Bridging Science and Magic:

Trick #1 Magic Color Changing Milk

Essential Question: How does surface tension allow some object to float on the top of water?

Materials: Shallow dish, whole or 2% milk, water soluble food color dyes, dish washing soap (Dawn), a double sided Q-tip (one end soaked in soap, the other end dry)

Procedure:

1. Carefully pour milk into the dish until the bottom is covered.

2. Place a few drops of four different colors of dye close together in the center of the dish.

3. Ask the students how you can create a rainbow effect without stirring or blowing on the dish. Allow them to see the Q-tip (double sided). Encourage various possible solutions; trying them if feasible. When they suggest using the Q-tip, insert the dry end.

4. After they have run out of ideas, say the magic words and then insert the soap dipped end in the middle of the dish. Observe them being amazed as the colors magically swirl around. This is a great trick to let them play with since there are no possible dangers and little cost.

Scientific Explanation: There are a number of scientific phenomena occurring. First, the milk and food dye have surface tension just like water. The soap lowers the tension making it easier for the dye to flow. At the same time, soap weakens the chemical bonds that hold the fats and proteins in the milk. As the soap molecule's hydrophobic (water fearing) end attempts to attach to the fat molecules, it causes them to race around bumping into the food dye; hence the visible movement. The more fat and protein in the milk solution, the more movement you will observe.

Possible Science Standards:

Properties of liquids, Properties of solutions, Chemical compounds and reactions, Scale and proportion, Surface tension

Trick #2 Regular Coke Vs. Magical Diet Coke

Essential Question: How does density affect floating and sinking in water?

Materials: One 12 ounce can of Regular Coke, One can of Diet Coke, Tank of clear freshwater

Procedure:

1. Have a student closely examine both cans to confirm that they are sealed and both appear to weigh the same.

2. Have students try to list similarities and differences. Ask what will happen when you put them into the water. Let them tell you or write their hypothesis and reason why they believe that will happen.

3. Drop the regular Coke in first and watch it sink, and then put a “magic spell” on the Diet Coke. When you place it in the water it will float to the top.

4. Try with a variety of canned drinks. Have students come up with a scientific explanation.

Extension: Use a scale to demonstrate the amount of sugar in each can of regular soda. I like using sugar cubes (about 16) and stacking them up.

Scientific Explanation: Discuss how more matter is packed into the same amount of space, or **VOLUME**, and that increases the **MASS**. The relationship of Mass to Volume is **Density**. The more atoms you place into a defined space, the denser it becomes. The Density of water is **$1g/cm^3$**, so an object will float in water if the density is 1 gram per cubic centimeter or less. An object will sink if its density is greater than 1. The regular sodas generally have more sugar, so more molecules in the same volume making it denser.

Science Standards: Observation, Misconceptions, Volume, Density versus Mass, Measurement

Trick #3 Magical Membrane Bubbles

Essential Question: What role do lipids and proteins in the cell membrane play in controlling what enters and leaves cells?
Materials: Shallow pan, Glucose (available at the local drugstore for a few dollars), Detergent and water, Pipe cleaners, Yarn, Various items such as a paper clip, pencil and tubing.

Procedure:

1. Make a container of supper bubbles using Glycerin and Dawn detergent in a shallow pan.
2. Create a flat "wand" using pipe cleaners.
3. Dip the wand into the bubbles and demonstrate how they make big bubbles, etc.
4. Ask the students what they think will happen if you stick a pencil through the middle…how about a paper clip…your hand
5. Have someone come up and try to do it, it should pop.
6. Then say your magic words and put your pencil through it (don't let them see that yours was soaking in the same solution. Drip solution on your hand while they aren't paying attention, and then put your whole hand through the bubble. This should lead to great discussions about cells.

Scientific Explanation:

The membrane that surrounds cells and organelles are made of a layer of phospholipids and proteins. It would take more than 10,000stacked membranes to equal the thickness of a piece of paper. The phospholipid bi-layer is fluid but holds its shape due to its interaction with water. We used soap bubbles as an analogy for the cell membrane because they are also bi-layers that are held together because of surface tension of water

Substances can move by passive transport, or by active transport. The use of simulations allows students to see the behavior of the cell membrane and of the movement of molecules too small to see with the microscope and helps students to build a deeper understanding of the factors that affect the transport of substances across membranes.

Check out the lab sheet

Science Standards: Cell structures, proteins, passive transport, active transport, fluidity

Trick #4 Dry Ice Bubble

Materials: Large bowl with a lip around the edge, water, pound of dry ice, strip of cloth (piece of an old towel), Detergent (Dawn), towel, gloves

Procedure:

1. Ask students about the states of water and how water turns to gas. They will all be familiar with the water cycle, so they get confident about how to change water to gas. Then ask how to change water to ice. Finally, challenge them to tell you how to change ice to gas without heat. They will try to tell you all sorts of ideas like using batteries, light bulbs, etc. at which point I have to tell them heat is a by-product of all these things.
2. Tell them that you are going to magically create a gas from ice without any heat source.
3. Place your dry ice in the bowl and add some water (it should start looking like a spooky cauldron).
4. Soak the strip material in your soapy mixture and run it around the lip of the bowl before dragging it across the top of the bowl to form a bubble layer over the dry ice. Let them watch as it grows and then changes into gas as it bursts.

Scientific Explanation:

Dry ice is carbon dioxide (CO_2) in its solid form. At temperatures above -56.4 °C (-69.5 °F), dry ice changes directly from a solid to a gas, without ever being a liquid. This process is called sublimation. When dry ice is put in water it accelerates the sublimation process, creating clouds of fog that fill up your dry ice bubble until the pressure becomes too much and the bubble explodes, spilling fog over the edge of the bowl. The dry ice turned into invisible carbon dioxide gas that disappears into the air. Magic!

EXTRA: Small bubbles can be made using a large container, rubber hose, and towel. Have the rubber hose come from a small whole in the side or top of a container. Dip the other end into the soapy solution and then close the container to force the gas through the hose creating smaller bubbles.

**Use gloves to handle the bubbles so the oils on your hands don't break the bonds of the soap causing them to bust. A clean towel or gloves should keep the bubbles "alive" longer as well.

Science Standards:

Animal Respiration (exchange of gases in the body leads to expelling carbon dioxide), Photosynthesis, Water cycle, States of Matter, Sublimation(change from solid to gas without becoming a liquid),

Trick #5 Fork and Toothpick

Essential Question: Is the center of gravity always in the middle of an object?

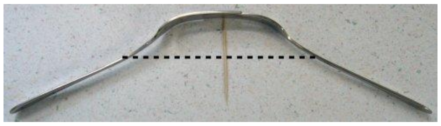
Materials: spoon, fork, flat toothpick, wide-brimmed glass, matches/lighter optional

Procedure:

1. Ask the students how it is possible to use only the shown materials and have both utensils in the air at the same time. The utensils can only touch the toothpick and the toothpick can only touch the glass. Allow for ideas and let students try as many as possible.
2. Once students are completely stumped, hook the fork and spoon together as seen in the picture. When they're connected, the utensils should make sort of a boomerang shape.
3. Get a matchstick or toothpick, and place it between the center prongs of the fork.
4. Balance the toothpick on your finger to get it centered and then gently place on the edge of the glass with the two handle ends pointing back towards the glass.
5. Try moving it from side to side, as well as closer to and farther away from the glass, to locate the best spot to balance.
6. Once they are amazed, light the outer edge until it burns away, then light the toothpick portion hanging inside the glass until it is burned right up to the glass. The utensils should not move…magic or science???

Scientific Explanation:

There is the same mass on both sides of the "center" which, depending on the utensils you use, is somewhere just below the middle of the toothpick. This center of gravity allows the utensils on the toothpick to be pulled down toward a point somewhere below the rim of the glass along the middle line between the two utensils



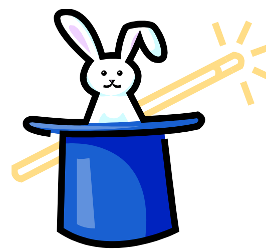
The second thing happening is called "torque". Torque is a little twisting motion that the spork is doing and it is hard to see with the eye. Gravity pulls the ends of fork and spoon down (since they're lower than the connected part) but the connected end of the spork gets pulled down too, which sets in motion a repeating pattern - swing up, swing down, up, down, etc.

Bridging Science and Magic

Sue Watters

Pickens County Middle School

suewatters@pickenscountyschools.org



GSTA Convention February 6-8, 2014

Macon, Georgia

This session is for science teachers in grades 4-8 who are interested in easy, inexpensive “Magic” demonstrations that will kick start discussions about scientific principles. I have attempted to include a brief explanation of the science behind each trick and then list a few of the areas of science in which they would be relevant to pairing. This is by no means a comprehensive list or in-depth explanation. YouTube is my best friend and there are videos out there to match each demonstration. Thanks to Steve Spangler for his informative site as well as the kids and teachers who post their own discoveries.