Bubble-ology

In the Classroom (Grades K – 5)

Group Size	Individual, Groups of 3 to 4
Duration	50-75 minutes (depending on activities selected)
Materials/ Equipment	H20 picture worksheets, Bubble-ology student worksheets, several small containers for water, bottle of bubble liquid, pennies (1 per student), various shaped wands (for example - flower, triangle, heart, star, square, multi or circle), pipettes, foil pie plates, paperclips, cup with water, wax paper, dish soap, toothpicks, tables, paper towels, trays, pencils, clipboards, water If doing Student Activity #3, plastic rulers, container for water, and flexible measure tape is needed. **It is recommended that this activity takes place outdoors.**
Resources	The Science of Bubbles: https://www.youtube.com/watch?v=zQHNX7HPtHk (2:11) Fun with Bubbles: Physics with Kids video: https://www.youtube.com/watch?v=XxU_QenIO54 (4:19) What Does a Scientist do? Lesson for Kids: https://study.com/academy/lesson/what-does-a-scientist-do-lesson-for-kids.html (2:59) Bubble-ology student worksheet H20 picture worksheets Table station diagram
Objective	Students will investigate and discover how surface tension and cohesion are related to soap bubbles. Students will develop predictions and hypothesize the outcome of experiments. Students will analyze and draw conclusions from their data. K.PS.1: Objects and materials can be sorted and described by their properties (color, size, texture). K-2-ETS1-1: Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved tool or object. K-2-ETS1-2: Develop a simple sketch, drawing or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. 2-PS1-1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. 2-PS1-2: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
Preparation	It is recommended that this activity take place outdoors. Review background information for teachers (found below), make copies of the Bubble-

	ology worksheet (one copy per student to be used as the student worksheet), make copies of the H20 picture worksheet, set up stations with pie plates of bubble solution (see table station diagram for instructions). Background information for teachers: Observing how surface tension works and how bubbles are shaped are all aspects of Bubble-ology. The secret to making a good bubble is surface tension, a bond that holds water molecules together. When the surface tension of water is combined with a soap or detergent, it becomes elastic. This springy quality is what makes bubbles possible. Bubbles float because they are about the same weight as the air around them. If left un-popped, bubbles will pop on their own as the solution settles to the bottom of the bubble, making the top of the bubble too thin. A bubble is made of a covering made up of water and detergent that encloses some air. When you blow air into the soap bubble solution, the liquid molecules of the solution are attracted to each. So they wrap around the burst of air until they can attach to each other again forming a bubble. The air inside the bubble is pushing the soap solution molecules apart. The attraction between the soap solution molecules is so great that the bubble holds its shape. The bubble doesn't pop because the molecules are hugging each other too tight. At the conclusion of the activity, please rinse off wands and pie plates with water. Please place all items back into the kit.
Procedure	Please see the attached page for teacher demonstrations and student activities. Please select as you see fit for your classroom. It is recommended that at minimum Student Activity #2 is selected. Begin with an introduction by asking students some of the following questions: What do they already know about bubbles? When have they played with bubbles? What happens when they blow a bubble? What does a bubble look like? Do bubbles float? Do they pop? In what shape do they normally see bubbles? What shape is the bubble wand? What is bubble solution made of? What would the shape of the bubble be if you used a different shaped wand? Share some facts: Bubbles are formed by blowing air into a liquid. When the bubble expands too much or touches a surface, it pops! Water, like all substances, is made of molecules that are too small to see. Explain that a water molecule has 2 Hydrogen atoms and 1 Oxygen atom (show H_20 picture worksheet). Water molecules are attracted to each other because the elements of hydrogen and oxygen are attracted to each other and hug each other very tightly. This is called cohesion. The molecules hug so close together that they do not want to touch other molecules around them. The effect of this attraction is called surface tension. Surface tension makes the water act as if it has an elastic or rubber skin. We see surface tension at work when you see a drop of water on a flat surface. It creates a little "bead" of water, like a little dome. Surface tension is what makes the dome shape – the water doesn't flatten out. Water tension is why water drops are tear shaped

	when they leave a faucet, but are round when they land on a surface.
Potential Questions	What do you predict will happen? What do you think bubble solution is made of? Have you ever seen a drop of water on a surface? What does it look like? What do you think a scientist or engineer does?
Air Force Connection	A scientist is a person who studies, specializes, or investigates a field of science or does scientific work. Scientists do many things. Biologists like to learn about living organisms. Geologists like to study rocks. Zoologists like to study animals. Scientists are people that love to solve problems. They solve these problems by doing experiments. Scientists observe, measure things, and communicate their findings. Ask the students: How are you like a scientist in this experiment?

Teacher Demonstration #1:

1. Fill a cup of water as high as you can without it spilling.
2. Use a dropper or pipette to add the last few drops, so it's as full as you can possibly get it.
3. Have students estimate how many paperclips they think will fit into the cup before the water overflows.
4. Begin dropping in paperclips in one at a time.
5. Ask students to notice and observe what is happening to the water.
    a. Keep track of how many paperclips you have dropped in the water.
    b. Keep adding paperclips until the water finally overflows.

Teacher Demonstration #2:

1. Use an eye dropper to place a few drops of water on some wax paper.
2. Ask the students to observe the drops closely.
    a. What do they notice?
    b. What shape does it take? (round, circle, sphere)
    c. Water molecules stay together and attach themselves to one another.
    d. What would happen if we tried to separate the droplet?
3. Try poking the water drop with a clean, dry toothpick. What happens?
4. Now poke the water drop with a clean, dry toothpick that has been dipped in dish soap.
    a. What happens?
    b. Why do you think this happened?

Teacher Demonstration #3:

1. Blow a few bubbles for the students using the bottle and regular round wand.
2. Discuss the shape and size of the bubble.

Student Activity #1

1. Give each student a pipette and a penny.
2. Ask them to predict how many drops of water will fit on the penny without spilling off the edge.
3. Have the students test their predictions.

If time allows, ask students to put drops of water on a penny again, then break the surface tension of the water on the penny by adding a drop of soap solution (pipettes with dish soap work well). Please note that pennies will need to be cleaned to remove all of the dish soap before the next use.

Student Activity #2

Have tables and stations set up with shallow pie plates already full of the bubble liquid. Each station will have a different shaped wand (see table station diagram for placement).

1. Review safety rules:
2. Do not blow bubbles towards someone's face and eyes.
3. Swinging the wand may give a good result, but they need to be careful of how close they are to other people.

4. Make sure they understand they will only go to one station before returning to their

seat in the grass.

5. Give students the Bubble-ology worksheet. Have students write their name on their worksheet.
6. Explain that they will test making bubbles with different shaped wands.
7. Discuss the word prediction.
8. Show the students the different wands.
9. Have students fill out the first column of their worksheet. What shape do you think the bubble will be when using different shaped wands?
10. Group students so a small group of 3 or 4 will travel from station to station together.
11. Send the students to their first station (students should leave their pencils and worksheet at their seat in the grass).
12. Give them a few minutes to blow bubbles with the wands only at that station.
    a. They will need to share and take turns.
    b. Remind them to observe shape and size of the bubbles.
13. Have them return to their seats and fill out the last two columns of their worksheet for the station that they tested.
14. Make sure everyone knows where their next station is located.
15. Rotate students through the stations until all 5 stations are completed.

Review results:
Gather everyone to review results. Hopefully, they noticed that all bubble shapes were circles, no matter the shape of the wand.

If the students are older, can they explain why the shape changes from the shape of the wand to a circle?

Student Activity #3
This activity is intended for students in 5th grade or older.

1. Students will still work in teams of 3 or 4.
2. Ask students to make predictions of how big a bubble they think they can create.
3. Each group will get 3 attempts to create and measure the height and width of the three bubbles.
4. One student on the team should blow a large bubble and get it to rest on the table (feel free to number students based on the specific job, ex. Student 1 will blow the bubble).
5. A different student should insert a wet plastic ruler into the bubble to measure the height (a dry ruler will burst it).
6. A third student should measure the width with a tape measure.
7. A fourth student, or the student who blew the bubble if there are just 3 of them, should record the results.
8. Compare and Discuss results.

Conclusion

1. Review with students that a water molecule has 2 Hydrogen atoms and 1 Oxygen atom.
2. Review with students that water molecules are attracted to each other because hydrogen and oxygen stick together tightly. This is called cohesion.
3. Review with students that the effect of this attraction is called surface tension. Surface tension is what makes the dome shape in a bead of water.
4. Review with students that no matter the shape or size of a wand, bubbles are round.