MAKE-IT-YOURSELF SLIME

OVERVIEW: Students will have the opportunity to make a polymer gel similar to slime that you find in toy stores to study the interesting properties of this material.

OBJECTIVE: Students will examine some properties of polymers and recognize that they are made by combining monomers. They will also recognize that polymers are a group of chemicals found in many forms in the world around us (including plastics)

GRADE LEVEL: 4-8

OHIO STANDARDS: PS7

Grade 7 Physical Science: The properties of matter are determined by the arrangement of atoms.

TIME: 30-45 minutes

VOCABULARY: Polymer, viscous, chemical bond, monomer, viscosity, cross-linker

MATERIALS: (per group of 3-4 students)

* 40 g (1/3 cup) Polyvinyl Alcohol Solution
* 4.0g (about 1/8 cup) sodium tetra borate (borax)
* 1 5oz. Plastic Cup
* 1 Craft Stick
* 1 Water Soluble Marking Pen
* 1 Small Piece of Paper or Index Card
*3-5 Drops of Food Coloring
* Self-sealing plastic baggie

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I.C.E and the University of Wisconsin assume no responsibility for attempting these activities.

IMPORTANT:

Read all instructions before proceeding

SAFETY AND DISPOSAL:

There is no danger in handling the slime, but, as with all chemicals, the students should wash their hands after use. The literature has reported that some people have developed an allergic reaction to powdered borax. Avoid inhalation and ingestion. As a result, care should be taken when handling it. Use adequate ventilation in preparing the solution and wash your hands after contact with the solid. If slime spills on the carpet, apply vinegar on the spot and follow with a soap and water rinse. DO NOT let the slime harden on carpeting. Do NOT set slime on natural wood furniture; it will leave a mark. Discard Slime in a waste can or flush it down the drain with lots of water.

GETTING READY:

Preparing the 4% Polyvinyl Alcohol Solution:

1. While stirring, sprinkle 40 grams of polyvinyl alcohol in 1 liter of water (about 1/3 cup of polyvinyl alcohol in 1 qt of water).
2. Heat the mixture and stir it over a moderately high heat. The solution will initially be quite milky in color, but it will clear when the polyvinyl alcohol is completely dissolved. The process may take up to 30-45 minutes. Do not be afraid of overheating.
3. Allow the solution to cool before using. If a slimy or gooey layer appears on the top upon cooling, simply skim it off and discard it. The solution can be stored for several months in a sealed container.

Preparing the Sodium Tetra borate Solution:

Add 4 g of Sodium tetra borate in 100ml of water and stir to dissolve. (Alternatively, 1/8 cup of borax can be dissolved in 1 qt of water

PROCEDURE:

STEP ONE: Forming the Human Polymer

1. Have 4-5 students stand in a line facing the class. "Define each student as being a monomer.
2. Have the monomers link arms or hold hands. Each link represents a chemical bond. The chain they form has many units in it. Thus, they represent a simulated polymer chain.
3. Show the class how flexible the chain is by leading the chain around the room, weaving between the students' desks and chairs.
4. Instruct a second team of 4 to 5 students to come to the front of the room and form a new "separate" polymer chain.
5. Have the chains move around as before. Note that the movement of one chain does not depend on the movement of any other unless the chains get very close to each other.
6. Add cross linkers between the polymer chains by assigning students not already in chains to hold onto both chains at once.
7. The movement of one chain now depends on the movement of others; the cross linkers hold the chains together. Show this by having the chains try to move in the same direction. The cross linkers will need to move also.
8. Now have the chains move in opposite directions. The cross-link bond will break at one of the chains. If the chains are moved back together, the cross links can reform in new places or the same places.
9. The original chain is like a wet piece of spaghetti, it may be flipped around and wiggled. The cross linked polymer is like overcooked spaghetti that sticks together. Individual polymer chains are not as free to move around.

STEP 2; MAKING SLIME

SAFETY:

Instruct the students never to taste chemicals when experimenting and not to put their fingers in their mouth after touching chemicals.

1. Give each student a plastic or paper cup and an ice-cream stick.
2. Make observations about the cup and the stick: What does it feel like? What does it smell like? What does it look like?
3. Pour about 20ml of the 4% polyvinyl alcohol solution into the cup. (This is about 1 inch deep when using a 5oz cup. The exact amount is not critical.)
4. Using the worksheets, record several observations about the 4% polyvinyl alcohol solution (Solution A). Stir the solution with your craft stick. Have paper towels ready to distribute in case of spills. The polymer is clear, colorless liquid. It has a syrupy texture and traps air bubbles when stirred. Freshly prepared solution is usually odorless, but with age it can develop a smell.
5. Stir in 1-2 drops of food coloring to solution A if you wish to have colored slime.
6. Pour about 3ml (about 2 tsp.) of sodium tetra borate solution (Solution B), the cross-linker, into the cup of polyvinyl alcohol. Be sure the student is stirring as you add the sodium tetra borate solution. Stir with the craft stick.
7. Once the gel has formed, remove the slime from the cup and kneed it with your hands. The gel will develop a consistency comparable to slime and other similar materials that are sold in toy stores.
8. Observe the properties of slime by trying the following:

    *Roll the slime into a ball and set it in the palm of your hand. Observe as the ball slowly flattens.

    *Pat the slime between your hands and try to from a think film. Hold the film at one end and observe as the slime flows slowly from your hand

    *Roll the slime into a long cylindrical shape and slowly pull apart while holding it at the two ends. The slime stretches.

    * Reform the tube and pull apart quickly. The slime breaks.

    *Use coins or small objects to make imprints in the slime.

    *Put the slime on top of a cup that is upside-down and see what happens.

9. Set the slime ball on the plastic baggie.
10. Write your initials or draw a face on the piece of paper using water-soluble ink.
11. Pick up the slime and shape it into a small pancake. With a rapid on and off motion touch the slime to the design. The slime will lift some of the ink from the paper. The pattern is the mirror image of the original design. DO NOT leave the slime on the paper too long...it will stick!
12. Place the slime in a plastic bag for storage. The slime lasts 2 days to 2 weeks. It will eventually get moldy; discard in a waste can.

EXPLANATION:

In this activity you examine some properties of polymers (poly which means many, and mers means unit). Polymers are made by combining repeating units called monomers (mono means one.) Polymers are and interesting group of chemicals that are found in many forms in the world around us, including plastics and biochemical molecules that make up our bodies.

The polyvinyl alcohol solution contains long polymer chains of polyvinyl alcohol that are dissolved in water. Because these chains are so long, they interfere with the movement of each other, causing this solution to be rather thick and to pour more slowly than water. Viscosity is a physical property of a liquid that describes its resistance to flow. For example, water and alcohol are described a s having a low viscosity because they flow quickly.

The preparation of make-it-yourself slime is completed when the solution of cross-linker (sodium tetra borate or borax) is added to the polymer solution (polyvinyl alcohol solution). The cross-linker bonds different polymer chains together. The slime becomes even more viscous than the beginning polymer, making it very gooey, bouncy, and slimy!

CURRICULUM INEGRATION:

Some suggested uses of this activity include properties of polymers and characterization of liquids and solids.

REFERENCES:

Casassa, E.Z; et al. "The Gelation of Polyvinyl alcohol with Borax," Journal of Chemical Education, 1986, Volume 63, pp.57-59

Sarquis, A.M. "Dramatization of Polymeric Bonding Using Slime, " Journal of Chemical Education, 1986, Volume 63, pp.60-61.

Sarquis, A.M.; et al. "Science Simple Hands-on Activities Reinforce Education (Share); Flinn Scientific Inc., Batavia, IL, 1989, pp.43-48.

MONOMERS/POLYMERS

WHAT CAN THEY DO?

Step 1: OBSERVATIONS: Look at and describe each of these solutions that you will be using.

Describe its color, thickness, amounts, or anything else you can describe about it.

SOLUTION A	SOLUTION B

Step 2: Stir in 1-2 drops of food coloring to solution A if you wish to have colored slime.

Step 3: With a partner begin stirring solution A and while you are stirring it, have your partner slowly pour solution B into your cup. Stir it up well. Now switch and help your partner make his/her slime.

Step 4: OBSERVATION: Once the slime is formed, take it out of the cup and describe how it looks, feels, and acts.

SLIME

Step 5: HOW DOES THE SLIME ACT?

Roll the slime into a ball and set it in the palm of your hand. Describe what happens as it sits there.

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Pat the slime between your hands and try to form a thin film. Hold the film at one end and describe what happens.

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Roll the slime into a long cylindrical shape and slowly pull apart while holding it at the two ends.

What happens?

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Re-form the tube and pull apart quickly. What happens?

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Use coins or small objects to make imprints in the slime. Can you?

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Put the slime on top of a cup that is upside down and describe what happens.

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