

ACTIVITY 2-3: WALKING WATER

OBJECTIVE(s): After completing the activity, students will be able to:

- ▷ recognize that surface tension causes water to cling to other substances (string).

MATERIALS:

6-50cm lengths of cotton string

6-50cm lengths of yarn

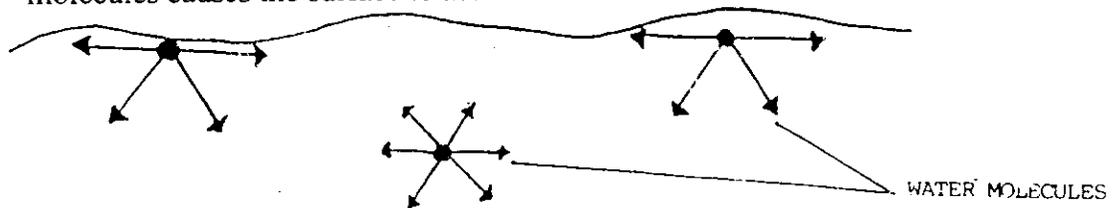
6-9oz plastic cups

6 plastic pitchers

6-3 gallon plastic tubs

BACKGROUND INFORMATION:

Surface tension is a property of a liquid that causes the surface to act like a stretched membrane. Water molecules (H_2O) have strong attractive forces between them. Individual water molecules within the liquid have equal forces acting on them from all directions. Surface molecules are not acted on in the same manner. These molecules are pulled more strongly into the liquid. These strong internal forces (grabbiness) pulling on the surface water molecules causes the surface to act like a stretched membrane or skin.



This phenomenon can be seen in nature. For example, the water strider, a common insect found in wetlands, uses surface tension to walk on water.



PROCEDURE:

1. In this activity student will make water "walk" down a string from a pitcher to a drink glass.
2. Place students into 6 equal groups with one instructor.
3. Put the 9 oz plastic cup into a 3 gallon plastic tub.
4. Tie one end of the 50 cm length of string to the handle of the plastic pitcher.
5. Fill the plastic pitcher 1/2 full of water.
6. Wet the string in the pitcher.
7. Stretch the string across the pitcher and over the spout. Have a partner hold the other end of the string over the cup in the plastic tub. (Make sure the string is stretched tightly.)
8. Raise the plastic pitcher so there is a slight angle between the pitcher and the cup in the plastic tub.
9. Pour the water out of the pitcher **very slowly and carefully**. Let each student in the group try this and then discuss their observations. (This may take some practice on everyone's part in order to ensure success.)
10. You can also demonstrate what happens with a pitcher of soapy water. The soapy water should **weaken** the effect.
11. Discuss the results with students and go over background information before going on with any other surface tension activities.

ACTIVITY 2-4: STRETCHING WATER

OBJECTIVE(s): After completing the activity, students will be able to:

- ▷ explore the concept of surface tension.

MATERIALS:

1 roll of waxed paper
15 medicine droppers
paper towels

15-9oz plastic cups
1 bar of Jergens soap
Student Activity Sheet 2-4

PROCEDURE:

1. In this activity, students will explore a drop of water and its characteristics such as shape and surface tension.
2. Students will work in groups of 2.
3. Each group will need the following materials:
 - 1-9oz plastic cup half filled with water
 - 2 pieces of waxed paper (approx. 30 cm square)
 - 1 medicine dropper
 - 1 sliver of Jergens soap (about the size of a match)
4. Have students follow the directions on Student Activity Sheet 2-4 to complete the activity.

ACTIVITY 2-5: **PEPPER RETREAT**

OBJECTIVE(s): After completing the activity, students will be able to:

- ▷ explore ways to weaken and strengthen the surface tension of water.

MATERIALS:

6 plastic pitchers	15-1oz plastic cups with 1/4 tsp. of pepper (fine)
15 cereal bowls	15-1oz plastic cups with 1/2 tsp. of sugar
15 medium paper clips	15-1oz plastic cups with 1/4 tsp. of cinnamon
15-1oz plastic cups	15 plastic forks
1 bottle of dawn detergent	Paper towels
1 set of measuring spoons	Student Activity Sheet 2-5

BACKGROUND INFORMATION:

Soap weakens or "loosens" the surface tension of water. For example, the dome-shape of a water droplet on waxed paper is lost when soap is added. A drop of soapy water is not spherical, but spread out and flat. (Refer to Activity 2-3, Part A) Sugar strengthens surface tension because water molecules are attracted (absorbed) to the sugar therefore increasing the elasticity of the membrane on the surface of the water.

Water is lipophobic (*lipo* means fat, *phobic* means fear of) and hydrophilic (*hydro* means water, *philic* means love). Soap, which is basically fat, is hydrophobic (water-fearing) and lipophilic (fat-loving).

PROCEDURE:

1. In this activity students will add substances to water to see which ones weaken and/or strengthen surface tension.
2. Students will work in groups of 2.
3. Fill cereal bowls half full of water using plastic pitchers.
4. Have students do Part A numbers 1-4 on Student Activity Sheet 2-5 and record observations.
5. After students finish Part A, they should wash out the cereal bowl to remove all traces of soap.
6. Then, refill the cereal bowl half full of water.
7. Students should follow directions and complete Part B.
8. When finished with activity, all pans should be cleaned and dried.

ACTIVITY 2-7: PREDICT A POP (BUBBLE-OLGY)

OBJECTIVE(s): After completing the activity, students will be able to:

- ▷ recognize pattern of color changes associated with popping bubbles.
- ▷ explore the affect that soap has on surface tension when added to water.

MATERIALS:

15 large plastic garbage bags	dish washing detergent
30 sheets of white paper	thread and/or string
15-9oz plastic cups	glycerin
6 plastic pitchers	straws, clear plastic
15-250ml beakers	6 medicine droppers

*Bubble solution (per 950 ml):

2 oz of dish washing detergent
15 drops of glycerin
950 ml of water

BACKGROUND INFORMATION:

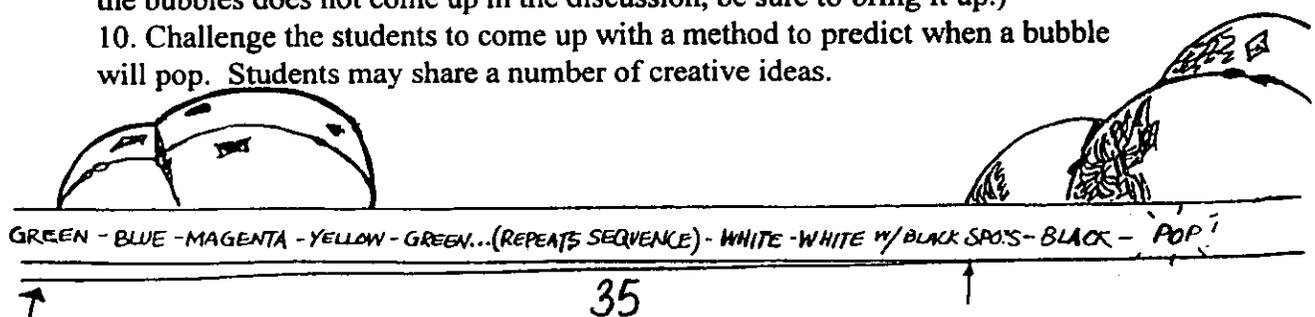
When soap is added to water, the surface tension lessens due to the weakened pulling force of water molecules. This can be demonstrated by floating a paper clip in a cup of water and adding a drop of soap. The paper clip floats on the water's surface until the drop of soap is added. At this time the paper clip sinks to the bottom of the cup. The surface of the soapy water cannot support the weight of the paper clip because it has lost some of its elasticity. An analogy that can be used here is having your hands represent water molecules. It is usually easy to hold hands with someone else when playing the game red rover. However, if you dip your hands in soapy water it becomes more difficult to hold on to each other.

The most dramatic evidence of reduced surface tension occurs when you push upward on the surface of soapy water by blowing air through a submerged straw. Bubbles form on top of the surface with the same dome-shape as water bubbles. Because of the decreased surface tension, these soapy bubbles last much longer.

In the activity Predict a Pop, the color of the bubble is an important clue. Even though most people see color as just a surface decoration, it is used to predict the life span of a bubble. The colors of a soap bubble are produced by the process called **interference**, which is the interaction between the bubble wall and light. The usual color sequence of bubbles is as follows: green, blue, magenta, yellow (this color sequence can repeat many times). As the bubble wall deteriorates, the pattern changes to: white, then white with black spots (the spots are actually transparent but appear black due to the black background), black, then the bubble pops. Bubbles pop when their walls are less than $1/1,000,000$ th of an inch thick.

PROCEDURE:

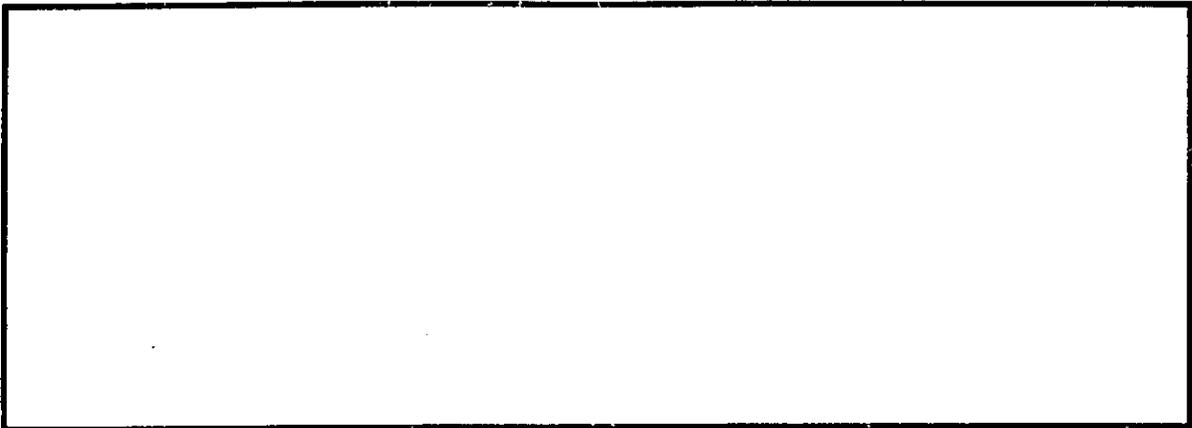
1. In this activity, students will experience a variety of ways to create bubbles and observe color changes that occur prior to the bubbles popping.
2. Students will work in groups of 2.
3. Instructor should demonstrate how a paper clip will float on water. To do this, fill a 9 oz cup full of water. Place the paper clip on a plastic fork and carefully lower it into the water. The paper clip should float on the surface of the water. Ask students why this happens. Ask students how we can sink the paper clip without touching it. (Hopefully, someone will say "add soap") You can demonstrate by adding a drop of dish washing soap to the cup.
4. Tables need to be covered with newspaper before covered with large plastic garbage bags.
5. Fill each 9 oz cup with bubble solution and distribute to groups of 2.
6. Have students pour a small amount of bubble solution on their plastic garbage bags (the solution should be spread evenly). Give a plastic straw to each student.
7. Instructors should demonstrate how to blow bubbles using the plastic straws.
8. Have students blow bubbles and make observations for about 10-15 minutes. Have students share observations in a group.
9. This discussion should lead into the Predict a Pop activity. (If the color of the bubbles does not come up in the discussion, be sure to bring it up.)
10. Challenge the students to come up with a method to predict when a bubble will pop. Students may share a number of creative ideas.



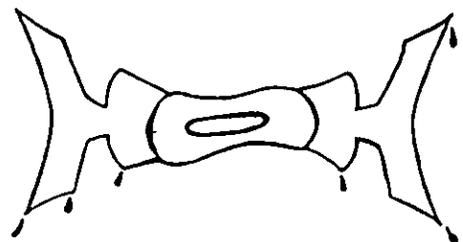


STRETCHING WATER

1. Place a sheet of waxed paper on the table.
2. Using the water in your cup, fill the medicine dropper.
3. Using the dropper, place several drops (scattered) onto the waxed paper.
Make observations. Describe what you see on the waxed paper. Use drawings to help your descriptions. Be sure to look at the water droplets from all angles.



4. Choose your best water droplet. Try to divide this droplet into 2 separate drops. Do this by pulling your medicine dropper through the droplet. Can you separate your droplet?
5. Touch a droplet of water with a sliver of soap. Make observations. Describe what you see. How does this drop compare to the other drops on the waxed paper?
6. Why does this droplet seem to be different than the others? What might have caused this change?





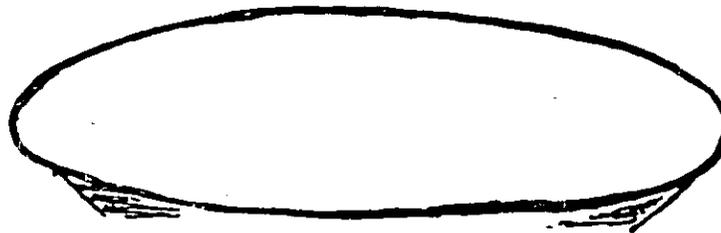
PEPPER RETREAT

Activity 2-5, Part A

1. Fill a cereal bowl **half full** with water.
2. Sprinkle the pepper over the surface of the water in the cereal bowl. Observe what happens. Draw the pepper in on the diagram below.



3. Using the point of a paper clip, place a small droplet of soap in the center of the cereal bowl. Observe what happens. Use drawings to describe the change you see.



4. Now, sprinkle the sugar over the entire surface of the water in the cereal bowl. Watch carefully, what happens to the sugar?

What happens to the pepper?

Activity 2-5, Part B

5. If time permits, repeat steps using another substance instead of pepper (cinnamon). If this is done, be sure to rinse all traces of soap out of the cereal bowl before you start over.
6. Use the terms soap and sugar, place them next to the correct statement below.

Weakened the surface tension of the water
(hint: made it lose its shape)

Strengthened the surface tension of the water
(hint: C & H)
