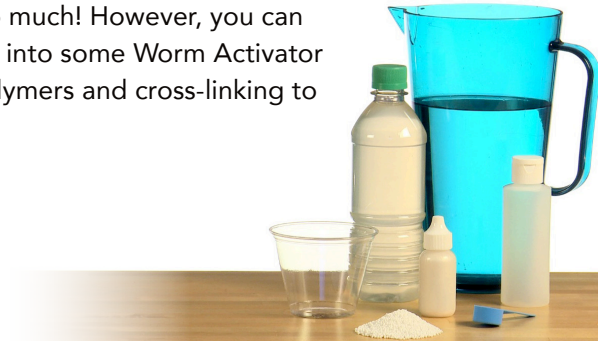
SICK! science®
insanely cool experiences

WORMS
EXPERIMENT GUIDE

WORMS

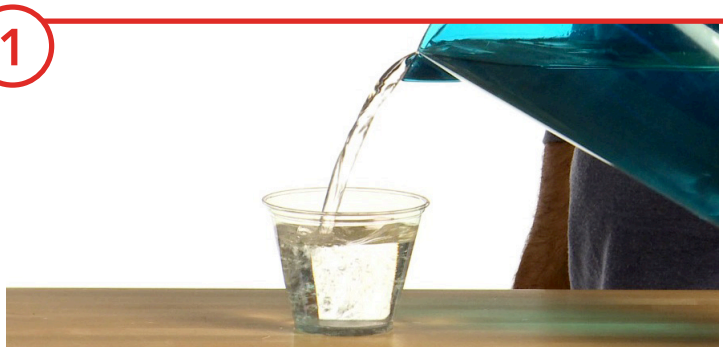
Earthworms are mostly accepted by people but, other worms? Not so much! However, you can create a bowl of worms that everyone will enjoy. Squirting Worm Goo into some Worm Activator instantly creates soft, worm-like tubes. It's a great way to combine polymers and cross-linking to create handfuls of science fun.



WHAT YOU NEED

- STRING SLIME GOO (FORMERLY INSTA-WORMS)
- STRING SLIME ACTIVATOR
- POWDER (FORMERLY INSTA-WORM ACTIVATOR)
- 4 OZ BOTTLE WITH CAP
- 9 OZ CUP
- TEASPOON
- WARM WATER
- PAPER TOWELS

1



Pour 8 oz (240 mL) of warm water into a clear, plastic cup.

2

Add 1 teaspoon of String Slime Activator powder to the water and stir it. Make sure the Activator is completely dissolved into the water before you move on to the next step.

3

Squeeze a steady stream of the String Slime Goo into each cup with the Activator and move your hand in a circular motion over the container as you're squeezing.

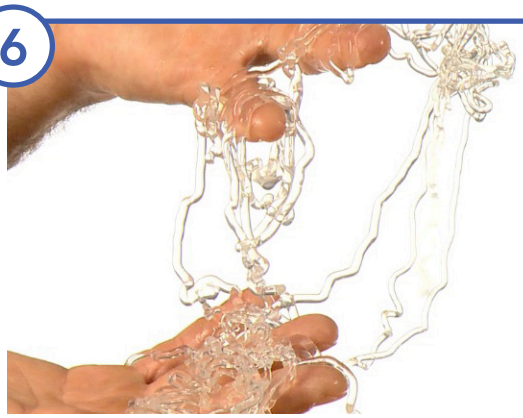
4

Reach in and pull out a worm.

5

Pull the worm apart so that it breaks into two pieces. Notice that on the broken end, it's still a gooey liquid inside!

6



Dip the broken ends of the pieces back into the Activator solution and it reseals!

HOW DOES IT WORK

The key to this experiment is a chemical reaction. The real name for the Worm Goo is sodium alginate. Sodium alginate is a long chain of repeating, identical molecules called a polymer. Polymers are long molecules made from many (millions of) smaller molecules joined together. Sodium alginate is also a polysaccharide, meaning that it is made of many sugars (taken from brown seaweed) that are linked together. Polysaccharides, such as starch and alginate, are made by linking together bazillions of glucose (sugar) molecules.

Sodium alginate polymer chains (the Worm Goo) instantly change from a liquid to a linked solid the moment they touch the Worm Activator solution. Calcium ions in the Worm Activator solution link the long alginate chains together. Scientists call this "cross-linking." This occurs because calcium ions replace sodium ions and serve as the cross-linking agent between two alginate polymer chains. The resulting cross-linked polymer is insoluble in the calcium chloride (Activator) solution and this results in the formation of a solid polymer strand. This reaction happens so fast that the Worm Goo in the middle of the tube remains liquid inside the cross-linked wall.

TAKE IT FURTHER

Leave a worm in the Activator solution overnight. When you're ready compare the worms, have your students create a new one and remove it from the Activator solution right away. Compare the "aged" and brand new worms. What differences and similarities do your students notice?

ADDITIONAL INFORMATION

Alginate is commonly used as a thickener for foods such as ice cream and fruit pies. Now that you know this chemistry secret, take a look at some food labels the next time you're at the grocery store. Your dentist uses alginate compounds in dental impression materials and it's found in wound dressings in hospitals, too.

SCIENCE FAIR CONNECTION

While making worms 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 one variable option that might work:

- How does changing the recipe of the Activator solution change the consistency of the worms you make. For the first batch, follow the basic recipe for the Activator solution from Activity #1 and with a steady 2 second stream of Worm Goo; for the second batch use ½ of a teaspoon (2.5 mL) of Activator solution with a steady 2 second stream; and for the third batch use 1 ½ teaspoons (7.5 mL) of Activator solution with a steady 2 second stream of Worm Goo. Create a table to record your observations of the three different worms you create and see if you can draw conclusions as to why the consistency of the worms vary.

This is just one idea, but you aren't limited to that! 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 the amount of Activator solution, make sure that all other factors in the test remain the same!

TEACHER NOTES:

SCIENCE CONCEPTS OVERVIEW ▸ Polymers, Chemical Reaction, States of Matter

The learning experiences contained in the following Experiment 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.

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.

Paraphrase: Students will be able to restate the main ideas of cross linking in their own language.

Cause and Effect: Students will identify cause and effect relationships between Worm Goo and Worm Activator.

Vocabulary Application: Students will write and speak while incorporating newly learned vocabulary.

Literature and Writing Connections: Read Diary of a Worm by Doreen Cronin aloud to the class. After reading the book, ask students to write a journal entry similar to those in the book, about a day that Worm might experience.

Math Connections: Students can practice measuring the lengths of the worms in either standard or non-standard units. They can then compare, add, multiply, or divide the lengths of the worms with class created word problems.

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 ____ **Polymer**	A A group of two or more atoms that stick together.
2 ____ **Chemical Reaction**	B A chemical compound formed from a long chain of the same molecule group.
3 ____ **Molecule**	C A state of matter in which molecules are capable of flowing freely like water. Not a solid or a gas.
4 ____ **Solid**	D The action between atoms or molecules to form one or more new substances.
5 ____ **Liquid**	E A state of matter in which a substance keeps its size and shape. Not a liquid or a gas.

Critical Thinking

NAME

PARAPHRASE —
Students will be able to restate the main ideas of cross linking in their own language.

Worm Goo is a liquid made of sodium alginate polymer chains. The moment that these polymer chains touch the calcium ions in the Worm Activator solution, they are linked together and form a solid. This happens because the calcium ions (from the Worm Activator) replace sodium ions in the alginate polymer chains (from the Worm Goo), and connects the polymers together. Scientists call this "cross-linking." It happens so quickly that the Worm Activator never touches the inside molecules of the Worm Goo.

In your own words, explain the cross linking that occurs to make worms. You may use pictures or diagrams to explain your thinking.

Critical Thinking

NAME

CAUSE AND EFFECT —
Students will identify cause and effect relationships between Worm Goo and Worm Activator.

Worm Goo is a liquid made of Sodium alginate polymer chains. The moment that these polymer chains touch the Calcium ions in the Worm Activator solution, they are linked together and form a solid. This happens because the calcium ions (from the Worm Activator) replace sodium ions in the alginate polymer chains (from the Worm Goo), and connects the polymers together. Scientists call this "cross-linking." It happens so quickly that the Worm Activator never touches the inside molecules of the Worm Goo.

The inside of the worm is a liquid while the outside of the worm is a solid. Use the paragraph above to explain what causes this.

Critical Thinking

NAME

VOCABULARY APPLICATION —
Students will write and speak while incorporating newly learned vocabulary.

Using the definitions below, explain how a worm demonstrates properties of both states of matter. You may use pictures or diagrams to help with your explanation.

Solid: A state of matter in which a substance keeps its size and shape. Not a liquid or a gas.

Liquid: A state of matter in which molecules are capable of flowing freely like water. Not a solid or a gas.

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. What is the difference between the molecules in a liquid and the molecules in a solid?
   a. The molecules in a liquid are larger than the molecules in a solid.
   b. The molecules in a liquid are smaller than the molecules in a solid.
   c. The molecules in a liquid are colder than the molecules in a solid.
   d. The molecules in a liquid move more freely than the molecules in a solid.

2. The reaction between the Worm Goo and the Worm Activator is an example of a _____.
   a. chemical reaction
   b. physical reaction
   c. polymer
   d. molecule

3. The act of linking polymer chains together is known as _____.
   a. connection
   b. cross-linking
   c. magnetism
   d. molecular hooking

4. Worms are made of both a solid and a liquid. On the lines below, list 3 solids and 3 liquids.

   _____ _____
   _____ _____
   _____ _____

5. If you break your worm in two pieces, the liquid will leak out of the broken ends. The leak can be stopped by dipping the worm back into the Worm Activator. On the lines below, explain why dipping the broken ends back into the Worm Activator stops the leak.

   _____
   _____
   _____

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	B Polymer	A	A group of two or more atoms that stick together.
2	D Chemical Reaction	B	A chemical compound formed from a long chain of the same molecule group.
3	A Molecule	C	A state of matter in which molecules are capable of flowing freely like water. Not a solid or a gas.
4	E Solid	D	The action between atoms or molecules to form one or more new substances.
5	C Liquid	E	A state of matter in which a substance keeps its size and shape. Not a liquid or a gas.

Critical Thinking- Answer Key

PARAPHRASE —
Students will be able to restate the main ideas of cross linking in their own language.

Worm Goo is a liquid made of sodium alginate polymer chains. The moment that these polymer chains touch the calcium ions in the Worm Activator solution, they are linked together and form a solid. This happens because the calcium ions (from the Worm Activator) replace sodium ions in the alginate polymer chains (from the Worm Goo), and connects the polymers together. Scientists call this "cross-linking." It happens so quickly that the Worm Activator never touches the inside molecules of the Worm Goo.

In your own words, explain the cross linking that occurs to make worms. You may use pictures or diagrams to explain your thinking.

Possible Answer:
Cross linking in worms happens when the calcium from the worm activator links together the sodium alginate polymer chains in the Worm Goo and turns them into a solid.

Critical Thinking- Answer Key

CAUSE AND EFFECT —
Students will identify cause and effect relationships between Worm Goo and Worm Activator.

Worm Goo is a liquid made of Sodium alginate polymer chains. The moment that these polymer chains touch the Calcium ions in the Worm Activator solution, they are linked together and form a solid. This happens because the calcium ions (from the Worm Activator) replace sodium ions in the alginate polymer chains (from the Worm Goo), and connects the polymers together. Scientists call this "cross-linking." It happens so quickly that the Worm Activator never touches the inside molecules of the Worm Goo.

The inside of the worm is a liquid while the outside of the worm is a solid. Use the paragraph above to explain what causes this.

Possible Answer:
The chemical reaction between the Worm Goo and the Worm Activator happens very quickly. It happens so quickly that the molecules form a wall around some of the Worm Goo before the Worm Activator has a change to get to it. The effect is a worm with liquid (Worm Goo) in the middle and a solid outer shell where the chemical reaction has taken place.

Critical Thinking- Answer Key

VOCABULARY APPLICATION —
Students will write and speak while incorporating newly learned vocabulary.

Using the definitions below, explain how a worm demonstrates properties of both states of matter. You may use pictures or diagrams to help with your explanation.

Solid: A state of matter in which a substance keeps its size and shape. Not a liquid or a gas.

Liquid: A state of matter in which molecules are capable of flowing freely like water. Not a solid or a gas.

Possible Answer:
A worm is both a solid and a liquid. The outside of the worm is a solid because it maintains a constant size and shape. The inside of the worm is a liquid because the molecules flow freely around the inner worm and do not keep a constant shape.

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. What is the difference between the molecules in a liquid and the molecules in a solid?
   a. The molecules in a liquid are larger than the molecules in a solid.
   b. The molecules in a liquid are smaller than the molecules in a solid.
   c. The molecules in a liquid are colder than the molecules in a solid.
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   a. connection.
   b. cross-linking.
   c. magnetism.
   d. molecular hooking.

4. Worms are made of both a solid and a liquid. On the lines below, list 3 solids and 3 liquids.

   Possible Answer:
   Wood, plastic, and glass are all solids. Water, tea, and dish soap are all liquids.

5. If you break your worm in two pieces, the liquid will leak out of the broken ends. The leak can be stopped by dipping the worm back into the Worm Activator. On the lines below, explain why dipping the broken ends back into the Worm Activator stops the leak.

   Possible Answer:
   If a leaking worm is dipped back into the Worm Activator solution, the leak stops because the chemical reaction between the Worm Goo and the Worm Activator occurs at the end of the worm. This reaction creates a solid which seals the the liquid inside of the worm.

Common Core State Standards

Student Outcomes	Standards
Students will be able to ask and answer questions about key details about their observations and discussion to demonstrate their understanding of the scientific concepts presented through the experiment.	RI.K.1, RI.1.1, RI.2.1, RI.3.1, RI.4.1
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 explain the connection between scientific ideas presented in the experiment.	RI.1.3, RI.2.3, RI.3.3, RI.4.3, RI.5.3
Students will be able to retell key details presented in the experiment in order to understand/determine the main idea.	RI.K.2, RI.1.2, RI.2.2, RI.3.2, RI.4.2, RI.5.2
Students will be able to recall information from experiences to answer a question.	W.K.8, W.1.8, W.2.8
Explain the procedure and ideas presented in a scientific experiment including what happened and why, including cause and effect, based on the information presented.	RI.3.3, RI.4.3
Students will create a graph and interpret data to analyze/solve problems.	1.MD.C.4, 2.MD.D.10, 3.MD.B.3, 4.MD.B.4, 5.MD.B.2
Students will be able to write a narrative that includes details.	W.K.3, W.1.3, W.2.3, W.3.3, W.4.3, W.5.3