# Pre-Lab Information

Purpose Conduct an investigation to explore how a change in temperature during a chemical reaction can be used to classify the reaction as endothermic or exothermic.

Time Approximately 60 minutes

Question How is a change in temperature used to classify a reaction as endothermic or exothermic?

Summary In Part I of this experiment, you will monitor changes in temperature during a reaction between hydrogen peroxide and yeast to determine if the reaction is endothermic or exothermic. In Part II of this experiment, you will monitor changes in temperature during a reaction between vinegar and baking soda to determine if the reaction is endothermic or exothermic. You will plot the data collected in Parts I and II on separate graphs to observe the change in temperature over time for each reaction.

# Safety

* Always wear a lab coat and safety goggles when performing an experiment.
* Make sure behavior in the lab is purposeful. Exercise caution when using chemicals and lab equipment.
* Label your glassware and paper cups clearly and appropriately, as many chemicals appear the same.
* Check glassware, such as beakers and graduated cylinders, for cracks and chips before using them.
* Report all accidents—no matter how big or small—to your teacher.

# Lab Procedure

1. **Gather materials.**

|  |  |  |
| --- | --- | --- |
| * Hydrogen peroxide (3% H2O2) * Yeast * Hot tap water * Vinegar * Baking soda * Paper towels | * 50 mL graduated cylinder * Two 100 mL beakers * Thermometer * Stopwatch * Triple-beam balance | * Two glass stirring rods * Two measuring spoons or scoops * Large plastic cup or container * Weighing paper/boats * Two colored pencils |

## Part I: Reaction of Hydrogen Peroxide and Yeast

1. **Measure the hydrogen peroxide and yeast.**
   1. Use the graduated cylinder to measure 30 mL of the hydrogen peroxide, and then pour the hydrogen peroxide into a clean, dry beaker.
   2. Put a thermometer in the beaker. Wait approximately two minutes to allow the thermometer to reach the temperature of the hydrogen peroxide. Record the temperature of the hydrogen peroxide in Table A.

While you are waiting to measure the temperature of hydrogen peroxide, place the weighing paper or boat on the balance. (If you are using weighing paper, fold it in half first.) Then, zero the balance.

* 1. Use a measuring spoon or scoop to measure 1.0 g of yeast onto the weighing paper.
  2. Check the temperature of the hydrogen peroxide, and record it in Table A.
  3. Thoroughly rinse the graduated cylinder with tap water.

1. **Combine the hydrogen peroxide and the yeast.**
   1. Add the yeast to the beaker. Start the stopwatch and immediately read the temperature while gently stirring the contents with a stirring rod. Record this temperature in Table A.
   2. Continue to record the temperature in Table A every 30 seconds as you observe the reaction for three minutes.
   3. After three minutes, remove the thermometer. Then, follow your teacher’s directions for disposing of the hydrogen peroxide and yeast, and clean the beaker, thermometer, and stirring rod thoroughly.
2. **Graph your results for the change in temperature over time.**
   1. Follow these directions to construct a line graph of your data from Part I. Sketch your graph in Section II of the MS Descriptive Lab Report Guide. You and your partner should each have your own graph.
   2. Label the *x*-axis as “Time (Minutes).”
   3. Label the *y*-axis as “Temperature (°C).”
   4. Create an appropriate scale for both axes. Remember that the axes do not have to start at zero unless zero is an appropriate value to plot.
   5. Using your data from Table A, construct a line graph to show how temperature changed over time for this reaction. Label the line “Hydrogen peroxide and yeast.”

## Part II: Reaction of Baking Soda and Vinegar

1. **Make a hot water bath.**
   1. Fill the large plastic container approximately halfway with hot tap water.
   2. Place the empty 100 mL beaker in the cup. Be sure that the water level does not exceed the top of the beaker.
   3. Remove the beaker from the water.
2. **Measure the vinegar and baking soda.**
   1. Use the graduated cylinder to measure 30 mL of the vinegar. Then, pour the vinegar into the beaker.
   2. Set the beaker in the hot water bath. Then, place the thermometer in the vinegar.Wait until the temperature of the vinegar rises to between 32°C and 38°C. Record the temperature of the vinegar in Table B.

While you are waiting for the vinegar to heat up, place the weighing paper or boat on the balance. (If you are using weighing paper, fold it in half first.) Then, zero the balance.

* 1. Use a clean measuring spoon or scoop to measure 1.0 g of baking soda onto the weighing paper.

1. **Combine the vinegar and baking soda.**
   1. Remove the beaker from the hot water bath.
   2. Add the baking soda to the beaker. Start the stopwatch and immediately read the temperature while gently stirring the contents with a clean stirring rod. Record this temperature in Table B.
   3. Continue to record the temperature every 30 seconds as you observe the reaction for three minutes.
   4. After three minutes, remove the thermometer. Then, follow your teacher’s directions for disposing of the vinegar and baking soda, and thoroughly clean the beaker, stirring rod, and thermometer.
2. **Graph your results for the change in temperature over time.**
   1. Follow these directions to construct a line graph of your data in Part II. Sketch your graph in Section II of the MS Descriptive Lab Report Guide. You and your partner should each have your own graph.
   2. Construct a line graph to show how temperature changed over time for the second reaction, using a different colored pencil than the color used in Part I. Label the line “Vinegar and baking soda.”
3. **Clean up.**
   1. If you have not done so yet, dispose of all materials according to your teacher’s directions.
   2. Thoroughly clean all glassware and store them as directed by your teacher.

# Data

Record your data in your lab notebook or in the space below.

**Table A. Temperature Measurements for the Hydrogen Peroxide and Yeast Reaction**

|  |  |
| --- | --- |
| **Time (minutes)** | **Temperature (°C)** |
| H2O2 only |  |
| 0 |  |
| 0.5 |  |
| 1.0 |  |
| 1.5 |  |
| 2.0 |  |
| 2.5 |  |
| 3.0 |  |

**Table B. Temperature Measurements for the Vinegar and Baking Soda Reaction**

|  |  |
| --- | --- |
| **Time (minutes)** | **Temperature (°C)** |
| Vinegar only |  |
| 0 |  |
| 0.5 |  |
| 1.0 |  |
| 1.5 |  |
| 2.0 |  |
| 2.5 |  |
| 3.0 |  |

# Follow-Up Questions

Answer the following questions.

1. What happened to the temperature in the reaction between hydrogen peroxide and yeast?

2. What happened to the temperature in the reaction between vinegar and baking soda?

3. Which reaction was endothermic, and which reaction was exothermic?