

Name: Akshaj Kammari

Date: 03/31/2020

Student Exploration: Feel the Heat

Vocabulary: calorimeter, conductor, controlled experiment, dissolve, endothermic, exothermic, insulator, solute, solution, solvent, surroundings, system

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

Eduardo hurts his knee during a basketball game. The trainer applies a cold pack, which gets cold after being squeezed. The next day, Eduardo's friend Beth is going sledding. Beth buys some hand warmers and puts them into her gloves. All morning, her hands stay toasty warm.

1. How do you think these devices work? _____

It activates after a change in temperature

2. Where do you think the "cold" and the heat comes from? _____

Comes from the friction of both the cold and heat pack

Gizmo Warm-up

As you saw with the instant cold pack and the hand warmers, some reactions absorb energy while others release it. In the *Feel the Heat* Gizmo, you will explore these energy changes while making your own hot and cold packs.

To begin, select the TEST POWDERS tab. Drag a bottle of $\text{NaC}_2\text{H}_3\text{O}_2$ (sodium acetate) from the shelf. Using the sliders, decide how much water and powder to add. Note the beginning temperature, and then press **Play** (▶) to see what happens.

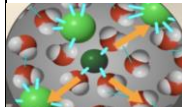
1. Did the temperature go up or down? up

2. Experiment with different powders until you find one that produces the opposite effect.

What powder did you use? ammonium nitrate

When a powder dissolves in water a **solution** is formed. The powder is the **solute** and the water is the **solvent**. Oftentimes energy changes accompany the formation of a solution. When added to water, some powders cause the resulting solution to get hot, while others make it cold. Some powders don't produce a temperature change at all. When energy changes do occur, they can be put to good use.



<p>Activity A: Molecular view</p>	<p>Get the Gizmo ready:</p> <ul style="list-style-type: none"> • Click Reset (↺). • Drag a bottle of $\text{NaC}_2\text{H}_3\text{O}_2$ from the shelf. 	
---	---	---

Introduction: The reactions in this activity are performed within a **calorimeter**, an insulated device that keeps heat from escaping, enabling you to accurately record temperature changes.

Question: Why does the temperature change when a powder is dissolved in water?

1. **Observe:** Turn on **Show molecular view**, and notice the water molecules. Set the **Water volume** to 100 mL and the **Powder mass** to 20 g, and then click **Play**. Click **Pause** (⏸) after adding the powder. You should now see show some sodium acetate in the water.
 - A. What color represents the bonds between the particles of $\text{NaC}_2\text{H}_3\text{O}_2$? blue
 - B. Click **Play**. Watch the animation a few times. What happens to the $\text{NaC}_2\text{H}_3\text{O}_2$ bonds? the increase and form more bonds
 - C. What happens to the bonds between water molecules? they are broken
 - D. What color are the new bonds that form between the solute and solvent? orange

2. **Investigate:** In the animation, the purple arrows represent energy that is being absorbed from the water, while the orange arrows show energy that is being released into the solution.
 - A. Replay the animation, carefully noting the purple arrows. What does this absorbed energy do? it breaks the bonds with water
 - B. Now replay the animation but focus on the orange arrows. What occurs every time an orange arrow is released? a bond is formed
 - C. Fill in the blanks: When bonds are broken, energy is absorbed.
When new bonds form, energy is released.
 - D. Based on the arrow sizes, do you think more energy is absorbed in breaking bonds, or is more energy released when new bonds form? formation of new bonds
 - E. Which bonds do you think are stronger, the bonds that are broken or the bonds that are formed? Explain your reasoning. formed, because the arrows are longer

(Activity A continued on next page)

