

Activity C20: Endothermic and Exothermic Reactions (Temperature Sensor)

Concept	<i>DataStudio</i>	<i>ScienceWorkshop (Mac)</i>	<i>ScienceWorkshop (Win)</i>
Reactions	C20 Endo and Exo React.DS	C20 Endo-Exo Reactions	C20_ENDO.SWS

Equipment Needed	Qty	Chemicals and Consumables	Qty
Temperature Sensor (CI-6505A)	1	Citric acid (H ₃ C ₆ H ₅ O ₇), 1.5 Molar	30 mL
Balance (SE-8723)	1	Hydrochloric acid (HCl), 0.5 Molar	30 mL
Beaker, 250 mL	1	Baking soda (NaHCO ₃)	10.0 g
Graduated cylinder, 50 mL	1	Magnesium ribbon (Mg)	20.0 cm
Protective gear	PS	Styrofoam cup	1
		Weighing paper	1

What Do You Think?

Many familiar chemical reactions involve the release of energy, such as combustion. Are there any chemical reactions that involve the absorption of energy?

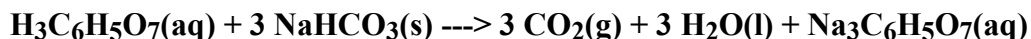
Take time to answer the 'What Do You Think?' question(s) in the Lab Report section.

Background

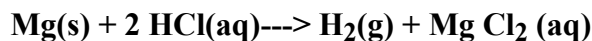
Many chemical reactions give off energy. Chemical reactions that release energy are called exothermic reactions. Some chemical reactions absorb energy and are called endothermic reactions. You will study one exothermic and one endothermic reaction in this experiment.



First, you will study the reaction between citric acid solution and baking soda. An equation for the reaction is:



Next, you will study the reaction between magnesium metal and hydrochloric acid. An equation for this reaction is:



SAFETY REMINDERS

- Wear protective gear while handling chemicals.
- Follow directions for using the equipment.
- Dispose of all chemicals and solutions properly.

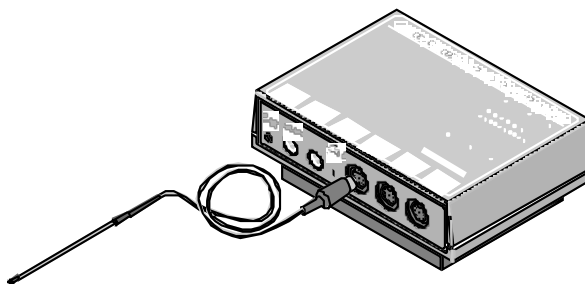


For You To Do

Use the Temperature Sensor to measure the change in temperature of a chemical reaction that releases energy. Then measure the change in temperature of a chemical reaction that absorbs energy. Use *DataStudio* or *ScienceWorkshop* to record and analyze the data.

PART I: Computer Setup

1. Connect the *ScienceWorkshop* interface to the computer, turn on the interface, and turn on the computer.
2. Connect the Temperature sensor's DIN plug into Analog Channel A on the interface.
3. Open the file titled as shown:



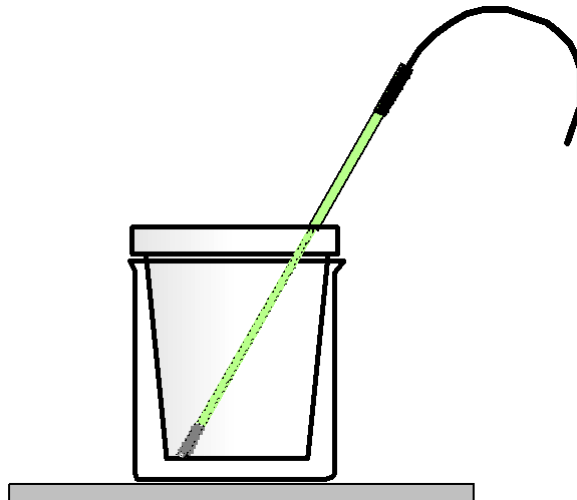
<i>DataStudio</i>	<i>ScienceWorkshop</i> (Mac)	<i>ScienceWorkshop</i> (Win)
C20 Endo and Exo React.DS	C20 Endo-Exo Reactions	C20_ENDO.SWS

- The *DataStudio* file has a Workbook display. Read the instructions in the Workbook.
- The *ScienceWorkshop* document has a Graph display of Temperature versus Time.
- Data recording is set for one measurement per second. Data recording stops automatically at 250 seconds (about 4 minutes).

PART II: Sensor Calibration and Equipment Setup

You do not need to calibrate the sensor.

1. Place a Styrofoam cup into the 250 mL beaker as shown in the diagram. Put 30 mL of 1.5 Molar citric acid into the cup. Place the Temperature Sensor into the citric acid solution.
2. Weigh out 10.0 g of solid baking soda on a piece of weighing paper.



PART IIIA: Data Recording - Reacting Citric Acid and Baking Soda

1. Get ready to record data. The Temperature Sensor must be in the citric acid solution for a few seconds before you begin recording data.
2. When everything is ready, start recording data.
3. After about 20 seconds, add the baking soda to the citric acid solution.
4. Gently stir the solution with the Temperature Sensor to ensure good mixing.

Remember to stir for good mixing.

5. Record data until a minimum temperature has been reached and temperature readings begin to increase or let the computer automatically end it after 250 seconds.
6. Dispose of the reaction products as directed by your teacher. Rinse the cup.

PART IIIB: Data Recording - Reacting Magnesium and Hydrochloric Acid

1. Measure out 30 mL of HCl solution into the Styrofoam cup. Place the Temperature Sensor into the HCl solution.
2. Obtain a 20.0 cm piece of shiny magnesium metal from the teacher.
3. Get ready to record data. Note: The Temperature Sensor must be in the HCl solution for a few seconds before you begin recording data.
4. When everything is ready, begin data recording.
5. After about 20 seconds, add the magnesium ribbon to the acid solution.
6. Gently stir the solution with the Temperature Sensor to ensure good mixing.

Remember to stir for good mixing.

7. Record data until a maximum temperature has been reached and temperature readings begin to decrease or let the computer automatically end it after 250 seconds.
8. Dispose of the reaction products as directed by your teacher. Rinse the cup.

Analyzing the Data

1. Set up your Table display so it shows both runs of data (that is, Run #1 for Citric Acid and Baking Soda and Run #2 for Magnesium and Hydrochloric Acid).
- Use the Table's analysis tools to find the minimum and maximum values for temperature for Run #1. Hint: Look at the graph to determine if the minimum or maximum occurred first. Record the initial temperature. Record the other as the final temperature.
1. Find the minimum and maximum values for temperature for Run #2. Look at the graph to determine if the minimum or maximum occurred first. Record this value as the initial temperature in the Data Table. Record the other as the final temperature.
2. Calculate the temperature change for each reaction by subtracting the initial temperature from the final temperature.

Record your results in the Lab Report section.

Lab Report - Activity C20: Endothermic and Exothermic Reactions**What Do You Think?**

Many familiar chemical reactions involve the release of energy, such as combustion. Are there any chemical reactions that involve the absorption of energy?

Data Table

	Run #1: Citric Acid - Baking Soda	Run #2: Hydrochloric Acid - Magnesium
Final temperature (°C)		
Initial temperature (°C)		
Temperature change (°C)		

Questions

1. Which reaction had a negative temperature change (ΔT)? Is the reaction endothermic or exothermic? Explain.
2. For each reaction, describe three ways you could tell a chemical reaction was taking place.
3. Which reaction took place at a greater rate? Explain your answer.

