

Break the Tension: A Water Experiment

Surface tension is one of water's most important properties. It is the reason that water collects in drops. It is also, why water can travel up a plant stem, or get to the cells through the smallest blood vessels. Help the students understand surface tension by showing them how they can create a "skin" on the surface of water with this interesting surface tension experiment.

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.

What We Need:

- Drinking glass
- Water
- Liquid dishwashing detergent
- Ground pepper
- Paper clips
- Piece of paper towel



What We Do:

1. Fill a cup of water. Ask the student: "Do we think a paper clip will float in the water?" Drop one in the cup to find out. Since the paper clip is denser than the water, it will sink to the bottom of the cup.
2. Now find out if we can use surface tension to float the paper clip: Gently lay the paper clip 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 paper clip in the water. Then lay the paper clip on top of it. In a minute or so, the paper towel will sink, leaving the paper clip floating on top of the water. Even though the paper clip 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. Now put a drop of dish soap in the water. This will bind with the water molecules, interfering with the surface tension. The paper clip will sink. The detergent disrupts the molecules and "breaks the tension." We can try floating other things on top of the water if we want; pepper floats well until we add dish soap. Can we find any other lightweight items that will float?

What Happened?

Surface tension happens when hydrogen bonds are formed between water molecules. The bonds, which are formed when hydrogen atoms in one water molecule are attracted to oxygen

atoms in another water molecule, create a strong and flexible film on the water's surface.

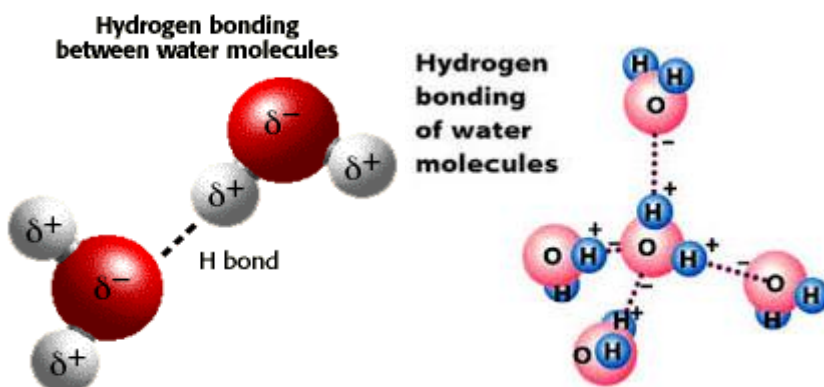
Safety:

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

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:

<https://www.youtube.com/watch?v=YfUGS6UEB9A>