PolySnow

Amount of time Demo takes: 1-2 minutes

Try this at home!

Lesson's Big Idea

- The PolySnow (sodium polyacrylate) has sodium molecules on the inside of the membrane. When water is added, the high sodium ion concentration inside of the polymer membrane causes water to move through the membrane and get absorbed by the polymer structure by the process of osmosis. This balances the sodium concentration inside and outside of the polymer membrane.
- Superabsorbent polymers like PolySnow can hold lots of liquids by "sucking" the liquid in and filling up like lots of tiny little water balloons (*water balloons do not have a semipermeable membrane like PolySnow).
- PolySnow and the water undergo a physical reaction. The water is absorbed by the PolySnow. The substances do not change chemically.

Materials

- PolySnow (Sodium polyacrylate)
- Distilled or tap water (Absorption: distilled water > tap water)
- Tablespoon (for measuring the PolySnow)
- Condiment Bottle (for pouring water)
- Container(s) for holding hands over to catch PolySnow
- Disposal bucket
- Table Salt - Sodium Chloride (*optional, but recommended)

SAFETY!

- Safety glasses
- PolySnow is nontoxic, but can irritate the eyes and nose mucus membrane, if exposed

Background Information

- Superabsorbent polymers absorb and hold on to large amounts of liquids, up to 800 times their weight!
    - Sodium polyacrylate and PolySnow are very similar, but the PolySnow is more fluffy (due to an extra linkage between polymer chains) when water has been absorbed. Poly Snow can hold up to 300 times its own weight!
- Polymers are large molecules that are made up of a long chain of smaller molecules that are bonded. The structure of PolySnow can be referenced in Figure 1.

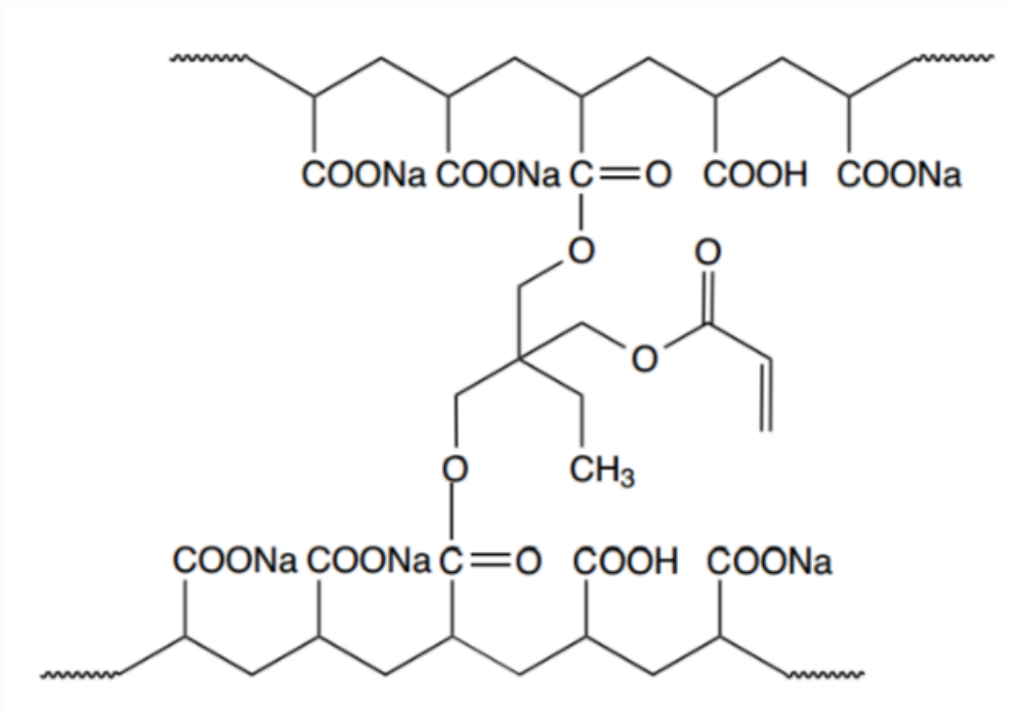

Figure 1: PolySnow chemical structure. Includes the middle linkage not found in standard sodium polyacrylate [1].

- Semipermeable membranes are sheet-like structures that only allow certain molecules to pass through it. The PolySnow has an outside membrane that allows water to pass through, but not dissolved ions like salt.
- Osmosis is the process when molecules pass through a semipermeable membrane from a low concentration to a high one. The inside of the PolySnow has a high concentration of salt ions compared to the water on the outside of the PolySnow. The water will move through the membrane to balance the salt ion concentration on both sides of the membrane.
- Physical reactions do not involve a chemical change in the substance. In this demo, water is being absorbed by the polymer. The PolySnow remains PolySnow, and water remains water. No chemical reaction

occurs.

Setup Instructions

1. Place all of the materials except for the disposal bucket on a flat surface

Instructional Procedure

1. Add **1 tbsp** of PolySnow to a container or ½ tbsp into a student's cupped hands
2. Add **150 mL** distilled water to a beaker/measuring cup
3. Slowly add the distilled water to the container with the PolySnow (smaller amount into student's hands)
    a. The "snow" will turn fluffy and "grow" out of the container
    b. If using sodium polyacrylate, the "snow" might not be very fluffy, but more slushy.
4. *Optional step: Add a dash (⅛ tsp) of table salt (sodium chloride) to the beaker
5. Empty the beaker with the "snow" into the disposal bucket

Tips & Tricks

- Rather than dumping all used PolySnow in a disposal bucket below the table, you can leave some in the bin on the table. Participants like to feel it.
- If time and material allow, you can make the PolySnow in a participant's hand. Again, it feels interesting and the participants like to try new things.

Assessment Questions

- What do you think will happen when we add water to the solid?
    - It will be absorbed and create PolySnow!
- What kind of reaction do you think is occurring?
    - A physical reaction, NOT chemical. The substances (PolySnow and water) are still chemically the same.
- What do you think will happen when we add some salt to the PolySnow?
    - The water will leave the polymer because we are increasing the salt ion concentration outside of the semipermeable membrane.

Careers & Real-World Applications

- Superabsorbent polymers are found in multiple hygiene products. One of the largest uses is in diapers.
- Osmosis is also used for desalination of seawater. It removes the dissolved salt ions so the water is drinkable!
- Chemical engineers and scientists can have careers that are involved with creating polymers (polymer science).

Clean Up

- PolySnow can be thrown away or allowed to dry for reuse
    - It can take a couple days for the water to evaporate completely if reusing the PolySnow
    - Adding salt during the demo can limit the future effectiveness of the PolySnow (if reusing). The salt is left behind after the water evaporates and remains outside of the polymer membrane and will increase the exterior salt ion levels when adding water in the future.
- Wipe safety glasses off with an alcohol wipe
- Make sure all containers and measuring equipment are **CLEAN AND DRY** before storing.

References

1. https://www.flinnsci.com/polysnow_1171b88b/dc10474/
2. https://www.stevespanglerscience.com/lab/experiments/insta-snow-polymer/
3. https://en.wikipedia.org/wiki/Superabsorbent_polymer

Related Next Generation Science Standards

- K-5
    - 2-PS1 Matter and its Interactions
    - 5-PS1 Matter and Its Interactions
- 6-8
    - MS-PS1 Matter and Its Interactions
- 9-12
    - HS-PS1 Matter and Its Interactions