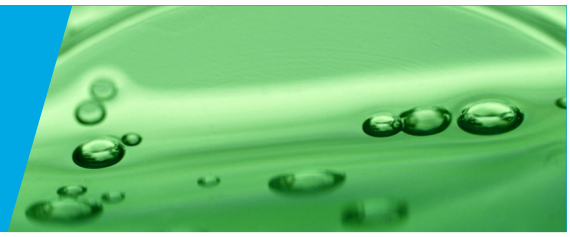
CURIOSITY AT HOME

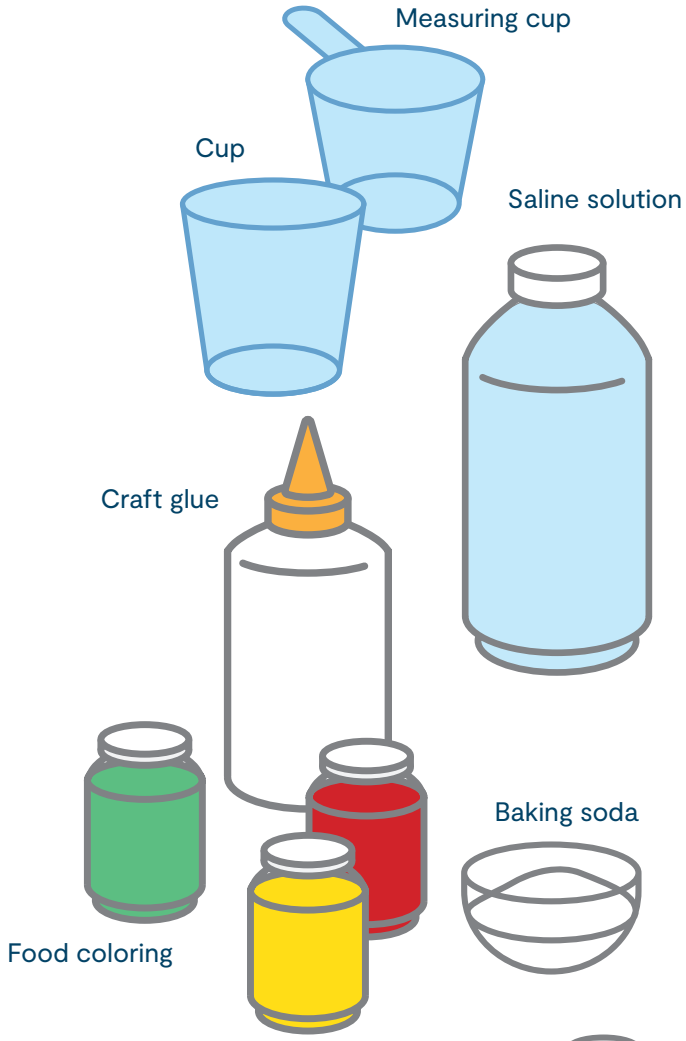
MATERIAL WORLD

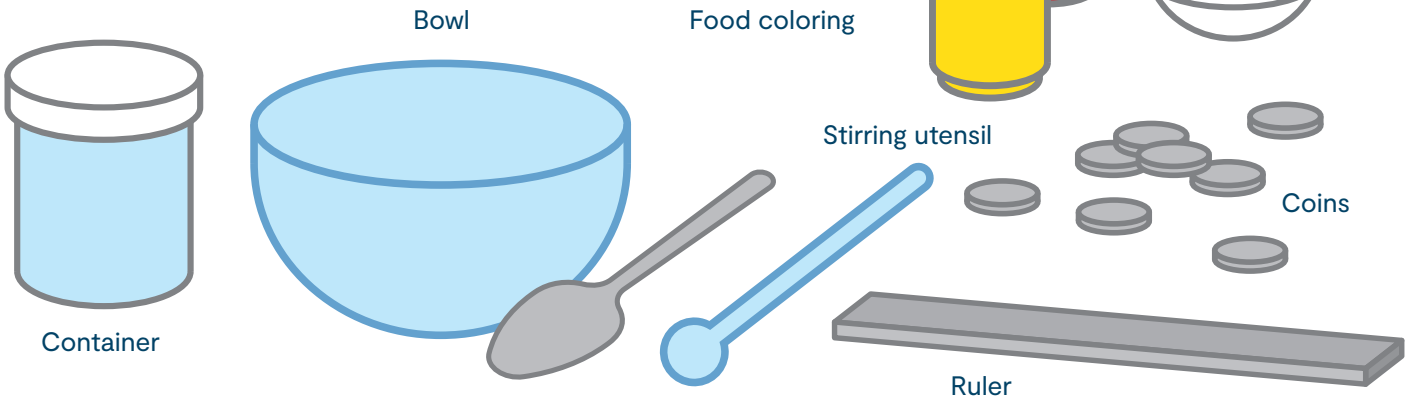


Materials science engineers rely on chemistry when designing new materials. They use what they know about the properties of materials to decide where and how new manufactured materials would best be used. In this activity, you will create a new mystery substance and perform tests on it to learn about its properties.

MATERIALS

- Cup or glass
- Measuring spoons
- Measuring cups
- Baking soda
- Bowl
- Non-toxic craft glue
- Stirring utensil
- Food coloring (optional)
- Saline solution or contact lens solution (must contain boric acid or sodium borate in the ingredients)
- Several coins of the same size (substitute any other small weight)
- A round pencil or dowel (substitute any object of similar shape and size)
- Ruler or tape measure (for grade 3-5 and 6-8 extensions)
- Plastic bag or container with lid
- Science notebook or piece of paper
- Something to write with





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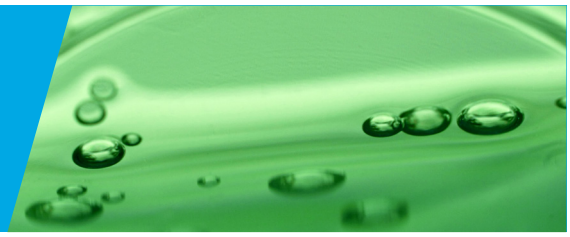


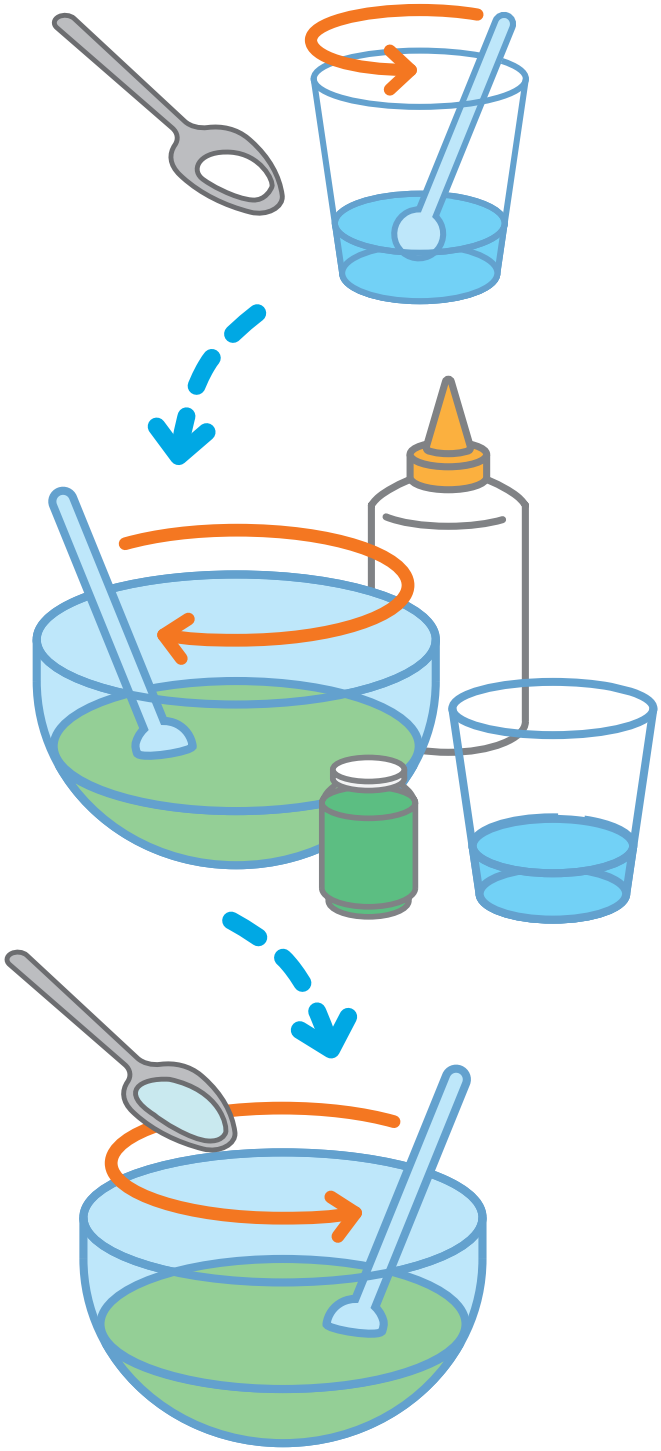
PROCEDURE

Make the mystery substance:

- Prepare an area where it's ok to get messy.
- In a cup or a glass, measure ¼ cup of warm water. Add ½ teaspoon of baking soda and stir until it is completely dissolved. Set the mixture to the side.
- Pour ½ cup of glue in a bowl. Add a few drops of food coloring if you like. Mix in the baking soda solution. Stir the ingredients thoroughly.
- Add one tablespoon of contact solution and stir. Once the mixture begins to pull away from the bowl, continue to knead it by hand.
- Explore your mystery substance. What are some words that could describe it? Record your observations in your science notebook. When materials scientists make a new substance, they also make observations about the properties of the substance, and perform tests to find out more about the way the substance works.

Test the mystery substance:

- Test to see how the mystery substance performs under certain conditions. How bouncy is it? Is it easy to squish down? Is it sticky enough to pick up a paper clip or metal coin? What happens when you stretch it out? Record your observations in your science notebook.
- Store the mystery substance in a plastic bag or airtight container. Be sure to wash your hands after handling.



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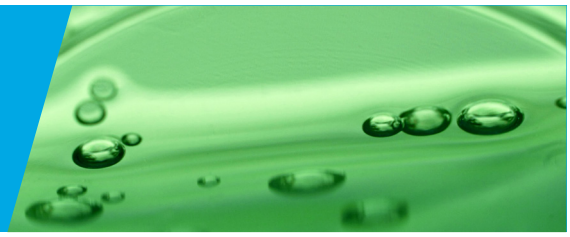

EXPLORE MORE:

- Look around the place where you did the experiment. What are some good materials you could use to build a chair? What are some good materials could use to build a trampoline? What is a safe test you could do to show that a material is sturdy? What is a safe test you could do to see if a material would be good for bouncing?
- Consider the following settings: farm, space shuttle (or cockpit), playground, construction site. Brainstorm a list of ways the substance you created could be used in each setting. How would you know if your substance would work for that particular use? What kind of tests could you perform?

WHAT'S HAPPENING?

You made slime! How does it work? It's all thanks to chemistry! The glue is a polymer and is made up of long, repeating, and identical strand-like molecules. These molecules flow past one another keeping the glue in a liquid state. When you add the saline solution to the glue, molecules of a chemical called borate start to connect the strands of glue molecules together. This process is called cross-linking. As these long strands tangle together, the substance becomes thicker and rubberier, until it becomes slime

Substances like slime are called non-Newtonian fluids. A non-Newtonian fluid changes based on how much pressure is put on it. It can be picked up like a solid, but it also will ooze like a liquid. Non-Newtonian fluids are used in paint, cosmetics, asphalt, glue and other industrial products.

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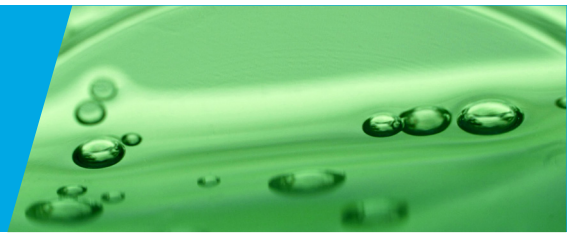

K-2 GRADE EXPLORATION

Explore the following questions and write your observations in your science notebook.

- Roll the slime into a ball, and drop it onto a table or flat surface. How much does the ball bounce? What do you notice about the shape of the ball after you dropped it?
- With a buddy, stretch the slime across the top of a cup and have one person hold the edges. Have the other person carefully place one coin at a time on the slime. How many coins can you add before it breaks?
- Using a round pencil or a wooden dowel, roll the slime into a pancake shape. Is it easy to squish flat? How thin can you roll it?
- Roll the slime into a long cylinder, like a snake. Slowly pull both ends of the cylinder away from each other. How far can you stretch it before it breaks? Roll it back into a cylinder. This time, pull both ends away from each other more quickly. How far can you stretch it before it breaks when you pull quickly?
- Roll the slime into a cylinder. Stretch it out a little bit, then lay it on a flat surface. Observe how the shape changes over time. Does it shrink? If so, how much?
- Place a few coins on a flat surface. Roll the slime into a ball and try using it to pick up the coins. Is it sticky enough to pick up a metal coin? How many coins can you pick up?
- What other tests can you perform to learn more about the properties of your slime?

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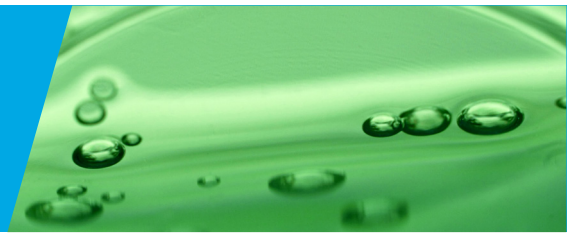

3-5 GRADE EXPLORATION

Test the physical properties of the slime you made. Use a ruler or tape measure to test your results. Perform each test three times (trials) to check for consistency. Copy the table below into your science notebook, and record the results.

Test #1 Bounciness: Roll the slime into a ball. Position your ruler vertically (one inch mark towards the bottom). Drop the ball from the top of the ruler and measure how high it bounces.

Test #2 Strength (needs a partner): Stretch the slime across the top of the cup and have one person hold the edges. Place one coin at a time on the slime until it breaks. How many coins could it hold?

Test #3 Squishiness: Using a round pencil or wooden dowel, roll the slime into a pancake shape. Use a ruler to measure how thin it can become.

Test #4 Stretchability: Roll the slime into a cylinder that is 3 inches long. Using a ruler, measure how long it can be stretched before it breaks. What if you stretch it quickly? What if you stretch it slowly?

Test #5 Elasticity: Roll the slime into a cylinder that is 3 inches long. Using a ruler to measure, stretch it to five inches, lay it on a flat surface and measure how much it shrinks in 30 seconds.

Test #6 Stickiness: Test how many coins you can pick up with the slime.

Test #7: What other tests can you perform?

Test	Trial #1 Results	Trial #2 Results	Trial #3 Results	Additional Observations
Test #1: Bounciness				
Test #2: Strength				
Test #3: Squishiness				
Test #4: Stretchability				
Test #5: Elasticity				
Test #6: Stickiness				
Test #7: _____				

After performing all of your tests, what are some additional words you might use to describe the slime?

_____

_____

_____

_____

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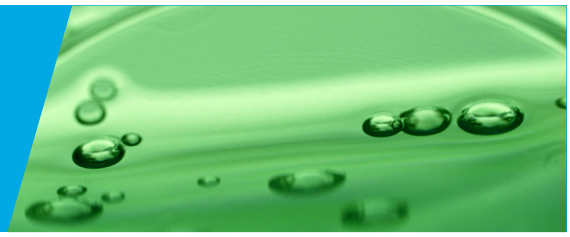

6-8 GRADE EXPLORATION

Materials science engineers and chemists often test different formulas, or recipes, to see how the quantity of ingredients can affect a material's overall properties. Test what happens when you add more borate to your slime in the form of additional saline solution.

- Take your slime and divide it into two equal size portions.
- Add ½ tablespoon extra saline solution to one portion and knead it to fully incorporate. This will be your "Test Formula."
- Leave one portion as is. This will be your "Control Formula."

Test the physical properties of both formulas. Use a ruler or tape measure to measure your results. Perform each test three times to check for consistency. Copy the table below into your science notebook, and record the results.

Test #1 Bounciness: Roll the slime into a ball. Position your ruler vertically (one inch mark towards the bottom). Drop the ball from the top of the ruler and measure how high it bounces.

Test #2 Strength (needs a partner): Stretch the slime across the top of the cup and have one person hold the edges. Place one coin at a time on the slime until it breaks. How many coins could it hold?

Test #3 Squishiness: Using a round pencil or wooden dowel, roll the slime into a pancake shape. Use a ruler to measure how thin it can become.

Test #4 Stretchability: Roll the slime into a cylinder that is 3 inches long. Using a ruler, measure how long it can be stretched before it breaks. What if you stretch it quickly? What if you stretch it slowly?

Test #5 Elasticity: Roll the slime into a cylinder that is 3 inches long. Using a ruler to measure, stretch it to five inches, lay it on a flat surface and measure how much it shrinks in 30 seconds.

Test #6 Stickiness: Test how many coins you can pick up with the slime.

Test #7: What other tests can you perform?

Test	Trial #1 Results	Trial #2 Results	Trial #3 Results	Additional Observations
Test #1: Bounciness				
Test #2: Strength				
Test #3: Squishiness				
Test #4: Stretchability				
Test #5: Elasticity				
Test #6: Stickiness				
Test #7: _____				

What are some key differences that you noticed between the two formulas? What could be some different applications, or uses, for each formula?

What other variables could you change? How do you think it will affect the slime's properties? Make a new batch of slime, changing a new variable and compare your results.

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