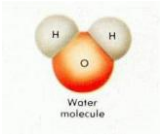
University of Florida Science Outreach Program

Break the Tension: A Water Experiment



Introduction: Surface tension is one of water's most important properties. It is the reason that water collects in drops, but it is also why water can travel up a plant stem, or get to your cells through the smallest blood vessels.

Objective: This experiment will teach students how the surface tension of water is formed and how strong it can be, all as they try floating objects that are denser than water in nature. They will also learn how water tension can be easily disrupted. By exploring surface tension, students will grow in their understanding of the structure and polarity of the fantastic molecule that is water.

Materials:

- Small dish
- Water
- Paperclips
- Dish soap
- Piece of paper towel
- Ground pepper

Safety:

- Remind students there is NO eating or drinking in the lab
- All spills should be cleaned up immediately

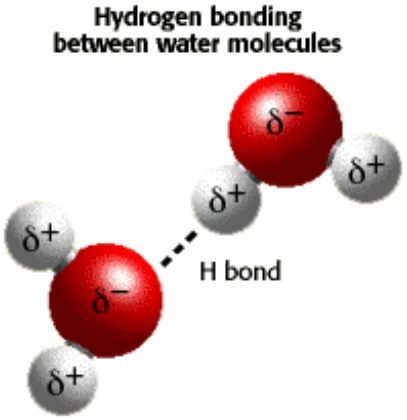
Procedure:

1. Fill a clean, soap-free bowl with water. Ask the students: “Do you think a paperclip will float in the water?” Now drop one in the cup to find out. Since the paperclip is denser than the water, it will sink to the bottom of the cup.
2. Now find out if you can use surface tension to float the paperclip. Gently lay the paperclip flat on the surface of the water. (This can be tricky — it may help to place a piece of paper towel slightly bigger than the paperclip in the water. Then lay the paperclip on top of it. In a minute or so, the paper towel will sink, leaving the paperclip floating on top of the water.) Even though the paperclip is still denser than the water, the strong attraction between the water molecules on the surface forms a type of "skin" that supports the clip.
3. Once several clips are floating, add a couple drops of dish soap to the water and watch what happens.
4. Try floating a paper clip now that the water has soap in it. What happens?
5. You can try floating other things on top of the water also — pepper floats well until you add dish soap. Can you find any other light items that will float?

Discussion:

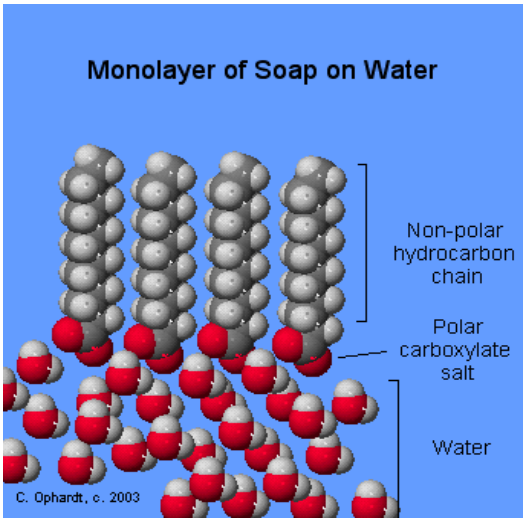
1. What is the molecular structure and polarity of water?
2. How does surface tension form?
3. Were you able to float paperclips after you added soap to the water? Why?

Water is a polar molecule. When the two positively charged hydrogen atoms attach to the negatively charged oxygen atom, a stable water molecule is created. The atoms attach in a "bent" shape. This does not allow for an equal "pulling" or sharing of the electrons between the three atoms, allowing the hydrogen atoms to develop a slight positive charge and the oxygen atom to develop a slight negative charge. The difference in charge across the molecule is called a "dipole".



The slightly positive hydrogen side of one water molecule attracts the slightly negative oxygen side of another water molecule, creating a natural "attraction" between the molecules. Water molecules on the surface of a bowl of water are attracted to each other as well as to the water below them, which creates a strong and flexible film on the water's surface. This is the surface tension that allows the paperclips to float.

When you add soap to water, however, the surface tension breaks. Soap molecules consist of nonpolar, dipole-free bodies and a polar head. When soap mixes with water, the polar heads attach to the surface of the water and the nonpolar bodies tend to point upwards, away from the water, reducing the water's surface tension. Thus, the paper clips sink and it becomes difficult to float new clips!



Source: This lab is a modified version of an activity from the website education.com that goes by the same name.