Department of Biomedical Engineering
UNIVERSITY OF WISCONSIN-MADISON

GVI: Straw Stamp and Slicer

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Clients: Sarah Hanson, Brett Breidor, and Ben Goss

Advisor: Professor Justin Williams

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Problem Statement

Motivation

- Quality control (QC) procedures investigating artificial insemination (AI) of bull semen for are time and labor intensive
  - 1 hour per plate, 8-10 plates per week

Goal

- Optimize quality control procedures
  - Design slicer to cut 12 straws simultaneously
  - Design stamper to push bull semen out of the straws, avoiding cross contamination
- Include removable components for cleaning

Client Description & Background

- Genomic selection and AI benefits [1]
- Genetic Visions-ST: Genetic sequencing of bull semen to execute QC program [2]
  - Ensures DNA matches bull listed on AI straw
- QC procedure: place each straw into well plate, cut the bottom off, and push the contents of the straw into the well plate

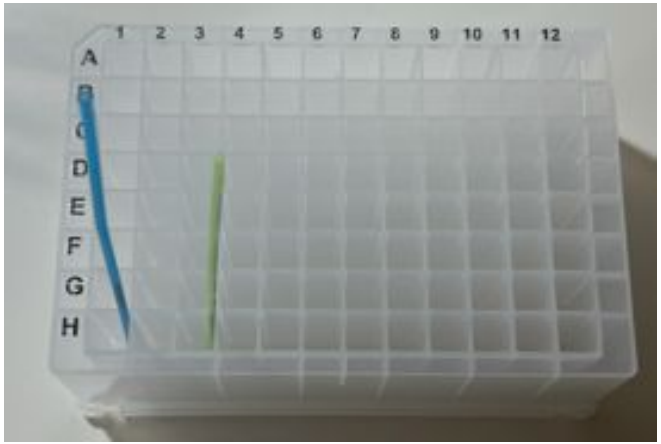

***Figure 1**: Artificial insemination straws in a 96-deep well plate*

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Current and Competing Designs

- GVI Design
  - Straws are placed, cut, and emptied by hand
  - Prototypes for slicer and stamper are non-functional
- Competing Design
  - MiniCutter: cuts singular AI straw, does not empty contents of straw [3]

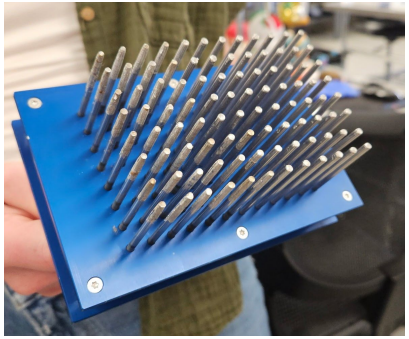

Figure 2: *GVI stamp prototype*

Figure 3: *GVI slicer prototype*

Figure 4: *MiniCutter for AI straws [2]*

PDS Summary

- Straws must not bend or break
- Bleach and/or ethanol safe
- Non-porous materials
- Must be removable for sanitation
- Each device must have a life-in-service > 1 year
- < $1000 for research and fabrication

Slicer Specific:

- 0.20-0.50” cut off of each straw

Stamper Specific:

- Stamper must push out ALL contents of the straw

The Clamp

- Pinching mechanism to hold straws
- Frame placed around well plate
- Notches to slip clamp into

Advantages

- Snug grip on all straws
- Self-tightening

Disadvantages

- Difficult to place and hold straws while tightening clamp

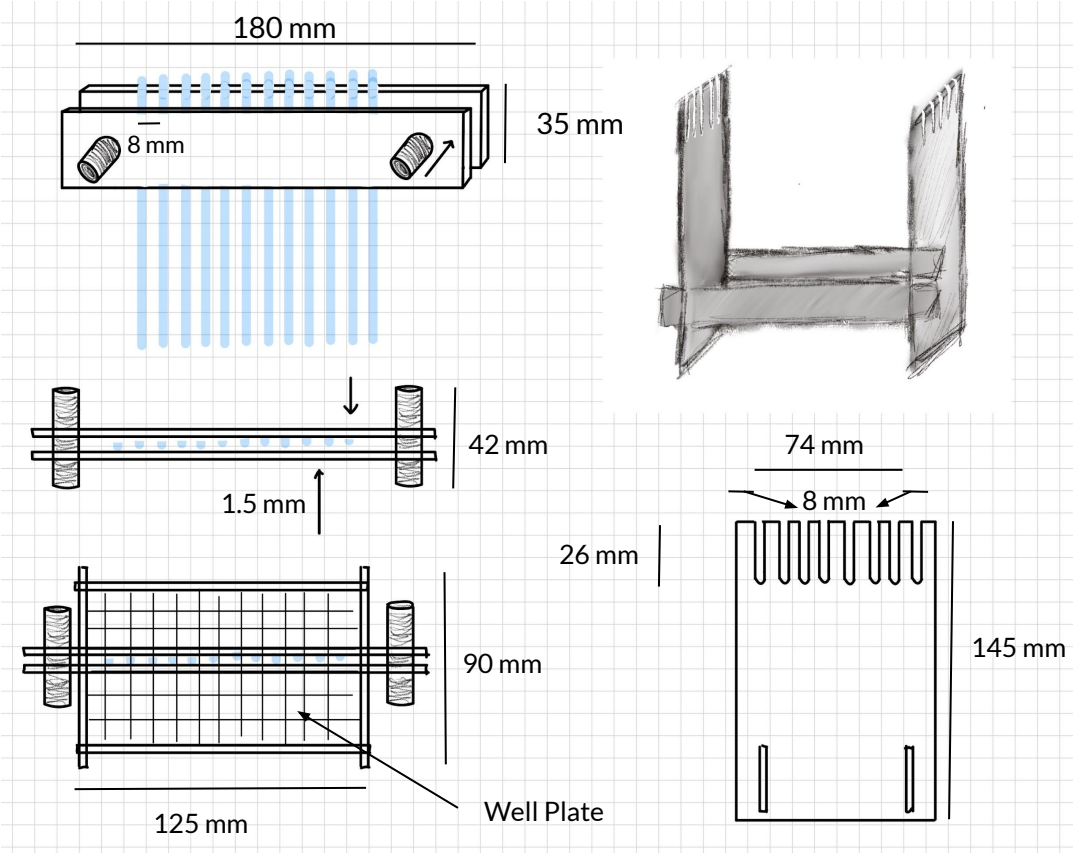

***Figure 5**: Clamp Mechanism Design*

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The Stamper

- 96 straws loaded at once
- Straws placed in well plate
- Top plate with prongs

Advantages

- Stopper to control depth
- Ergonomic handle

Disadvantages

- Difficult to get each straw to line up

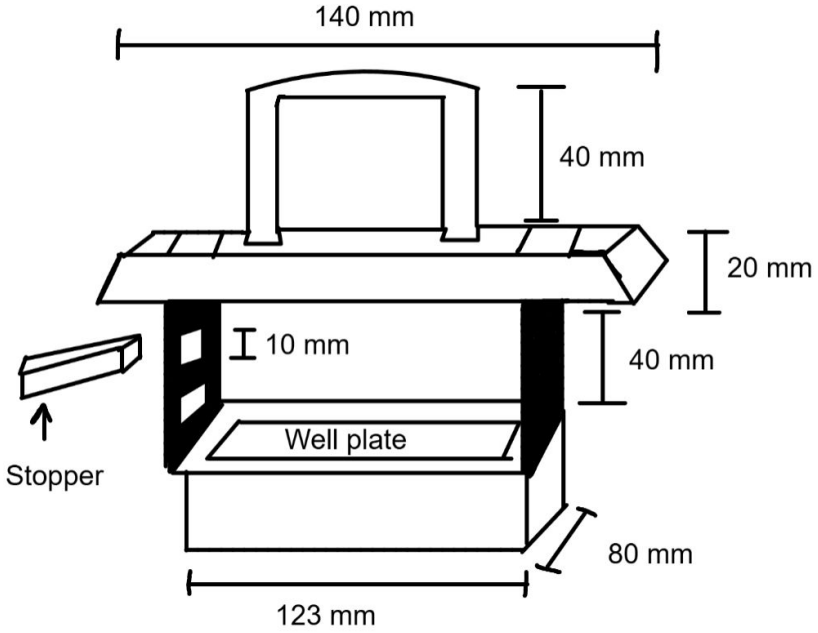

Figure 6: *Stamp Design*

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The Compartments

- 12 individual compartments
- Gap near bottom for slicer

Advantages

- Decreased contamination risk

Disadvantages

- Difficult to place straws into
- Can only do 12 at a time

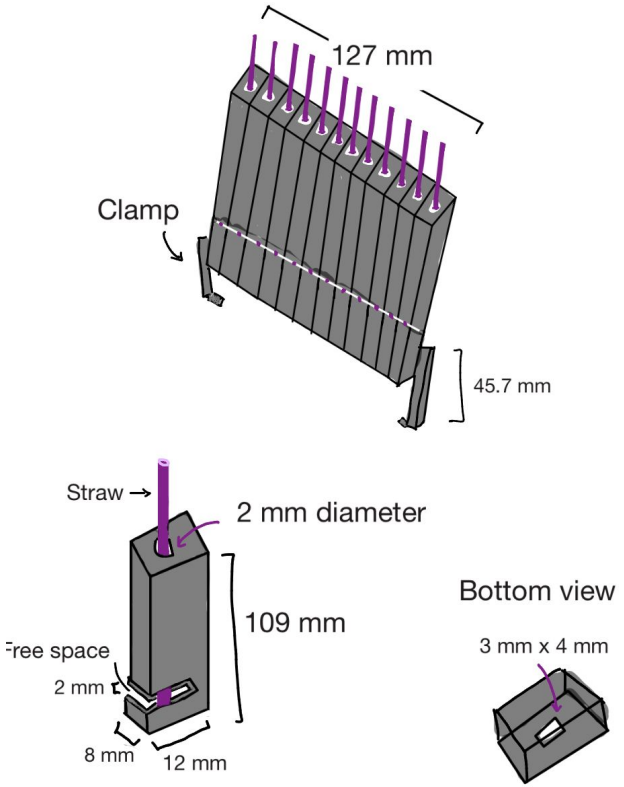


***Figure 7**: Compartment Design*

Design Matrix

- Contamination was biggest concern
- Compartments idea won overall
  - Least contamination risk

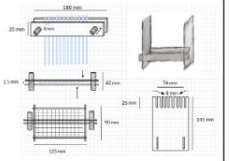
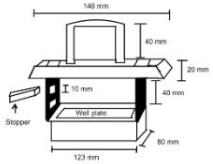
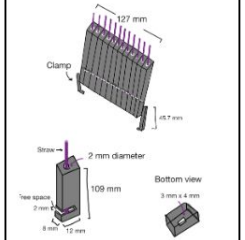
Criteria	The Clamp		The Stamp		The Compartments	
						
Criteria (Weight)	Raw Score	Weighted Score	Raw Score	Weighted Score	Raw Score	Weighted Score
Contamination risk (25)	3/5	15	2/5	10	5/5	25
Sanitation (25)	4/5	20	4/5	20	2/5	10
Ease of use (20)	3/5	12	3/5	12	3/5	12
Ease of fabrication (15)	3/5	9	4/5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

Table 1: *Frame Design Matrix*

The Retractable Stamper

Advantages

- Attaches directly to frame
- Easier to align straws
- Springs to retract prongs
- Prevent possible contamination

Disadvantages

- Difficult to sanitize

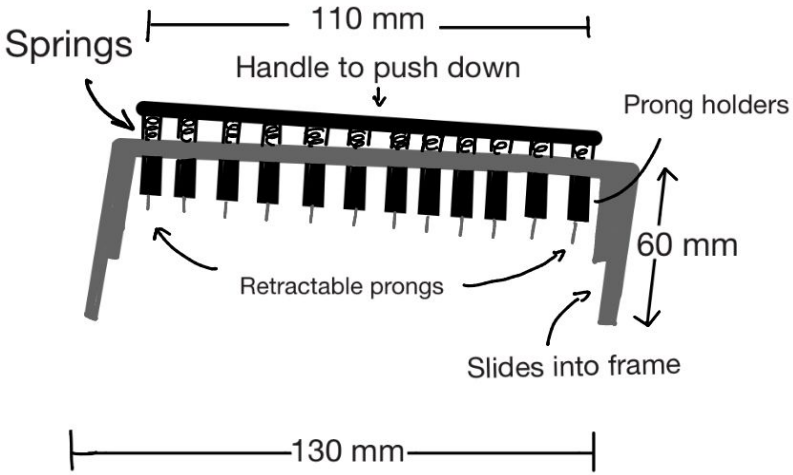


***Figure 8**: The Retractable Stamper*

Janice Amornthanomchoke

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The Removable Prongs

Advantage

- Ergonomic handle
- Clips to secure stamp to the side
- Replaceable prongs
- Easier to clean

Disadvantage

- Issues with alignment

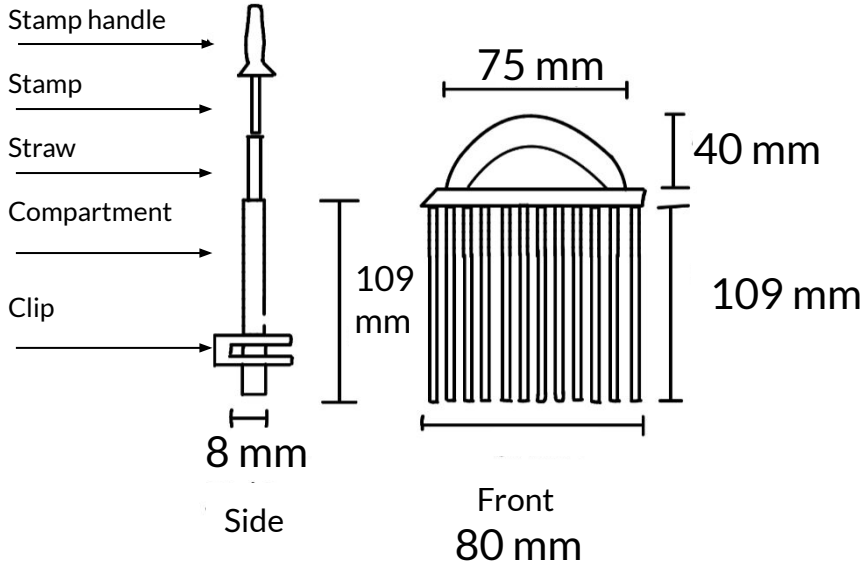


Figure 9: *Removable Prongs*

Stamper Design Matrix and Final Design

Removable Prongs won

- Must align with straws each time
- Simpler design and fewer components
- Prongs are replaceable when worn
- Manual stamper is more reliable

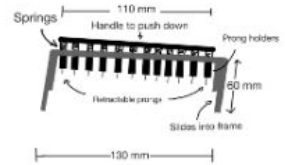
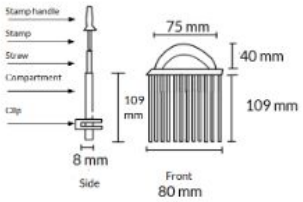
	Retractable Stamper		Removable Prongs	
				
Criteria (Weight)	Raw Score	Weighted Score	Raw Score	Weighted Score
Ease of use (25)	4/5	20	3/5	15
Sanitation (25)	4/5	20	5/5	25
Durability (20)	3/5	12	4/5	16
Ease of fabrication (15)	2/5	6	5/5	15
Safety (10)	5/5	10	5/5	10
Cost (5)	4/5	4	5/5	5
Total (100)	72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

Table 2: *Stamper Design Matrix*

Catie King

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Testing

Force:

- Force to push out semen
- Force to cut 12 straws simultaneously

Time:

- Initial and final time for full procedure
  - Cutting and stamping straws
  - Cleaning each component

Contamination:

- Inspect any cross contamination between straws

***Figure 10**: MTS Electromechanical System [4]*

Future Work

This Semester:

- Determine slicing mechanism
- Finalize design
- Order materials
- Design and 3D print frame and stamper
- Conduct testing

Beyond Semester:

- Optimize device
  - 12 straws -> 96 straws
  - More ergonomic
- Production use

Acknowledgements

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References

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

[2] Nasco, “MiniCutter for Semen Straws - Nasco Education,” Nasco Education.

[3] “About Us.” Genetic Visions, 2022. Accessed: Sept. 17, 2025. [Online]. Available: https://www.geneticvisions.com/about-us.aspx

[4] “Criterion Custom Test Systems,” *MTS*, 2024. https://www.mts.com/en/products/materials/static-materials-test-systems/criterion-custom