

Silly Putty

Lesson Plan

Summary: Students mix Elmer's® glue, borax and water to create silly putty. Students then think about silly putty to learn more about polymers.

Estimated Time: 25-40 minutes [Depending on age and number of participants]

Materials Needed

Each person needs:

- 1 clear 8-oz (or larger) plastic cup
- 2 tbsp of Elmer's® glue*
- 1 plastic spoon
- 1 plastic Ziploc bag

Each group of 4 needs:

- 1 clear 8-oz (or larger) plastic cup labelled "Borax" marked at 200 mL
- 1 clear 8-oz (or larger) plastic cup labelled "Water"
- 1 tsp borax
- 1 plastic spoon labelled "Borax"
- 1 permanent marker
- water
- paper towels
- newspaper (put down first to protect the working surface)

*Use regular Elmer's® glue. Elmer's® washable glue is not as effective.

Safety Notes: Students should not ingest any of the lab materials. Borax should be kept away from eyes. We recommend that safety goggles be worn when working with borax. Hands should be washed thoroughly at the end of the activity. Silly putty should not be put in a sink, on carpet, or in hair.

Introduction: We just learned a lot about polymers. When we made our people polymer we talked about how to make it stiffer or stronger and how to make it weaker. Now we are going to try to change how a polymer acts in an experiment. What polymers do you see in front of you? Paper, plastic spoons, cups, and plastic bags are all polymers but there is another polymer. Glue is a polymer. This is the polymer we will use for our experiment.

Procedure:

- Write your name on your Ziploc bag.
- Fill the "Water" cup half way with water. Fill the "Borax" cup to the 200 mL line with water.
- In your clear cup, put 2 tbsp (6 tsp) of glue. Add 4 tsp of water, from the water cup, to the glue. Stir.
 - How did your glue change when you added the water?
- Add 1 tsp of borax to the "Borax" cup using the "Borax" spoon. Stir until most of the borax is dissolved.
- Add 4 tsp of the borax solution to your glue cup using the "Borax" spoon. Count to three. Then gently stir your cup using your spoon. Stir thoroughly so that all of the glue comes into contact with the borax solution.
- Observe what is happening. Take out the silly putty and play with it. Do not try to "dry" it on paper towels or newspaper because it will stick. The silly putty will naturally dry out and become the correct consistency as you play with it.

Think About It:

Elementary Level:

What happened to the glue? First it became runny when we added water then it became almost like a solid when we added the borax solution. It is almost like a solid but not quite. If you leave the silly putty sitting still on a table it will flatten out very thin. Why do you think the borax made the glue change from runny to stiff?

- Do you remember what a polymer looks like? It looks like a long chain. [Hold up paper clip chain from "Spot the Polymer".] The borax links together these polymer chains. [As a visual, you can show two horizontal paper clip chains linked together with vertical paperclips. These vertical bonds represent the borax.] Now it is harder for each polymer to move, because it is attached to another polymer. The borax is called a cross-linker because it links the glue together.

Middle/High School Level:

The glue contains a polymer called polyvinyl acetate resin. We changed the polymers behaviours twice in this activity; once when we added water and the second time when we added borax. What kind of change was adding the water, physical or chemical? [physical] Why did it make the glue runnier? What kind of change was adding the borax? [chemical] Why? How do you know that? What did the borax actually do? The borax is called a cross-linker. It chemically "ties together" the long strands of the polyvinyl acetate. [See more detailed explanation above] This tying together changed the viscosity of the glue. It increased the viscosity because the new cross-linked chains interfere with the ability of the solution to flow. As a result the silly putty is "stiffer". It is not a solid though. How do we know this? If we leave the silly putty alone on a table it will flatten out.

Teaching Tips:

- Typically we have students complete this activity in groups of 4. The glue and borax fit nicely into 2-oz plastic cups. You can get these at school supply stores, craft stores or food stores. The containers we use are called ramekins and come with plastic lids. These are great because things can be portioned ahead of time and stacked. We recommend that you pre-measure ingredients for young students.
- Food colouring can be used to create coloured silly putty. If using food colouring, add it to the GLUE during preparation. Adding it to the water will result in a mess.
- Borax can be found in stores as a laundry detergent.
- It is important to label anything containing or used with the borax. Only reuse these things with borax. Borax is very basic and will contaminate materials for a long time, even after cleaning.
- Students may take their silly putty home in plastic Ziploc bags. Over time the silly putty will dry out.
- This activity also makes a good language activity. Students can listen to directions, tell directions and use many different adjectives to describe the silly putty and how it was made.