Lesson: Bubbles

Location: Classroom and outdoor space
Time: 1-1.5 hours
Grades: K-5

Standards:

- Science and Engineering Process Standards K-8
- **K.PS.2:** Identify and explain possible uses for an object based on its properties and compare these uses with other students' ideas.
- **1.PS.1:** Characterize materials as solid, liquid, or gas and investigate their properties, record observations and explain the choices to others based on evidence (i.e., physical properties).
- **1.PS.2:** Predict and experiment with methods (sieving, evaporation) to separate solids and liquids based on their physical properties.
- **Math 2.M.2:** Estimate and measure the length of an object by selecting and using appropriate tools, such as rulers, yardsticks, meter sticks, and measuring tapes to the nearest inch, foot, yard, centimeter and meter.
- **2.PS.1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- **2.PS.2:** Predict the result of combining solids and liquids in pairs. Mix, observe, gather, record, and discuss evidence of whether the result may have different properties than the original materials.
- **2.PS.4:** Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- **3.PS.1:** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object
- **4.PS.1:** Investigate transportation systems and devices that operate on or in land, water, air and space and recognize the forces (lift, drag, friction, thrust and gravity) that affect their motion.
- **5.PS.1:** Describe and measure the volume and mass of a sample of a given material.
- **3-5.E.1:** Identify a simple problem with the design of an object that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost.
- **3-5.E.2:** Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- **3-5.E.3:** Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can't be improved.

STEM Careers: Materials Scientists and Engineers

Everything in the environment, whether naturally occurring or of human design, is composed of chemicals. Materials scientists apply chemistry, as well as physics, to study all aspects of materials. Chemistry, however, plays an increasingly dominant role in materials science because it provides information about the structure and composition of materials.

Materials scientists study the structures and chemical properties of various materials to develop new products or to enhance existing ones. They also determine ways to strengthen or combine materials, or to develop new materials for use in a variety of products. Materials science encompasses the natural and synthetic materials used in a wide range of products and structures—from airplanes, cars, and bridges to clothing and household goods. Materials scientists often specialize in specific areas, such as ceramics or metals.

Materials engineers are involved in the development, processing, and testing of the materials used to create a range of products, from computer chips and aircraft wings to golf clubs and snow skis. They work with metals, ceramics, plastics, semiconductors, and composites to create new materials that meet certain mechanical, electrical, and chemical requirements. They are also involved in selecting materials for new applications. Materials engineers have developed the ability to create and then study materials at an atomic level, using advanced processes to replicate the characteristics of materials and their components with computers. Most materials engineers specialize in a particular material. For example, metallurgical engineers specialize in metals such as steel, and ceramic engineers develop ceramic materials and the processes for making them into useful products, such as glassware or fiber optic communication lines.
Source:
http://www.sciencebuddies.org/science-engineering-careers/engineering/materials-scientist-and-engineer

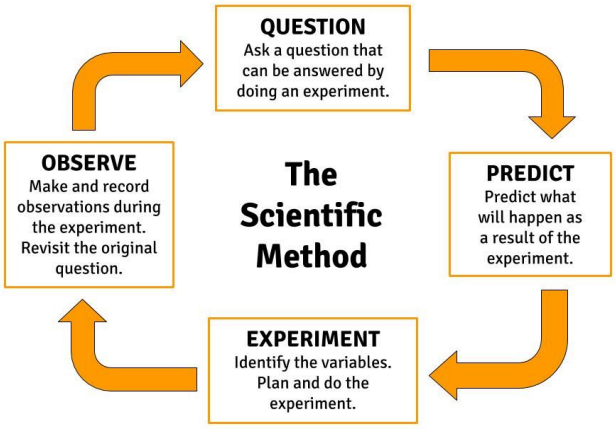
Background Information: The Scientific Method

The **scientific method** is a process for experimentation that is used to explore observations and answer questions. Does this mean all scientists follow *exactly* this process? No. Some areas of science can be more easily tested than others. For example, scientists studying how stars change as they age or how dinosaurs digested their food cannot fast-forward a star's life by a million years or run medical exams on feeding dinosaurs to test their hypotheses. When direct experimentation is not possible, scientists modify the scientific method. In fact, there are probably as many versions of the scientific method as there are scientists! But even when modified, the goal remains

the same: to discover cause and effect relationships by asking questions, carefully gathering and examining the evidence, and seeing if all the available information can be combined into a logical answer.

Even though we show the scientific method as a series of steps, keep in mind that new information or thinking might cause a scientist to back up and repeat steps at any point during the process. A process like the scientific method that involves such backing up and repeating is called an iterative process.
Source: http://www.sciencebuddies.org/science-fair-projects/project_scientific_method.shtml

The STEM Connection Scientific Method Diagram:



Background Information: Bubbles
What Are Bubbles?

Bubbles are pockets of soap and water that are filled with air. When soap and water are mixed together and air is blown into the mixture, the soap forms a thin skin or wall and traps the air, creating a bubble. Soap bubbles are not the only kind of bubbles. You can find bubbles in lots of liquids. You might see small bubbles in plain water, but they will always be in the water, or floating on the surface of the water, not floating through the air. There are bubbles in soda pop, too. The special thing about soap bubbles is that they can float freely in the air; they don't have to be touching water or another liquid like most bubbles do. Can you find other bubbles around your house? What about something that is round and filled with air like a bubble? (Some examples are balls, balloons, and bubble wrap.)

How does soap help make bubbles out of water? Soap makes the *surface tension* of water weaker than normal. It also forms a very thin skin that is more flexible

than water. When air gets trapped under the surface of the mixture of soap and water, the flexible skin stretches into a sphere shape (round like a ball), making a bubble! You can see the flexible skin that forms a bubble by dipping a bubble wand into some bubble solution. When you pull it out, the hole will be filled with a stretchable skin of liquid. If you blow gently on the skin, you'll blow a bubble!

What Happens to Bubbles?

Since bubbles are made from soap and water, they can only last as long as the water lasts. In dry air, water *evaporates* - it is soaked up by the dry air around the bubble and the skin of the bubble gets thinner and thinner until it finally pops! Evaporation isn't the only thing that pops bubbles. Anything dry can pop them. When a bubble floats through the air and lands on your finger, on a blade of dry grass, the wall of your house, or your pet's fur, the bubble will pop. When something sharp and dry touches the bubble, it pokes a hole in the bubble's skin, all the air goes out of it, and the bubble disappears!

Why Are Bubbles Round?

Bubbles that float in the air and are not attached to anything are always round because the thin wall of soap is pulling in while the air inside of it is pushing out. A bubble always tries to take up the smallest amount of space and hold the most air that it possibly can. A sphere, the round ball-shape of a bubble, is the best way to take up a little space and hold a lot of air. Even when a bubble starts out as a square or another shape, it will always turn into a round sphere as soon as it floats away into the air. A square bubble would take up more space than a round one.

There are a few times when bubbles are not round. Sometimes the wind blows them into different shapes. When bubbles are surrounded by lots of other bubbles, the ones in the middle get squished into other shapes, like squares or hexagons (shapes with six sides). Try blowing a lot of bubbles right next to each other in a shallow container and see if there are any that are not round. If you pop the bubbles on the outside, the ones on the inside will not be squished anymore and they will push back out to round bubbles again!

What Causes the Colors in Bubbles?

The pretty colors you see in bubbles are caused by light that is reflected off of the walls of the bubble. When light is reflected, here is what happens: light touches the outside of the bubble and bounces off of it, then it goes to your eye and you see color! As the surface of a bubble gets thinner, you will see different colors. When you first blow

a bubble, you will probably see green and blue, then magenta or purple, and then just before the bubble pops, most of it will be a dark golden yellow color, or almost black. Sometimes the surface of the bubble is very thin on some parts, and thicker on other parts. When that happens, you will see lots of different colors on the bubble at once making it look like a rainbow! Next time you are outside blowing bubbles, see if you can tell when they are about to pop - remember, most of the bubble will probably be dark yellow or black just before it pops!

Source: https://www.homesciencetools.com/a/learn-about-bubbles

Literature Connections: *Pop! A Book About Bubbles* (Let's-Read-and-Find-Out Science, Stage 1) by Kimberly Brubaker Bradley, *Bubble Trouble* (Rookie Readers) by Joy N. Hulme, *Floating and Sinking* (My Science Library) by Amy Hansen, *Things That Float and Things That Don't* by David A. Adler

Materials: Container of store-bought bubbles, a handful of balloons filled with air, device to show online video clip, large jar(s), measuring cups/spoons, dish soap, corn syrup or glycerin, spoons for mixing, pie pans or other container to put bubble mixture during testing, materials to use as and/or to make bubble blowers (rings from milk jugs/plastic bottles, toilet paper tubes, straws, plastic water bottles, pipe cleaners, paper/plastic cups, etc.), rulers, food coloring or liquid water color, white paper

Preparation: Set-up device to show online video clip, blow up a handful of balloons, and gather other materials.

Directions:

1. **Engagement:**
    a. Questions:
        i. Have you ever blown bubbles? What shapes and colors did you notice? Draw a picture of some bubbles and the wand you used to blow them.
        ii. Where in nature can bubbles be found? Draw pictures of your ideas.
    b. Activity: Look at the balloons and bubbles (blown by teacher for observation). How are balloons and bubbles similar and how are they different?

2. **Background Information: Bubbles**
    a. What is a bubble? (pocket of air surrounded by something like soap and water, etc.)
    b. What state of matter makes up the outside of a bubble? (solid or liquid)
    c. What state of matter makes up the inside of a bubble? (gas)
    d. Where in nature can bubbles be found? (in water when underwater organisms breathe or give off gas, by waterfalls, on a beach when waves crash into the shore, frogs croaking, on leaves, in lava from volcanoes, etc.)
    e. What shape are bubbles? (round, spherical)
    f. Bubbles are always round because the thin wall of soap or other outer materials is pulling in while the air inside of it is pushing out. A bubble always tries to take up the smallest amount of space and hold the most air that it possibly can. A sphere, the round ball-shape of a bubble, is the best way to take up a little space and hold a lot of air.
    g. Because bubbles are filled with air, they are very light and not very dense. Just like a beach ball floats on water, a bubble will float through the air.
    h. Today we are going to experiment with bubbles, but before we get started, we are going to watch a short video to help us learn a little more about bubbles and blowing bubbles. Show Engineering is Elementary: Adventures in Engineering: Bubble Artist Interview video - http://eie.org/engineering-adventures/resources/bubble-artist-interview

3. **STEM Activity:** Investigating Bubbles and Bubble Wands
    a. Make Your Own Bubble Mix
        i. As a large group or in small groups, have children help make their own bubble mix.
        ii. Put 2 cups of water in a large jar.
        iii. Add ⅓ cup dish soap and gently stir (try not to let the mixture get too bubbly or foamy).
        iv. Add ⅛ cup corn syrup or glycerin and gently stir.
    b. Experiment with Different Bubble Blowers
        i. Since we made our own bubble mix, we don't have the bubble-blowing wands that come with the bubble solution when we buy it at a store.

ii. To blow a bubble, we have to be able to blow air through an opening that has some bubble solution on it.
iii. Does anyone have any ideas about what we could use as a bubble blower? (let students share some ideas)
iv. Discuss steps of the scientific method for this experiment.
    1. **Question:** What common household items can be used to blow bubbles?
    2. **Predict:** Show students some of the items they have to test: rings from milk jugs/plastic bottles, toilet paper tubes, straws, plastic water bottles, pipe cleaners, paper/plastic cups, etc. Have students predict which one they think will work best.
    3. **Experiment:** Go outside and give students time to test out the different bubble blowers.
    4. **Observe:** Have students make observations about bubble blowers to determine which one is best. Discuss with students which blowers worked well and which ones didn't work well.
    5. Extensions:
        a. Have students test which blower makes the biggest bubbles.
        b. Have students test different ways of blowing to determine which method works best for big bubbles or lots of bubbles, etc.
        c. Have students blow bubbles toward the ground so they pop on the ground and make a circle of soap. Use rulers to measure diameters of circles. See how big or how small of bubbles they can make.

c. Make Your Own Bubble Wand

i. Provide students with straws and pipe cleaners.
ii. Have students use the given materials to design and create their own bubble wand.
iii. Extensions
    1. Challenge students to make a wand that makes the biggest bubble possible.
    2. Challenge students to make a wand that makes a bubble that is a different shape than a sphere. NOTE: Bubbles will

only be different shapes while they are on the wand; once blown, all bubbles will reshape to form a sphere.

d. **Art Extension:** Use food coloring or liquid water color to dye samples of bubble solution different colors. Place white paper on the ground and have students blow colored bubbles onto the white paper so they pop into circles and splatters of different colors. You may want to have some traditional bubble wands on hand for this.

8. **Reflection:**
    a. What is a bubble?
    b. What states of matter make up the different parts of a bubble?
    c. Why do bubbles float through the air?
    d. What causes bubbles to pop?
    e. What are some everyday household items that can be used as bubble blowers?