10C – SURFACE TENSION

INQUIRY

What is surface tension? What are some factors that affect the surface tension of a liquid?

MATERIALS

- Beaker (glass), 400-mL
- Plastic storage bin, 30 cm x 20 cm x 10 cm
- Soap solution
- Paperclips, unused, 1 small and 1 large
- Staple, unused
- Heater stirrer
- Forceps
- Dropper bottle with distilled water
- Pipet
- Penny
- Dime
- Ground pepper (small flakes)
- Tap water (room temperature and hot)

BACKGROUND

All liquids have a specific surface tension under standard conditions. Surface tension exists due to the attractive (cohesive) forces between molecules. In water, these intermolecular forces are created by the polar nature of the water molecules. Inside a sample of water there are attractive forces acting in all directions with neighboring molecules. At the surface, the molecules are attracted inward creating a tension on the surface. Because of this, even objects that are more dense than water can appear to float, when in reality it is the force of surface tension that is keeping them from sinking.

Many factors affect the surface tension of a liquid. In this investigation, you will investigate how the presence of surfactants such as soaps and detergents, changes in temperature, and the physical properties of a particle affect the surface tension of water.

SAFETY

Follow regular lab safety procedures.

PROCEDURE

Part 1 – Demonstrating surface tension

1. Clean and dry a penny to remove oils and detergents. Place the penny on a flat surface.

2. Begin slowly adding drops of water to the penny. Count every drop. Leave a gap between the drop coming out of the bottle and the water bead on the penny as shown so you do not accidentally draw water back into the bottle.

PROCEDURE

3. Count and record the number of drops that fit on the penny before the water spills over in Table 1 on your answer sheet. Describe your observations of the water on the penny just before the water spills over.

ANALYSIS

Complete the analysis for Part 1 on your answer sheet.

QUESTIONS

Answer the questions for Part 1 on your answer sheet.

PROCEDURE

Part 2 – Surface tension supports weight

1. Use the beaker to fill a clean plastic bin with about 400 mL of room temperature tap water. Refill the beaker with another 400 mL of water. Place the beaker on the heater stirrer and turn it on to a low setting. Your goal is to heat the water until it is hot, but not too hot to touch, to be used in Part 4.

2. Clean and dry the small paperclip to remove oils and detergents. Carefully place the small paperclip flat on the surface of the water, making it float. An easy way to float the paper clip is to position it horizontally between forceps or between your thumb and index finger. Gently release the paper clip as it first touches the surface of the water. Record your observations in Table 2 on your answer sheet.

3. Clean and dry the large paper clip, the staple, and the dime. Try to float each object one at a time. Record your observations in Table 2.

ANALYSIS

Complete the analysis for Part 2 on your answer sheet.

QUESTIONS

Answer the questions for Part 2 on your answer sheet.

PROCEDURE

Part 3 – Surfactants

1. Clean and dry either the small or large paperclip to remove oils and detergents. Float the paperclip on the surface of the water so it is supported by surface tension.

2. Carefully add a drop of soap solution to the water. Do not touch the pipet directly to the water, and do not drop the soap directly on the paperclip.

3. If nothing happened, add more drops until you see a change. Record your observations and the number of drops required to cause the change in Table 3 on your answer sheet.

ANALYSIS

Complete the analysis for Part 3 on your answer sheet.

QUESTIONS

Answer the questions for Part 3 on your answer sheet.

PROCEDURE

Part 4 – Temperature and surface tension

1. Carefully check the water temperature inside the beaker on the heater stirrer. The water should be hot, but not too hot to touch. Turn off the heater stirrer if the water is too hot or when the water has reached an acceptable temperature. Continue heating the water at a higher setting if needed.

2. Empty the contents of the bin and rinse it thoroughly. Clean and dry the large and small paperclips to remove oils and detergents.

3. Pour the hot water into the bin. Try to float the small and large paperclips on the hot water one at a time. Record your observations in Table 4 on your answer sheet.

ANALYSIS

Complete the analysis for Part 4 on your answer sheet.

QUESTIONS

Answer the questions for Part 4 on your answer sheet.

PROCEDURE

Part 5 – Surface tension and small particles

1. Empty the contents of the bin and rinse it thoroughly with tap water.

2. Fill the bin with 400 mL of tap water.

3. Sprinkle 2-3 pinches of ground pepper evenly above the surface of the water. Record your observations in Table 5 on your answer sheet.

4. Carefully add a drop of soap solution to the water. Do not allow the pipet to directly touch the water. Record your observations.

5. Empty the contents of the bin. Rinse and dry the bin.

ANALYSIS

Complete the analysis for Part 5 on your answer sheet.

QUESTIONS

Answer the questions for Part 5 on your answer sheet.