

A Silly Polymer

Period_____

Name_____

Objective: Cross-Linking a Polymer to Create Everyone's Favorite Childhood Toy, Silly Putty

How does it work?

The mixture of Elmer's Glue with Borax and water produces a putty-like material called a polymer. In simplest terms, a polymer is a long chain of molecules. You can use the example of cooking spaghetti to better understand why this polymer behaves in the way it does. When a pile of freshly cooked spaghetti comes out of the hot water and into the bowl, the strands flow like a liquid from the pan to the bowl. This is because the spaghetti strands are slippery and slide over one another. After awhile, the water drains off of the pasta, the strands start to stick together. The spaghetti takes on a rubbery texture. Wait a little while longer for all of the water to evaporate, and the pile of spaghetti turns into a solid mass -- drop it on the floor and watch it bounce. Many natural and synthetic polymers behave in a similar manner. Polymers are made out of long strands of molecules like spaghetti. If the long molecules slide past each other easily, then the substance acts like a liquid because the molecules flow. If the molecules stick together at a few places along the strand, then the substance behaves like a rubbery solid called an elastomer. Borax is the compound that is responsible for hooking the glue's molecules together to form the putty-like material. There are several different methods for making this putty-like material. Some recipes call for liquid starch instead of Borax soap. Either way, when you make this homemade Silly Putty you are learning about some of the properties of polymers.

Materials and Supplies:

- * 55 % Elmer's glue solution in water
- * 4 % borax solution (sodium borate)
- * zip-lock bags
- * food colors

General Safety Guidelines:

- * Since borax solution may burn the eyes - take care!
- * Hands should always be washed after kneading the silly putty and finishing the experiment.

Procedure:

1. Pour 20 ml of the Elmer's glue solution into a zip bag.
2. Add ONE drop of food color, if desired.
3. Add 10 ml of the cross-linker (borax solution) to the bag.
4. Immediately, zip the bag, keeping out as much air as possible.
5. Knead the solutions together using your hands.
6. Continue to knead until the desired consistency is reached.
7. Using a ruler to measure, drop the ball from a height of 30 centimeters. To what height does it rebound? (Record to nearest cm.)
8. Stretch the silly putty slowly from each side. (Record observations)
9. Compress the silly putty back into a ball.
10. Pull the silly putty quickly from each side and compare the results. (Record observations)
11. Place the silly putty on some regular newsprint and press down firmly.
12. Remove the silly putty from the news print and make observations. (Record observations)
13. Follow good laboratory procedure and wash your hands with soap and water when you have finished the experiment. The silly putty is non-toxic and safe to handle so you can put it in a zip-lock bag and take it home.
14. At Home:
 - Place your ball in the refrigerator for 10 minutes. Recheck the bouncing portion of this experiment.

SILLY POLYMER RESULTS

Period_____

Name_____

Data and Analysis:

Height of the rebound: _____ cm.

Observations of pulling the silly putty slowly:

Observations of pulling the silly putty quickly:

Observations of the silly putty on newsprint:

Height of rebound after 10 min in fridge: _____ cm.

Questions:

1. How do the physical properties of the glue, water mixture change as a result of adding the sodium borate?
2. What would be the effect (your thoughts) of adding more sodium borate solution?
3. What is the ratio of the height of the drop to that of the rebound distance? (Show work!)
4. Who in the class had the ball with the most elasticity?
5. How did you come to the conclusion of whose ball was most elastic?
6. Why do you think you got the results you did for the cold?