Super Science Connections: Bubble Fest!

How do bubbles behave?

This activity is intended for children entering grades K-4 in the next school year—but children of all ages (and adults) have fun making bubbles. To carry it out safely there must be a responsible older person to prepare materials, read directions aloud, and supervise the activity. This could be a parent, guardian, or older sibling. The supervisor should do the preparation steps and consult the science background information on the last pages before leading children through the activity. Two extension activities are offered beginning on the fourth page. The science background can be found on the next to last page.

Materials

- 5 cups (1.2L) of water (distilled water works best)
- ½ cup (120mL) dishwashing soap/detergent (Dawn™ works especially well)
- ¼ cup (60mL) glycerin (optional, but helpful)
- Baby food jars/small plastic containers (for bubble solution)
- Pail/bucket
- Pipe cleaners (called chenille stems in craft stores)
- Straws
- A ruler or tape measure
- Sponges (for cleaning up)
- Tabletop, desktop, flat tray, or cutting board (make sure it won't be damaged by soap-bubble mix)

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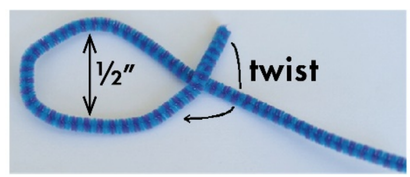
http://ice.chem.wisc.edu/sites/ice.chem.wisc.edu/files/images/Publications/SSC/SSC_Surface.pdf

Preparation

- Bubble solution may be messy if this activity is done indoors. To avoid this, the activity could be done outdoors on a day when there is little or no breeze to blow the bubbles away.
- Find a level table or desk. If you have a large cutting board or flat tray, place it on the table or desk as a surface for experimenting. Avoid getting bubble mix on wood surfaces because water-based solutions can damage the finish of the wood. Surfaces can be protected with plastic sheeting or a large plastic bag.
- In a pail/bucket, mix the water, dishwashing detergent, and glycerin in the proportions given above (5 cups of water, ½ cup dish washing detergent, ¼ cup glycerin; glycerin is optional but makes the bubbles last longer) (1.2 L water, 120 mL dishwashing detergent, 60 mL glycerin). Stir gently to avoid getting suds on the top. Pour into the baby food jars or small plastic containers, one container for each participant. This mixture can be saved and reused.

Directions



Pipe cleaner wand.

1. Make a bubble wand from a pipe cleaner by bending one end of the pipe cleaner into a small loop, about ½ inch (1.2cm) in diameter.
2. Obtain a small jar of bubble solution.
3. Lightly coat the top of the experimental surface with the bubble solution.
4. Use the bubble wand to blow some bubbles onto the experimental surface. Watch the bubbles carefully when they hit the surface.
5. Make a small puddle of bubble solution on the experimental surface. Hold a soda straw at a slight angle away from vertical, insert the end of the straw into the puddle, and blow into the straw to make bubbles.
6. Watch the bubbles until they pop. When a bubble pops, it leaves a ring on the surface. Measure the diameter of the ring each bubble made on the tabletop. Who made the biggest bubble? Who made the smallest?
7. How do you think you can you control the size of the bubble? Try your idea to see if it works. Record your observations.

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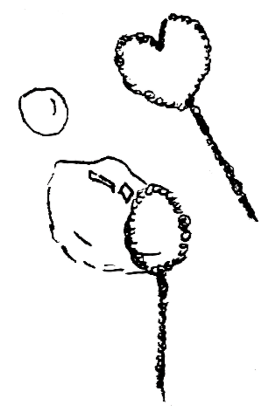
8. Bend your bubble wand into a different shape. (If there are several participants each can make a shape different from the others.) Do you get a different bubble shape by using a different-shaped wand?



pipe cleaners

9. Here are more questions to prompt observations:
    a. How do two bubbles join?
    b. Can you join three bubbles?
    c. Can you form a cluster of bubbles?
    d. Can you form a tower of bubbles?
    e. Can you make a bubble inside of a bubble?
    f. Which takes longer to break—a large or a small bubble?
    g. What colors do you see on the bubble's surface?
    h. What color do you see just before the bubble pops?
    i. Which makes a bubble that lasts longer, blowing into the wand or waving the wand back and forth?

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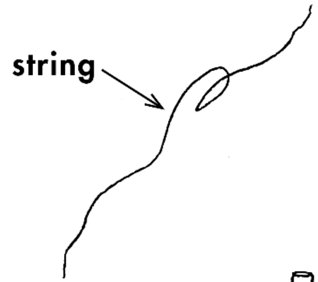
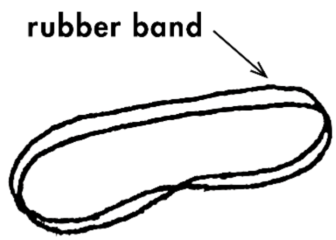
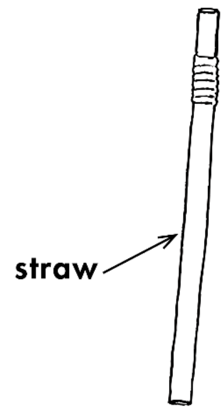
Extension Activities

Bubble Technology I:



Can you make a better bubble wand than with the pipe cleaner? Challenge participants to work like an inventor to design a bigger, better bubble wand! Some of the things that you might make available are





- Straws
- Strings
- Paper clips
- Rubber bands

Include some items that will not work—a spoon or a dish, for example.

Have participants test their invention to decide whether it makes a big bubble, a small bubble, or no bubble at all. (Some of the wands are better tested outdoors because they can be messy.)

See whether participants can discover what is similar about all the invented wands that make bubbles and what is missing from the ones that don't.

Bubble Technology II:

Can you turn a non-bubble blower into a bubble blower? Challenge the participants to look around the home to find materials that might be able to be used as a bubble blower. Some examples of things that could be used are:

- Mason jar tops (bands)
- Tea balls
- Paper towel rolls
- A potato masher
- A fly swatter

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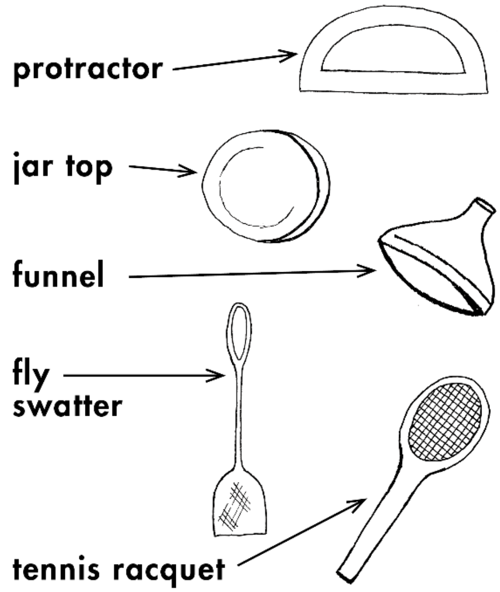
- A funnel
- A protractor
- Plastic rings from a six pack of soda
- A wire whisk
- An empty roll of clear tape
- A tennis or a badminton racquet



Some of these, such as the tennis racquet, have to be used outdoors, instead of inside and may require more soap-water solution. Have the participants predict the what type or size of bubbles they think their wands will make. Have them draw what they predict and then have them draw the kind of bubble that was actually made. Space for writing is provided on the next page.

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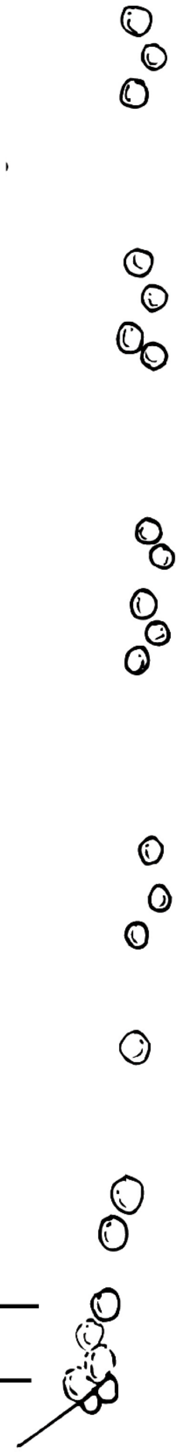
Draw the bubble shape you *think* your blower will make.



Draw the bubble shape your blower *really* made.

Names of the scientists ______________________

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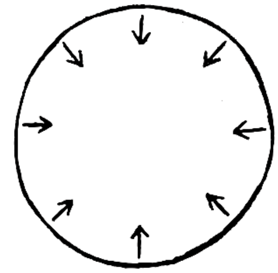
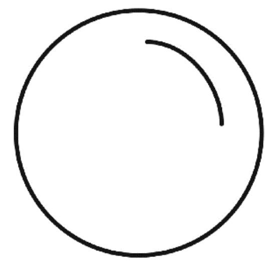
Science Background



Surface tension.

The molecules in water are attracted to each other. This creates what is called *surface tension*. Surface tension is like stretched skin or stretched elastic: it tries to reduce the area of the water surface. For example, a drop of water on a non-stick pan forms a nearly round (spherical) shape. (On surfaces that are wetted by water, the water spreads out more.) A sphere is the geometric shape that has the smallest surface area for a particular volume (called the *surface area to volume ratio*).



Bubble in air.

Adding soap to the water lessens the force that attracts the water molecules to each other; it lowers the surface tension. This makes the water more "stretchable" and makes it easier to form a bubble with air trapped inside a film of water.

A bubble is just a soap-water film with air inside it. (You "blow" a bubble to get the air inside.) The soap-water film tries to achieve the smallest possible surface area—a sphere, and the smaller the sphere the better. But the air trapped inside the bubble pushes back. The air pressure inside the bubble increases until it balances the surface tension trying to shrink the bubble.

To make a soap bubble you need something on which the soap-water film can form (such as the pipe-cleaner wand) and a way to get air inside the soap-water film (blowing the bubble or waving the wand back and forth).

The smallest surface area determines the shape of the bubble, so it doesn't matter what shape the wand is—after the bubble forms, the bubble will be nearly spherical.

As the water evaporates, the soap-water film gets thinner. Eventually it gets thin enough that a hole forms in the soap-water film. The hole develops into a tear, letting the air escape, and the bubble pops. Glycerin helps to keep the bubbles from drying out, so they last longer. Bubbles made only from water and soap do not last as long because the bubble wall evaporates more quickly and a hole forms sooner.

Colors appear on the surface of the bubbles because different thicknesses of the film reflect the light differently. If you watch carefully you can usually see that the color changes to black just before the bubble pops.

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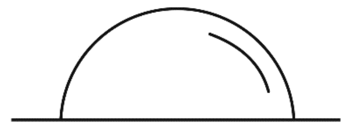
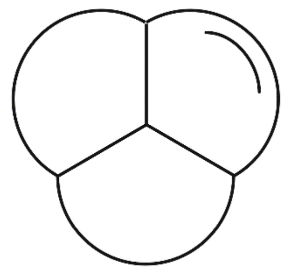
On a flat surface, the bubble takes on a shape of a half of a sphere (a *hemisphere*). The bubble is flat where it touches a horizontal surface because the soapy water is attracted to the surface. This attraction overcomes the attraction of the water molecules to each other and, consequently, overcomes the tendency of the bubble to be rounded. If the water molecules were not attracted to the surface at all, the bubble would sit like a ball on the surface!



Bubble on a flat surface (side view).

Likewise, you may find that individual bubbles in large clusters have various geometric shapes. The bubbles form flat surfaces where they touch each other and are rounded elsewhere. This result is a balance between each bubble finding its minimum surface area and its attraction to other bubbles!



Bubble cluster on a flat surface (top view).

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