raft RESOURCE AREA FOR TEACHING

STEAM SCIENCE TECHNOLOGY ENGINEERING ARTS MATHEMATICS

LEARNING ACTIVITY

Wired on the Water

Investigating Surface Tension with Coated Wire

You will investigate one of the special properties of water: surface tension. Coated copper wire has a greater density than water and will normally sink, but bending a wire into fancy shapes can make the wire rest or scoot on top of water like a water strider insect!

Activity Challenge

Form a thin coated wire into a shape that will rest on top of water for the longest time without breaking the water's surface tension and sinking.

Preparation

1. Review the Materials Needed list and gather the required items.
2. Find a suitable workspace which is OK to get wet.
3. Coated copper wire is wire surrounded by plastic or rubber insulation. The ends of the wire are not coated. Wire can be taken from non-working, discarded or unused electrical or electronic items. If your wire is part of a flat ribbon cable or similar wire bundle, pull the coated wires apart to use the individual insulated strands.
4. Cut the wires into 9 to 14-inch lengths.
5. Fill the shallow tray/pan or bowl with water. Have paper towels or absorbent rags nearby to wipe up any spills.
6. Draw a data table like the one shown on the next page.

To Do

1. Create several different **flat** shapes using the strands of coated wire.
2. Choose one of the wire shapes and draw it in the data table.
3. Balance the shaped wire on the tines of a fork.
4. Lower the wire and fork very slowly onto the surface of the water and submerge the fork. Keep the wire shape as horizontal as possible.
5. Slowly pull the fork out from underneath the wire shape.
6. If the wire shape "floats", start the stopwatch to measure the time that it takes to sink.
7. If the wire shape immediately sinks, dry it completely before trying to re-float it. Try each shape 2 to 5 times.
8. Repeat for each wire shape, one at a time, noting your observations.

Note: The wire seems to be floating, but it is really resting on top of the film formed by surface tension. Floating is due to buoyancy, not surface tension.

Material Needed

- o Shallow tray, pan, or bowl
- o Plastic or rubber coated wire 9 to 14 inches long and about as thick, (including coating), as a straight pin
- o Fork
- o Towels
- o Stopwatch or equivalent
- o Water
- o Pencil/pen
- o Writing paper

Grade Range

3-5
6-8

Topics/Skills

Science: Surface Tension; Forces; Molecules; Properties of Matter

Learning Standards

NGSS: Structure and Properties of matter; Forces and Motion

Duration

20 - 45 minutes

Prep Time

10 - 20 minutes

Observations

- Draw a picture of each wire shape you test.
- Measure and record the resting (or "floating") time for each shape.
- Record the number of attempts needed to "float" each shape.
- Use your data to identify the wire shape that floated the longest time.

Extensions

- Investigate the difference between floating objects using buoyancy vs. using surface tension.
- Try "floating" the wire shapes on different liquids (such as rubbing alcohol) to see how the surface tension compares with water. The greater the surface tension, the longer the object will rest on top of the liquid.
- Try mixing some dish soap into the water, and repeat the experiment, noting any different results.
- Investigate water striders, insects that use surface tension to "walk on water".
- Float several wire shapes in the same water and observe and record their motion over time.
- Make and test 3-D shapes. Can you float a shape that has a high ratio of height to area of the bottom?

The Science behind the Activity

Water molecules are attracted to other water molecules; this attraction is called **cohesive** force and is responsible for the phenomenon known as surface tension. Molecules at the surface lack water molecules on all sides, and therefore cohere more strongly to the adjacent water molecules. This forms a "skin" or film at the surface. (You can see this "skin" by noticing the spherical shape of a small drop of water). Objects exerting a small enough force will not break through this film and will rest on it at the water's surface.

Surface tension is measured in force per length. In the **International System of Units (SI)** the unit of force is the **Newton** (N) or **dyne,** (A Newton is 100,000 dynes). The SI unit of length is the meter (m). In the English system, force is specified in pounds (lb) and length can be specified in feet (ft).

Water's surface tension in SI units is 72.8 millinewtons (mN)/meter or 72.8 dynes/centimeter (cm). In English units this is .005 pounds (lb)/foot (ft). Water has a higher surface tension than many other liquids. For example, ethyl alcohol (surface tension = 22.3 dynes/cm), has a much "thinner skin" than water. Given enough time, multiple wire shapes floated in the water will eventually collide with one another and appear to stick together. This motion is because of the slight depressions in the surface caused by the wire masses, like two bowling balls on the surface of a trampoline; the wire shapes slide downhill towards one another.

Data Table: Surface Tension Investigation

Wire Shape Drawings	Float Time (seconds)	Number of Float Attempts
Shape 1		
Shape 2		
Shape 3		
(Add more rows as needed)		