Putting Tension to Good Use

By Josephine Ann A. Aparte

Have you ever wondered why water droplets form beads on smooth, waxy surfaces? Or witnessed insects flit on the surface of water? These are just two real-life demonstrations of surface tension.

Surface tension is the strong force that keeps water molecules sticking together. If you will observe, molecules on the surface of water are not completely surrounded by fellow water molecules. They are partially surrounded by air on top and partially by water on the sides and bottom. This makes surface water molecules unstable because not all of their hydrogen and oxygen atoms can pair off with suitable atoms unlike the water molecules in the "interior" of the liquid.

So what they do? They try to stick more closely to their fellow water molecules. The surface molecules' strong pull toward fellow water molecules produces an "elastic skin" or "film" on the surface of the water. This film is what helps small objects float on water and insects skim across the surface of ponds without falling through.

Surface tension also gives liquid substances the tendency to become as small as possible. This is why water droplets form beads and mercury, when placed on a horizontal surface, becomes almost like a round ball. The way tension is distributed on a thin film of soap can

Paper clip floats on water because of surface tension.

also explain why a soap bubble takes on a near-perfect round shape. Liquid adjusts its shape to expose the smallest possible surface area.

Surface tension, however, is not a very strong force. Some types of liquids have lower surface tension than others, while some substances reduce surface tension even more. For example, hot water cleans better than cold water because of its low surface tension. Cold water tends to "bridge" pores and cracks with surface tension; hot water can seep into pores and soiled areas better, which makes it a superior "wetting agent."

Detergents have ingredients known as "surfactants" or surface-active agents. Surfactants change or disrupt the way water's hydrogen atoms bond, which then weakens the atoms' ability to stick to one another. Put a few drops of a liquid detergent into oily water and you will see the oil pull away from the detergent. Detergents make the "skin" on the surface of the water too thin to support any weight. This is why a paper clip or a needle or any other small object floating on water will sink once detergent is placed in the water.

The concept of surface tension can explain the physical and chemical behavior of liquids. Learn the concept and be mystified no more at insects that can "walk" on water.

Commercial Importance of Surface Tension

The concept of surface tension is applied in many industries and products, some of which are enumerated below:

- Chemical industry (paints, inks, coloring ingredients, insecticides)
- Food (dissolving powders such as milk or cocoa)
- Antistain or antifrost glass treatment
- Construction (waterproofing of concrete, protection of monuments, etc.)
- Automobile manufacturing (surface preparation prior to painting, treatment of tires to promote adhesion even on wet or icy roadways)

Sources

Cobb, Vicki. *A Dramatic Easing of Surface Tension*. <<www.education-world.com/a_lesson/showbiz_science/showbiz_science023.shtml>>

Introduction to Surface Tension. <<web.mit.edu/nnf/education/wettability/intro.html>>

Lesson on Surface Tension. <<www.cis.udel.edu/~vijay/BLAST/Surface_Tension_Lesson.html>>

Surface Tension. <<http://hyperphysics.phy-astr.gsu.edu/hbase/surten.html>>

Surface Tension. <<www.ilpi.com/genchem/demo/tension/>>

ACTIVITY

The Battle of the Two Liquids

Some liquids have lower surface tension than water. Alcohol is an example of such a liquid. If you drop some alcohol in the middle of a shallow pool of water, you can see a dramatic struggle between the two liquids.

Materials Needed:

- water
- rubbing alcohol
- food coloring
- teaspoon
- glass baking dish

Steps:

1. Pour a thin layer of water into the dish. Use enough water to just cover the bottom of the dish.
2. Color the water by adding just a few drops of food coloring.
3. Drop 1/2 teaspoon of rubbing alcohol into the center of the colored water.

See how the water retreats from the alcohol, and the alcohol follows -- leaving a clear, dry spot in the center of the dish. Observe the borderline where the two liquids meet and where they will eventually blend. In time, the "troubled waters" will be peaceful again.

What Happened Here?

Both the water and the rubbing alcohol have surface tension, but the water's surface tension is stronger. The rubbing alcohol created a surface of alcohol in the middle of the water. This produced the "tug of war" between the liquids. The water pulled away because, with its stronger surface tension, it is more attracted to itself than to the alcohol. With its weaker surface tension, the alcohol is more attracted to the water than to itself. So the alcohol followed the water, leaving a dry spot behind.

The conflict is resolved when the two liquids merge. Eventually, the alcohol spread evenly throughout the water and a new alcohol-water solution moved over the dry spot and reformed an unbroken surface.

ACTIVITY

Surface Tension-powered Boat

Cut a piece of thin cardboard (e.g., cutout from a cereal box) or index card into any shape that roughly looks like a boat. Cut a small notch at the rear of the boat as shown in the figure.

Place this boat on water in a bowl or sink (make sure that the bowl/sink is free of contaminants like oil/grease and soap). Add a drop of liquid soap or detergent just behind the notch. The soap will reduce the water tension behind the boat. The higher tension in front of the boat will put it forward and boat will move quite a bit.