Pond Ecology

Tension Tamers

Pre-visit activity, grades 4+

Adapted from Instructor, "Explore Our Watery World," April 1992, Linda Whren and Project Wet

Objective

Students will experiment with the effects of surface tension.

Materials

- Plastic straws
- Eye droppers
- Food coloring
- Waxed paper
- Pennies
- Liquid soap
- Paper clip and plastic fork for each group
- Light wood or other objects to float in water
- Toothpicks, cotton balls, beans, & other insect-designing materials
- Cup of water per group
- Picture of water strider or other water surface living insect
- Pepper

Background

Water molecules are electrically charged particles, one end has a positive charge and the other a negative charge. Just as the opposite ends of a magnet attract, so do the opposite ends of water molecules. The attraction of

water molecules to other water molecules is called cohesion. Water molecules form hydrogen bonds between themselves.

Surface tension is the attraction among water molecules at the surface of a body of water. Surface water molecules have air above them, so they are most attracted to other water molecules below and adjacent to the surface. The hydrogen bonds between surface water molecules form a skin-like barrier between the air above and the underlying water molecules. Surface tension can be seen by looking at the surface of a glass filled to the brim. If more water is added gently, the level of the water will exceed the top of the glass.

Surface tension is strong enough to support the weight of small objects such as paper clips and needles. Some aquatic insects could not survive without the support that surface tension gives their specially adapted bodies. Water striders live on the surface of fresh water. Compared to a piece of wood floating in the water, paper clips and water striders are not actually floating. Instead, they are held on top of the surface by the hydrogen bonds between water molecules. Floating objects break the surface tension of water. They stay afloat because water molecules deeper in the water can support their weight.

Procedure

1. Divide students into groups of three or four. Have groups think of cool team names for themselves such as, Water Wonders or Super Splashers. Provide each group with a cup, half full of water that you have colored with food coloring. Give each group an eyedropper, a straw, and a sheet of waxed paper. Using the eyedropper, the group should place a drop of colored water on the waxed paper. Challenge the students to make the drops move across the paper with their straws. Ask: what shape is the drop? How did you get it to move? Does it hold together or break apart? How many drops can you drip onto the wax paper before the water changes shape?

2. Have students predict how many drops of water will fit on a penny. Distribute pennies and allow them to test their predictions by doing several trials and averaging the results. What keeps the water drops from running off the penny? (surface tension!) You can do this as a contest having one member of each group come up and as the rest of

the class watches, they try to fit as many drops as they can on a penny. Record the results on the board under the team names.

3. Discuss the concept of hydrogen bonds creating the surface tension that holds the water molecules together on top of the penny. Demonstrate the concept further with a glass of water, filled to the brim. Add drops of water gently to show how the water level will go over the top of the glass as the surface tension holds the water together. Carefully fill a cup for each team with an equal amount of water and have one student from each team try to add as many pennies as they can, one by one, without spilling water out of the cup. Record the results on the board.

4. Explain that surface tension bonds are strong enough to support the weight of small objects such as paper clips. Students experiment by placing a paperclip on the prongs of a fork and gently lowering the fork into water, or by using any other method that works for them. Surface tension supports the paper clip. Float a light piece of wood or some other material next to the paper clip and discuss the difference between floating and resting atop surface tension. Again, you can do this step as a contest having a different member of each group come up and try to support as many clips as they can on the water's surface. Record results on the board.

5. Ask students to imagine what shape an insect would have to be to enable it to scoot across the top of the water's skin. Distribute toothpicks, cotton balls, beans, pom-poms, and any other building materials you have gathered. Challenge students to design an aquatic insect (with six legs and three body parts: head, thorax, and abdomen) that won't break through the surface tension and sink. Test insect designs in a pan or tub of water. Discuss successful designs. Discuss weight distribution over surface area.

6. Compare successful student insect designs with pictures of actual aquatic insects such as water striders.

7. Ask students what things might break the water's "skin". Like water, liquid dish detergent is made up of electrically charged molecules, but in soap, they are much larger. When attracted to water molecules, the detergent molecules interfere with the orderly arrangement of water molecules and break the surface tension. Have each group sprinkle the

surface of their water with pepper and notice how surface tension keeps the pepper on top. Put a drop of dish soap in the middle. What happens? The detergent molecules spread the water molecules out, weakening the bonds in that area. Anything placed on the surface will move to where the surface tension is strongest, in this case the edges, where the soap has not yet reached.

8. Think about a real pond outside. How could pollution, like soap, affect the creatures that use the surface of the pond for a home? Creatures that live underwater? At the edge of the pond? Discuss different ideas and possibilities.