

Ages:

8 to 12

Getting Silly with Silly Putty

(Adapted from *Jr. Boom Academy*, The Wild Goose Company, 1992, B.K. Hixson and M.S. Kralik.)

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Main idea: This activity will introduce students to polymers. They will learn about properties of materials made from polymers, and how these properties change when the polymer molecules change in length. In doing the activity, they learn that materials, which we commonly observe, can be understood in terms of molecular properties.

Objectives: This activity will help students understand polymers and enjoy science.

Materials:

- q 1 bottle white glue (about 2 tablespoons needed for each ball of silly putty)
- q Sodium tetra borate (Borax)
- q 1 cup of water

- q Plastic cup, mug, or bowl
- q 1 bottle of food coloring (optional)
- q 1 popsicle stick or spoon
- q ¼-teaspoon measuring spoon
- q 1 eye dropper

Motivator: Ask the questions:

- q What is a polymer?
 - ü A polymer is a chemical compound formed from long chains of the same molecule group, repeating over and over.
- q Do you see any?
 - ü Rubber soles, any plastics
- q What polymers do you use daily?
 - ü Toothbrush, tires, phone, etc.
- q How are these different from each other?
 - ü Some are brittle, some very flexible, some break, some do not break
- q What properties can you use to describe these different materials?
 - ü Soft, pliable, hard, rigid...

Questions:

Before beginning the activity, ask students:

- q Where does clothing come from? (A: Cotton, other plants, and animals.)
- q Metal? (A: Mined substances, rocks.)
- q Paper products? (A: Trees, other plants.)
- q Glass? (A: Sand.)
- q Where do plastics come from? (A: Oil.)

Most students will not know that plastics are petroleum products. Begin a discussion with the learners about scientists and what they do. Explain that scientists called chemists design and make molecules with special properties. Chemists perform chemical reactions to hook atoms into long chains called polymers. Plastics are made of polymers. Some polymer molecules contain thousands or millions of atoms in long chains. This activity will allow students to create a polymer.

Activity:

1. Dissolve $\frac{1}{4}$ tsp sodium tetra borate (Borax) into $\frac{1}{4}$ cup water. (Make sure the Borax dissolves completely or your silly putty will be gritty.)
2. Pour about 2 tablespoons of glue into cup, mug or bowl.
3. Add five drops of food coloring to the glue and stir well. (This step is optional, without food coloring silly putty will be white.)
4. Fill teaspoon or eyedropper with sodium tetra borate solution and slowly drip (about 5 drops at a time) into glue, stirring vigorously after each addition. Do this several times until you get the same consistency as silly putty. (If your mixture is too stiff you have added too much sodium tetra

borate.)

5. Stir vigorously with the popsicle stick once again. Stir for about two minutes.
6. Remove the solid glob and roll it around in your hands to dry it off a little bit. It will remain sticky for one to two minutes and then will eventually take on that elastic quality like putty.

Learning checks:

Answer the following questions about the physical properties of the material you have created:

- q Does it stretch?
- q What happens when it is pulled hard?
- q Form a piece into a ball and drop it on a hard surface. Does it bounce?
- q Form a piece into a ball and let it sit on a flat surface undisturbed. Predict what will occur. What do you observe?
- q Did everyone's Silly Putty have the same softness and texture? Describe the differences? What do you think caused these differences?

Background: What is happening? Polymers contain long chains of molecules tangled up together. The starting substance, glue, is made of short molecules. When we add sodium tetra borate (Borax) to the glue, the tetra borate joins the short glue molecules together, making much longer chains of molecules. During the joining process the chains become entangled. You start with jump ropes and end up with something like a climbing net. Depending on how much tetra borate is added, the end product can be sticky goo, rubbery silly putty, or a stiff ball. You have just made a polymeric compound of sodium tetra borate and glue.

Extensions:

Explore resources on the web, these sites are interesting, colorful and contain activities which will be great for further exploring polymers:

- q <http://www.psrc.usm.edu/macrog/new.htm> (great activities)
- q <http://www.npcg.org> (interesting uses)
- q <http://polymer.bu.edu/> (interesting images)
- q <http://www.mse.cornell.edu/courses/engri111/polymer.htm> (informative)