

Topics: Chemistry,
Crystals, Phase Changes

Materials List

- ✓ Zap Packs (sodium-acetate heat pads)

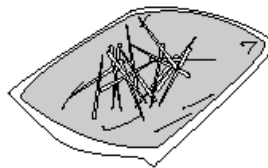
This activity can be used to teach:

Next Generation Science Standards:

- Structure of matter (Grade 5, Physical Science 1-1)
- Properties of materials (Grade 2, Physical Science 1-1, 1-2; Grade 5, Physical Science 1-3)
- Changes of state (Middle School, Physical Science 1-4)
- Chemical reactions (Middle School, Physical Science 1-2; High School, Physical Science 1-2)

Zap Pack

Turning Stored Energy into Heat with the Snap of a Disk



These great, little packs grow crystals right before your eyes, and produce a nice amount of heat for about a half an hour. Energy is released as the liquid in the pack turns to solid, a simple phase change. Zap Packs can be “recharged” over and over!

Assembly

1. Recharge Zap Packs (if necessary) by following the directions on the outside of the package. Remember: **DO NOT PLACE ZAP PACKS IN A MICROWAVE!!**
- **Alternate preparation:** Place one or two packs into a coffee cup (paper, foam, or ceramic) and add hot water from a water-cooler type dispenser. Let the pack sit in the cup until the water has cooled. Zap Packs should be clear.

To Do and Notice

1. Snap the disk inside the Zap Pack to trigger crystal growth.
2. Observe crystal growth and temperature increase in the Zap Pack!
3. For best results, store Zap Packs in a liquid (clear) state.

The Science Behind the Activity

Zap Packs contain a liquid that would normally be a solid at room temperature. This solution of Sodium Acetate ($\text{NaC}_2\text{H}_3\text{O}_2$) and water normally “freezes” (turns to solid) at 54°C (129°F), but crystals require something to grow on. Until then, the particles remain in the liquid state, even though they are colder than the freezing point (“supercooled”). The Sodium Acetate in the Zap Pack will turn to solid crystals as soon as a seed crystal forms. Snapping the disk jolts a few particles, aligning them to form crystals. Once this seed crystal forms, the rest of the sodium acetate in solution rapidly forms crystals. In terms of the phases of matter, solids have the least energy and gases have the most (i.e. - In order to get steam (a gas), you need to add energy to water by putting it on the stove). Energy is stored in the liquid solution. When the crystals (solids) form from this supersaturated and supercooled solution, energy is released (exothermic). The water in the pack is raised quickly to the “freezing point” of Sodium Acetate 54°C (129°F).

Taking it Further

Compare 2 Zap Packs: 1 at room temperature and 1 that has been in the refrigerator for a few minutes. The colder Zap Pack will grow crystals more quickly than the warmer one! Encourage students to investigate the Zap Pack further!

Web Resources (Visit www.raft.net/raft-idea?isid=473 for more resources!)

For more detailed information on Sodium Acetate heat packs, visit:

<http://www.howstuffworks.com/question290.htm/printable>

<http://quest.arc.nasa.gov/space/teachers/microgravity/12rapid.html>