W 1212

4-H BUBBLEOLOGY

A SCIENCE OF FUN

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INSTITUTE OF AGRICULTURE
THE UNIVERSITY OF TENNESSEE

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Skill Level:
Beginner (5th graders)
Intermediate (6th-8th graders) Advanced (9th-12th graders)

Learner Outcomes:
The learner will be able to:

- Test, measure and evaluate measurements of bubble solutions with 90 percent accuracy

Tag(s): 4-H Science

Impact:
Students are successful if they can:

- Demonstrate the primary concepts in scientific inquiry through hypothesizing, experimenting and discussion
- Demonstrate the primary concepts of measurement in liquid and length
- Demonstrate the skills of finding the mean, median and mode of problems
- Write about their experiment with prompted questions and study

Time Needed: 45-120 minutes

Materials Needed (each student):

- One yardstick
- Two plastic drinking straws
- One container of each of the three solutions
- Bubble Solutions Worksheet
- Table, desk or counter along with a pencil or pen

Materials Needed for Teacher:
For preparation and cleanup:

- 8 ounces (240 milliliters) of three different brands of dishwashing liquid (be sure to buy a cheap one, one that is in the mid-price range, and one that is expensive)
- Water
- One measuring cup or graduated cylinder
- Three 1-gallon containers for mixing bubble solution
- One roll of masking tape for marking
- Two rolls of paper towels
- Glycerin
- Squeegee

Author

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Introduction to Content

The challenge of Bubbleology is determining which dishwashing soap solution will make the biggest bubbles. This activity will quantify how well a soap solution forms bubbles.

Introduction to Methodology

Students will have the chance to experiment with dishwashing solutions, blow bubbles and measure their bubbles.

Teacher Talk

In advance, you will need to do the following:

1. Make one copy of the "Bubble Solutions" worksheet for each student.
2. Prepare three different bubble solutions (one solution for each brand of dishwashing liquid you purchased) in three 1-gallon containers:
   - 1 cup (240 milliliters) of dishwashing liquid
   - 50-60 drops of glycerin
   - 1 gallon of water
3. Label each of the containers with the name of each dishwashing liquid.
4. Pour 1 cup of each solution into smaller containers so that each student will have one sample of each solution.
5. Place containers of each solution, yardstick and worksheet at each testing station.

Setting the Stage/Opening Question

Say: "Today, we are going to turn ourselves into scientists!"

Students will hopefully be intrigued by the idea of using science for fun in this activity.

Say: "First, we will consider what it means to be a scientist." Ask questions for brainstorming about what scientists do in their everyday work.

1. This science experiment aims to compare brands of dishwashing liquids to determine which solutions will make the biggest bubbles.
2. There must be a standard method of measurement to be sure that we compare the solutions fairly and correctly. Demonstrate the procedure that follows for measuring the bubbles:

   a. Pour a 50-cent-piece-sized amount of solution onto the table and use your hand to wet the area.

   b. Dip the straw into the solution that remains in the container.

   c. With the straw barely touching the soapy surface of the table, gently blow through the straw to form a bubble dome. Continue blowing the bubble that you created until it pops. Take more than one breath if necessary.

   d. With a yardstick, show the students how to measure the inside of the diameter of the ring of soap suds that remain from the bubble dome.

Experience

1. Ask students which brand they think will make the best or largest bubbles. On the board, construct a hypothesis statement using an if/then statement. An example would be: *If the more expensive soap costs more in the store, then it will produce bigger bubbles.* The statements will vary with the experience of the students within any given group. If the students do not have any insight, coach them to ask the formalized questions of a hypothesis.

Strategies to Increase Student Engagement

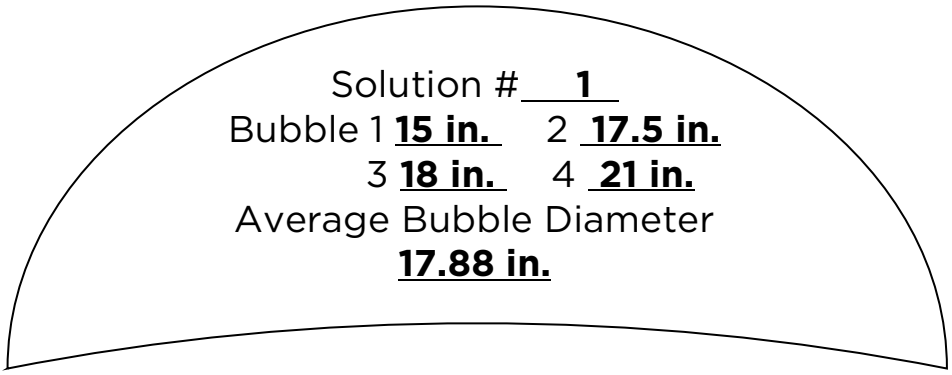
Notes

2. Have the students work in pairs to share materials. Students have been known to blow huge bubbles! Have the students space out the solutions on three different sections of the table so the solutions will not mix. They should record their measurements in inches on the Bubble Solutions Worksheet.

3. As the students experiment, they may come to you with questions, such as: "He popped my bubble; does that one have to count?" or "My bubble is oblong; how can I measure that?" Remind them they are scientists, and it will be up to them to get their four trials the best way they know how. They must keep the same experimenting and standards for all solutions, not just special treatment for one.

Analyzing the Findings

1. Once all trials have been completed for each solution, have the students figure the average of their bubbles per solution. For example: Jay's bubble trials look like this:



To average:
Add the outcomes for Trial 1 (15), Trial 2 (17.5), Trial 3 (18) and Trial 4(21). The sum will be 71.5. Divide the sum by the number of trials (4), which will give you the average for the solution: 17.88.

2. On the board, write the names of the dishwashing solutions across the top and have the students record their averages under each column. Once they are all recorded, have your students calculate the grand average for the solution. For example:

Solution 1	Solution 2	Solution 3
17.88	15.0	19.5
25.0	16.0	21.0
15.5	23.0	19.0
17.5	15.0	21.0
16.0	17.0	19.5

The grand average for Solution 3 would be (19.5+21+19+21+19.5) = 100/5(total number of averages recorded) = 20

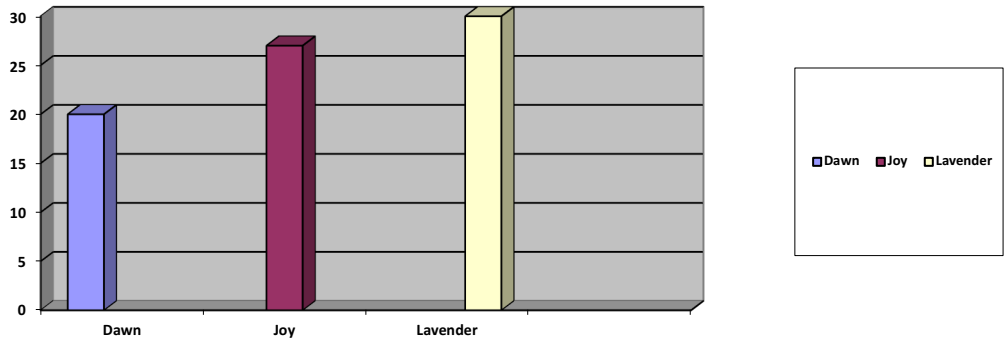
3. Working with the averages, find each set of averages' mean, median and mode. The following are definitions for each of these mathematical functions:

    a. **Mean** – It is the average of a given set of data or numbers. (It is also the grand average for the set of data they have found.)

    b. **Median** – It is the exact middle of the given numbers. Place each value in numerical order, and the exact middle number will be the median value. If you have an even set of values, you will have to take the two middle numbers, add them together and then divide by two to get your median. Odd sets of values will have an exact middle value.

    c. **Mode** – It is the number that is used most. There can be more than one mode, or there might not be a mode with value sets. It all depends on the data found in the experiments.

4. Have the students graph the grand averages (means of each solution) on a bar graph. This will show them which solution worked best for the tests.



Explore the Findings and Go Further

1. Ask the students if this has been a fair test. Fair tests are those in which all testing is conducted uniformly and the same materials and methods are used, etc. Things to think about:

    a. Was the same amount of solution used each time?

    b. Were all the bubbles measured in the same way?

    c. Was there anything else that could have affected the results we found?

2. Explain that the factors that change from one time a bubble is blown to the next are called **variables.** In a fair test, all variables are kept the same or controlled except the **test variable.** Scientists call this a **controlled experiment** with variables and test variables. Ask the students what they think the test variable is in this experiment. (The soap brand is the test variable!)

3. Have your students write a three-paragraph report about the experiment. They can use the hypothesis as the opening statement of their introductory paragraph. The final paragraph should include the results that were found.

Share/Process

Say: "Share with the person sitting next to you something you learned from our experiment today."

Generalize
Say: "How will this lesson help you be more aware of experimentation in the future?"

Apply
Say: "In what ways will this lesson help you in your own life? Are there ways you can use this type of experiment in your own home or community?"

Supplemental Information
Educational Standards Met

TIPPS
Life Skills

Grade 5 Math

Perimeter, Area, Volume and Equivalent Measures
Circles – Understand and apply theorems about circles
M3.G.C.A.2: Identify and describe relationships among inscribed angles, radii and chords.

Outcomes and Measures of Center
Probability and Statistics – Summarize and describe distributions
6.SP.B.5: Summarize numerical data sets in relation to their context.
a. Report the number of observations.
b. Describe the nature of the attribute under investigation, including how it was measured and its units of measurement.
c. Give quantitative measures of center (median and/or mean) and variability (range) as well as describing any overall pattern with reference to the context in which the data were gathered.
d. Relate the choice of measures of center to the shape of the data distribution and the context in which the data were gathered.

Equations and Properties
Probability and Statistics – Investigate patterns of association in bivariate data
8.SP.A.1: Describe patterns such as clustering, outliers, positive or negative association, linear association and nonlinear association

Expressions and Equitations - Solve real-life and mathematical problems using numerical and algebraic expressions and equations and inequalities
7.EE.B.3: Solve multistep real-world and mathematical problems posed with positive and negative rational numbers presented in any form (whole numbers, fractions, and decimals).
a. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate.

Grade 5 Language Arts

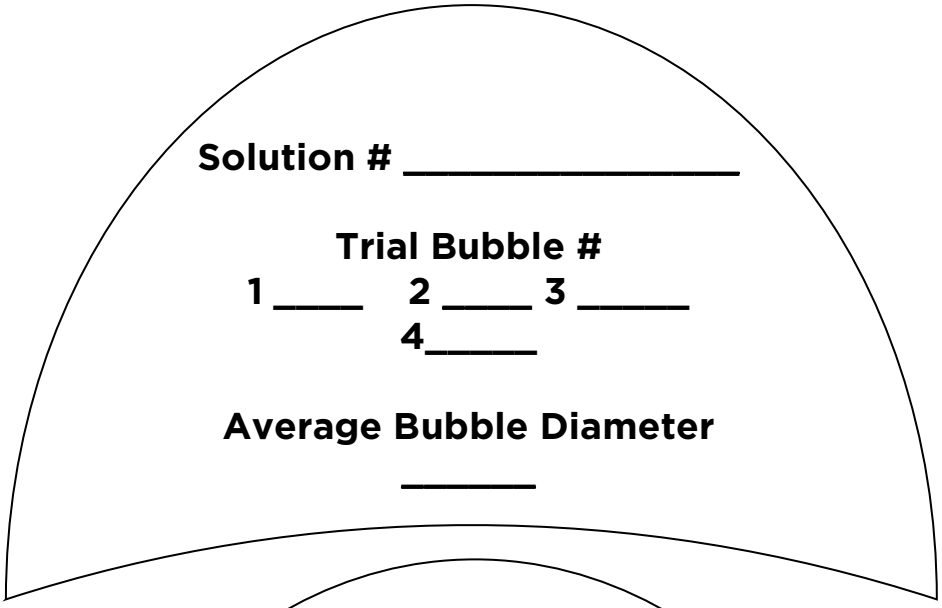
Speaking and Listening
5.SL.CC.1: Prepare for collaborative discussions on 5th-grade level topics and texts; engage effectively with varied partners, building on others' ideas and expressing one's own ideas clearly.
5.SL.CC.2: Summarize a text presented in diverse media such as visual, quantitative and oral formats.
5.SL.CC.3: Summarize the points a speaker makes and explain how each claim is supported by reasons and evidence.
5.SL.PKI.5: Include multimedia components and visual displays in presentations, when appropriate, to enhance the development of main ideas or themes.

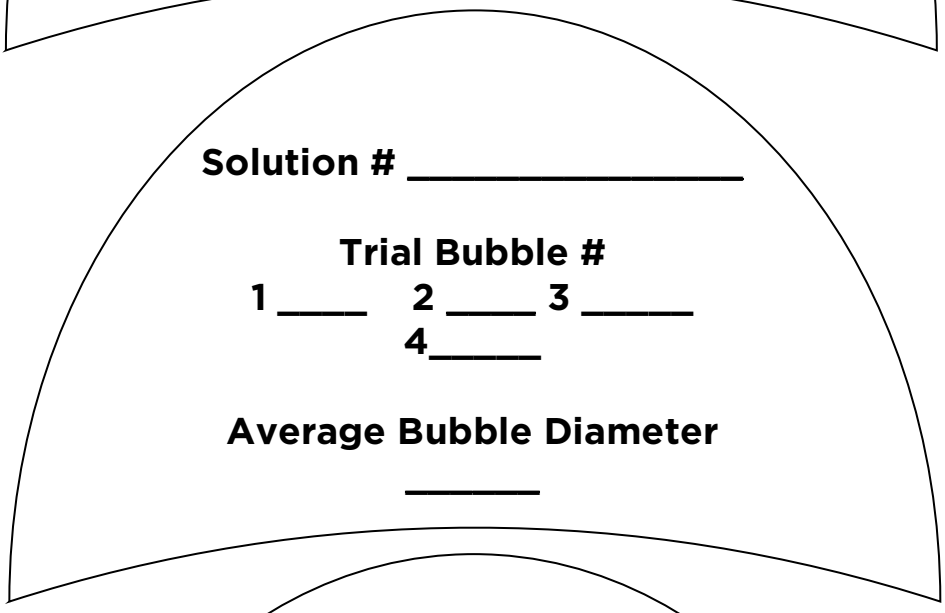
Grade 5 Science

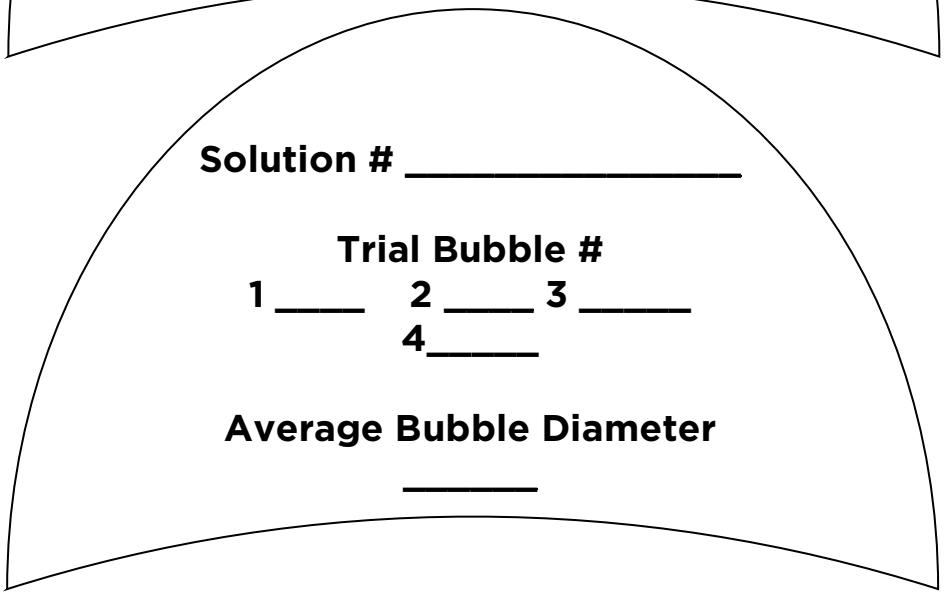
Applications of Science
SCRE.ETS3:
1) Research and present information about the history of the development of a scientific theory. Articulate reasons for refinements and/or replacement of this theory over time.
2) Engage in argument from evidence supporting the statement that science is tentative.
3) Generate questions and engage in discussion regarding the role of ethics in scientific research and in decision-making based on scientific information.
4) Make observations and ask questions about the natural world. Refine the questions such that they can be answered by way of scientific investigation.

Matter and Its Interactions
5.PS1: 1) Analyze and interpret data from observations and measurements of the physical properties of matter to explain phase changes between a solid, liquid, or gas.
2) Analyze and interpret data to show that the amount of matter is conserved even when it changes form, including transitions where matter seems to vanish.
3) Design a process to measure how different variables (temperature, particle size, stirring) affect the rate of dissolving solids into liquids.

Student Worksheet:
4-Trial Bubble Solutions







2-Trial Handout

You will become a scientist today in the study of bubbles – BUBBLEOLOGY!! There are a few things that you need to remember about science. Science is a study, not a set standard. When you are testing variables and solutions … you must remember that we have tests/trials for a reason. If we depended on only one trial, then our information would not be accurate to provide evidence for our research. Research is defined as the investigation or experimentation to discover and interpret facts. In this fun session, you will learn quite a bit about science, math and measurement!

Listen and follow the directions to ensure we get the most out of each test and trial.

There will also be directions that you will need to follow below:

- Choose a partner that you will work with very well. We need scientists to be able to listen and follow instructions without having to speak to them time and time again!

- Once you have your partner, you must follow the instructions to set up the room for your testing area.

- Once you have your partner and testing area, please choose Member A on your worksheet and Member B of your pair/group. This will be important when you start to measure your bubbles for testing.

- This can be a messy experiment, and we must keep our areas as clean as possible. Make sure to take care of your solution containers and not waste any materials during our experiment. Cleanup will take place in between solutions.

- Instructions will be given about what to do once you have completed your trials, but in order to prepare you further. Place all the materials on your testing area (your straw, ruler, pencil and container with a tightly closed lid) and raise your hand for the next solution.

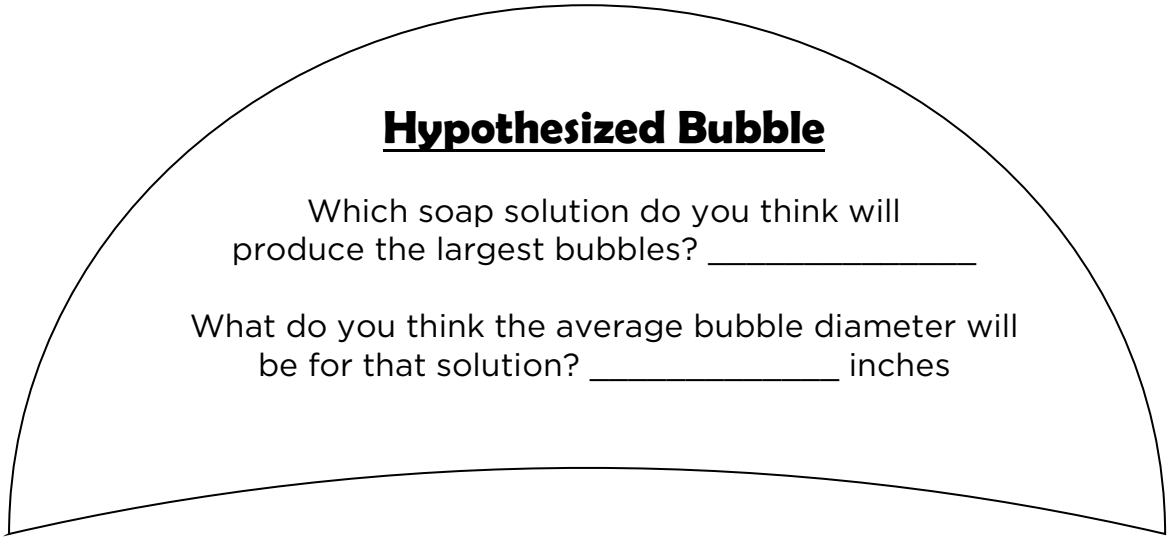
- Once you have completed all solutions, you will need to do some math work. Once your math work is completed, you will be filling in a grid on the board. Be sure to give accurate readings so that our trials and tests are not inaccurate with the final findings.

- Have a blast being a BUBBLEOLOGIST!

Bubbleology and Scientific Inquiry

The **hypothesis** is defined as an _____ _____. We use this to pose questions and thoughts about how our experiment may or may not work. As scientists without formal training, we can use context clues to get a "*cause*" and "*effect*" for the solutions in this *bubbly* experiment.

What variables should we consider from what we see or observe?



If, then *statements help us explain our hypothesis. For example,* ***if*** *solution A has more bubbles in the solution container,* ***then*** *it would blow the largest bubbles for the experiment. From the variables you wrote down and from what you guessed in your "hypothesized bubble," write your own* ***if, then*** *statement below:*

If_____ _____,

Then_____ _____.

Final Thoughts/Conclusions

Was your hypothesis correct? Why or why not? What made it correct or incorrect?

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