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Measuring Surface Tension (Method 2)

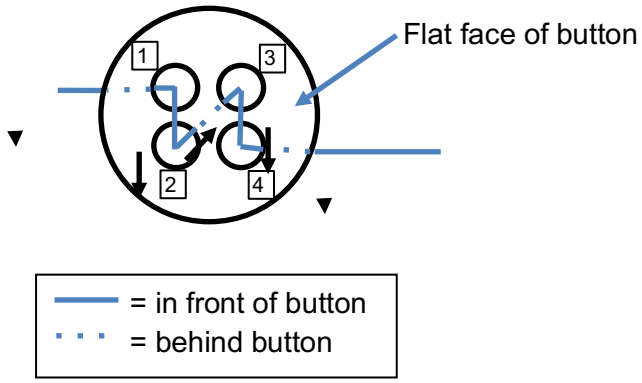
Instructions: During this activity, you will be measuring the surface tension of water and water with a surfactant added to it. In the first part of the activity, you will be assembling the testing apparatus, which will consist of a triple beam balance, button, and thread. In the second part of the activity, you will be using a triple-beam balance to measure the surface tension of different solutions.

Part 1: Assembling the Testing Apparatus

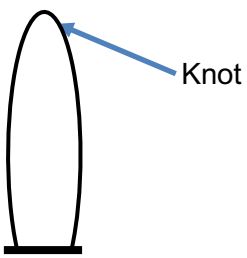
Materials	
• 50 mL beaker • 1 spool of thread • 1 medium plastic button	• 1 triple-beam pan balance • 1 ruler with units in centimeters

Set up:

1. Using your ruler, measure the radius of your button and record it here_____.
2. Now convert the radius measurement to meters. (Note: you will need this for calculations later) _____.
3. Using your thread, thread the button to create a single loop. Follow the threading diagram below:



4. Once the button is correctly threaded, tie the two ends of the string so that you have a continuous loop suspending the button. It should look like this:



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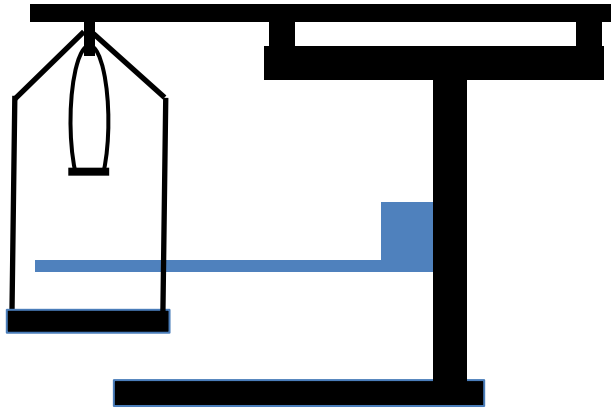
5. Adjust the platform of your triple-beam balance to be above the weighing pan of your balance. It should look like this:

6. Attach your threaded button to the bottom hook of your balance beam and the weighing pan to the top hook of your balance beam.
7. Once assembled, your testing apparatus should look like this:



8. Using the sliding weights on the beams, balance your apparatus. Note the starting weight of the testing apparatus here:_____
9. Remaining assembly will be done right before conducting the trials.

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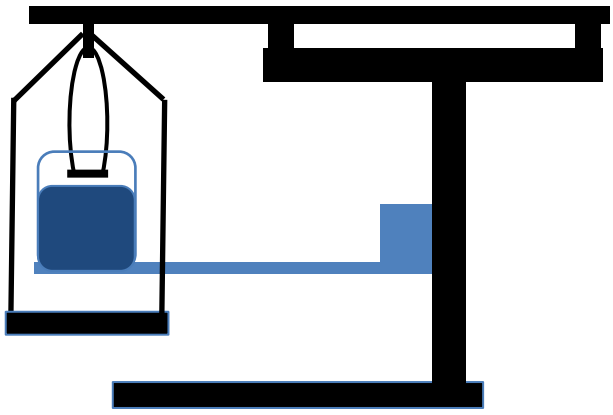
Part 2: Conducting Surface Tension Trials

Materials	
• Assembled testing apparatus from Part 1 • 50 mL beaker • 50 mL water (preferably distilled) • 50 mL Chemical #1	• 50 mL Chemical #2 • 50 mL Chemical #3 • 50 mL Chemical #4

10. Place a 50 mL beaker on the platform of your assembled testing apparatus.
11. Fill your beaker until the level of the liquid comes in contact with the bottom of the button. Record the volume of liquid added to the beaker here: _____



12. To test the surface tension of a liquid:
    a. Start from the weight where the button is floating on the surface of the liquid and the apparatus is balanced.
    b. Slowly adjust the weights on the balance until the button breaks away from the surface of the liquid.
    c. Record the weight at which the button broke away in the data table below.
    d. Repeat your measurement at least three times for each tested liquid.
    e. When changing liquids, make sure you fill your beaker to the above noted volume and set the apparatus to the above noted weight to start.
13. Once you have collected all of your data, complete the calculations and answer the questions.

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Data Sheet

Langmuir-Pockels Testing Data				
Liquid	**Trial**	**Initial Weight (gf)**	**Weight at Surface Break (gf)**	**Weight Applied to Break (gf)**
Water	1			
Water	2			
Water	3			
Unknown Chemical #1	1			
Unknown Chemical #1	2			
Unknown Chemical #1	3			
Unknown Chemical #2	1			
Unknown Chemical #2	2			
Unknown Chemical #2	3			
Unknown Chemical #3	1			
Unknown Chemical #3	2			
Unknown Chemical #3	3			
Unknown Chemical #4	1			
Unknown Chemical #4	2			
Unknown Chemical #4	3			

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Data Calculations

1. Convert your observed force applied to break in gf to forces in mN using the following conversion: 1 gf = 9.8 mN
2. Record your values in a new data table with headers like below:

mN Forces for Each Trial		
Trial	Measured weight to break (gf)	Calculated force to break (mN)

3. Using your converted forces calculate the surface tension measured with each trial using the following equation:

$$\gamma = \frac{F_{break}}{C}$$

where

- γ is the surface tension
- F_{break} is the force applied to break away from the liquid
- C is the circumference of your button **in meters**.

4. Using your calculated surface tensions calculate the surface pressure of each chemical solution using the equation:

$$surface\ pressure = \gamma_0 - \gamma_A$$

where

- γ_0 is the surface tension of pure water
- γ_A is the surface tension of the solution

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Reflection Questions

1. What chemical will you pursue as a potential surfactant? Support your answer with your collected data.

2. What structural features could contribute to your chosen chemical as a potential surfactant? Be sure to include your chosen chemical's structure here.