

Biological Chemistry: Making a Polymer

Polymers, molecules made of many subunits, are not just found in cells. Polymers are synthesized to create any number of household products. In this activity you will produce a polymer with properties similar to silly putty from Elmer's glue, water and borax.

Elmer's glue is a compound called polyvinyl acetate. It is a polymer (many monomer units joined together) in which the backbone of the molecule is composed of repeating 2-carbon (acetate) units. Borax is a laundry whitener. It is a white powder. Chemically Borax is sodium tetraborate; there are 2 sodium atoms and 4 boron atoms in each ring structure. When these 2 compounds are combined borax catalyzes the crosslinking of the already long chains of polyvinyl acetate. Crosslinking produces very long polymer chains which results in a more solid and less liquid product. The product of the reaction is chemically and physically different than the reactants. This reaction is analogous to what happens in cells during dehydration synthesis. Small units (monomers such as amino acids or monosaccharides) are joined together to produce a larger molecule with properties or characteristics that differ from the original reactants.

Materials

Water

Elmer's glue

Borax (20-Mule Team Borax)

Plastic spoons - 3

Balance

Weigh boat

500 mL beaker - 1

250 mL beaker – 1

100 mL beaker - 3

Graduated cylinder – 100 mL

Graduated cylinder – 50 mL

Procedure

1. Use the balance and weigh boat to dispense 10 grams of borax. Remember to tare the balance.
2. Add the borax to the 500 mL beaker.
3. Use the 100 mL graduated cylinder to add 120 mL of distilled water to the borax in the beaker.
4. Stir the solution with a spoon until the borax dissolves.
5. Add 50 mL of glue to a second 250 mL beaker. Glue will stick to the inside of the graduated cylinder, therefore to make clean-up easier use the markings on the side of the beaker to make the measurement. This doesn't have to be exact. Add 50 mL of water to the beaker containing the glue.
6. Stir the solution with a clean spoon until well mixed.
7. Label the 3 – 100 mL beakers, 3 parts glue, 2 parts glue and 1 part glue.
8. Use the graduated cylinder to add 45 mL of the diluted glue mixture the beaker labeled 3 parts glue.
9. Use the graduated cylinder to add 30 mL of the diluted glue mixture the beaker labeled 2 parts glue.

10. Use the graduated cylinder to add 15 mL of the diluted glue mixture to the beaker labeled 1 part glue.
11. Rinse the graduated cylinder.
12. Use the graduated cylinder to add 15 mL of the diluted borax solution to the beaker labeled 3 parts glue.
13. Use the graduated cylinder to add 30 mL of the diluted borax solution to the beaker labeled 2 parts glue.
14. Use the graduated cylinder to add 45 mL of the diluted borax solution to the beaker labeled 1 part glue.
15. Use a spoon to stir each cup.
16. Dispose of all polymers in the garbage can or store in a baggy.

Which beaker (which glue concentration) produced the thickest, most viscous polymer?

Which beaker (which glue concentration) produced the least viscous polymer? How do you explain this result?