Polymer Synthesis Lab

Polymers can be designed to have specific physical properties including density, transparency, and stiffness. These properties depend on the amount and type of repeat unit and crosslinker used to bond the polymer chains together.

The stiffness of a polymer is an important physical property. Polymers can be designed to create materials with a range of stiffness. A football helmet is much stiffer than Jell-O, even though they are both made of polymers!

Both of these items are made of polymers!

Objective
The purpose of this lab is to explore the relationship between the chemical and physical properties of polymers. We will synthesize polymers of varying stiffness by altering the ratio of a polymer with its crosslinker.

More info on polymers!
http://pslc.ws/macrog/kidsmac/kfloor2.htm

Materials
Plastic cups
A cup of “solution A”
A cup of “solution B”
Plastic teaspoons
Permanent marker
Food coloring
**Procedure**

By varying the ratio of monomer repeat unit to crosslinker, a polymer can be made with different stiffness. To start, make a polymer with a 3 to 1 ratio of solution A to solution B:

1) Label a cup with “3:1.”
2) Add 3 teaspoons of solution A to the cup.
3) Add 1 teaspoon of solution B to the cup.
4) Stir the mixture until all of the liquid is gone.
5) Once you have a polymer gel, take it out of the cup and knead it with your hands.

Questions:

1) Write down your observations of the polymer (color, shape, stiffness, etc.)

2) What happens when you pull the polymer apart quickly? Why do you think this happens?

3) What happens when you pull the polymer apart slowly? Why do you think this happens?
4) Roll the polymer into a ball and let it sit on the table for a few minutes. How does the polymer change? Why do you think this happens?

5) Would you characterize the polymer as a solid or a liquid? Why?
Design an Experiment

Experiment Objective: To determine how the amount of polymer crosslinker alters the stiffness of the polymer.

Goals
- Create 3 new polymers with different ratios of solution A to solution B.
- Compare the stiffness of all the polymers you made.
- Quantify and graph your results

1) State your hypothesis:

2) Record the ratios of solution A to solution B you used here:
   i) ___:___
   ii) ___:___
   iii) ___:___

3) Based on your observations, what happens to the stiffness of the polymer when you change the amount of crosslinker?
4) Describe the methods you used to measure polymer stiffness.

5) How will you communicate your findings to the rest of the class? Explain and show below: