Endo- and Exothermic Reactions

Contributors

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Intended Audience

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<td>K-4</td>
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<td>5-8</td>
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<tr>
<td>9-12</td>
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Activity Characteristics

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Classroom Setting</td>
<td>X</td>
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<tr>
<td>Requires special equipment</td>
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<tr>
<td>Uses hands-on manipulatives</td>
<td>X</td>
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<tr>
<td>Requires mathematical skills</td>
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<tr>
<td>Can be performed individually</td>
<td>X</td>
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<tr>
<td>Requires group work</td>
<td>X</td>
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<tr>
<td>Requires more than one (45 min class) period</td>
<td>X</td>
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<tr>
<td>Appropriate for special needs student</td>
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Introduction

Description
Students will use common baking products to investigate and identify endothermic and exothermic reactions.

Abstract
Exothermic and endothermic reactions are common chemical reactions. In this lab, students will measure the changes in temperature during two reactions and determine what type of reaction has occurred.

Core Themes Addressed

<table>
<thead>
<tr>
<th>Core Themes Addressed</th>
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<tbody>
<tr>
<td>Microbial Cell Biology</td>
</tr>
<tr>
<td>Microbial Genetics</td>
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<td>Microorganisms and Humans</td>
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<td>Microorganisms and the Environment</td>
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<tr>
<td>Microbial Evolution and Diversity</td>
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<tr>
<td>Other - Chemistry</td>
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<tr>
<td>X</td>
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Keywords
Chemistry, Chemical Changes

Learning Objectives
At completion of this activity, learner will

1. Describe the differences between endothermic and exothermic reactions
2. Identify chemical reactions as endothermic or exothermic

National Science Education Standards Addressed

Standard A: Science as Inquiry
- Abilities necessary to do scientific inquiry

Standard B: Physical Science
- Chemical reactions
Student Prior Knowledge

Students should have the following knowledge prior to completing this activity:

1. Be able to recognize the difference between physical and chemical changes
2. Be able to identify when a chemical change has taken place.

Teacher Background Information

A chemical reaction is a process that leads to the transformation of one set of chemical substances to another. In chemical reactions, one or more substances are formed. The starting substances used in a reaction are known as reactants. The new substances formed in a reaction are known as products. In a chemical reaction, it is very difficult to reverse a chemical reaction and change the products back into reactants.

An exothermic reaction is a change that releases heat. Because heat is given off, the temperature of the substance rises. An endothermic reaction is a change that requires (or absorbs) heat. Because heat is taken in, the temperature of the substance decreases.

Class Time

This activity will require a minimum of one 90 minute class period but it can be broken down into two 45 minute class periods.

1. Introductory reading – 10 minutes
2. Introduction PowerPoint – 10 minutes
3. Ice pack demonstration – 10 minutes
4. Activity 1 – 25 minutes
5. Activity 2 – 25 minutes
6. Wrap up worksheet – 10 minutes

Teacher Preparation Time

This lesson will require approximately 20 minutes of solution preparation time.

1. Baking Soda Solution – 10 minutes
2. Citric Acid Solution – 10 minutes
This lesson will require approximately 20 minutes of lab preparation time.

1. Set up material stations – 10 minutes
2. Set up student lab benches – 10 minutes

Safety Precautions

These reactions are very mild and should not explode. However, reactions may bubble up and out of glassware. Therefore, students should wear gloves and goggle.

Materials and Equipment (Demonstration)

1. 3 Ice Packs (Instant cold packs)

Materials and Equipment (4 per group)

1. 20 ml baking soda solution (liquid)
2. 150 ml citric acid solution (liquid)
3. 1 teaspoon calcium chloride
4. 3 teaspoons baking soda (dry)
5. 50 ml graduated cylinder
6. 250 ml beaker
7. Thermometer
8. Stirring Rod

Methods

Set Up (Pre Lab)

1. Prepare citric acid and baking soda solution.
   a. Citric Acid – 1 Tablespoon of powdered citric acid per 200 ml of diH2O
   b. Baking Soda – 1 Tablespoon of baking soda per 200 ml of diH2O

Demonstration

1. Pass around the ice pack BEFORE you break it to let students feel the initial temperature
2. Break the ice pack.
3. Pass around for the students to be able to feel the difference after the chemical reaction has taken place

Reaction 1

1. Pour 20 ml of baking soda solution (liquid) into the graduated cylinder
2. Place the thermometer in the graduated cylinder
3. Record the initial temperature in the table below.
4. Add 1 teaspoon of calcium chloride into the graduated cylinder
5. Record the Temperature at 30s, 60s, and 120s.
6. Record the Final Temperature

Reaction 1

1. Add 150 ml of citric acid solution (liquid) to the 250 ml beaker
2. Place the thermometer in the beaker
3. Record the initial temperature
4. Add 2 teaspoons of baking soda (dry) into the beaker
5. Mix the solution with stirring rod.
6. Record the temperature after 1 minute.
7. Add another teaspoon of baking soda (dry).
8. Record the temperature after 1 minute.

Tips/Suggestions

1. To reduce clean up, place glassware in a tray to catch any reaction overflow.
2. Citric acid and baking soda solutions will settle out. Mix each solution before students use them.

References

This activity was modified from:
How To Create an Endothermic Chemical Reaction (Safe). 20 March 2013.  
http://chemistry.about.com/cs/howtos/ht/endothermic.htm


Answers to Student Handouts

1. In your own words, what is the definition of a chemical reaction?

A process that causes a transformation from one chemical substance to another. This process is very difficult to be reversed.
2. List two ways you can tell if a chemical reaction has taken place
- Change of color
- Bubbles
- Temperature change
- Gives off light

3. In 2-3 sentences, describe the difference between exothermic and endothermic reactions.
Endothermic reactions absorb heat, which means that the temperature decreases. Exothermic reactions release heat, which means that the temperature increases.
Introduction

An exothermic reaction is a change that releases heat. Because heat is given off, the temperature of the substance rises. An endothermic reaction is a change that requires (or absorbs heat). Because heat is taken in, the temperature of the substance decreases.

Student Background Knowledge

Students should have the following knowledge prior to completing this activity:

1. Understand the difference between physical and chemical changes
2. Be able to identify when a chemical change has taken place.

Vocabulary

Exothermic: a chemical reaction that releases heat

Endothermic: a chemical reaction that requires (or absorbs heat)

Reactants: the starting substances used in a reaction

Products: the new substances formed in a reaction

Safety Considerations

Reactions will expand and bubble and therefore, students should wear safety goggles and aprons.

Materials Checklist

<table>
<thead>
<tr>
<th>Item</th>
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<tbody>
<tr>
<td>20 ml baking soda solution</td>
</tr>
<tr>
<td>150 ml citric acid solution</td>
</tr>
<tr>
<td>1 teaspoon calcium chloride</td>
</tr>
<tr>
<td>3 teaspoons baking soda (powder)</td>
</tr>
<tr>
<td>50 ml graduated cylinder</td>
</tr>
<tr>
<td>250 ml beaker</td>
</tr>
<tr>
<td>Thermometer</td>
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<tr>
<td>Stirring Rod</td>
</tr>
</tbody>
</table>
Procedure

A. Demonstration

1. The teacher will pass around today's demonstration.
2. Make observations in the results section below.

B. Reaction 1

1. Pour 20 ml of baking soda solution into the graduated cylinder.
2. Place the thermometer in the graduated cylinder.
3. Record the initial temperature in the table below.
4. Add 1 teaspoon of calcium chloride into the graduated cylinder.
5. Record the Temperature at 30s, 60s, and 120s.
6. Record the Final Temperature

C. Reaction 2

1. Add 150 ml of citric acid to the 250 ml beaker.
2. Place the thermometer in the beaker.
3. Record the initial temperature.
4. Add 2 teaspoons of baking soda into the beaker.
5. Mix the solution with stirring rod.
6. Record the temperature after 1 minute.
7. Add another teaspoon of baking soda.
8. Record the temperature after 1 minute.

Results

A. Demonstration

What happened in the demonstration? What type of reaction is this?
B. Reaction 1

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature</th>
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<tbody>
<tr>
<td>Initial</td>
<td></td>
</tr>
<tr>
<td>After 30s</td>
<td></td>
</tr>
<tr>
<td>After 60s</td>
<td></td>
</tr>
<tr>
<td>Final</td>
<td></td>
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</tbody>
</table>

1. Was this reaction an exothermic or endothermic reaction? Why?

2. What did you notice about the initial and final temperatures?

C. Reaction 2

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td></td>
</tr>
<tr>
<td>After 1 minute</td>
<td></td>
</tr>
<tr>
<td>After adding more</td>
<td></td>
</tr>
<tr>
<td>Baking soda</td>
<td></td>
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</table>

1. Was this reaction an exothermic or endothermic reaction? Why?

2. What happened when you added more baking soda?
Student Worksheet

Endo- and Exothermic Reactions

Students Name: ___________________________ Date: ______________

1. In your own words, what is the definition of a chemical reaction?

2. List two ways you can tell if a chemical reaction has taken place.

3. In 2-3 sentences, describe the difference between exothermic and endothermic reactions.