

# LAB 13 Probeware Activity



## Endothermic and Exothermic Processes

When a substance dissolves in water, a change in energy usually occurs. Although a change in energy can be a sign of a chemical change, the dissolving of a substance is a physical change. The water molecules break apart into positive and negative parts and surround the particles of the substance that is dissolving. In some cases, dissolving releases heat energy into the surroundings. Processes that release heat energy are called *exothermic*. In other cases, dissolving absorbs heat energy from the surroundings. Processes that absorb heat are called *endothermic*. How can you tell if heat energy is released or absorbed? In this activity you will collect data and search for clues to determine which type of heat energy transfer is taking place.

### What You'll Investigate

- What happens when  $\text{CaCl}_2$  and  $\text{KCl}$  are added to water?
- Will these processes produce temperature changes?

### Goals

- Measure** the change in temperature when substances are added to water.
- Calculate** any change in water temperature that occurs during the process.
- Graph** temperature changes over time.

### Materials

- CBL 2 or LabPro unit
- TI graphing calculator
- link cable
- DataMate program
- temperature probe
- 400-mL beaker
- 100-mL beaker
- plastic spoon
- glass stirring rod
- distilled water (room temperature)
- 5.0g calcium chloride ( $\text{CaCl}_2$ )
- 5.0g potassium chloride ( $\text{KCl}$ )

### Safety Precautions



- Always wear safety goggles and a lab apron.
- Report any spills to your teacher.
- Do not taste, eat, or drink any materials used in the lab.
- Wash your hands before leaving the laboratory.

### Pre-Lab

1. What is a physical change?
2. What are examples of physical change?
3. What is an exothermic process?
4. What is an endothermic process?

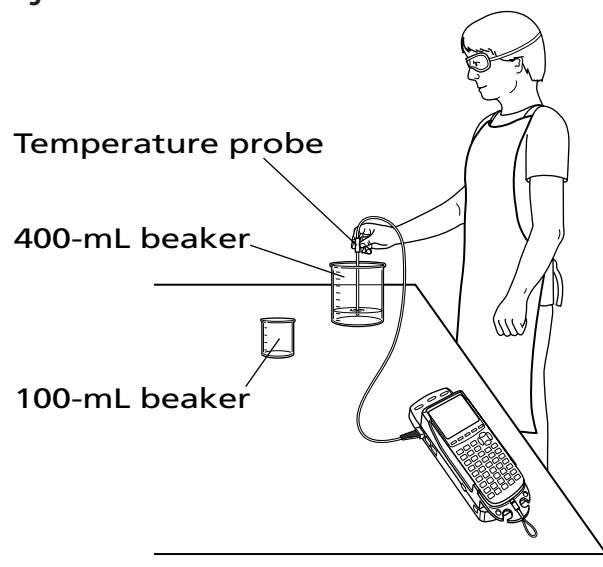
## Probeware Activity 13 (continued)

### Procedure

#### Part A: Preparing the CBL System

1. Set up the calculator and CBL 2 unit, as shown in **Figure 1**. Plug the temperature probe into channel 1 of the CBL 2 unit.
2. Turn on the calculator and start DataMate. Press **CLEAR** to reset the program. The temperature probe should be recognized automatically. If not, turn to page *vi* for instructions on how to set up the probe manually.

Figure 1



#### Part B: Collecting Data

1. Add 100 mL of room-temperature water to the 400-mL beaker.
2. Place the temperature probe in the water.
3. Use a balance to measure 5.0 g of potassium chloride on a piece of weighing paper or in a weighing dish.
4. On the graphing calculator, select **START** to begin the data collection. About five seconds after data collection has begun, carefully add the potassium chloride to the water. Make sure all of the potassium chloride is emptied into the water. Data will be collected for 180 seconds.

5. Using a glass stirring rod, gently stir the water in the beaker for about 20 seconds to help the potassium chloride dissolve.
6. After 180 seconds have lapsed, the calculator will display a graph of temperature versus time with temperature on the  $y$ -axis and time on the  $x$ -axis. Sketch and label this graph in your **Science Journal**.

#### Part C: Examining the Data

1. Return to the main screen by pressing **ENTER**.
2. Select **ANALYZE**.
3. Select **STATISTICS**.
4. Press **ENTER** to select the beginning of the temperature graph. Use the right arrow key to select the last temperature data point reached. Press **ENTER** to select this point.
5. Your calculator will display the minimum and maximum temperatures reached. Determine which of these is the starting temperature and which is the ending temperature—the temperature after all of the solid dissolved. Record these temperatures in the **Data Table**. When you are finished, press **ENTER**. Select **RETURN TO MAIN SCREEN**.
6. Rinse your beaker thoroughly and repeat parts **B** and **C** using 5 g of calcium chloride.
7. When you are finished, press **ENTER**. Select **RETURN TO MAIN SCREEN**. Select **QUIT**. Follow the directions on the screen.

#### Cleanup and Disposal

1. Turn off the graphing calculator and disconnect the temperature probe and CBL 2 unit.
2. Clean and return all equipment as directed by your teacher and answer the questions on the following page.

**Probeware Activity 13 (continued)****Data Table: Dissolving of KCl and CaCl<sub>2</sub>**

Substance	Starting Temperature (°C)	Ending Temperature (°C)	Temperature Change (°C)	Type of Process
Potassium chloride (KCl)				
Calcium chloride (CaCl <sub>2</sub> )				

**Conclude and Apply**

1. Calculate the temperature change for each substance by subtracting the starting temperature from the ending temperature. Record your results in the **Data Table**. How are these temperature changes different?

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2. Which process is endothermic and which is exothermic?

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3. Look at your graphs. Suggest a possible explanation for why the temperature of the water changed rapidly at first and then leveled off.

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4. From your results, infer what the result might be if twice as much potassium chloride was added to the same amount of water.

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# Notes