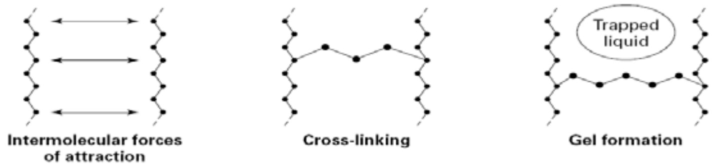
NAME ____ **DATE** ______________________

Polymers

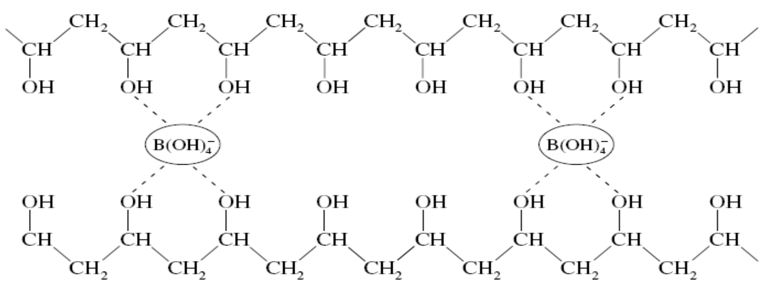
IMPORTANT BACKGROUND INFO:

Polymers are giant molecules consisting of repeating monomers, which are groups of atoms that form chains that are thousands of atoms long. Because these long molecular chains are linked by intermolecular forces, they can be molded into useful objects. If short bridges of atoms form between long polymeric chains, the polymer is then said to be cross-linked. Cross-linking gives the polymer new properties. In this experiment, you will investigate the properties of Polysnow®, sodium polyacrylate (Waterlock®), and polyvinyl alcohol.



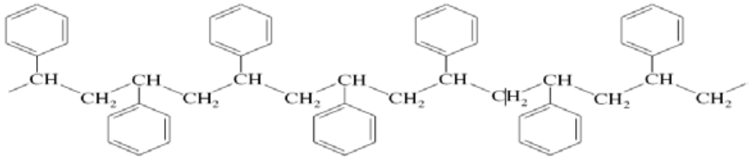
Sodium polyacrylate is a strongly cross-linked polymer that has superabsorbent properties. It can form a gel by absorbing water that has as much as 800 times its own mass. Currently, it is used to coat seeds before planting and to remove water from diesel and aviation fuels. Some brands of disposable diapers contain this superabsorbent polymer.

Polyvinyl alcohol can be weakly cross-linked with the hydrated borate ion, B(OH)4. This polymer forms a non-Newtonian gel, which has properties similar to the Slime toy manufactured by Mattel, Inc. When kept in motion, it forms a semirigid mass; when held steady, it flows.



Polyvinyl alcohol cross-linked with borate ion

Polystyrene is not cross-linked, but its intermolecular forces of attraction make it useful for constructing products such as radio cases, toys, and lamps. When polystyrene is expanded to produce the material called plastic foam, it has a very low density and is used to make egg cartons, insulation, and fast-food containers. The intermolecular forces of attraction in polystyrene are destroyed by the action of acetone, and the polymer loses its shape and becomes fluid.



Polystyrene chain

OBJECTIVES

Infer chemical structures from differences in chemical properties.

Describe the properties of three polymers.

MATERIALS

- 100 mL graduated cylinder
- ziptop bag
- Polysnow®
- four pre-cut paper towels - ***(use these only for Part 2)***
- Waterlock® (sodium polyacrylate)
- 10 mL graduated cylinder
- thin stem pipet
- NaCl
- 50 mL beaker
- glass stirring rod
- 4% polyvinyl alcohol
- 4% sodium borate solution
- *Food coloring (optional)*

SAFETY NOTES

For this experiment, wear safety goggles and a lab apron, to protect your eyes, and clothing. If you get a chemical in your eyes, immediately flush the chemical out at the eyewash station while calling to your teacher.

Do not inhale the Polysnow® or Waterlock® as they could cause serious respiratory distress.

Make sure to wash your hands at the end of the lab. Call your teacher in the event of a spill. Spills should be cleaned up promptly, according to your teacher's directions.

DO NOT LET ANY Polysnow® or Waterlock® GET INTO THE SINK, ESPECIALLY DOWN THE DRAIN.

PROCEDURE – Part 1

1. Add one teaspoon of Polysnow® to a ziptop bag and examine it. Slowly add 150 mL of water to the bag. Examine the results and record your observations.

OBSERVATIONS

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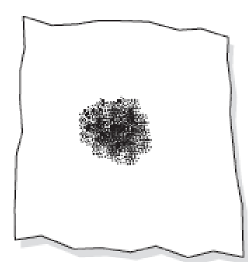
2. The materials may be taken home in the ziptop bag and then allowed to dry out. Make sure you open the bag, or mold will form on the Polysnow®. Also you can heat the Polysnow® in a pan in a "low" oven, at about 250°- *not in the plastic bag*. The Polysnow® will return to its original condition and can be used again.

3. Wash all containers with soap and water, and rinse well. Store them upside down in the cabinet to air dry.

PROCEDURE – Part 2

CAUTION: Although sodium polyacrylate is nontoxic, it readily absorbs water. For this reason, its dust should not be inhaled. In addition, be careful to insure that none of the powder or gel goes down the drain.

4. Place two squares of paper towel, about 10 x 10 cm, on your lab bench, about 5 cm apart. Sprinkle the center of the second paper towel with one level teaspoon of sodium polyacrylate (Waterlock®) polymer, as shown to the right. Cover each paper towel with a second paper towel. Both sets of paper towels will represent two different types of disposable baby diapers.



5. Slowly add water to the first set of paper towels *(the set without the Waterlock®)* and record the amount of water required to completely saturate this "baby diaper." You will add water until it completely soaks the towels and just begins to seep around the edges.

OBSERVATIONS

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6. Slowly add water to the second set of paper towels *(the set with the Waterlock®)* and record the amount of water required to completely saturate this "baby diaper." Follow the guidelines above. *If time permits, attempt to add* *more water to the Waterlock® to see how much more water it will hold. Record your observations in the space below.*

OBSERVATIONS

7. Remove the top paper towel from the Waterlock® diaper. Visually examine and then touch the Waterlock®. Wash your hands and record your observations.

OBSERVATIONS

8. Sprinkle about one teaspoon of salt onto the top of the water saturated Waterlock®. Examine the results and record your observations. (Hint: make sure you have plenty of paper towels handy.)

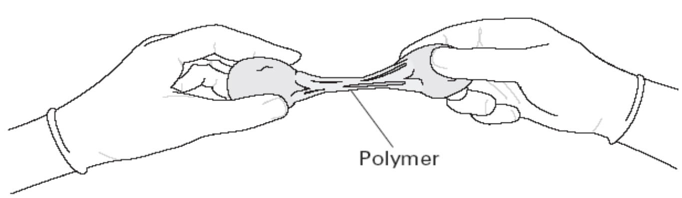
OBSERVATIONS

9. Dispose of the Waterlock® in the chemical trash. **DO NOT LET ANY Waterlock® GET INTO THE SINK OR DOWN THE DRAIN!**

PROCEDURE – Part 3

10. Pour 25 mL of 4% polyvinyl alcohol into a 50 mL beaker. If you want to add food coloring, add 1 – 2 drops to 3.0 mL of 4% sodium borate solution.

11. Slowly stir in 3 mL of 4% sodium borate solution, and after it is added, stir briskly to make sure it is thoroughly mixed. Pour the gel in your hands. Knead it into a ball. Pull it slowly, as shown below. Pull it quickly. Hold part of it in your hand over a beaker, and let the remainder stretch downward. Wash your hands with soap and water. Record ALL your observations below.



OBSERVATIONS

12. Dispose of the gel in the chemical garbage can. Wash all containers with soap and water, and rinse well. When you finish, wash your hands with soap and water.

QUESTIONS

1. Refer to the structures of the polymers, and explain why sodium polyacrylate can absorb large quantities of water but a polymer like polystyrene cannot.

2. Why shouldn’t you ever let a baby wearing a disposable baby diaper into a swimming pool?

3. What is the advantage of coating a seed with sodium polyacrylate polymer before planting?