretching forces will decrease after the first few large deformations (Mullins effect) but will recover over time when rested at room temperature, and recovery time will be longer if subject to greater strain. The data I found is valuable for designing the device's stretchability and flexibility, but we would need to conduct puncture experiments to determine the lifespan (number of needle uses) of our model. This particular data can still be helpful when considering the vaginal canal that must support the speculum, as the elasticity of this part may vary over time with strain.

2025/10/16- Silicon and polymer mechanical testing

ABIGAYLE CHAPMAN - Oct 16, 2025, 12:05 PM CDT

Title: Silicon and polymer mechanical testing

Date: 10/16/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Determine current existing methods for testing of silicon strength, specifically when related to the use of silicon to mimic human vascular tissue.

Content:

Source:https://pmc.ncbi.nlm.nih.gov/articles/PMC9188865/

Citation:

Norris, Nicholas G., William C. Merritt, and Timothy A. Becker. "Application of Nondestructive Mechanical Characterization Testing for Creating in Vitro Vessel Models with Material Properties Similar to Human Neurovasculature." *Journal of Biomedical Materials Research. Part A* 110, no. 3 (2022): 612–22. https://doi.org/10.1002/jbm.a.37314.

Notes:

This study assessed the mechanical properties of a new 3D-printable polymer (VC-A30) for creating more realistic endovascular vessel models, comparing it to human vascular tissue and standard silicone models.

The tests were conducted on circular or tube samples of human common carotid arteries, the new VC-A30 polymer, and a commercial silicone vessel phantom (1.8 mm wall thickness).

-They conducted 8 mechanical tests, noting the similarity to human vascular tissue.

-Prior to testing, all samples were submerged in phosphate-buffered saline (PBS). VC-A30 material softens significantly after being submerged, and the mechanical properties stabilize after 4 days. This softening step helps the material to better mimic the human vessel environment.

Mechanical tests:

Test 1: Compressive modulus - Dynamic axial strain (100 μm) applied across a frequency sweep (1.0 to 20.0 rad/s) using an 8 mm flat plate, preloaded to 1 N (150 mmHg).

Measured: Resistance to compression at various physiological heart rates.

Test 2: Shear modulus - Dynamic shear strain (1%) applied across a frequency sweep (1.0 to 20.0 rad/s) using an 8 mm plate.

Measured: Resistance to rotational deformation.

Test 3: Poisson's ratio - Sample compressed at a known displacement, and the resulting diameter change was measured optically (up to 10 N force).

Measured: The ratio of lateral expansion to axial compression (how much the sample bulges when squeezed).

Test 4: Tensile modulus- Tensile strain (100 μm) applied across a frequency sweep, with samples prestressed to 100 mmHg and 160 mmHg.

Measured: Resistance to being stretched longitudinally.

Test 5: Hardness -A 5 mm ball indenter compressed the sample at 25 μm/s until rupture or max force of 10 N.

Measured: Modulus (stiffness) at the point of sample damage/rupture.

Test 6: Radial force - Tube sample compressed to 50% of its outer diameter (OD).

Measured: Resistance to being squeezed radially (a common test for endovascular stents).

Test 7: Compliance -Tube samples pressurized with liquid contrast agent (80 to 300 mmHg) while diameters and lengths were measured with fluoroscopy.

Measured:Change in vessel volume per change in pressure ($\Delta V/\Delta P$).

Test 8: Lubricity- A microcatheter dragged along the inner lumen of a 3 cm tube sample under a fixed normal force (0.091 N).

Measured: Coefficient of friction (simulating catheter tracking through a vessel).

Four of these eight tests were destructive and could not be performed on the same sample.

- From the order listed above, the first four tests are non-destructive
- The last four tests are destructive

Results:

-VC-A30 closely resembled human tissue in four of eight tests.

-Silicon was only similar to human tissue in two out of eight tests (Poisson's ratio and compliance)

-It can be concluded that standard silicon models often lead to inaccuracies in testing.

Conclusions/action items: This study dealt specifically with similarities of a material to mechanical properties of human vasculature, meaning the network of blood vessels in the body. The uterus and cervix are supplied by this network, but they are not actually blood vessels, so these tests cannot directly translate to our project and the mechanical properties our model must mimic. However, we can take inspiration from some of these tests and align them with our purposes. Not all of these tests are useful, as we are mostly measuring resistance of the material, and are less concerned with aspects such as resistance to rotational deformation. However, tests like the compressive modulus could be reformulated to measure the material's elastic resistance to localized pressure or deformation (it can therefore be a test for resistance for a needle insertion, or to the cervical os resistance to opening for an IUD insertion). The hardness test can be used for a measurement of general tissue stiffness, since it provides a measure of the material's resistance to deformation and therefore can give us an idea of tactile feel. The lubricity test measures the friction coefficient, so it could be used for testing the feel of the friction of the IUD stem against the uterine wall.

2025/10/16- MTS Testing

ABIGAYLE CHAPMAN - Oct 16, 2025, 7:57 PM CDT

Title: MTS Testing

Date: 10/16/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Understand what MTS testing is and how we might utilize it.

Content:

Source:

Citation:

> "Bionix® Tabletop Test Systems." *MTS*, www.mts.com/en/products/biomedical/biomaterial-test-systems/bionix-tabletop#technical. Accessed 16 Oct. 2025.

Notes:

MTS stands for Materials Test Systems.

About the company:

- Created in 1966
- Has been part of many engineering projects, involved in many patents
- Works in many engineering fields, including aerospace, civil, biomedical, ect.
- Leading global supplier of test and simulation systems
- Improve products through innovation. Devise solutions for simulating real world tests and taking measurements

Potentially useful devices for our particular product:

Bionix Tabletop Test System

Applications:

- Tension
- Compression
- Shear
- Flex
- Bend
- Kinematics

-The tabletop contains fatigue-rated actuators that can help predict fatigue life of a product or material.

-Used primarily for biomaterials and medical devices

-Provides general mechanical testing of biomaterials and components

Citation:

> "Exceed® Electromechanical Test Systems." *MTS*, www.mts.com/en/products/materials/static-materials-test-systems/exceed-electromechanical. Accessed 16 Oct. 2025.

Exceed® Electromechanical Test Systems:

Tests polymers, as well as:

- Elastomeric Materials
- Elastomers
- Plastics
- Rubber

Applications:

- Tension
- Compression
- Flex/Bend
- Shear

-Electromechanical attachments can perform with some smaller loads (as low as 5 N or 1.1 lbf) as well as larger (up to 100kN).

Citation:

"Criterion® Electromechanical Test Systems." *MTS*, www.mts.com/en/products/materials/static-materials-test-systems/criterion-electromechanical. Accessed 16 Oct. 2025.

Criterion® Electromechanical Test Systems

-Accessories support a wide range of testing, at forces from 600 kN (132,000 lbf) down to 1 N (0.2 lbf).
-Capable of high-speed, low-vibration testing
- 5000 Hz data acquisition rate

Tests on:

- Metals
- Aluminum
- Plastics
- Elastomeric Materials
- Composites
  - Carbon Fiber
  - Ceramic Matrix Composites
  - Composites
  - Metal Matrix Composites
  - Polymer Matrix

Applications:

- Tension
- Compression
- Flex/Bend
- Shear

Conclusions/action items: The listed MTS machines above are the ones that may be useful for inspiration for testing, or directly for our testing. They include machines that specifically can test durability, compression, shear, ect. on polymers like the Ecoflex 00-20 we plan to use, and some of these machines are specifically geared towards biomaterials or medical devices. Mainly, I looked for standard

compression plates or custom fixtures designed to apply force and measure the resulting localized deformation (such as that we would expect from a needle puncture) in a precise area of the device. Also useful would be a machine that can test friction (specifically for measuring friction of the IUD insertion against the uterine wall), although machines specifically for this purpose are not immediately clear. One possibility may be Bionix® Orthopaedic Subsystems, while often used for entire joint simulation, may can be configured for complex wear or friction under loads.

2025/10/21 - Needle Puncture Resistance testing

ABIGAYLE CHAPMAN - Oct 21, 2025, 3:48 PM CDT

Title: Needle Puncture Resistance testing

Date: 10/21

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: See what tests exists for measuring resistance in materials to needle punctures.

Content:

Citation:

“Standard Test Method for Protective Clothing Material Resistance to Hypodermic Needle Puncture.” Accessed October 21, 2025. https://store.astm.org/f2878-19.html.

Notes:

Standard methods for testing of needle puncture resistance exist. One is summarized below.

-Test method evaluates puncture resistance of clothing materials, including plastics/elastomeric films, coated fabrics, textile materials, leather, laminates, ect.

-Testing involves use of hypodermic needles with specific dimensions. These serve as puncture probes.

3 gauges of needles used:

- 21- gauge
- 25- gauge
- 28- gauge

-Puncture resistance is evaluated by carefully performing the test so the puncture occurs perpendicular to the material's surface, with no supporting structure behind the material.

It should be noted that this particular testing method doesn't attempt to simulate all potential uses of needle.

Variables which may impact puncture resistance, which this test fails to address:

- presence of lubricants
- tension on specimen
- stiffness of backing material (structure behind the material)

Citation:

“Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.” Accessed October 21, 2025. https://store.astm.org/d2582-21.html.

Notes:

This 'puncture-propagation tear resistance' standard test measures a material's resistance to dynamic puncture, and measures to what extent the aftermath of the puncture may lead to a tear.

-Test is intended to give a clearer picture of strength of plastic film and sheeting specifically.

-Results are intended to be used to reduce snagging-type hazards.

- Refers to industrial bags, liners, tarpaulins, ect.

-Units measured in test: Newtons (in regard to tear resistance)

Important notes for this test:

-For many materials, puncture doesn't contribute significantly to the force value found, since the probe is sharp.

- To better determine this force (if present at all) results of pre-punctured specimens should be compared other specimens to show extent of puncture resistance in the result

-For this particular test, procedural modifications are often necessary for different materials. Material specifications must be consulted.

Procedure:

- A specimen is placed in clamps and is then laid against a holder with a tear slot.
- A carriage with a probe is lowered until the probe touches the specimen.
- Probe is then released to create a puncture.
- The force required to propagate the tear from the initial puncture is measured.

Conclusions/action items: While these tests do not directly relate to what we are trying to test, which is the durability of a silicon mold when deformed through repeated insertion of a needle, it is useful to know what tests already exist regarding resistance of materials to needle punctures. Information online is limited about these tests, and very few tests exist for our specific criteria, but the general procedures can be adapted as needed. We can use these tests to help formulate our own tests for the durability of our silicon and measure the resistance of our simulated human tissue in regards to needle penetration.

2025/10/21 - Friction Testing

ABIGAYLE CHAPMAN - Oct 21, 2025, 4:22 PM CDT

Title: Friction Testing

Date: 10/21

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Learn about methods for testing friction, so these can be used if we choose to test our device for the friction it would provide on an IUD when the IUD is pushed against the fundus. We want to see a friction that will mimic realism of the human uterine tissue.

Content:

Citation:

Vilhena, Luís, Luís Afonso, and Amílcar Ramalho. “Skin Friction: Mechanical and Tribological Characterization of Different Papers Used in Everyday Life.” *Materials* 16, no. 16 (2023): 5724. https://doi.org/10.3390/ma16165724.

Notes:

This research project explored friction and mechanical properties of paper against human skin.

Research investigated:

- Coefficient of friction between 7 types of everyday paper (including printing paper, hygeiene papers) and human skin

Friction results were then compared to paper's mechanical properties, including:

- tensile strength
- energy absorption
- stiffness
- elongation at rupture

Key findings:

1. Friction in Different Anatomical Regions

- The coefficient of friction was ultimately higher on the palm of the hand compared to the surface of the forearm.
- On average, the μ on the palm was 25% higher than on the forearm. This difference is likely due to the palm's greater roughness, higher natural moisture content, and differences in skin properties like thickness and stiffness.

2. Effect of Relative Humidity (RH)

- The coefficient of friction varied between a minimum of 0.26 and a maximum of 0.68 across all tests.
- The research did not find a trend with the effect of relative humidity (32%, 55%, and 83%) on the coefficient of friction for the different papers. This was attributed to the individual paper's thickness and capacity to absorb moisture.

3. Correlation Between Friction and Mechanical Properties

Using Spearman correlation analysis, the study found strong relationships between the coefficient of friction (measured at the volar (meaning the underside of) forearm, RH=55%) and two mechanical properties, tensile strength and tensile energy absorption.

The experimental process involved mechanical tensile tests on the paper specimens and tribological friction tests on human skin. These processes gave quantitative results for the papers' mechanical properties and their coefficients of friction (μ) against the skin.

Mechanical Characterization: Tensile Tests

The mechanical properties of the paper specimens were measured using a Shimadzu Autograph AG-X-5kN universal testing machine.

Test procedure/setup:

- Specimen Preparation: Paper samples were cut into rectangular strips (25.4±0.5 mm width, 50±0.5 mm length between grips).
- Method: The tests were performed in the with standard tensile wedge grips, following ASTM D828 standard.
- Parameters: The samples were placed under constant strain rate (elongation speed). Two different speeds were used to compare results (7.1 mm/min and 25.4 mm/min.)
- Replication: Five tests were carried out for each paper type and speed.

Results:

The test machine recorded the load (force) and displacement (strain), which were used to calculate four quantitative mechanical properties for each paper:

1. Tensile Strength (units- kN/m): The maximum stress the paper can withstand before breaking.
2. Elongation at Rupture (units- %): The amount of deformation (strain) the paper can take before breaking.
3. Tensile Stiffness (units- N/m2): A measure of the paper's resistance to elastic deformation.
4. Tensile Energy Absorption (also known as TEA) (units- J/m2): The total energy absorbed by the paper up to the point of rupture (area under the stress-strain curve).

2. Tribiological Characterization: Friction Tests

Friction between the paper and skin was measured in-vivo using a portable, manually-operated tribometer equipped with a two-axis force sensor.

Test procedure/setup:

- Setup: A paper sample, fixed to a smooth, spherical PVC probe via an O-ring, was slid over the skin surface. The tribometer's two-axis force sensor measured both the Normal Force and the Tangential (Frictional) Force.
- Anatomical Regions: Tests were performed on a person in two distinct areas: the palm of the hand and the ventral (meaning underside) surface of the forearm.
- Sliding Conditions:
  - Sliding Velocity: Constant, 60±10 mm/s.
  - Normal Load: Increasing load, with a maximum value of 11±2 N.
- Environmental Condition: The influence of paper moisture was tested at three controlled relative humidities (32%, 55%, and 83%), achieved using salt solutions (CH3COOK and K2SO4).
- Replication: Three tests were performed for each paper type, anatomical region, and relative humidity.

Results:

The tribometer's A/D conversion board took the Normal Force and Tangential Force data points during the test.

1. Calculation Method: dynamic coefficient of friction was determined by plotting the Tangential Force as a function of the Normal Force
2. Model: The μ value corresponds to the slope of the resulting trend line, using a simple linear regression model based on the Amontons-Coulomb friction model ($F=\mu W$).
3. Final Results: This process gave a quantitative μ value (for instance, $\mu=0.35$ for handkerchiefs on the forearm at RH=55%) for each combination of paper type, anatomical site, and relative humidity.

Correlation analysis:

Results were compared using the Spearman correlation coefficient. This statistical analysis determined the intensity and direction of the relationship between the measured mechanical properties and the coefficient of friction.

A value close to +1 meant a strong positive correlation, and a value close to −1 represented a strong negative correlation.

Conclusions/action items: The fact that the test observed friction against human skin means the test may be somewhat applicable to our tests regarding our model's friction of the simulated uterine wall. We do not necessarily need a correlation analysis of the mechanical properties, but we now know a tribometer could take the coefficient of friction for our model. We could find the needed value by utilizing the slope given from this data, if the appropriate equipment could be acquired.

2025/10/28 - Potential Complications with Paracervical Block

ABIGAYLE CHAPMAN - Oct 29, 2025, 11:59 AM CDT

Title: Potential Complications with Paracervical Block

Date: 10/28

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Gain a more complete understanding of what may go wrong with paracervical block procedure, so we might be able to emulate that in our project for those learning using our device.

Content:

Citation:

Rosen, Mark A. "Paracervical Block for Labor Analgesia: A Brief Historic Review." *American Journal of Obstetrics and Gynecology* 186, nos. 5, Supplement (2002): S127–30. https://doi.org/10.1016/S0002-9378(02)70187-7.

Notes:

General key complications that may occur during or due to a paracervical block:

- Fetal Bradycardia (Slowed Fetal Heart Rate): This can occur specifically when the block is used during labor. It occurs in 10% or less of patients, usually developing 10-20 minutes after injection and lasts less than 10 minutes. It resolves on its own.
    - Thought to be caused by the anesthetic (like lidocaine) crossing the placenta and temporarily depressing the baby's heart function.
- Systemic Side Effects (from the anesthetic): These are generally mild but can include:
    - Low blood pressure or hypotension
    - Fever.
    - Dizziness, lightheadedness.
    - Ringing in the ears (tinnitus).
    - Metallic taste in the mouth.
- Rare but Serious Risks:
    - Allergic reactions to the anesthetic.
    - Bleeding or hematoma (broad ligament hematoma).
    - Infection.
    - Accidental puncture of the uterus (uterine perforation).
    - Systemic Local Anesthetic Toxicity (can lead to seizures or cardiac arrest if too much anesthetic is absorbed, often due to inadvertent intravascular injection).
    - Direct injection into the fetus.

Paracervical block complications specifically involving procedural mistakes or practitioner error include:

- Structural Trauma: Physical damage caused by the needle, including
    - Accidental puncture of the uterus (uterine perforation).
    - Cervical laceration or other structural trauma.

    - Inadvertent intravascular injection- Injection directly into blood vessel. This mistake causes a rapid and high surge of the anesthetic (like lidocaine) into the bloodstream, which is a common pathway for dose-related lidocaine toxicity.
        - Symptoms of this toxicity: lightheadedness, a metallic taste in the mouth, and ringing in the ears. In severe cases, it can lead to seizure or cardiac arrest.
- Hematoma:
    - Broad ligament hematoma can happen if a vessel is punctured or the injection is placed into a vascular area.
    - Hemorrhage (excessive bleeding) can also result from trauma.
- Direct Injection info fetus:
    - Direct fetal injection can occur if the needle is misplaced during the procedure, although rare
- Ineffectiveness due to misplacement: It can be noted that an injection placed directly into the cervix might relieve some dilation pain, but will fail to block the pain of the uterus contracting, indicating an error in achieving the block's correct anatomical target (the broad ligament).

Conclusions/action items: Many of the paracervical block problems or side effects that occur are unrelated to procedural mistakes, such as an allergy to the anesthetic. Others are specific to women who are pregnant, or in labor. However, some are related to procedural errors or process, such as intravascular injection or accidental uterine perforation. We can consider a sound effect for insertion into a blood vessel, or for an injection that goes too deep. Some research could be done regarding location of blood vessels near the cervix and vagina to discover where these problematic injections may occur.

2025/10/28- Blood vessel locations

ABIGAYLE CHAPMAN - Oct 29, 2025, 12:12 PM CDT

Title: Blood Vessel Locations

Date: 10/28/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Determine location of blood vessels in and around the injection site of the paracervical block procedure.

Content:

Source link: https://pmc.ncbi.nlm.nih.gov/articles/PMC3458254/

Citation:

Bereza, Tomasz, Krzysztof Andrzej Tomaszewski, Marta Bałajewicz-Nowak, Ewa Mizia, Artur Pasternak, and Jerzy Walocha. "The Vascular Architecture of the Supravaginal and Vaginal Parts of the Human Uterine Cervix: A Study Using Corrosion Casting and Scanning Electron Microscopy." *Journal of Anatomy* 221, no. 4 (2012): 352–57. https://doi.org/10.1111/j.1469-7580.2012.01550.x.

Notes:

This study used corrosion casting and scanning electron microscopy (SEM) of human uteri. Data was taken from autopsies of women (ages 20–45 years) less than 24 hours after death. Study was performed using uteri from cadavers of menstruating nulliparas (17 uteri) and menstruating multiparas (25 uteri).

It was the first study to describe in detail the microvasculature of the vaginal and supravaginal (located above the vagina) parts of the uterine cervix.

Note: Nulliparas refers to the cervix a woman who has not given birth, while multiparas refers to the cervix of a woman who has given birth to two or more babies.

1. General Vascular Zoning of the Cervix

Both the supravaginal and vaginal parts of the cervix are organized into four distinct, concentric vascular zones, moving from the periphery toward the cervical canal:

1. Outer Zone: Contains largest arteries and veins.
2. Arteriole and Venule Zone: Characterized by loose and irregular texture, located within muscular layer.
3. Endocervical Mucosal Capillaries Zone: Zone of dense capillary texture.
4. Pericanalar Zone: Located immediately around the cervical canal. Contains small veins and capillaries.

2. Blood Supply and Arterial Organization

- Primary Supply: The blood supply to the cervix mainly comes from the uterine artery.
- Contributing Vessels: The cervix is also supplied by cervical arteries (originating from the uterine artery) and vaginal arteries (originating from the uterine artery or the internal iliac artery).
- Branching Pattern: Large arteries and veins in the outer zone give off branches that run toward the cervical canal (perpendicular to the long axis of the canal) to supply or drain mucosal capillaries.

3. Capillaries and Venous Drainage Systems

The capillaries act as the center of the microcirculation.

The nature of their drainage suggests the existence of a dual system:

A. Capillary Structure and Location

- Arrangement: The arterial branches divide and form capillaries with diameter of 12–18 μm. Capillaries are arranged in a 'ladder' or 'H'-shaped fashion.
- Vaginal Portion: Moving toward the vaginal portion of the cervix, the capillaries begin to take on a pattern, appearing as parallel vessels running at a slanted angle to the axis of the endocervical canal, showing few interconnections.
- Cervical Glands: The cervical glands are surrounded by a dense capillary network (plexus), which can be made up of parallel capillaries or irregularly formed vessels.

B. The Two Mucosal Capillary Drainage Systems

The study introduced the idea of two different systems responsible for draining blood from the mucosal capillary plexus:

1. **Peripheral System:** A system using the venules and veins found in the middle and peripheral zones of the cervix.
2. **Pericanalar System:** System based on small subepithelial veins (80–150 μm diameter) located in the pericanalar zone.
    - These veins run parallel to the long axis of the cervical canal.
    - Veins are joined by perpendicular capillaries (12–20 μm diameter).
    - Capillaries cover these pericanalar veins, forming a plexus around them.
    - These veins run along the entire length of the cervical canal, except for the last segment near the external os.

4. Vascular Architecture of the Vaginal Part and Cervicovaginal Junction

At the external os of the uterus (the opening near the vagina), the vessels are organized into three layers:

1. Supplying Vessels: Characterized by relatively large diameters. This layer contains large veins (500–800 μm in diameter), which were observed to not join the smaller pericanalar veins.
2. Oblique or Perpendicular Vessels: A layer of small arteries and veins that run slanted at an angle or perpendicularly.
3. Subepithelial Capillaries: The outermost layer of capillaries that join the slanted/perpendicular vessels.

5. Functional and Theoretical Insights

Specific arrangement of the blood vessels leads to two conclusions regarding the cervical and cervicovaginal hemodynamics:

- Refutation of the "Portal System": The study is against the concept of a functional "portal system" (this was a previous theory) flowing from vagina to uterus. The data and images gathered regarding capillaries drained by venules confirms that cervical vasculature operates as a classic circulatory system.
- Potential for Countercurrent Transport: In both the muscular layer and the pericanalar zone, many arterioles and venules were discovered to pass close to each other, often adjoining. This proximity suggests (possible) existence of a countercurrent transport mechanism between these veins and arteries, allowing for localized exchange of substances.

Specific zones that may come into play regarding the Paracervical block procedure (summarized):

Outer zone (deep, lateral tissue corresponding to the Outer Zone of the vascular architecture):

- Location: The outer zone of both the supravaginal and vaginal parts of the cervix, located more laterally (outward) from the cervical canal.
- Vessels: This zone contains the largest vessels, described as large arteries and veins with a diameter of approximately 500 μm.
- Connecting Vessels: Perpendicular branches run from these large outer vessels toward the endocervical canal.

Pericanalar zone (contains small to medium vessels in the region that is shallow and close to cervical canal):

- Location: The Pericanalar Zone, which is subepithelial (just below the uterine lining) and surrounds the cervical canal.
- Vessels: Zone contains a drainage system of small subepithelial veins (diameter 80–150 μm) running parallel to canal axis. These veins are covered by a network of capillaries (12–20 μm diameter), which form a plexus.

Conclusions/action items: Risk of injecting a blood vessel during a paracervical block is associated with two primary zones the study took into account: the lateral (Outer) zone and the zone closest to the endocervical canal (Pericanalar zone). For the outer zone, an injection placed too deep or too far sideways in the paracervical tissue risks puncturing these major supplying/draining vessels, leading to potential immediate intravascular injection. This could result in systemic toxicity and at worst, seizures, as seen in previous research. Perpendicular branches run from the large outer vessels towards the endocervical canal, and injecting along the course of these branches also holds a risk of vascular entry. In regards to the pericanalar zone, an injection placed too close to the cervical canal risks puncturing a small network of subepithelial veins and capillaries. This would also be detrimental to a patient.

Comments

Randolph Ashton Oct 30, 2025, 10:43 AM CDT

Excellent research! Document how this information contributes to design ideas/modifications to the final prototype.

2025/11/03- Vaginal wall and introitus dimensions

ABIGAYLE CHAPMAN - Nov 04, 2025, 4:03 PM CST

Title: Vaginal wall and introitus dimensions

Date: 11/3

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Find accurate numbers depicting width of tissue surrounding vagina, as well as vaginal opening width and length.

Content:

Citation:

Ghanbari, Zinat, Maryam Kazemi, Nasim Eshraghi, Sina Shiri Hamedani, and Azam Zafarbakhsh. "'Normal Vulva' Based on the First National Labiagram Design in Adult Iranian Women Not Seeking Female Genital Cosmetic Surgery: A Pilot Study." *Sexual Medicine* 11, no. 6 (2024): qfad070. https://doi.org/10.1093/sexmed/qfad070.

Notes:

The width of the labia minora (the inner folds of skin) changes depending on where you measure it.

Widest Part (Upper Section): The skin was widest at the top. The average width for the left side was about 17.6 millimeters (mm), and the right side was about 16.7 mm.

Middle Section: The width narrowed in the middle. The average left side was about 14.6 mm, and the right side was about 13.2 mm.

Lower Section: The skin became very thin near the bottom, averaging less than 5 mm wide.

Labia Minora (Inner Lips) Width

Widest Spot (Upper Section):

Left Side averaged about 17.6 mm (or 1.76 centimeters).

Right Side averaged about 16.7 mm (or 1.67 centimeters).

Narrowest Spot (Lower Section):

The width became much smaller here, averaging less than 5 mm wide.

The study showed there is a huge range: the maximum width measured in any woman was 60 mm.

Labia Majora (Outer Lips) Length

Length in Women with a Vaginal Delivery: Averaged 91.3 mm.

Length in Women without a Vaginal Delivery: Averaged 87.3 mm.

History of vaginal deliver resulted in far longer measurements.

Other Measurements (External Genitalia).

Clitoris Glans (The Head):

Width averaged 8.1 mm.

Length averaged 9.9 mm.

Introitus (Vaginal Opening Length): Averaged 48.7 mm.

Citation:

Huang, Mengqi, Yidan Wang, Jiajun Xu, Huiru Xiao, and Jingyan Xie. “Assessing Vaginal Wall Indexes in Premenopausal versus Postmenopausal Women by Transrectal Linear Array High-Frequency Probe.” *European Journal of Medical Research* 28, no. 1 (2023): 390. https://doi.org/10.1186/s40001-023-01378-y.

Notes:

Average Vaginal Wall Thickness (VWT) measured in groups of women pre and post menopause:

Section of vagina: Upper
Average thickness before menopause: 9.37mm
After: 6.73mm

Middle:
Before: 8.69 mm
After: 6.45mm

Lower (nearest entrance of vagina)
Before: 9.21mm
After: 6.70mm

Citation:

Barnhart, Kurt T., Adriana Izquierdo, E. Scott Pretorius, David M. Shera, Mayadah Shabbout, and Alka Shaunik. “Baseline Dimensions of the Human Vagina.” *Human Reproduction (Oxford, England)* 21, no. 6 (2006): 1618–22. https://doi.org/10.1093/humrep/del022.

Notes:

Findings regarding vaginal opening:

Based on MRI measurements of undistended vaginas in adult women, for the narrowest part, which is the introitus, the study found an average value of 26.2 mm (or about 2.62 cm).

It should be noted that there is significant individual variation in all vaginal dimensions.

Length (or height) varied greatly.

Citation:

Haylen, Bernard T., Dzung Vu, and Audris Wong. “Surgical Anatomy of the Vaginal Introitus.” *Neurourology and Urodynamics* 41, no. 6 (2022): 1240–47. https://doi.org/10.1002/nau.24961.

Notes:

Height of the vaginal introitus (defined as the distance measured from the middle of the external urethral opening to the posterior edge of the vaginal introitus/hymen):

Mean Measurement (in women without significant pelvic organ prolapse):

2.7 cm (or 27 mm)

Range of this measurement in women without significant prolapse is reported around 2.0–4.5 cm.

Conclusions/action items: The introitus (and our slit in our vaginal opening piece) should be about 2.7 cm in height and 2.6 cm in width. The skin surrounding the vagina the speculum must part (and width of our vaginal opening piece) should be about 10 cm. We will incorporate this into our design.

2025/11/12 - Ecoflex maintenance and upkeep

ABIGAYLE CHAPMAN - Nov 12, 2025, 8:50 PM CST

Title: Ecoflex maintenance and upkeep

Date: 2025/11/12

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Research the best ways to maintain and care for silicon used for medical purposes, so as to slow degradation and ensure the most possible use.

Content:

Source:

Wezgowiec, Joanna, Anna Paradowska-Stolarz, Andrzej Malysa, Sylwia Orzeszek, Piotr Seweryn, and Mieszko Wieckiewicz. "Effects of Various Disinfection Methods on the Material Properties of Silicone Dental Impressions of Different Types and Viscosities." *International Journal of Molecular Sciences* 23, no. 18 (2022): 10859. https://doi.org/10.3390/ijms231810859.

Notes:

The study investigated specifically the impact of disinfection methods on various types of silicon.

The study's goal was to compare the impact of different disinfection techniques on the dimensional stability, tensile strength, and hardness of silicone impression materials.

The tested materials included:

- Addition reaction silicones (A-silicones, with putty, medium, and light viscosities)

- Condensation-reaction silicones (C-silicones, with putty and light viscosities).

The disinfection methods compared were traditional approaches (commercial liquid solution immersion and spraying)

The study also considered alternative methods (Ultraviolet C, or UVC, radiation and gaseous ozone).

Conclusions of the study: When comparing the non-disinfected materials, the A-silicones displayed superior properties, showing higher dimensional stability, greater tensile strength, and a higher Shore A hardness compared to C-silicones.

Regarding the effects of disinfection, both the traditional and alternative methods generally did not significantly affect the tensile strength or the dimensional stability of most silicones.

However, disinfection significantly affected the hardness of the materials, especially for the C-silicone material ('Oranwash L').

Varying impacts were witnessed regarding the shore hardness of the silicon, depending on the silicon type:

- Putty-Type Materials (Both A- and C-silicones): The hardness increased after disinfection procedures. This was observed for C-silicone (Zetaplus Putty) and A-silicone (Panasil Putty Soft).

- Light- and Medium-Bodied Materials: The hardness was reduced by most of the disinfection methods studied.

- Oranwash L (Light-Bodied C-silicone): The impact was very significant for this material. Its hardness was affected by all disinfection methods tested. Both traditional chemical disinfection methods—immersion (liquid bath) and spraying softened it, with immersion having the most impact.

Overall, the materials were harder at the putty viscosity, and softer at the light and medium viscosities after disinfection.

Researchers noted a statistically significant difference in the linear dimensional change for the C-silicones (Zetaplus Putty and Oranwash L) when compared to the non-disinfected control group, with a p-value of less than 0.01 ($p<0.01$). The study ultimately concluded alternative methods like UVC and ozone do not strongly affect the material properties of most silicones (similar to standard liquid disinfectants) but their suitability should be considered and evaluated as necessary for each individual material.

Oranwash L possessed: Shore A ≈ 20.0

Conclusions/action items: The study I explored related specifically to silicon used for dental prosthesis, which must sustain the wear and tear of disinfectant as well as the acids of the human mouth, however, it is reasonable to assume our client may also want to disinfect or wash the ecoflex of our model after a certain number of uses, depending on the longevity of our product. Therefore, knowing the durability of silicon in the face of disinfectant may be useful information to pass on to her. Oranwash L has a shore closest to our Ecoflex (00-20) so we can compare our product to the results of the testing on Oranwash L. Oranwash L became softer when tested with all disinfectant methods, with immersion being the most impactful. We should recommend to our client that she limit cleaning the silicon to only when strictly necessary in order to avoid degradation.

2025/12/03 - Young's modulus- data interpretation

ABIGAYLE CHAPMAN - Dec 03, 2025, 7:56 PM CST

Title: Young's modulus- data interpretation

Date: 12/3

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Understand how to interpret Young's Modulus graph/data so I understand our tensile and compressive results for our MTS testing.

Content:

Citation:

Moebs, William, Samuel J. Ling, Jeff Sanny, William Moebs, Samuel J. Ling, and Jeff Sanny. "12.3 Stress, Strain, and Elastic Modulus - University Physics Volume 1 | OpenStax." OpenStax, September 19, 2016. https://openstax.org/books/university-physics-volume-1/pages/12-3-stress-strain-and-elastic-modulus.

Notes:

Young's Modulus:

Young's modulus (E, aka modulus of elasticity) is a fundamental mechanical property.

Serves as a way of quantifying a solid material's stiffness or resistance to elastic deformation under axial stress (i.e. tension or compression).

Graphical interpretation:

Young's modulus is determined directly from the slope/gradient (or ratio) of the initial, linear portion of the material's stress-strain (σ vs. ϵ) curve.

Stress (σ): Plotted on the Y-axis (Force per Unit Area).

Strain (ϵ): Plotted on the X-axis (Relative Deformation).

Linear Region: The linear segment represents the 'elastic region', where the material obeys Hooke's Law (which says stress is directly proportional to strain, which is why a linear trend is anticipated) and will return to the original dimensions upon removal of the load.

Equation:

E = stress/strain = Slope of the linear-elastic curve

Young's modulus in regard to isotropic vs non-isotropic materials:

Isotropic Materials: For many materials, for instance certain metals (e.g., steel, aluminum), the material is isotropic (meaning, the material has the same properties in all directions). In an idealized scenario, the linear portion of the stress-strain curve under tension is a mirror image of the curve under compression.

This means the Young's modulus is expected to be the same for both.

Non-Isotropic Materials: For materials like bone/concrete, material is 'anisotropic', which means the material's properties differ in differing directions. The modulus may change notably between tension and compression data.

This requires two different values to be reported.

Interpretation of the modulus is the same for both tests (slope of the initial linear response in loading direction.)

Interpreting data values:

Resulting E directly indicates the material's stiffness:

- High Young's Modulus: Material is stiff and resists deformation (e.g., steel: ~200 GPa). It requires a large amount of stress to produce a small amount of strain.
- Low Young's Modulus: Material is flexible and deforms easily (e.g., rubber: ~0.01 GPa). A small stress results in a large amount of strain.

Conclusions/action items: Upon completion of our Young's Modulus graph, we concluded (based on the value derived from the slope of the linear portion of the graph) that both the compressive and tensile properties of Ecoflex 00-20 were appropriately similar to cervical tissue, since the resulting E value matched our research for cervical tissue properties.

2025/9/07- LUCIA Design

ABIGAYLE CHAPMAN - Sep 11, 2025, 5:50 PM CDT

Title: Design Research (LUCIA)

Date: 9/07/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Learn more about competing affordable cervical models.

Content:

Reference: https://pmc.ncbi.nlm.nih.gov/articles/PMC6407823/

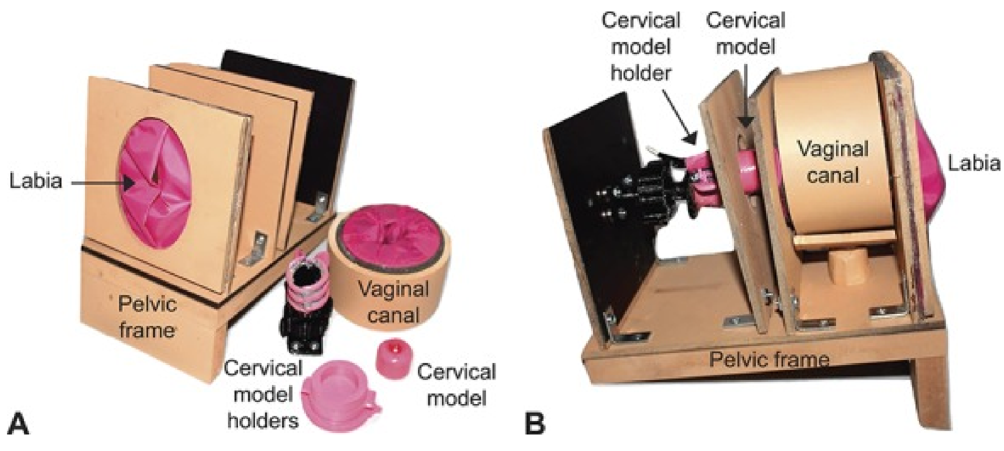
Citation:

Parra, Sonia, Maria Oden, Kathleen Schmeler, and Rebecca Richards-Kortum. "Low-Cost Instructional Apparatus to Improve Training for Cervical Cancer Screening and Prevention." *March 2019*, February 4, 2019, 559–67. PubMed Central. https://doi.org/10.1097/AOG.0000000000003140.

Findings:

LUCIA (low-cost universal cervical cancer instructional apparatus) is a hands-on simulation model that can be used for training for many procedures. The model costs $47, and is made from wood, a pipe, waterproof fabric, and foam, and is designed to hold a cervical model. The model can be interchanged for others, so multiple procedures can be performed.
The product comes with 20 cervical models, which are 3D printed and made to-scale from polylactic acid, as well as six cervical gel molds (which are intended to create cervical models with ballistics gel). Four models are also printed using NinjaFlex material and contain penetrable endocervical (inner part of the cervix) canals for taking samples. These are included in the 47 dollar cost.
LUCIA is primarily intended for training activities involving cancer-related tests, diagnoses, and treatments. It can also be used for Pap tests and HPV collection samples.
It is used by being placed at the end of a table, with the cervical model placed in the holder.

LUCIA model:



LUCIA faces some criticisms, for instance, the gel molds do not cut like tissue and do not realistically simulate biopsy procedures. Animal tissue was preferred in these cases.

Further research on NinjaFlex-

Reference: https://www.sciencedirect.com/science/article/pii/S2666912923000144

Citation:

Duran, Myka Mae, Gafaru Moro, Yang Zhang, and Aminul Islam. “3D Printing of Silicone and Polyurethane Elastomers for Medical Device Application: A Review.” *2023* 7 (November 2023). ScienceDirect. https://doi.org/10.1016/j.aime.2023.100125.

Findings:

NinjaFlex, manufactured by NinjaTek, is a commercially available TPU-based filament. It is a conductive material.
TPU refers to thermoplastic polyurethane, which becomes pliable when heated and hardens at cooler temperatures.

Reference: https://ninjatek.com/shop/ninjaflex/

Citation:

NinjaTek. *Ninjaflex 3D Printer Filament*. n.d. Accessed September 11, 2025. https://ninjatek.com/shop/ninjaflex/.

Cost: $102/kg

Further research on Ballistics gel-

Reference: file:///C:/Users/chapm/Downloads/The_use_of_gelatine_in_wound_ballistics_research.pdf

Citation:

Carr, D.J., T. Stevenson, and P.F. Mahoney. “The Use of Gelatine in Wound Ballistics Research.” *April 25, 2018* 132 (n.d.): 1659–64. Springer Nature. https://doi.org/10.1007/s00414-018-1831-7.

Ballistics gel contains a viscosity that mimics human tissue. It stretches but will deform and tear under impact. Different concentrations of the gel can be used to simulate different conditions. In the past, it has been used for military purposes to test the effects of bullet wounds. 10 or 20% gelatine conditioned at 4 and 10 degrees Celsius are used today when performing wound studies and tests.

Certain types of gel, for instance, Clear Ballistics Gel, can be used without needing to be conditioned to a certain temperature first.

Conclusions/action items: While LUCIA may be intended for cancer specific procedures, and not paracervical blocks for IUD insertion, it's a valuable example of a training model for medical training. It's worth considering some of the materials LUCIA uses for cervical models. Ballistics gel in particular may hold promise for use for a paracervical model material due to it's ability to mimic human tissue. It can also be made using a mold rather than requiring 3D printing technology, which may provide a way reduce cost and make the product more easily accessible.

2025/09/11- Cervical Cerclage Trainer

ABIGAYLE CHAPMAN - Sep 11, 2025, 7:39 PM CDT

Title: Task Trainer for Cervical Cerclage

Date: 09/11/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Learn about another design currently available for training medical professionals for cervical procedures, and consider what was done well or poorly and how that might contribute to our product design.

Content:

Source: https://www.ajog.org/article/S0002-9378(10)01970-8/fulltext

Citation:

Nitsche, Joshua, Wendy White, Jonathan O'Brien, Normal Davies, William Watson, and Brian Brost. "A Cervical Cerclage Task Trainer for MFM Fellows and OB/GYN Residents." *January 2011* 204, no. 1 (n.d.). https://doi.org/10.1016/j.ajog.2010.10.711.

-This device is intended for training for cervical cerclage procedures.

-PVC pipes simulate the pelvic structure.

-Foam covered with latex sheets lines the inside of the trainer to mimic vaginal sidewalls.

-This design utilizes frozen animal tissue to cut cylinders 1.5 cm in diameter and 4 cm in length to mimic the cervix. A cervical canal is created by drilling a hole through the cylinders, which, once thawed, are fastened to the foam disk with sutures and then secured within the PVC pipe so it's at the top of the vagina replica. The entire model is then secured in a holder.

-Removing the foam inserts creates an option to allow new trainees to have an easier time performing procedures.

-Vaginal length and angle of the pubic arch can be adjusted to simulate varying situations which may be encountered in real procedures.

Conclusions/action items: The materials and build of this training model allow for it to be easily adjusted, which is convenient. The necessary materials are also all fairly accessible, although for our product in particular, we have a need to be able to replace the model frequently. This raises questions about storage and potentially a need for transportation of frozen animal tissue. While this device was made for a different procedure than the one we plan to build our product for, there are still valuable takeaways to consider here, especially in regards to the material and the way in which this device is assembled. The way in which the assembly of the device was outlined may be helpful when we think about developing our potential design ideas.

2025/19/09 - BSAC Executive Committee

ABIGAYLE CHAPMAN - Sep 19, 2025, 11:49 AM CDT

Title: BSAC Executive Committee meeting #1

Date: 09/19/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Discuss confusing topics from last meeting, prepare for next BSAC meeting.

Content:

-Training goals and requirements in regards to the design class are unclear/were not made clear.

-Website for picking projects could be completely redesigned, there are lots of flaws. Could be possible to have a group of BSAC separate to work on it if approved.

-In general there is confusion with course advising page and track spreadsheet. This is not discussed in class. The only info about it was brought up in an email received over the summer.

-BME 200 could have a lecture, but would make it three credits. Could use one general overview at the beginning instead to clear up confusion and make course expectations more clear.

-Teaching BME 200 students about PDS and expectations occurs through the team rather than through the class, which is hard when things are busy in the fall.

-Project proposals could be better managed. 300s should have some priority for their proposals.

-Course advising: We should have a later email after the start of classes to give a better overview of the class, as people are more likely to see and read it.

-We should check in next meeting to see how PDS went, clear up confusion. Everyone should have met with their client by now.

-Should be more guidance about making a PDS, how to deal with a client who doesn't really know what they want, more clear grading standards and how lenient the PDS is especially around the early stages of the class.

-It's hard when are discrepancies in advisor grading regarding PDS. Could try to find a way to standardize grading? Hard when different teams are in different spots with their project.

-We should discuss mentorship soon.

-If possible, would be nice to have a prescheduled client meeting so everyone in that group can meet right away with client at beginning. Would need to be a time when everyone is known to be free.

Conclusions/action items: The BSAC executive committee has some ideas regarding how to clear up confusion in the class. Differing email times, clearer communication, and grading standards would all help students better understand expectations.

2025/09/26- Faculty Meeting 1

ABIGAYLE CHAPMAN - Sep 26, 2025, 11:49 AM CDT

Title: Faculty Meeting 1

Date: 9/26/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Become acquainted with faculty, share input on discussion topics and collaborate.

Content:

-Some groups are experiencing issues with advisors not showing up to meetings.

-Lab archives expectations are unclear and vary from grader to grader. Some advisors require 100 pages, some don't mention any standards. A rubric or a note from each advisor would be helpful to understand expectations. Theoretically, it seems that lab entries should exemplify 4-6 hours of work or research.

-More direction as to what to discuss with advisor at advisor meetings could be useful.

-According to staff feedback:

The idea of the notebook is to give early feedback. Rough sketches, initial research, ect. can guide the early conversation and help us with feedback in initial project stages. Lots of entries in lab archives can show you're being influential about the project.

It's a way to document the process, and show the advisor what is important for the project rather than having to talk about it.

In internships and co-ops, we will need to similarly document our process and findings.

-Trainings could be project-specific, advisors could recommend helpful trainings according to each project rather than everyone doing the same trainings.

-BME 200s prefer the idea of doing the in-person shop training as a group.

Conclusions/action items: Lab notebook expectations should be more clearly communicated and laid out. At bare minimum, having something to access and look at on a canvas page would be useful, whether that's a document or a note. Additionally, a rubric would be appreciated from each advisor to understand individual grading differences.

2025/10/10-BSAC Meeting

ABIGAYLE CHAPMAN - Oct 10, 2025, 11:45 AM CDT

Title: BSAC Meeting

Date: 10/10/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Discuss inquiries, mentor/mentee program, ect.

Content:

-Lecture for BME 200 might be helpful, but would need to take a credit from somewhere else in the course. Asynchronous lecture might be best. It could be recorded, so if people had to schedule another class it would work better.

-Scheduling a preset meeting with a client isn't realistic logistically. New faculty pick projects first for 200/300, advisors have specialties with projects.

-Training throughout the curriculum:

- Survey for adding trainings seems useful.
- Needs to be a certain length.

-Preliminary presentations:

- We could use a way to control presentation times so everyone has enough time, and no groups at the end feel rushed. Is there a way advisors could control the length/a hard cutoff time that could be implemented?

-Preliminary reports:

- Went well, some confusion with communication/expectations for some groups.
- Imbalance of contributions has been an issue for some groups.
- Feedback fruits could more specifically focus on the report.
- Preliminary report sections have a lot of grey area. There could be more clarity.

-Show and tell:

- We have some concept of Show and Tell. It seems like it's supposed to be a mini-poster presentation type of thing with a prototype. It's a halfway point/check in.

-Grades:

- Some people have zero grades currently in the grade book.
- No feedback on Preliminary presentation came from advisors.
- Feedback on preliminary presentation may have helped with feedback on report-if report due date was further back, could be useful.

-Advisors:

- Could use clearer expectations for them to keep things somewhat standardized?
- Feedback fruits for advisors, or some way to review them halfway through the semester?

-Makerspace money. Do we have $50 like we did in INTEREGR 170?

-Encouraging variation and deviation from the normal structure could be important. Ex. don't include shelf life in PDS if project doesn't involve shelf life.

-Advisors could encourage deviation from normal path to make things more realistic/real world.

Conclusions/action items: Overall, we have discussed how things are currently going and will move forward with prototyping and preparing for show and tell. As far as feedback, we feel preliminary report expectations could be more clearly outlined, and grading should be submitted in a timely manner.

2025/10/17 - BSAC Executive Committee Meeting

ABIGAYLE CHAPMAN - Oct 17, 2025, 11:27 AM CDT

Title: BSAC Executive Committee meeting

Date: 10/17

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Discuss responses to past meetings, plan next BSAC meeting.

Content:

-Flowchart for BME 462 class to ensure progression requirements are met in time.

-Mentees asking for research opportunities, but options are limited. Just BME research page (can cold email), student job page. Meeting with undergraduate research.

-Swapping order of 200 and 201 isn't possible. 201 may give tools to navigate design course, but mentorship of 300s is important/desired.

- It's also harder to get projects for spring semester (clients don't respond over winter break).

-Topics for next BME meeting:

- How prepped are people for show and tell?
- BME mentor feedback
- How can advisors facilitate show and tell?
- Simplified flowchart
- Testing plan
- How has ordering materials gone?
- Questions on classes for next semester, upperclassmen share experiences/give advice

Conclusions/action items: We have a plan for next BSAC meeting, and will move forward with the meeting with faculty next week. The flowchart is a useful addition.

2025/10/24 - BSAC Faculty Meeting

ABIGAYLE CHAPMAN - Oct 24, 2025, 11:46 AM CDT

Title: BSAC Faculty Meeting

Date: 10/24/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Discuss meeting topics, including Show and Tell, enrollment, material ordering and testing, engage with faculty.

Content:

-Many mentors have not met with their mentees (emails get lost for freshmen).

-Most prototypes are ready for Show and Tell. Expectations seem clear for what is going to happen/what is required with Show and Tell.

-Some materials are still being ordered for many groups. Some materials need to be ordered in stages, because amounts or sizes needed cannot be determined at this time.

-Teams have developed testing plans, some less detailed then others. Some people have chosen to test their device on volunteers at ECB.

-Talking to professors specifically in tracks may help offer an alternate path to getting into certain courses earlier. Specially made meetings or office hours can be utilized for this. For instance, Dr. Putchinelli was able to recommend a way to take biology with other courses to get into Biomaterials faster, pushing physics/varying courses to later in favor of taking biomaterials earlier.

-Materials ordering is at times confusing. It may be needed to be picked up, sometimes it can't be reimbursed directly through students, ect. No one solution seems to work for most teams. A more convenient way to get money from clinicians to students is needed.

-There's a canvas page with a notebook insert for the training, apparently.

-Everyone has done the training for the course.

Conclusions/action items: Everyone is prepared for show and tell and understands expectations. Plans are being formulated for testing, or have been fully formulated. Machining has been completed. We are ready to proceed and move forward with our projects.

2025/11/07-BSAC Meeting

ABIGAYLE CHAPMAN - Nov 07, 2025, 11:34 AM CST

Title: BSAC Meeting

Date: 11/7

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Discuss previous questions, go over today's meeting topics.

Content:

Conclusions from last time:

-Report deadlines will remain the same.

-BME 201 and 200 cannot swap.

General thoughts on training throughout the curriculum:

- City training is more geared towards research. Training also expires in 3 years.

Suggestion form:

- Trainings can be added to the list of optional trainings. For 201 and 301, any training can fulfill requirements.

Mentor/mentee program update:

-Course offerings and course track recommendations are likely most helpful for course selection.

-Research options are also available on the canvas page.

Show and tell/project status:

-Overall was interesting to see other groups' projects.

-Testing is happening, people are at very different places with their projects.

-Some groups are experiencing unclear communication at times between juniors/sophomores.

-Some people got decent feedback.

-Some of the benefit of show and tell is just to explain the project and develop your elevator pitch for your project for interviews, ect. It's good for developing a succinct, clear summary of your project.

-Projects should be done before Thanksgiving. After coming back from the Thanksgiving break, poster presentation is Friday and the poster should be printed on Wednesday. Testing needs to be done by Monday so it can be added to the poster.

Conclusions/action items: Now show and tell is over, it is important for us to move forward with finishing up our prototype and finishing testing in the next two to three weeks.

2025/11/14 - BSAC Executive Meeting

ABIGAYLE CHAPMAN - Nov 14, 2025, 11:31 AM CST

Title: BSAC Executive Meeting

Date: 11/14

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals:

Plan next meeting, discuss.

Content:

-Next BSAC meeting, we should consider plans for the remainder of the semester, talk about enrollment, final poster presentation preparation, ect.

-Considering if the project is continued next semester.

-Awards for every semester could be cool. Design excellence comes from a project for a specific client.

-Ask advisor about notebook entries. Late in the game we should still be doing a lab archives entry every time you work on the project- team entries or individual entries for testing should be happening about this time.

-How is communication with clients, are they going to attend power presentation? Client feedback form (if a client doesn't reply, ect)?

-For BME 400, you don't have to continue the project, but if there is work to be done that's possible. Group members can vote on if they want to continue it.

Conclusions/action items:

ABIGAYLE CHAPMAN - Dec 10, 2025, 3:34 PM CST

In conclusion, we have created a list of topics to discuss during our next meeting. The group agrees a client feedback form would be beneficial for assessing how involved and helpful clients are, and helps to determine who should be a client in the future. We have some good ideas about awards for the future. We will carry forward with preparing for the next meeting.

[Download]

BSAC_11_14_Conclusion.pdf (22 kB)

2025/11/21 - BSAC Meeting with Faculty

ABIGAYLE CHAPMAN - Nov 21, 2025, 12:43 PM CST

Title: BSAC Meeting with Faculty

Date: 11/21

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Discuss topics decided at last week's executive meeting, ect.

Content:

Stages in testing:

-Most people are beginning testing, others are about halfway done.

BME Mentees:

-Most people haven't had a lot of meetings with their mentees.

Poster presentation:

-Similar to INTEREGR 170.

-Include lots of pictures, prioritize it over words. We could include an image of the tomato model as well.

-Physical model is helpful to show what's going on. We could likely include a video of the actual paracervical block, as that's the most confusing portion of the presentation for most people new to the terminology/procedure.

-Extension cords are not provided, may want to bring one to show a video of the block.

-There will be tables in the Tong auditorium locked together, ect, if a table is needed for our project.

-Posters should be set up by 11am. We can walk around and look at posters from 11-12.

-Pizza will be had this year at the poster presentation, out of the design lab (the blue room). Around 11am we can get pizza.

-There will be a feedback fruits assignment. You must go around and evaluate other peoples' posters. There will be a link for this assignment on canvas.\

Enrollment:

-A senior has had no issues with enrollment ever before. He just had a full class with a full wait list before he was able to enroll. He feels something is different this year, as he has never had that issue before.

-Certain classes are required for senior capstone and BMEs unfortunately don't get precedence. We aren't allowed to enroll until December.

Masters programs:

-Can get first enrollment in certain classes.

Conclusions/action items: We should wrap up our testing, our final reports, and final posters as soon as possible. We will proceed to wrap up our project over Thanksgiving.

2025/09/18- Initial Design #1

ABIGAYLE CHAPMAN - Sep 18, 2025, 10:06 PM CDT

Title: Initial Design 1

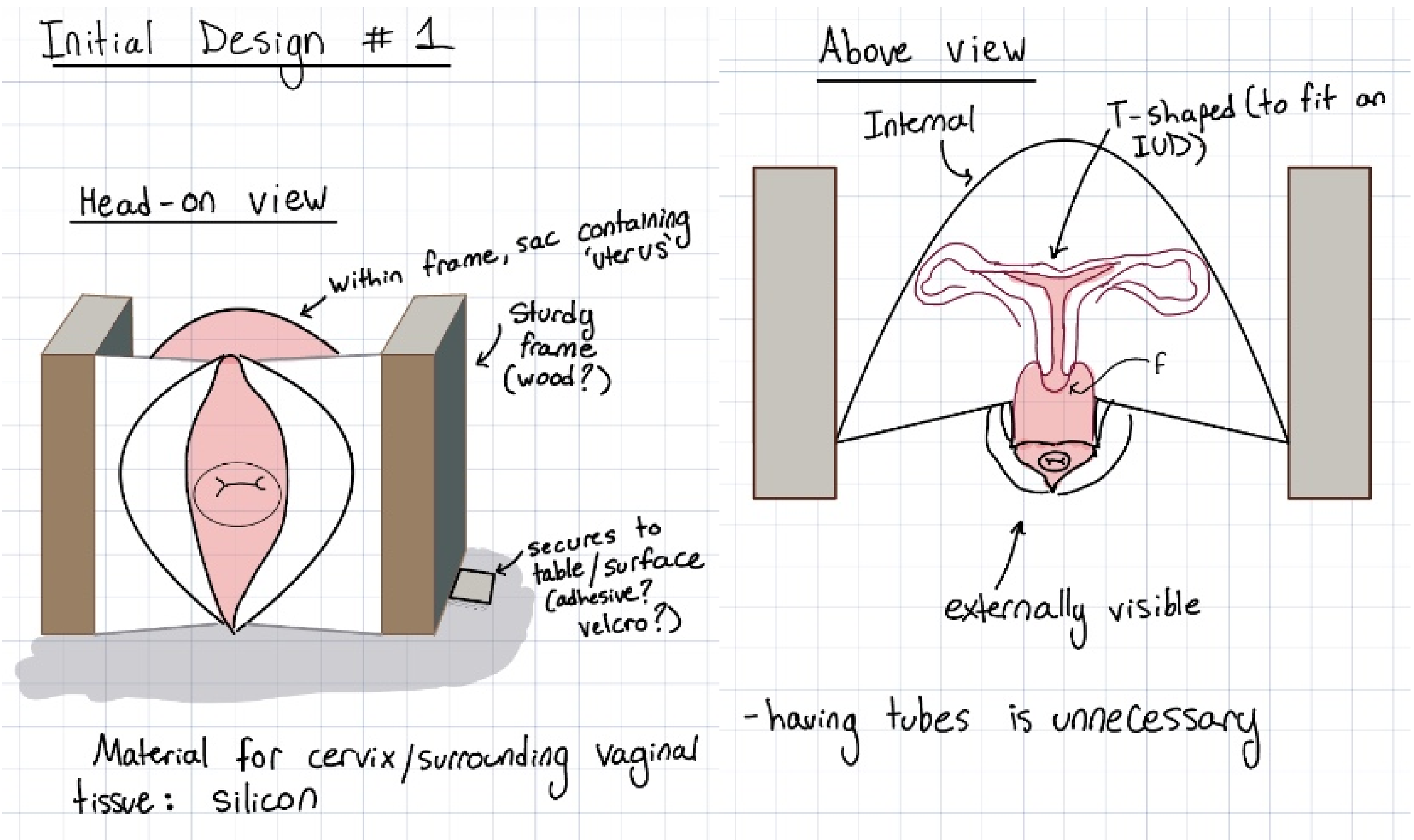
Date: 9/18/2025

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Document initial rough sketches of first design idea.

Content:



Conclusions/action items: The design needs work, and does not yet include dimensions or materials for all the moving parts. It will need more development and refinement. The fallopian tubes are also an unnecessary feature, but are included in this initial sketch.

2025/10/24 - Solidworks Design - Vaginal Opening with Top Plate

ABIGAYLE CHAPMAN - Oct 25, 2025, 7:09 PM CDT

Title: SolidWork's Design 2 - Vaginal Opening with Top Plate

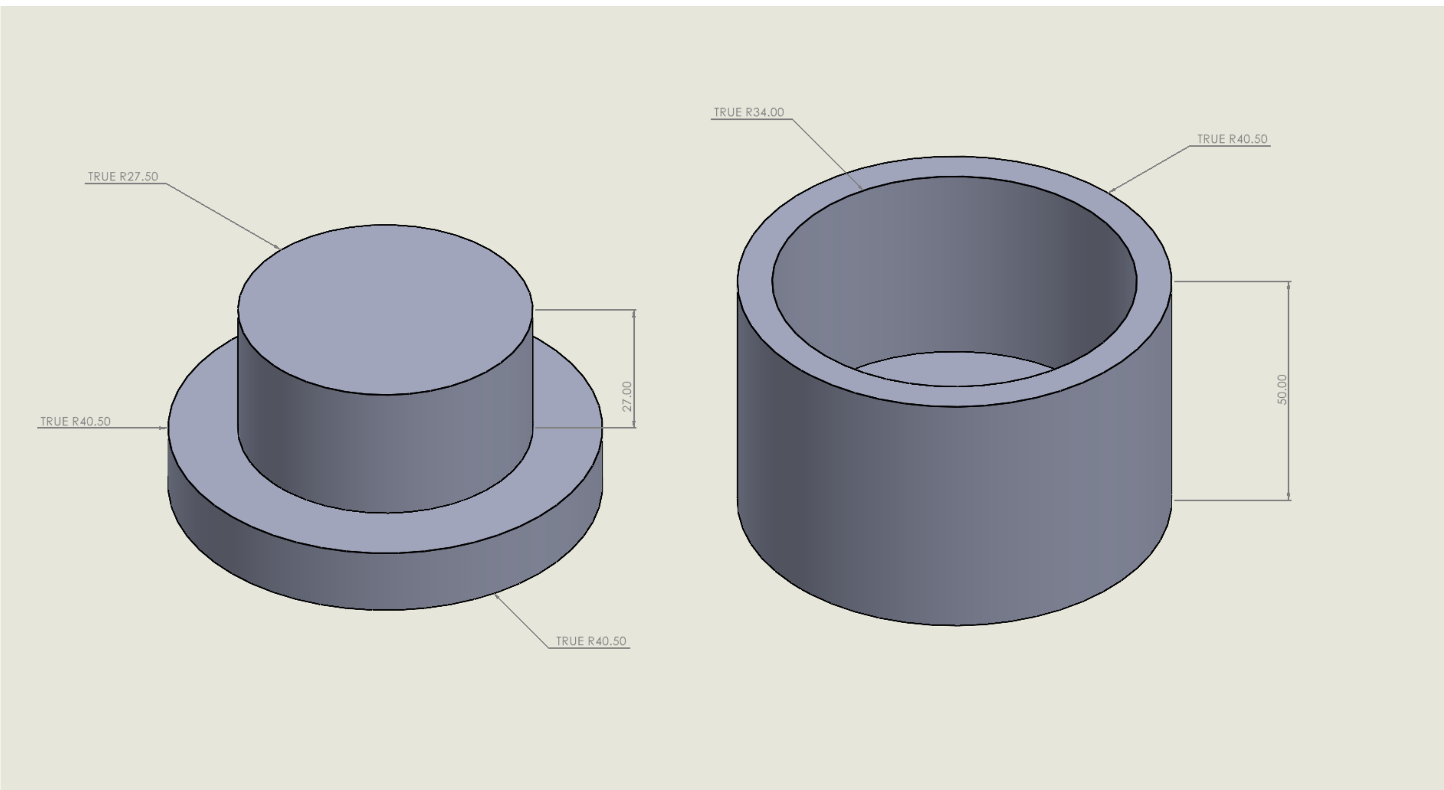
Date: October 24th, 2025

Content by: Renee Sobania & Abigayle Chapman

Present: Abigayle Chapman

Goals: To modify the original inner mold design to include a top plate so we can keep a constant thickness with the vaginal opening.

Content:



Conclusions/action items:

In conclusion, this mold now includes a top plate. Now we need to 3D print and test it.

2025/10/29 - Solidworks Dogbone Mold for MTS Testing

ABIGAYLE CHAPMAN - Oct 29, 2025, 8:07 PM CDT

Title: Solidworks Dogbone Mold for MTS Testing

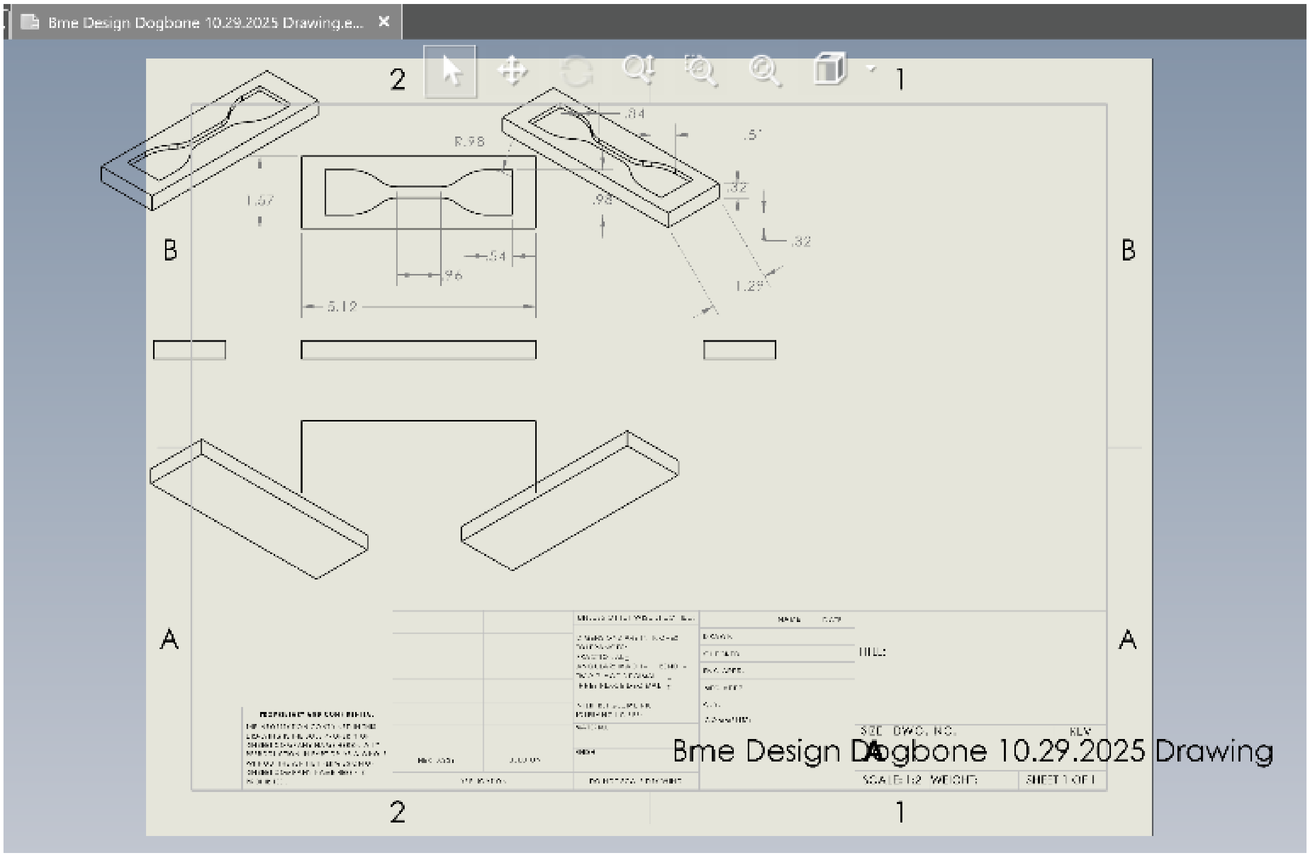
Date: 10/29

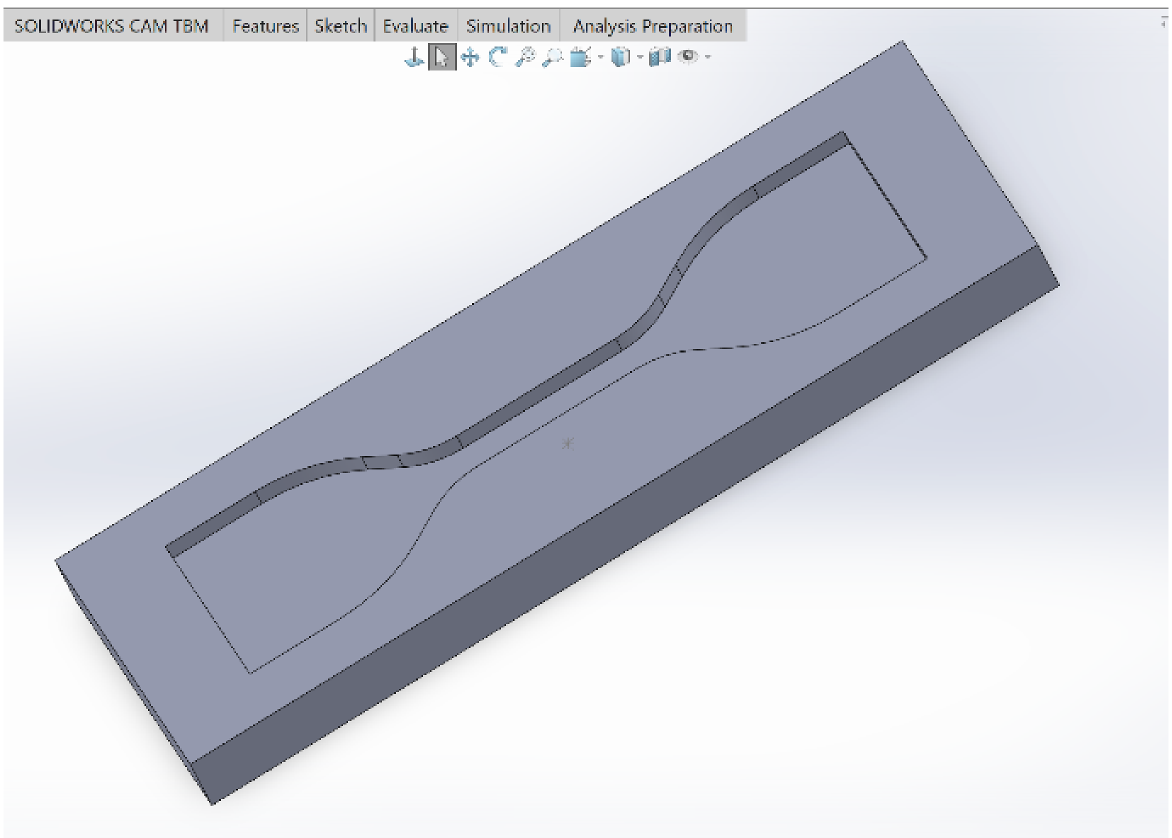
Content by: Abigayle Chapman

Present: All group members

Goals: Create a Solidworks Dogbone mold and drawing for future use with MTS testing.

Content:





Conclusions/action items: As BME 200s, we have a better understanding now of Solidworks and how to operate it, which will be helpful for the future.

2025/11/03 - Cervicovaginal junction with cervix mold

ABIGAYLE CHAPMAN - Nov 05, 2025, 4:08 PM CST

Title: Cervicovaginal junction with cervix mold

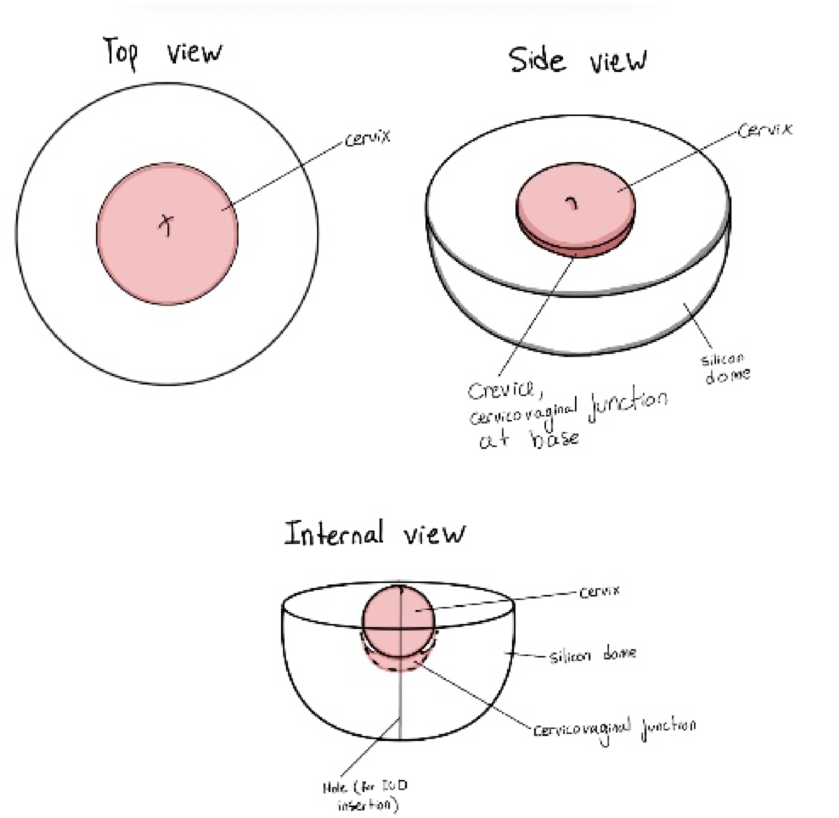
Date: 11/3

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Create design for Cervicovaginal junction and cervix according to client specifications.

Content:



https://acrobat.adobe.com/id/urn:aaid:sc:VA6C2:f373a65b-bb9f-4254-b07e-a0fc099d5d0e

Conclusions/action items: I drew up a new design idea to share with the group. We will go over them together.

2025/10/29 - Intro to Machining

ABIGAYLE CHAPMAN - Oct 29, 2025, 11:07 AM CDT

Title: Intro to Machining

Date: 10/29

Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Complete intro to machining training.

Content:

I created the alpha part over the duration of one session on the lathe, and one session on the mill.

Proof of completion:

ABIGAYLE CHAPMAN

ID Number: 908687 8544

Eligibility: CoE Students

Profile

Program Registrations

Bookings

Memberships

Orders

Invoices

My Memberships

Membership Type	Start Date	Expiry Date	Renew	Card Info
Machining	Wed, Aug 20 2025	Permanent	Not Renewable	N/A
Shop Tools	Tue, Aug 20 2024	Thu, Jan 2 3000	Not Renewable	N/A
Laser Cutter	Tue, Aug 20 2024	Thu, Jan 2 3000	Not Renewable	N/A
Machining - Training Eligible	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Renewable	N/A
Lab Orientation	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Renewable	N/A
Shop Tools - Training Eligible	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Renewable	N/A
Laser Cutter - Training Eligible	Tue, Aug 20 2024	Wed, Dec 31 3000	Not Renewable	N/A

Conclusions/action items: I have finished the trainings for BME 200.

2025/10/29 - Chemical Safety Training

ABIGAYLE CHAPMAN - Oct 29, 2025, 11:12 AM CDT

Title: Chemical Safety Training

Date: 10/29

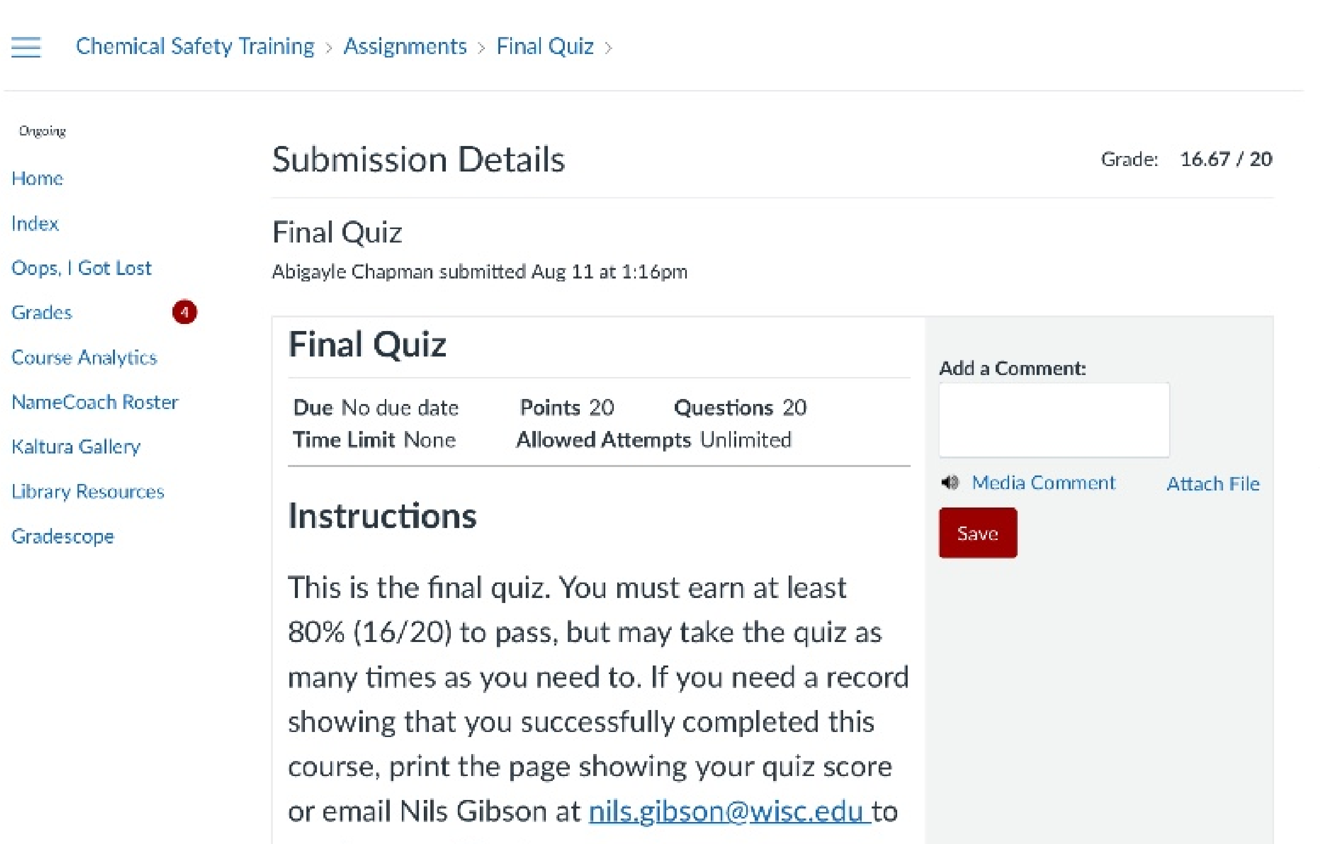
Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Complete Chemical Safety OSHA training.

Content:

Below is my final quiz score for the training module, which meets requirements (16/20 points minimum).



Conclusions/action items:

I have completed Chemical Safety training.

2025/10/29 - Biosafety required training

ABIGAYLE CHAPMAN - Oct 29, 2025, 11:20 AM CDT

Title: Biosafety required training

Date: 10/29

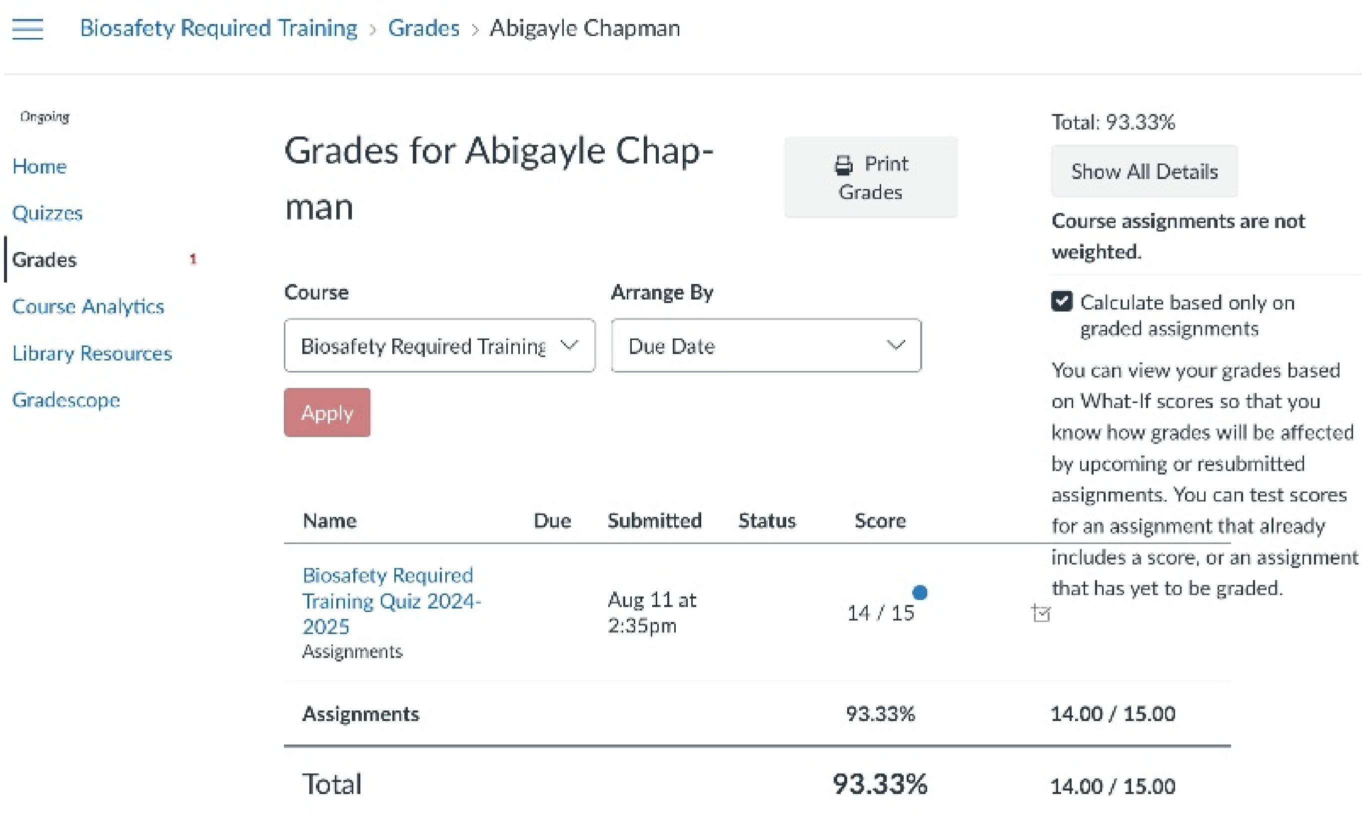
Content by: Abigayle Chapman

Present: Abigayle Chapman

Goals: Complete Biosafety required training.

Content:

Proof of completion:



Biosafety Required Training › Grades › Abigayle Chapman

Ongoing

Home
Quizzes
Grades 1
Course Analytics
Library Resources
Gradescope

Grades for Abigayle Chapman

Print Grades

Course: Biosafety Required Training

Arrange By: Due Date

Apply

Name	Due	Submitted	Status	Score	
Biosafety Required Training Quiz 2024-2025 Assignments		Aug 11 at 2:35pm		14 / 15	
Assignments				93.33%	14.00 / 15.00
Total				93.33%	14.00 / 15.00

Total: 93.33%

Show All Details

Course assignments are not weighted.

Calculate based only on graded assignments

You can view your grades based on What-If scores so that you know how grades will be affected by upcoming or resubmitted assignments. You can test scores for an assignment that already includes a score, or an assignment that has yet to be graded.

Conclusions/action items:

I have completed Biosafety training.

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: