raft resource area for teaching
www.raft.net

Curriculum topics:

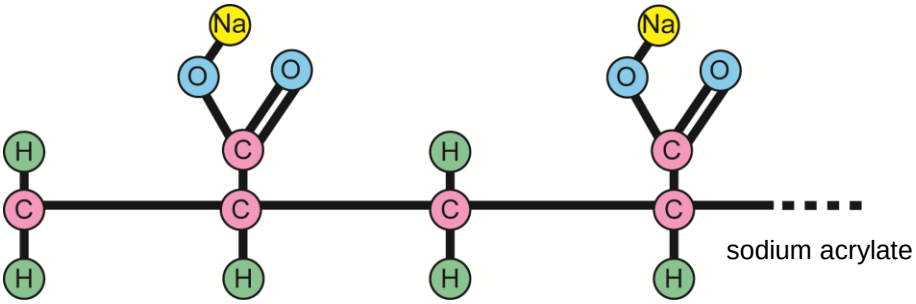
- Matter
- Molecules
- Chemistry
- Polymers
- Volume
- Chemical versus Physical change

Subject:
Physical Science

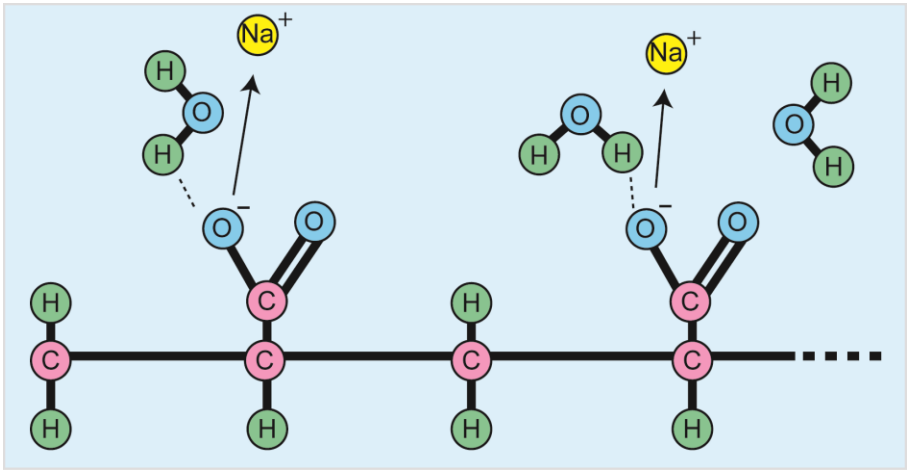
Grade range: 4 – 12

AMAZING HYDRO ABSORBER

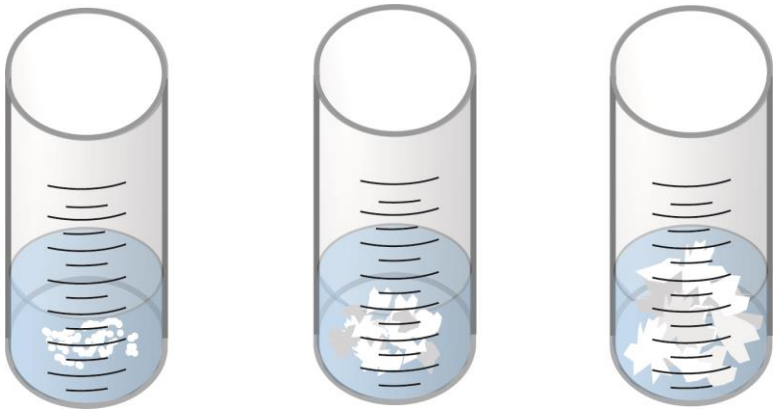
Test the properties of a superabsorbent polymer



In the polymer Olympics, this substance would win a gold medal!
It can soak up and hold up to 3000 times its weight in water!
Observe the polymer "grow" as water is absorbed.
Explore the effect of salt on the polymer's efficiency.



In water, sodium detaches; water molecules form hydrogen bonds with polymer



Who we are:

Resource Area for Teaching (RAFT) helps educators transform the learning experience through affordable "hands-on" activities that engage students and inspire the joy and discovery of learning.

For more ideas and to see RAFT Locations

www.raft.net/visit-raft-locations

© 2013, RAFT

http://www.raft.net/raft-idea?isid=686

Materials required

- Superabsorbent polymer, crystals
- Superabsorbent polymer, powder
- Clear containers at least 50 ml (~¼ cup) with graduated volume markings, 1
- Salt, ~ 1 ml (~1/4 teaspoon)
- Measuring spoons or equivalent, 2
- Measuring containers, ~30 ml (1 oz), 2
- Stir sticks, 3
- Water
- Safety goggles
- Crystal Polymer Activity Data Sheet (at http://www.raft.net/raft-idea?isid=686)
- Clock or timer

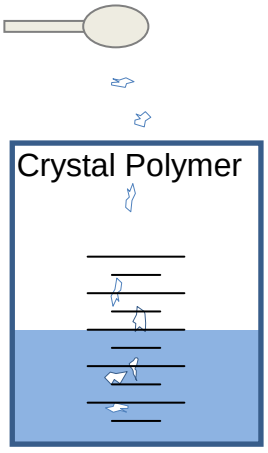
Note: For external use only. This substance is non-toxic, however, because the crystals and powder absorb water and swell they can pose a hazard. Provide adult supervision.
Use proper safety precautions.

- *Do not use with children under 8 years old.*
- *Do not eat, drink, or inhale the superabsorbent polymer.*
- *Avoid eye contact. Wear safety goggles.*
- *Wash hands & contacted skin areas after handling polymer.*

To do and notice

Note: Use **Crystal polymer** for Experiment 1 and **Powder polymer** for Experiment 2

Experiment 1: Observe Crystal polymer growth over time

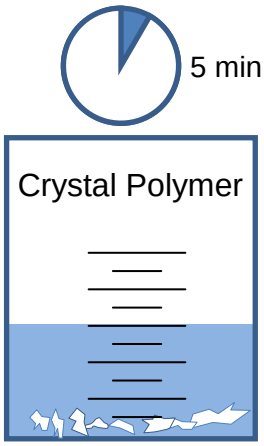


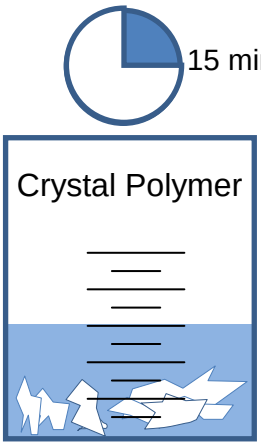
1 Put 30 ml (~ 1/8 cup) of water into a clean clear container with graduated volume markings.

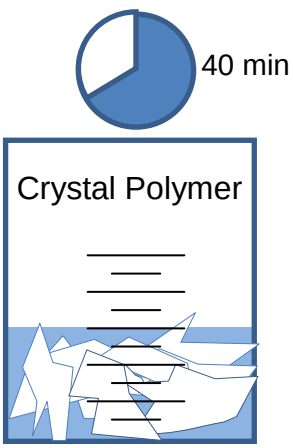
2 Add 0.5 ml (~⅛ teaspoon) of superabsorbent polymer crystal to the container and stir.

3 Every 5 minutes measure and record the volume of the wet polymer in the data sheet on page 5. Optional: calculate change in volume, percentage change, and rate of change.

To measure the volume of the polymer – **gently shake** container to settle contents and measure the level of the polymer on the volume markings.



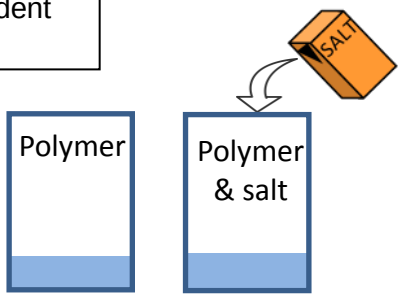




© 2013, RAFT

Experiment 2: Observe the effect of salt on the Powder polymer

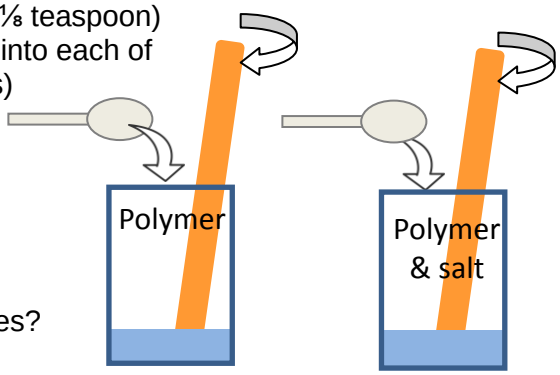
Teaching Tip: If doing this experiment with a group of students have student work in groups and/or have just a few students create samples with salt.



1 Label one container “polymer” and the other container “polymer and salt”. Put 20 ml (~ ⅔ oz) of water in each of the containers.

2 Add 1 ml of salt to the “polymer and salt” container.

3 Using a clean measuring spoon, measure out 0.5 ml (~⅛ teaspoon) of superabsorbent polymer powder and slowly sprinkle into each of the 2 containers. Shake or stir. (Use different stir sticks)



4 Observe after 1 minute, 2 minutes, and 5 minutes. Draw observations.

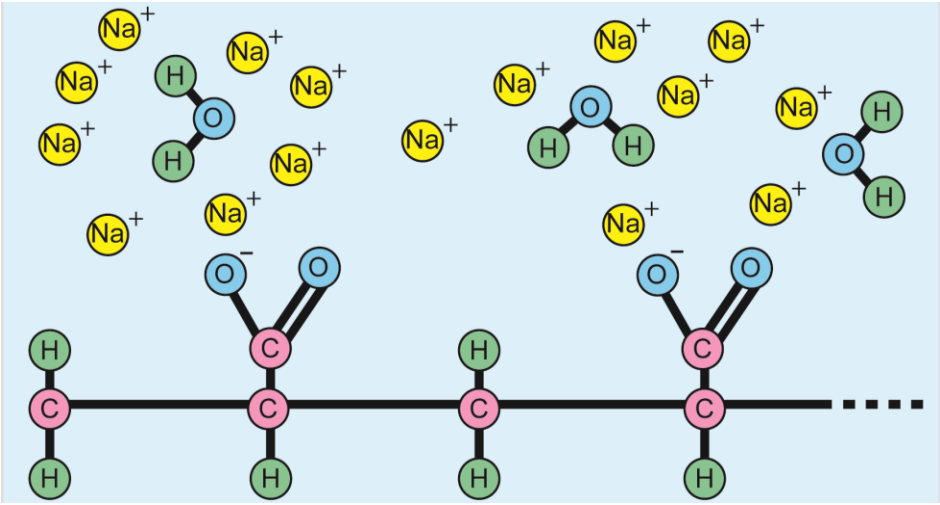
5 Is there a noticeable difference between the two samples? Which polymer sample absorbed the water? Based on observations, does salt interfere with the polymer’s ability to absorb water? Speculate on how salt might interfere with the polymer’s water-absorbing ability.

Polymer **without** salt added can be dried and reused. To dispose of the polymer – place in a plastic bag and put in the trash. Never flush or pour polymer down the drain - it could clog drain

The science behind the activity

The **superabsorbent** (water retaining) **polymer**, **sodium acrylate**, is a cross-linked polymer in gel form. It can absorb 500 to 3000 times its weight in pure water, depending on the degree of “cross-linking” within the molecules.
In water, the sodium molecules detach from polymer. Water molecules then form hydrogen bonds with the polymer drawing the water molecules into the network of polymers. (See illustration on page 1.) Due to cross-linking, the polymer chains cannot expand so the granules expand as water is absorbed.

Adding salt (**electrolytes**) to the mixture interferes with the polymer’s ability to absorb. The positively charged **ions** (sodium, Na+) are attracted to the negative charges on the polymer, creating a barrier for the water and decreasing the amount of water that can penetrate into the polymer. See below.



© 2013, RAFT

Curriculum Standards:

Structure of matter (Next Generation Science Standards: Grade 5, Physical Science 1-1)

Property of materials (Next Generation Science Standards: Grade 5, Physical Science 1-3)

Mixtures (Next Generation Science Standards: Grade 5, Physical Science 1-4)

Chemical reactions (Next Generation Science Standards: Middle School, Physical Science 1-2; High School, Physical Science 1-2, 2-6)

Science & Engineering Practices (Next Generation Science Standards Grades 4 – 12)

Additional standards at: http://www.raft.net/raft-idea?isid=686

The science behind the activity (continued)

Some of the many uses for sodium acrylate and other similar types of superabsorbent polymer:

--Diapers and feminine hygiene products
--Cooling evaporative headbands and collars
--Growing plants without soil
--Crafts and home decorations
--Blocking water penetration in wires and cables, above & below ground
--Hot and cold therapy packs
--Fire-retardant gel
--Medical waste solidification
--Water absorption from gasoline/diesel fuel tanks

Learn more

- Examine how light passes through the polymers. Compare with how light passes through clear water.
- Add food coloring to water add dry polymer – examine how light passes through the colored polymer. Compare with clear polymer & water.
- Determine how temperature affects absorption
- Compare the absorption of water and vinegar.
- Plant seeds in wet polymer.
- Add water to baby diapers and then dissect them to observe the superabsorbent polymer inside

Related activities: See RAFT Idea Sheets:

Bubbling Potions-
http://www.raft.net/ideas/Bubbling Potions.pdf

Freezing Water into Ice-
http://www.raft.net/ideas/Freezing Water Into Ice.pdf

Is it Really Full-
http://www.raft.net/ideas/Is it Really Full.pdf

Just a Phase-
http://www.raft.net/ideas/Just a Phase.pdf

Ooh Ooh Oobleck-
http://www.raft.net/ideas/Ooh Ooh Oobleck.pdf

Overnight Crystals-
http://www.raft.net/ideas/Overnight Crystals.pdf

Water Beads-
http://www.raft.net/ideas/Water Beads.pdf

Resources

Visit www.raft.net/raft-idea?isid=686 for "how-to" video demos & more ideas! See these websites for more information on the following topics:

- **History of superabsorbent polymer chemistry** – http://www.m2polymer.com/html/history_of_superabsorbents.html
- **The components of a typical disposable diaper** – http://disposablediaper.net/faq/what-are-the-components-of-a-typical-disposable-diaper/

© 2013, RAFT