Polymers

Required Equipment:

- Plastic cups
- Borax powder
- Liquid glue
- Food coloring
- Spoons (plastic or metal)

Pre-Lab Lecture Key Points:

➔ *Polymer* = a material such as a plastic or a resin

➔ Important to mention that polymers are essentially long chains of individual units called monomers

➔ *Monomer* = a molecule that joins together to form a polymer

➔ An excellent analogy for a polymer is a group of entangled necklaces (or tree branches) where each necklace is an individual polymer chain and each component/ring on the necklace is an individual monomer

➔ Examples of polymers that can be usually be found in a classroom are water bottles, marker casings, mechanical pencil casings, plastic cups, and even the bottoms of shoes/sneakers (polyisoprene!)

➔ Polymers are a very important type of material because their properties can be controlled and tuned over a wide range

➔ The above can be demonstrated by letting the students try to bend a flexible plastic and an inflexible plastic, both of which are ultimately polymers

Student Lab Procedure:

*Make sure students are careful when handling the borax powder since it can be concentrated and dangerous is ingested; if possible, use gloves

1. Fill two plastic cups halfway with water (roughly 4 ounces).

2. In one cup, add 2 spoonfuls of borax powder. In the other cup, add 6 spoonfuls of borax powder. Stir both cups for about 2 minutes or until a cloudy solution is formed.

3. Now take two more plastic cups and fill them halfway with liquid glue.

4. Add a drop or two of food coloring to each cup.

*The food coloring has no real function except to make the final product more visually appealing

5. In one cup of glue, add a few (4-5) spoonfuls of the less concentrated borax-water solution. In the other cup, add a few (4-5) spoonfuls of the more concentrated borax-water solution.

6. Stir both mixtures vigorously for approximately 5 minutes.

*The borax powder will act as a cross-linking agent and join the glue molecules (which are already polymers) together into a tangled web; the actual reaction is a little more complicated but can be simplified down to this

*The concentration of borax should vary the stiffness of the resulting polymer (more borax = more cross-linking = stiffer polymer)

7. After 5 minutes, you should have two ready-to-use polymers! Describe them in the Observations section of your worksheet.

*The resulting polymer might be a little dirty but can be washed with water

8. The polymer that was created with less borax should be easy to bend and fold. On the other hand, the polymer that was created with more borax should be much stiffer!

*Students are welcome to take the polymers home with them (once they are washed with water)

<u>Wrap-Up</u>:

➔ Ask students one last time to explain the structure of a polymer

➔ Also ask them to think carefully and describe why the polymer with more borax turned out stiffer in comparison to the one with less borax