HIV Barrier Model

Team

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BME BIOMEDICAL ENGINEERING

Overview

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Problem Statement

Currently the original version has been received extremely well by client's classes in the medical genetics course "Contemporary Issues on HIV/AIDS"

However, the current model is fragile and not easily transportable. The client is requesting an improved more sturdy and mobile product.

Design needs to demonstrate the strength and durability of latex and polyurethane barriers against HIV infection and other sexually transmitted infections.

Background

- University of Texas Volunteer Studies
  - Couple studies where one partner has HIV while the other was not infected.

	US	Haiti	England
Consistent Users	0%	1%	0%
Inconsistent Users	10%	6.8%	4.8%

Current Testing Techniques

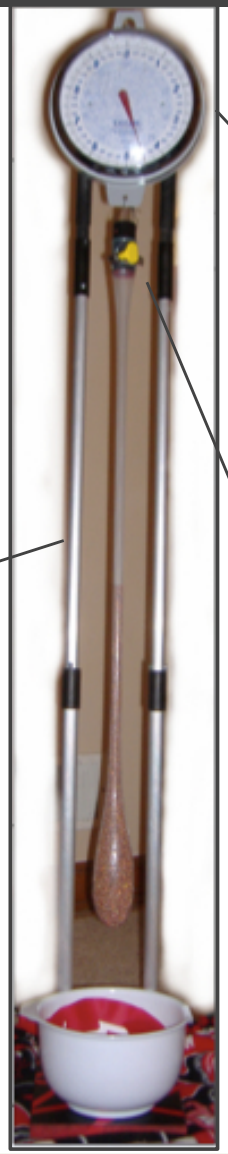
Motivation

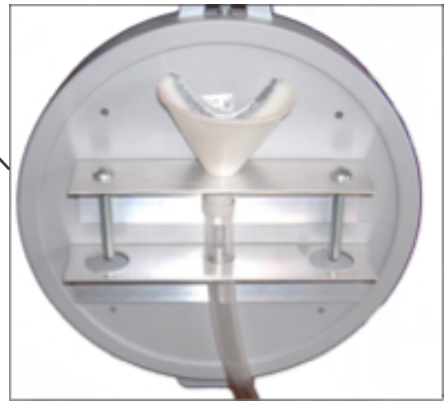
- Safer Sex
- Consistent Condom Use
- Education

http://www.funnycommercialsworld.com

Current Model - Apparatus

Base/Structure





Analog Scale

Clamp

Current Model – Current Conditions

Defects

- Fragile pole
- Heavy weight (beads)
- Time-consuming installation
- Bulky for transportation

Design Specification

- Client Requirements
  - A more portable model
  - Light weight
  - Large enough for classroom demonstration
  - User friendly
    - Easy to assemble and replace parts
    - Easy to operate
  - Dramatically show the effectiveness and toughness of condom
  - Under $100
  - Table model

Design Specification

- Sticking with the original, adding new improvements.
  - Changing the material of the load placed in the condom?
  - Similar structure and components, but a more compact and portable model

Preliminary Testing

Beads (left)
Water (center)
Airburst (right)

Presentation Mechanism

Apparatus

Final Design

Design Alternatives

Design Alternatives

Presentation Mechanism

+

Apparatus

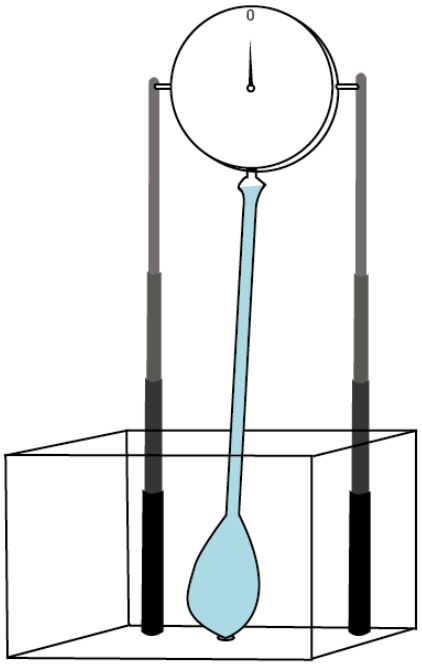
- Options for demonstration
  - Pouring Beads (original)
  - Water Dye
  - Combination (Beads + Water)
  - Free Fall

Design Alternative – Presentation Mechanism (I)
Pouring Beads

Using the Current Design

- Method is proven to work
  - Has the necessary dramatic effect
  - Can be operated by someone without any prior knowledge
  - Can be made visible to a large audience
  - Low cost
- Problems
  - Needs to be rebuilt
  - Not the most visually appealing demonstration device
  - Assembly is confusing with too many parts

Design Alternative – Presentation Mechanism (II)
Water Dye



- Tremendously Dramatic!
  - Easy to see
  - Condom can hold more water weight than bead weight, leading to a more impressive display
  - Parts can be used from previous design
- May be more difficult to operate
  - Containing the water could prove to be challenging
  - Costly
  - Assembly/disassembly time may be a concern

Design Alternative – Presentation Mechanism (III)
Combination (Water + Beads)

- Unique display
  - Possibly more visually appealing
- Drawbacks
  - Condom still breaks at low weight, due to presence of beads
  - Clean-up is difficult; separating beads from water

Design Alternative – Presentation Mechanism (IV)
Free Falling

- A more realistic model
  - Dropping metal rods of increasing weight into the condom
  - Could lead to a more interactive experience for the students
- Problems
  - The latex material is quite elastic causing the weight to bounce
  - A completely new apparatus would need to be built
  - Acceleration due to gravity might not be enough to break the condom with a reasonable weight

Design Matrix (I)
Presentation Mechanism

- **Water Weight + Dye**
  - Criteria were given priority by your client
  - The defining category was Dramatics

Design Matrix 1: Presentation Mechanism				
Category	Current design (only beads)	**Water Weight (with dye)**	Combination (beads + water)	Free Falling Weight
Ease of Use (out of 25)	25	**22**	20	10
Dramatics (20)	15	**19**	17	9
Functionality (20)	15	**20**	20	15
Visability (15)	13	**14**	13	10
Size (10)	10	**7**	8	10
Cost (5)	5	**3**	2	1
Assembly/Disassembly Time (5)	3	**2**	1	3
Total (100)	86	**87**	81	58

Design Alternatives

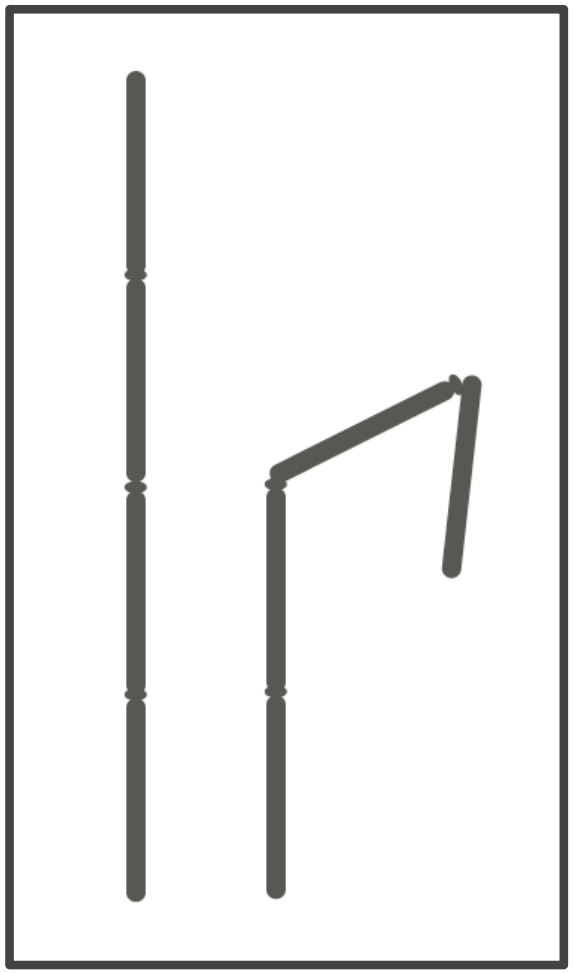
Presentation Mechanism

+

Apparatus

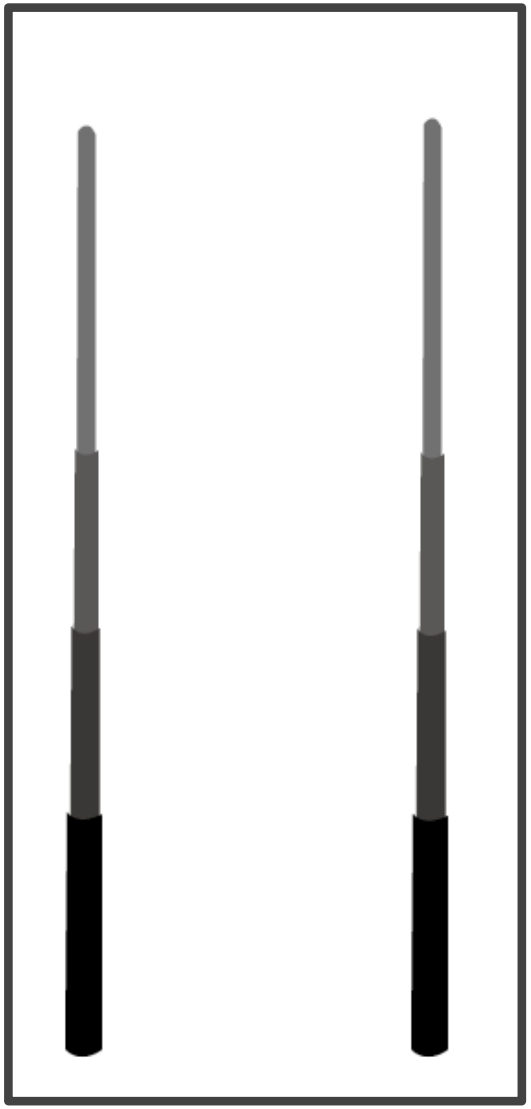
- Options for Apparatus
  - Folding Poles + Hand Trolley
  - Telescoping Poles + Hand Trolley

Design Alternative – Apparatus (I)
Folding Poles



- Easy Transportation
  - Can be folded into a compact space
- Problems
  - Not variable
  - Not stable

Design Alternate – Apparatus (II)
Telescoping Poles



- Higher adjustability
  - Easy to operate
  - More flexible in different height
- Drawback
  - Accessibility?

Design Matrix (II)
Apparatus

- **Telescoping Poles + Hand Trolley**
  - Criteria were given priority by your client
  - The defining category was Adaptability

Design Matrix 2: Transport Mechanism		
Category	Folding Poles	**Telescoping Poles**
Ease of Use (out of 50)	43	**43**
Adaptability (25)	20	**25**
Size (25)	24	**24**
Total (100)	87	**92**

Water Dye

+

Hand Trolley +
Telescoping Poles

=

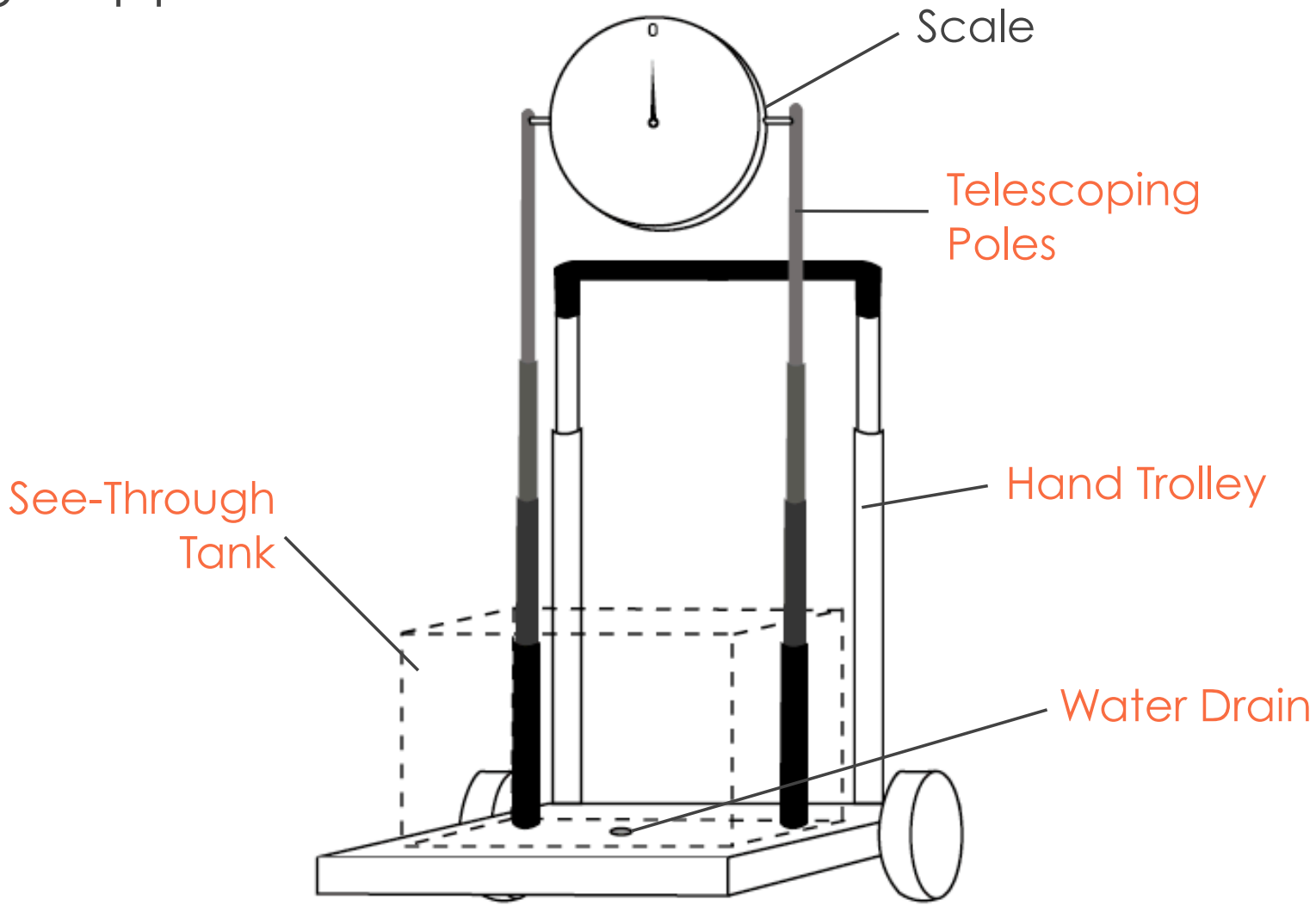
Final Design

Final Design

Final Design –
Water Dye + Hand Trolley + Telescoping Poles

Requirements/Expectations	Solution
More dramatic demo	Water
Higher transportability	Hand trolley + removable tank
Time-consuming installation	One-piece design
Releasing water problem	Small drain
Adaptability to teaching environment	Standing + Table model
Different breaking points	Telescoping Poles + Marking on the pole at corresponding length
If water source is not available	Similar design as original

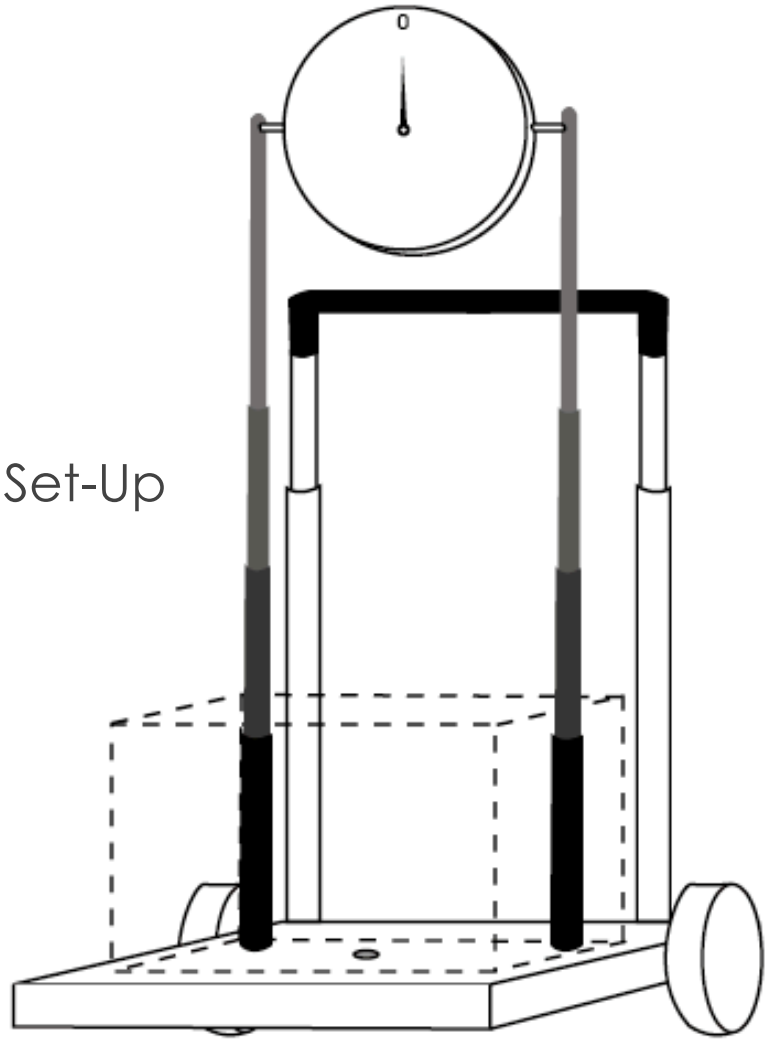
Design Apparatus



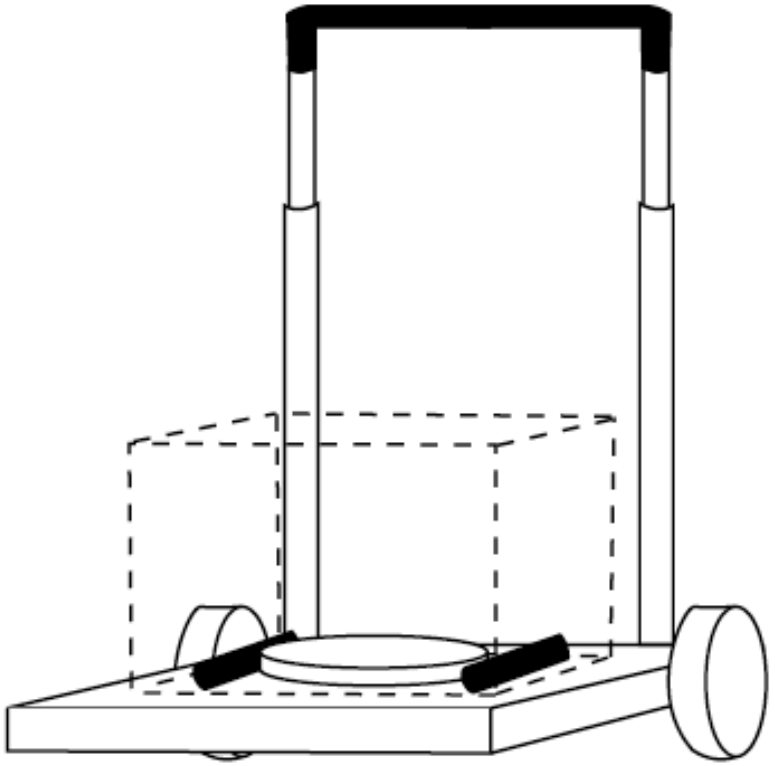
Final Design –
Water Dye + Hand Trolley + Telescoping Poles

Design Apparatus

Set-Up



Compact



Final Design –
Water Dye + Hand Trolley + Telescoping Poles

Standing Model

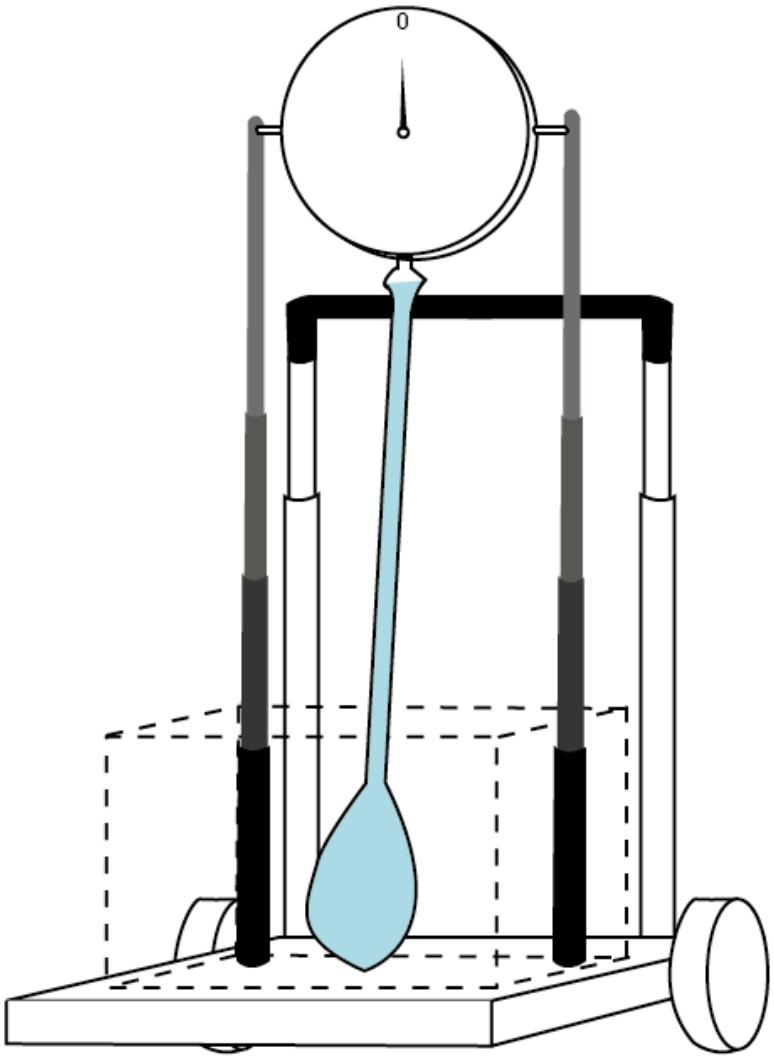
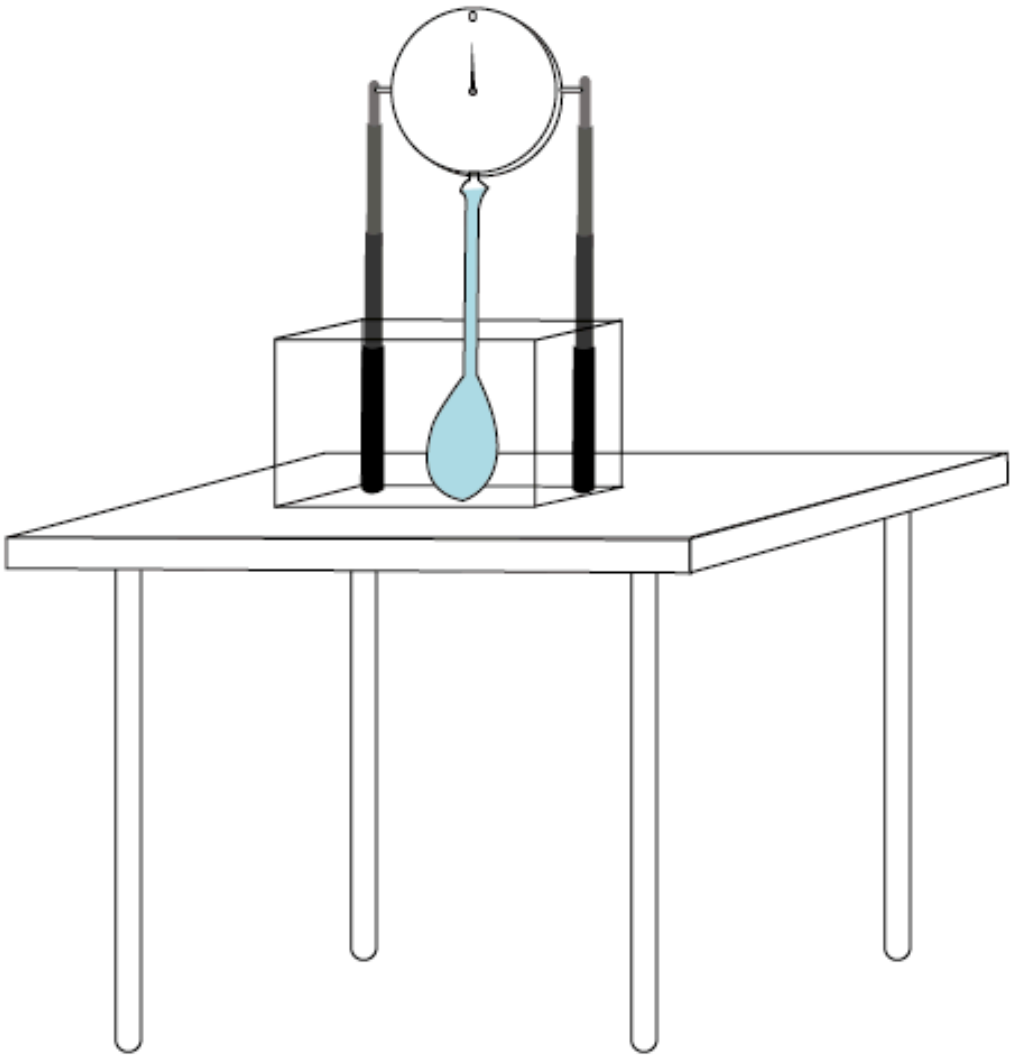


Table Model



Final Design –
Water Dye + Hand Trolley + Telescoping Poles

Future Work

- Model Material Selections
  - Hand trolley (weight)
  - See-through tank (dimensions; weight)
  - Telescoping poles (extendable length, weight)
- Model Construction
- Condom Testing (different brands)
  - Elongation
  - Maximum weight
  - Stretching shape
- Demonstration in client's class
  - Impression on the students
  - Client's satisfaction

References

Pease, C. M. & Bull, J. J. (2000). Models of sex in condom testing. http://www.utexas.edu/courses/bio301d/Topics/Condoms/Text.html

Wilson, T. V. (2009). How Condoms Work. HowStuffWorks.com. http://health.howstuffworks.com/sexual-health/contraception/condom.htm

Questions?