9/12/07
Bubble Booth

DRAFT

Activity Description
This activity shows students how the properties of water can be changed with the addition of soap. The activity also shows hydrogen bonding.

Take Home Message
Water molecules can be attracted to other water molecules and can also be attracted to other materials. This process is called hydrogen bonding. When this happens at the water surface it is called surface tension.

Massachusetts Frameworks
Physical Science
Properties of Matter #2

Supplies/Set-up
- Plastic child swimming pool
- Cement block (for some reason we are always loosing the block….you can use a step stool-borrowed from the library or office if you are in a pinch)
- Plastic tarp
- Sheet
- 2 buckets of water (4 gallons)
- 2 8 oz. bottle of glycerin
- 2 large bottles (18 oz) of either Dawn or Joy Ultra original scent (don't accept substitutes)
- Bubble wand
- Sunglasses
- Trivia Questions
- Colored magnets

Set-Up
We have found that making up the solution ahead of time greatly improves the bubbles, the formula for the solution is as follows and should be measured carefully. Mix this up in a large clean bucket 4 gallons water (warm if possible), 1 cup (8 oz) glycerine, 2 1/4 (18 oz) cups ultra dawn original scent. You should have 2 buckets of solution on hand, so purchase double that amount at a time. Use warm water if possible, let sit overnight before using. TIPS: Keep BRICK CLEAN, don't let kids in with dirty shoes, dust affects the perfomance of the bubbles. The solution will be strained and saved between festivals.

1. Place sheets on top of waterproof tarp
2. Place wading pool on top of sheet
3. Add enough bubble solution to cove the bottom of the pool 1-2 inches.
    - **You don't want the mixture to be sudsy or frothy**. The mixture should only be 1-2" deep, just enough to cover the bubble wand.
4. Place CLEAN cement block in the center of pool. Place wand in the pool. Test bubble after letting sit 5-10 minutes. Do not add water to dilute the mixture, if you need more, add more solution from the spare bucket.

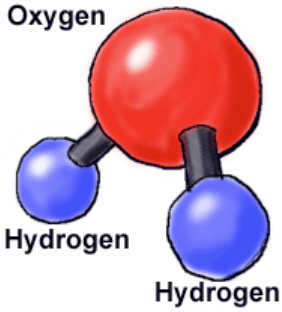
Background Science and Vocabulary

Starting with the Basics: Molecules and Polarity

Water is a **molecule** that is made up of one oxygen and two hydrogen atoms, as described by its chemical name, H_2O. In chemistry each type of molecule has a different configuration, and some have parts that carry a positive or negative charge. The configuration of the water molecule is such that it is polar: positively charged on the hydrogen side and negatively charged on the oxygen side. The polarity of water is one of the most important properties.

One reason polarity is important is because water can bond to other polar molecules; hence water is often called the universal solvent. A good example of this is the addition of sugar to water. Because sugar is also a polar molecule, the positive end of the water joins to the negative end of sugar and vice versa. Oil and water do not mix because oil is non-polar and therefore doesn't have a positive or negative side.

Salt is an example of an exception to this. Salt is a non-polar molecule, yet water can dissolve it. Salt dissolves in water because it breaks down into ions in solution. It becomes Na^+ and Cl^- ions that the water molecules attach to. Water, like other liquids, can also dissolve gases. An increase in pressure allows gasses to more easily dissolve in water and an increase in temperature causes a decrease in the ability to dissolve gases. This is why soda manufactures put the bottles under pressure to ensure the carbon dioxide gas does not escape and the gas remains dissolved in the soda.



Adhesion, Cohesion, Surface Tension, and the Capillary Effect

Two of the unique properties of water are caused by its polarity. Water molecules are attracted to each other; this is called **cohesion**. When water molecules bond to themselves, the bond is called a **hydrogen bond**. Although this bond is not as strong as a covalent bond, it provides stronger attractions between molecules than most polar bonds. Hydrogen bonds are responsible for surface tension as well as the high specific heat of water. The cohesion of molecules of water that allows it to support paper clips or water striders is called surface tension. The polarity of water also makes it stick to other types of substances. This is called **adhesion**. These properties are the reason plants can get water and blood can travel through the body. When water appears to be climbing a paper towel or a string that is at an angle with the ground it is because the water is attracted to the substance as well as itself. The water molecules will continue to "climb" until they are overcome by the force of gravity.

The reason that you can form bubbles comes from the property of adhesion. When soap is added, especially a soap like glycerin which is a **hygroscopic** (water-absorbing) chemical, you can increase the distance between water molecules without breaking the surface tension. The water molecules are still attracted to themselves forming the **surface tension**, but they are also attracted to the soap and glycerin mixture allowing them to be further apart then normal.

Activity Procedure/Script ****IMPORTANT READ SAFETY TIPS********

- **Ask the students if they know what a water molecule is.** Explain that a water molecule is made up of 2 hydrogen atoms and 1 oxygen atom and is the smallest particle of water. This is where water also gets the name H_2O.

- **Tell the students that water molecules can be attracted to other water molecules and other things. Ask them if they can think of any examples of when this happens.**
    - Examples include water traveling up plant stems, blood moving through the body or water climbing up a paper towel or string- The scientific name is **ADHESION, when water molecules are attracted to different molecules.**
        - Demonstrate how water climbs up a string-
            - Place part of the string in the water and keep the other half in your hand. Point out to the students how the water starts to climb the string

- **Ask the students if they have ever seen a bug walk across water.** Explain that the bug stays on the top of the water because of surface tension. When water molecules pull tightly together they create a skin on the top of the water called surface tension- or **COHESION, when the molecules are attracted to each other.** Explain that water molecules are attracted to each other because have a positive end and a negative end.
    - Pull on the magnets and let the kids try to have them attract to each other.
        - Ask the kids why they think the different ends attract and repel.
        - Tell them that it is because one side is positive and one side is negative. Water is attracted to itself in the same way 2 magnets work.
        - Explain that because the water molecules have two different charges on either end, they are opposites and so they attract!

- **Ask students if they have ever seen a bubble made from soap and water.** Explain that when you add soap to water, the water molecules become attracted to the soap and to the other water molecules and so they can be pulled farther part without breaking the surface tension.
    - A good example is to line up a few kids, have them hold hands and tell them they are water molecules.
        - Ask the kids to spread out as much as possible. They can spread but there is a limit when their arms won't reach any more.
        - Now ask the remaining few kids to step between the other kids and everyone hold hands.
        - Ask them to stretch again. They will find they go a lot farther this way.
        - Explain that the initial kids represented the water molecules all by them selves. The additional kids were the soap molecules that bonded in between the water molecules. This shows how a bubble can form because you can stretch the water surface tension further.

- Explain that now the kids are going to get into a bubble. Remind the kids that it can get very slippery and they will need to be careful.
    - **Ask the first student a trivia question about water from the festival (keep it simple).**
        - Once they get the answer, help the student (take their hand) step onto the brick in the pool, have them hold arms at side and stand quietly
        - Pull the bubble up around them
        - The kids will go nuts at this point, so be prepared
        - Lower the wand and help the student step off of the brick (take their hand)

********IMPORTANT POINTS FOR SAFETY**********

- **Help each student into and out of the pool,**
- **Raise and lower wand while student is standing on brick, always return the wand to the pool, never take it out until you are done and ready to clean up**
- **Don't let the students play with the soap water. If you want to let them try to raise a bubble, demonstrate the technique and supervise. Don't let them froth the water or move the wand to another location.**
- **If the floor seem wet, grab the mop and mop it up a bit**
- **Always be on the lookout for leaks from the pool, the plastic pools don't last forever**

Clean – Up

During the festival

- Throw away the strings and gather the magnets back up after each group
- You may need to add some extra solution from the spare bucke if the level is going down, but that is rare.

After the festival

- Carefully empty bubbly solution into bucket using a pitcher and straining it through a colander lined with nylon stockings and seal the bucket tightly and save for next festival
- Pool and tarp need to be rinsed off and dried
- Sheets should be washed **without detergent** to remove bubble solution. If possible rinse the sheets outside or in a sink first to get out as much of the soap as possible, then machine wash on cold **without soap**. You may have to use 2 rinses.
- In the wintertime you will have to store the solution in a heated building so it doesn't freeze.