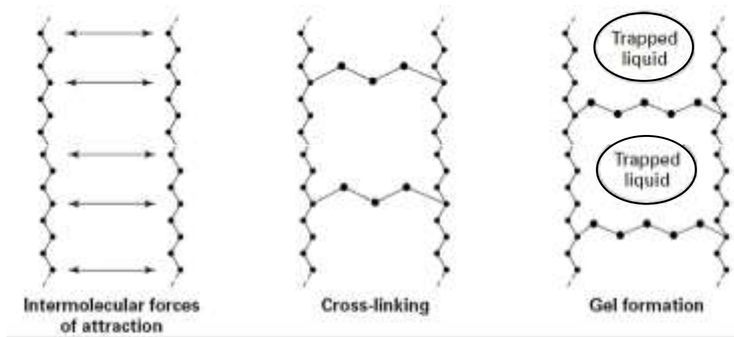
NAME ____ DATE __________________

Polymers, Parts 1 & 2

IMPORTANT BACKGROUND INFO:

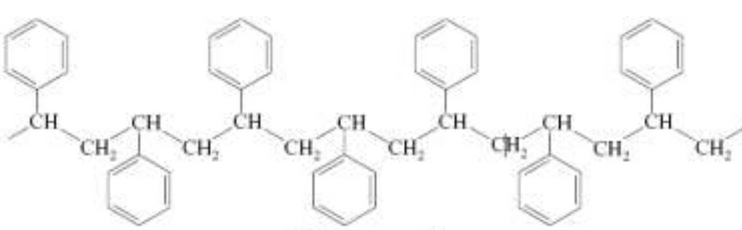
Polymers are giant molecules consisting of repeating monomers, which are groups of atoms that form chains that are thousands of atoms long. Because these long molecular chains are held together by intermolecular forces, they can be molded into useful objects. If short bridges of atoms form between long 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® and sodium polyacrylate (Waterlock®)



Sodium polyacrylate is an example of a super-absorbing polymer whose properties result from cross-linking. It is a cross-linked polymer that contains sodium ions and absorbs water by **osmosis**. When the (sodium-containing) polymer is placed in contact with water, there is a tendency for the sodium to distribute equally between the polymer network and the water due to osmosis. That means some of the sodium ions want to leave the network and move to the water where there is a lower concentration of sodium ions. When these sodium ions leave, they are replaced with water molecules. Water then swells the polymer network to try to keep the sodium concentration balanced between the polymer and the water. The cross-links that connect the chains together prevent them from dissolving/breaking apart in the water. Sodium polyacrylate (Waterlock®) can absorb 800 times its weight in distilled water, but only 300 times its weight in tap water, since tap water already contains some sodium, calcium and other mineral salts.

Sodium polyacrylate (Waterlock®) and PolySnow™ are actually both forms of the same compound; however, they differ in the amount of cross-linking and therefore have different properties. Sodium polyacrylate (Waterlock®) has fewer cross-links, and therefore can absorb more water than the PolySnow™. Currently, sodium polyacrylate (Waterlock®) is used to coat seeds before planting and to remove water from diesel and aviation fuels. Some brands of disposable diapers also contain this superabsorbent polymer.

Polystyrene is not cross-linked, but the intermolecular forces of attraction between the molecules hold the polymer chains together and 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.



Polystyrene chain

Source: LGC Education Media, https://www.cmu.edu/gelfand/lgc-educational-media/polymers/index.html

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OBJECTIVES

- **Describe** the properties of two polymers.
- **Explore** the result of crosslinking in a polymer.

MATERIALS

- 100 mL graduated cylinder
- ziptop bag
- Polysnow®
- four pre-cut paper towels ***(use only for Part 2)***
- sodium polyacrylate - Waterlock®
- 10 mL graduated cylinder
- thin stem pipet
- NaCl

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.**
- Do not taste any chemicals or items used in the laboratory.
- Never return leftovers to their original containers; take only small amounts to avoid wasting supplies.
- 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.
2. Slowly add 150 mL of water to the bag and "fluff" the bag to evenly mix the Polysnow® and the water.
3. Examine the results. Open the bag and feel the Polysnow®. Record your observations. *(Be careful to not let any Polysnow® get on the floor as it it very slippery. If it does spill, clean it up quickly.)*

OBSERVATIONS

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4. Dispose of the Polysnow® in the chemical trash. OR the Polysnow® 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 250º - *not in the plastic bag*. The Polysnow® will return to its original condition and can be used again.
5. Wash your hands with soap and water.

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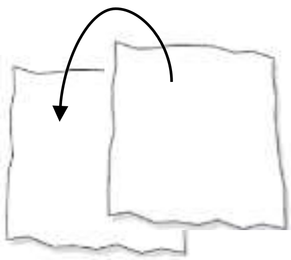
PROCEDURE – Part 2

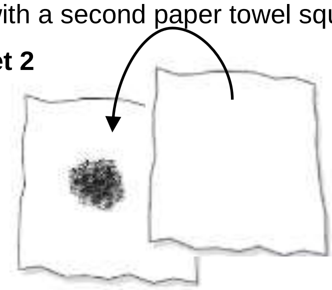
CAUTION: Although sodium polyacrylate is nontoxic, it readily absorbs water. For this reason, its dust should not be inhaled. In addition, be careful to insure that none of the powder or gel goes down the drain.

4. Prepare two sets of paper towels. Both sets of paper towels will represent two different types of disposable baby diapers. One partner work on one set and the other partner work on the other set.
   - For SET 1, place two 10 x 10 cm paper towel squares on top of each other, as shown below. This is your control.
   - For SET 2, place a 10 x 10 cm paper towel square on your lab station. Sprinkle the center of the paper towel with about a half teaspoon of sodium polyacrylate (Waterlock®) polymer and spread around the middle - as shown **below.** Cover the paper towel with a second paper towel square.

Set 1



Set 2



5. SET 1. Use a small graduated cylinder to slowly add water to the middle of the first set of paper towels *(the set without the Waterlock®)* and record the amount of water required to completely saturate this "baby diaper." It is completely saturated when you see water begin to seep from around the edges of the paper towels.

OBSERVATIONS ____

6. SET 2. Use a larger graduated cylinder to slowly add water to the middle of the second set of paper towels *(the set with the Waterlock®)* and record the amount of water required to completely saturate this "baby diaper." It is completely saturated when you see water begin to seep from around the edges of the paper towels.

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

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8. Sprinkle ½ to 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

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

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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. Use the background information to explain what you think happened when salt was added to the water saturated Waterlock®.

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

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

5. How could a low density, hydrophobic (doesn't like water) polymer be used to clean up an oil spill in water?