Kindergarten: States of Matter

Objective: Students will learn about the difference in properties between the three states of matter and observe changes created by chemical reactions.

Docent Lab Guidelines:

Schedule a date and time with your teacher to have the students come into the lab.
Estimated time for this lab: 30-45 minutes
Input the day and time into the Science Lab Master Schedule. Please make sure you include 30 minutes set up and clean up time, and add your name
Begin with a review/discussion of the different states of matter (use demonstration materials in the demo box). Then conduct the Balloon experiment and Fizzing Formulas experiments with students sitting at the tables. The last activity is a demonstration to be done by the docents outside on the lawn.
Note: this lab requires freezing water balloons the day before. It also requires preparation of test tubes before the class comes to the lab.

General Docent Information for Reference:

Each phase of matter has its own physical characteristics or properties of its molecules and atoms that make it unique.

Solids

A solid can be described as hard, ridged and brittle. If you were to look at the atoms of a rock under a microscope you would be able to see the molecules are close together. There is very little space in between each molecule. If there is little or no space this means there is no room for the molecules to move around and its shape stays constant or the same. Molecules in a solid are slow and inactive. The mass of a solid is dense and its shape will not change without for example a physical force like pressure (hammer hitting a table). Sand is also a solid but is just has smaller pieces of the original rock it came from. The same is true for baby powder. Although baby powder is smooth, soft and powdery looking it is still a solid.
We described a solid as hard and ridge but not all solids are hard. Your clothes are a solid even though they are soft.

Liquids

A liquid has a definite volume meaning it can occupy a space but it does not have a specific shape. Liquids are shape changers. It takes on the shape of whatever container you put it in. This is because the molecules in a liquid have more space to move around. This movement creates the fluidity of liquids. The top part of a liquid will usually have a flat surface. That flat

surface is the result of gravity pulling on the molecules. There are many types of liquids but not all liquids flow at the same rate. For instance if you had a drop of water, oil and honey on one end of a tray and sloped the tray so that the water, oil and honey are at the top of the tray….which liquid would flow the fastest? This property of liquids is called viscosity.

Gases

A gas does not have a defined volume or a defined shape. Most of the time gas cannot be seen and many do not have an odor. Gas will fill a room but you cannot see it. A gas is usually clear but not always. The molecules in a gas are so far apart you cannot see them. These molecules are very active in comparison to a solid's molecules.

Gases can fill a container of any size or shape. It doesn't even matter how big the container is. The molecules still spread out to fill the whole space equally. That is one of their physical characteristics.

Introductory Discussion:

Review differences between solids, liquids and gases, and how water changes into the different states of matter. Use demonstration materials in the box, or show a video from the youtube playlist. **Docent tip:** The first two activities are done in small groups of 4 at the tables (number of students/groups is up to you and the teacher). The last experiment is to be done outside on the lawn by the docent only.

Balloon Experiment:

Materials needed for Balloon Experiment, done in groups of 4:

- 1 Balloon filled with helium (optional)per group
- 1-2 Balloons filled with air (gas) per group
- 1 Balloon filled with water (liquid) per group
- 1 Water balloon frozen overnight ahead of time(solid) per group
- A pin for each group

- A bowl/container for each group

1. Students work in groups of 3-4, with one set of balloons per group. **If necessary, fill extra balloons with air or water so that each student can pop one of the balloons.**
2. Students can feel and describe the similarities and differences between the balloons, representing the three phases of matter.
3. Poke a hole in the balloon with water and pour the contents into a container. Notice how the liquid takes the shape of the container.
4. Poke a hole in the balloon with air. What happens?
5. Poke a hole in the solid ice balloon. Does it change shape? Does the balloon deflate?
6. Review properties of solids, liquids and gases. How did the 3 different balloons feel? Talk about the
differences in density, in malleability, in feel.

References:
Mellett, Peter. 2001. Hands-On Science: Matter and Materials. Kingfisher Publications. Boston. P.14.

Fizzing Formulas:

Materials needed For Fizzing Formulas, done in groups of 4:

- Test tubes and stands (1 stand per group, with a tube for each student)
- Food coloring
- Baking soda
- Vinegar and droppers
- Prepare ahead of time: Put a drop of food coloring at the bottom of each beaker (different color in each one) and cover with a teaspoon of baking soda

Procedure:

Ask students what types of matter they will be using (baking soda is a solid, vinegar is a liquid).

Students take turns to use droppers to put vinegar in the test tubes and observe the results. Ask: what happened? Why? (The reaction between the baking soda and vinegar creates a gas, which can be seen in the fizzing bubbles. The food coloring makes the bubbles different colors.)
Optional activity: students could draw a picture of the results.

Docent Demonstration: Mentos Diet Coke Geyser

(from stevespanglerscience.com)
Materials needed:

A roll or box of Mentos mints (2 per class)

- 2-liter bottle of diet cola soda (2 per class--diet or regular soda will work, but diet soda is not as sticky)
- plastic geyser attachment (from Steve Spangler science)

Experiment
1. This activity is probably best done outside in the middle of an abandoned field, or better yet, on a huge lawn, and done only by the docent, not the students.
2. Carefully open the bottle of soda. Position the bottle on the ground so that it will not tip over.
3. Unwrap the whole roll of Mentos. The goal is to drop all of the Mentos into the bottle of soda at the same time (which is trickier than it looks). One method for doing this is to roll a piece of paper into a tube just big enough to hold the loose Mentos. You'll want to be able to position the tube directly over the mouth of the bottle so that all of the candies drop into the bottle at the same time.
4. Don't drop them into the bottle just yet! Warn the spectators to stand back. Okay, you're going to drop all of the Mentos into the bottle at the same time and then get truckin' (move out of the way… so long… bye- bye… hasta la vista!)
5. It's just like fireworks on the 4th of July. The spectators erupt, of course, in a chorus of ooohs and ahhhs. Someone yells out, “Do it again” and you do.

How Does It Work?
Here's the question of the day… Why does mixing Mentos with soda produce this incredible eruption? You should know that there is considerable debate over how and why this works.

While we offer the most probable explanations below, we also understand and admit that other explanations could be possible… and we welcome your thoughts.

As you probably know, soda pop is basically sugar (or diet sweetener), flavoring, water, and preservatives. The thing that makes soda bubbly is invisible carbon dioxide gas, which is pumped into bottles at the bottling factory using tons of pressure. Until you open the bottle and pour a glass of soda, the gas mostly stays suspended in the liquid and cannot expand to form more bubbles, which gases naturally do.

But there's more… If you shake the bottle and then open it, the gas is released from the protective hold of the water molecules and escapes with a whoosh, taking some of the soda along with it. What other ways can you cause the gas to escape? Just drop something into a glass of soda and notice how bubbles immediately form on the surface of the object. For example, adding salt to soda causes it to foam up because thousands of little bubbles form on the surface of each grain of salt. Many scientists, including Lee Marek, claim that the Mentos phenomenon is a physical reaction, not a chemical one.

Water molecules strongly attract each other, linking together to form a tight mesh around each bubble of carbon dioxide gas in the soda. In order to form a new bubble, or even to expand a bubble that has already formed, water molecules must push away from each other. It takes extra energy to break this “surface tension.” In other words, water “resists” the expansion of bubbles in the soda.

When you drop the Mentos into the soda, the gelatin and gum arabic from the dissolving candy break the surface tension. This disrupts the water mesh, so that it takes less work to expand and form new bubbles. Each Mentos candy has thousands of tiny pits all over the surface. These tiny pits are called nucleation sites – perfect places for carbon dioxide bubbles to form. As soon as the Mentos hit the soda, bubbles form all over the surface of the candy. Couple this with the fact that the Mentos candies are heavy and sink to the bottom of the bottle and you've got a double-whammy. When all this gas is released, it literally pushes all of the liquid up and out of the bottle in an incredible soda blast. You can see a similar effect when potatoes or pasta are lowered into a pot of boiling water. The water will sometimes boil over because organic materials that leach out of the cooking potatoes or pasta disrupt the tight mesh of water molecules at the surface of the water, making it easier for bubbles and foam to form.(more at stevespanglerscience.com)

SUPPLY LIST for K States of Matter

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For Mentos Diet Coke Geyser Demonstration:

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