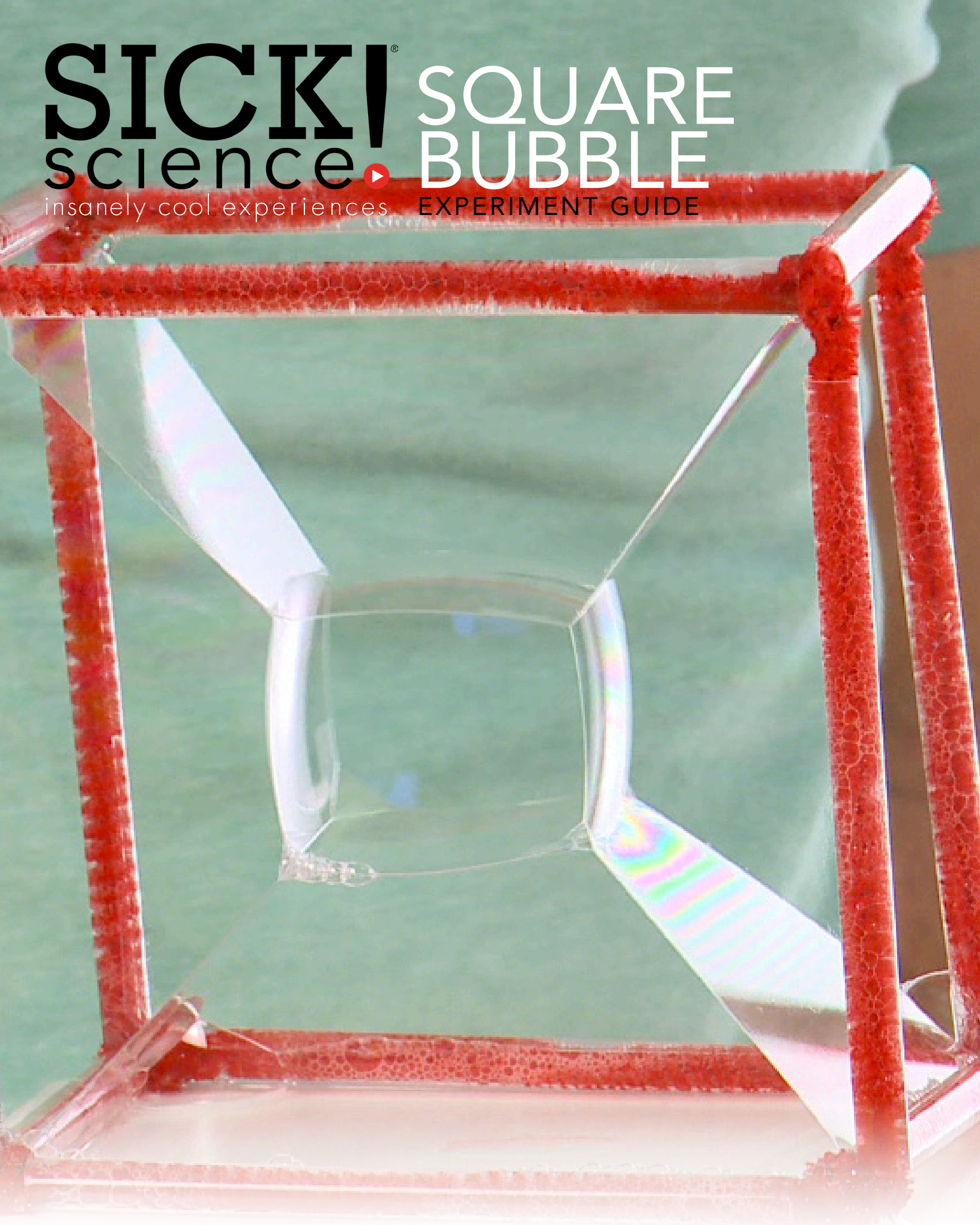
SICK! science®
insanely cool experiences

SQUARE BUBBLE

EXPERIMENT GUIDE



SQUARE BUBBLE

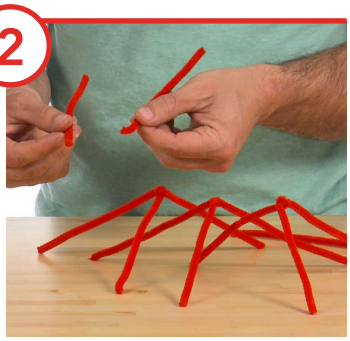
Soap bubbles that are not spherical are unusual and they don't happen without a little help. Nature is funny like that. Square bubbles are easy to make and can serve as a great learning tool to explore solutions, soap films, and surface tension. You build a bubble maker that's a cube, dip it into some soap solution, and the film stretches out flat. The film clings to the edges of the cube causing the bubble to appear to be a square. Well, it's *almost* a square.

WHAT YOU NEED

- 6 CHENILLE STEMS
- 6 STRAWS
- SCISSORS
- DISH SOAP
- WATER IN A LARGE BOWL OR BUCKET
- BUBBLE WAND

1 Use the scissors to cut each of the six chenille stems and straws in half. You'll have twelve pieces of each.

2

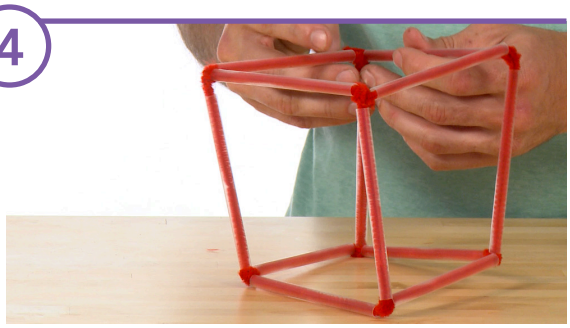


Twist three of the chenille stems together at an end to make a triangular, pyramid-shape. You'll end up with four, three-legged pieces

3

Slide a piece of straw onto each chenille stems. Some of the pipe cleaner should stick out of the straw on each leg.

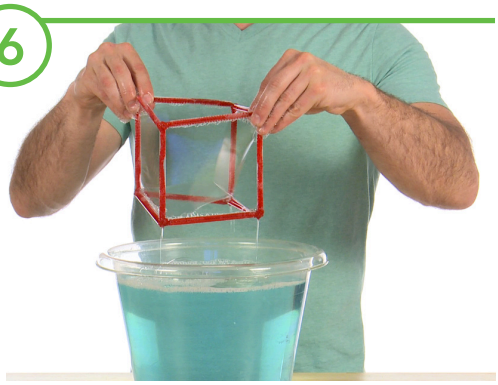
4



Build the cube by twisting the pipe cleaner's ends on one part to the ends on another part. Connect the legs until the cube is complete. Make it as even as you can.

5 Mix the bubble solution. (Check out the "Making Bubble Solution" suggestions on the next page.)

6

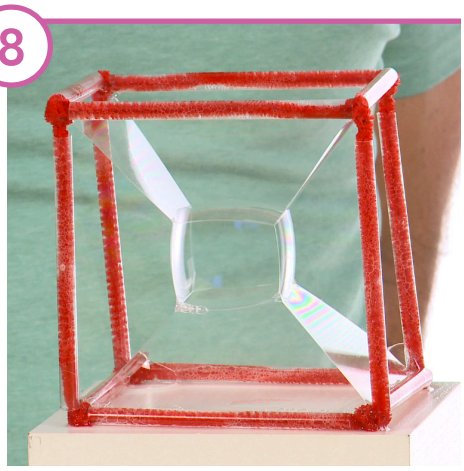


When your bubble solution is ready, dip the cube shape into the solution. Let it sit in the solution a few seconds and lift it out by holding onto two corners. Giving the cube a gentle shake helps the soap film even out itself and causes excess solution to drip back into the bowl or bucket. Set the "square" bubble on a flat surface to keep the bubble film stable.

7

You can gently shake the cube to change the way the film faces or just rotate the cube to make sure the square bubble in the center is horizontal. You need to see the square when you look down into the cube from above it.

8



Use a bubble wand or make a pipette into a wand by cutting off half of the bulb end. Blow a bubble and drop it into the center of the square. Voilá! The bubble you dropped into the cube "magically" transforms from a sphere to a bulging cube. Now that's a square bubble!

HOW DOES IT WORK

Bubbles form because water has reduced surface tension in the presence of soap. Hydrogen atoms in one water molecule attach to oxygen atoms in another water molecule. This clinging together of water molecules is called cohesion. Soap molecules help the water molecules be more "stretchy" or flexible by decreasing the force of the attraction between the molecules. Soap and glycerin reduce the evaporation of water molecules, so individual bubbles can last longer. There is also some strengthening of the soap film.
Why are bubbles always round? Physicists will tell you that bubbles use a minimum amount of surface area needed to enclose the volume of air trapped inside. In this activity, however, as you dip the cube into the bubble solution, the solution stretches between the edges of the cube and the soap film clings to the sides. This is called adhesion. This causes the bubbles to appear square or cubic. The soap film connects the shortest possible distance while still connecting all of the sides. Notice, however, that even the bubble you blew into the center at the end of the demonstration bulges slightly on its sides. Bubbles love a spherical shape!

MAKING BUBBLE SOLUTION

Make a batch of bubble solution with the ingredients listed below. Making your bubble solution at least 24 hours in advance and allowing it to sit undisturbed will allow the bonds in your bubble solution to strengthen. You know what that means, right? Strong bubbles!

It is important to remember that no two homemade bubble solutions are going to be the same. We suggest using the following ingredients, but the amounts of each may vary.

Water - The single most important part of the bubble solution is the water. Good quality water that does not contain high levels of iron or minerals is best. If you're uncertain as to the quality of your tap water, invest in a gallon of distilled water from the grocery store.

Soap - When it comes to soap, Dawn® dish soap just seems to work the best from homemade bubble solutions.

Glycerin - Glycerin is the secred additive that gives a bubble its extra strength. Don't be too shocked by the price on a bottle of high quality glycerin. Contact the pharmacist at your local grocery store for availability. (Note: Some bubble recipes substitute Karo® Syrup for glycerin due to the expense and availability of glycerin.

SCIENCE FAIR CONNECTION

While creating a square bubble is fun, it is not a science fair project. You can create a science fair project by identifying a variable, or something that you can change, in this experiment. Let's take a look at some of the variable options that might work:

- Make the dish soap the variable. Create bubbles with different brands of dish soap or try using the same brand but with different scents! Which dish soap creates the longest lasting bubble? Timing the "life" of the bubble is a great way to collect data.

- Test different cube sizes. Build cubes of varying sizes with wires, chenille stems, or other plastic toys. Time the bubble to see how long it takes them to pop!

These are just a few ideas, but you aren't limited to them! Come up with different ideas of variables to test and give them a try. Remember, you can only change one variable at a time for each test. For example, if you are testing different brands of dish soap, make sure that all other factors in the test remain the same!

TEACHER NOTES:

SCIENCE CONCEPTS OVERVIEW ▸ Surface Tension, Cohesion, Adhesion, Evaporation

The learning experiences contained in the following Guide are designed to engage students and deepen understanding, not only of the underlying scientific concepts upon which these experiments/demonstrations are built, but also of critical thinking and problem solving skills. Teachers should allow students to actively participate in each activity as an investigation, where questions are being asked, hypotheses are developed and redeveloped, and where students own the discoveries. Vocabulary was included, assessments were created and critical thinking questions were designed with this underlying goal in mind.

The following are some suggested teaching points that could accompany this experiment/demonstration:

SICK Science Teaching Points: The SICK Science video can be utilized in a variety of ways. It can be used to introduce a scientific concept or in place of doing the demonstration/experiment if materials are unavailable. The video can also be used as a review or to help students complete the various learning experiences included in this guide. The video can also be used as a review or to help students complete the various learning experiences included in this guide.

Visit the landing page below to locate the appropriate video for this activity
stevespangler.com/sick-science-resources

Vocabulary: Students will enhance their science-content related vocabulary. You may choose to introduce the vocabulary words and explicitly teach the meaning of each. You may also use the vocabulary words as an investigation, where students may research the meanings of the words. Finally, students may develop their own meaning for each word through their experience with the experiments and critical thinking work.

The Scientific Method: Students can complete a full lab report for the demonstration, including asking questions, identifying variables, forming a hypothesis, designing the experiment, collecting data, and drawing conclusions. Differentiation using the lab report is easy. For lower levels, complete the lab report as a class. As students are more independent, encourage students to work in partnerships or groups to complete the lab report. Eventually, students should be able to complete the lab report independently or design a new experiment using the lab report form based on the demonstration completed in class.

Vocabulary Comprehension: Students will be able to understand and define content related vocabulary words.

Cause and Effect: Students will identify cause and effect relationships and describe the connection between amount of bubble solution and the ability to create a square bubble.

Relation and Application: Students will predict and describe the impact that changing characteristics of bubbles would have on the experiment/demonstration.

Literature Connection: Bubble Bubble by Mercer Mayer

Informational Writing: Students can write a step-by-step procedure for creating a square bubble. This could include the steps of building the cube, of preparing bubble solution, or making the bubble. Remember, all steps should be in the correct sequence and older students should use transitions.

Math Connection: Using chenille stems and straws, ask students to create other 3 Dimensional shapes. Then, encourage students to use their shapes to create bubbles in other shapes such as pyramids, prisms, etc. Does it work? Students should name each shape they create, as well as identify the number of vertices, edges, and faces.

Expert Vocabulary

NAME _____

WORDS AND DEFINITIONS —
Match the word on the left with the correct definition on the right by filling in the blank with the correct letter.

VOCABULARY WORDS	DEFINITIONS
1 ____ **Cohesion**	A — The outside area of an object or body.
2 ____ **Cube**	B — The act of liquid turning to gas.
3 ____ **Evaporation**	C — The act of different types of molecules sticking together.
4 ____ **Surface Area**	D — The act of like molecules sticking together.
5 ____ **Adhesion**	E — A three dimensional shape that has six square sides.

Critical Thinking

NAME

VOCABULARY COMPREHENSION —
Students will be able to understand and define content related vocabulary words.

The surface of an object is the outer layer or boundary. Tension is when something is stretched tightly. Using what you know about these words and what you observed when you created bubbles, create a definition for surface tension and give an example of where surface tension was present in this activity.

Critical Thinking

NAME

CAUSE AND EFFECT —
Students will identify cause and effect relationships and describe the connection between amount of bubble solution and the ability to create a square bubble.

If you tried using more or less bubble solution in your water, what effect do you think this would have on making the square bubble?

How could you prove your predictions?

Critical Thinking

NAME

RELATION AND APPLICATION —
Students wil predict and describe the impact that changing characteristics of bubbles would have on the experiment/demonstration.

Joey is playing with his little sister and is blowing bubbles for her to chase. Unfortunately, the bubbles are popping too quickly and they never make it over to his sister.

Joey's friend, Maria, knows that bubbles pop because the water present on the surface of the bubble evaporates, and that a larger surface area allows the water to evaporate more quickly. What advice should Maria give to Joey to help him blow bubbles that last longer?

Assessment

NAME _____

ASSESSMENT QUESTIONS —
Read each question, then circle the letter next to the correct answer or write your response on the back of this page or in the box.

1. The space inside a bubble is filled with
   a. water
   b. air
   c. bubble solution
   d. soap

2. Even when nothing touches is, a bubble can still burst because
   a. the thin soap film that creates the bubble's surface starts to evaporate and gets too thin and the wall finally collapses.
   b. it floats up too high and the air gets too thin.
   c. the bubble changes shapes.
   d. the air inside the bubble gets too hot.

3. The outside or "skin" of the bubble it made of
   a. air and bubble solution mixed together.
   b. plain water.
   c. water, oil, and air molecules that connect each other.
   d. bubble solutoin that stretches out and connects water molecules.

4. You have two bubbles with exactly the same volume, but one is a cube and the other is a sphere. If neither bubble touches anything, which one do you think will pop first? Why?

   _____

   _____

   _____

5. If you wanted to know which type of dish soap creates the longest lasting bubbles, how could you scientifically test which dish soap is best?

   _____

   _____

   _____

Expert Vocabulary - Answer Key

WORDS AND DEFINITIONS —
Match the word on the left with the correct definition on the right by filling in the blank with the correct letter.

VOCABULARY WORDS	DEFINITIONS
1 D Cohesion	A The outside area of an object or body.
2 E Cube	B The act of liquid turning to gas.
3 B Evaporation	C The act of different types of molecules sticking together.
4 A Surface Area	D The act of like molecules sticking together.
5 C Adhesion	E A three dimensional shape that has six square sides.

Critical Thinking- Answer Key

VOCABULARY COMPREHENSION —
Students will be able to understand and define content related vocabulary words.

The surface of an object is the outer layer or boundary. Tension is when something is stretched tightly. Using what you know about these words and what you observed when you created bubbles, create a definition for surface tension and give an example of where surface tension was present in this activity.

Possible Answer:
Surface tension is the stretchy layer around the outside of something, like a skin. The film around the bubbles can move and bounce, so it has surface tension.

Critical Thinking- Answer Key

CAUSE AND EFFECT —
Students will identify cause and effect relationships and describe the connection between amount of bubble solution and the ability to create a square bubble.

If you tried using more or less bubble solution in your water, what effect do you think this would have on making the square bubble?

Possible Answer:
I think that adding more bubble solution to my water would make the bubble last longer. I think this because the soap would add more bubble film to the surface of the square bubble and make the water molecules stick together better.

I think that adding less bubble solution would make it harder to create a bubble. I think this because plain water does not work at all to make a bubble, so less bubble solution would be like having regular water where the water molecules don't stick together because there is not enough surface tension.

How could you prove your predictions?

Possible Answer:
I could actually do the experiment and record my results. I would try to make the square bubble using more bubble solution and then try to make the square bubble using less bubble solution and record what happens.

Critical Thinking- Answer Key

RELATION AND APPLICATION —
Students wil predict and describe the impact that changing characteristics of bubbles would have on the experiment/demonstration.

Joey is playing with his little sister and is blowing bubbles for her to chase. Unfortunately, the bubbles are popping too quickly and they never make it over to his sister.

Joey's friend, Maria, knows that bubbles pop because the water present on the surface of the bubble evaporates, and that a larger surface area allows the water to evaporate more quickly. What advice should Maria give to Joey to help him blow bubbles that last longer?

Possible Answer:
Maria should tell Joey to blow smaller bubbles. Smaller bubbles have less surface area, which means that the water does not evaporate as quickly. If the water does not evaporate as quickly, the bubble will last longer and his little sister can chase and maybe even catch them more easily!

Assessment - Answer Key

ASSESSMENT QUESTIONS —
Read each question, then circle the letter next to the correct answer or write your response in the boxes.

1. The space inside a bubble is filled with
   a. water
   b. air
   c. bubble solution
   d. soap

2. Even when nothing touches is, a bubble can still burst because
   a. the thin soap film that creates the bubble's surface starts to evaporate and gets too thin and the wall finally collapses.
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   a. air and bubble solution mixed together.
   b. plain water.
   c. water, oil, and air molecules that connect each other.
   d. bubble solution that stretches out and connects water molecules.

4. You have two bubbles with exactly the same volume, but one is a cube and the other is a sphere. If neither bubble touches anything, which one do you think will pop first? Why?

   Possible Answer:
   I think that the cube will pop first because it has more surface area than a sphere. More surface area means that evaporation can occur more quickly, which will make the walls thinner and cause the bubble to pop quicker.

5. If you wanted to know which type of dish soap creates the longest lasting bubbles, how could you scientifically test which dish soap is best?
   Possible Answer:
   If you wanted to find out which dish soap made the longest lasting bubbles, you would have to make different bubble mixtures, each one using a different type of soap. You would have to use the same amount of dish soap in each mixture so that each variable was used in the same amount. Then, you could use the cube structure to make a bubble. Time how long each bubble lasts before it pops to find out which dish soap made the bubble that lasted the longest.

Common Core State Standards

Student Outcomes	Standards
Students will be able to explain the connection between scientific ideas presented in the experiment.	RI.1.3, RI.2.3, RI.3.3, RI.4.3
Students will be able to ask and answer questions to help determine the meaning of vocabulary presented as part of an experiment.	RI.K.4, RI.1.4, RI.2.4, RI.3.4, RI.4.4, RI.5.4
Students will be able to refer back to their observations and discussion to demonstrate their understanding of the scientific concepts presented through the experiment.	RI.3.1
Students will be able to use information gained from observations of the experiment to demonstrate understanding of the concepts presented.	RI.4.5
Students will be able to participate in writing projects and write a sequence of instructions.	W.1.7
Students will participate in shared writing projects and record scientific observations.	W.K.8, W.2.7
Students will be able to recall information from experiences to answer a question.	W.1.8, W.2.8
Students will identify a cube.	2.G.A.1

