

The Heat is On!

Science Standard I:

Students will understand that chemical and physical changes occur in matter.

Objective 3:

Investigate evidence for changes in matter that occur during a chemical reaction.

Intended Learning Outcomes:

1. Use Science Process and Thinking Skills
4. Communicate Effectively Using Science Language and Reasoning

Content Connections:

Language Arts VIII-1, 6

Science Standard I

Objective 3

Connections

Background Information

This activity gives students experience with *chemical change*. The evidence of chemical change they will see is production of a gas, color change, and production of heat.

Note: pH is a measure of the acidity or basic nature of a solution.
pH = 7 is neutral; pH < 7 is acid; pH > 7 is base.

The scale is **not** linear—an acid of pH 4 is ten times more acidic than a pH of 5.

This activity makes use of pH indicator solution. Indicators show a change from a base to an acid or an acid to a base. The mixed calcium chloride, baking soda, and water make an acid solution. Phenol red is the indicator used in the instructions, but other indicators may be used. Bromothymol blue works well, changing from a blue to a yellow. Red cabbage juice (made by boiling the leaves of red cabbage) may be used. Cabbage juice starts off blue or violet and changes to bright pink. There are no special safety considerations for any of these indicators.

Calcium chloride is commonly used as a sidewalk ice-melt and comes in pellets. It is available in the automotive department under the brand name "Heat" and many others. It is also available through science supply companies, but is more expensive. When purchased through science supply companies, it generally comes in small flakes. The powder from the calcium chloride is harmful if inhaled. The pellet form is less likely to have powder that can be inhaled. *The pellet form is strongly recommended for safety.*

Any time things are mixed or heated in the classroom, safety goggles must be worn. The amounts of chemicals listed in these instructions are designed to keep the bags from popping open. Larger amounts of chemicals produce more gas that may cause bags to pop open and create an additional splash danger.

Invitation to Learn

Review the mixing of colors. What does red plus yellow make? How about blue and yellow? What if you mix red and white? Students may be surprised when we conduct today's experiment!

Instructional Procedures

Materials

- Baking soda
- Calcium Chloride
- Water
- Phenol red or other indicator
- Film canisters or small bottle
- Ziploc bags
- The Heat is On!* data sheet
- Safety goggles

Advance Preparation

1. Prepare a Ziploc bag containing two teaspoons baking soda and one teaspoon calcium chloride for each pair of students. *These amounts should not be increased, or the bag may burst open.*
2. Prepare small bottles or film canisters (without lids) with approximately three tablespoons of water. Add two or three drops of phenol red. Use only enough phenol red to make the color show.

Activity

3. Distribute *The Heat is On!* data sheets (p. 4-13) and safety goggles. Read instructions and remind students that goggles must be worn until the chemicals are disposed of and desks are clean.
4. Discuss what makes a good scientific observation. Measurements are great! Objective observations are great! Statements like "it stinks" or "it turned an ugly color" are opinions and could be rephrased to be more objective. Saying, "It has a strong odor," or saying, "It changed to a bright yellow-orange color," is more objective.
5. Goggles should be worn at this point. Distribute bags and bottles.
6. Make initial observations about contents of the bag and bottle. Students record observations on the data sheet. Remember to measure temperature.
7. Zip the bottle inside the bag.
8. Tip bottle over and observe. Remember to measure temperature.
9. Record observations on data sheet.
10. Clean up by placing closed bags into garbage. Wash hands and put away goggles.
11. Discuss the evidence of chemical change. Students may write a one-paragraph summary of the activity.

Possible Extensions/Adaptations/Integration

Writing

- Students write a paragraph telling what they know about chemical change, giving examples from this activity and daily life.

Adaptations

- Allow students to illustrate what they observed in the activity without writing the sentences OR just label the things that are evidence of chemical change like "heat," "color change," "new gas." Students may record some observations in drawing form only.
- Pair ELL students with a partner with the same primary language to do the writing work.
- Review key vocabulary words before beginning writing.

Assessment Suggestions

- Assess student learning using the "filmstrip" at the bottom of the data sheet. Did s/he identify evidence of chemical change?
- Students write a paragraph explaining how they know something has undergone a chemical change.

Additional Resources

Books

Science Experiments You Can Eat, by Vicki Cobb;
ISBN 0064460029

The Science Chef: 100 Fun Food Experiments and Recipes for Kids,
by Joan D'Amico and Karen Eich Drummond;
ISBN 047131045X

Web site

How Stuff Works, <http://www.howstuffworks.com>

Some articles would be good for non-fiction reading for our study of matter, especially if shortened, including *How does bread work?* and *How do light sticks work?*

Family Connections

- Most students know what happens when they mix baking soda and vinegar together- it bubbles indicating that a gas has formed. With adult supervision, try other cooking liquids (e.g., milk, buttermilk, lemon juice, orange juice, etc.) to find which form a gas when combined with baking soda.
- Students make a T-chart listing the physical and chemical changes involved in preparing a favorite food.

Name _____

The Heat is On!

1. Put on goggles. They must stay on until all chemicals are cleaned up.
2. Write your observations of the substances in the bag and bottle.

Temperature of liquid _____
 Temperature of solids _____

3. When your teacher tells you, zip the bottle of liquid inside the bag. When it is zipped tightly, tip the bottle of liquid over into the powder. Watch for changes.
4. What changes did you observe? Write them below. Be sure to measure temperature.

5. Was this a physical change or a chemical change? Provide evidence below.
 - a. _____
 - b. _____
 - c. _____

6. Filmstrip: Using the four to five filmstrip cells below, illustrate what happened during this experiment. Under each cell, write a one-sentence caption telling about the picture. Use words like: chemical change, produces heat, produces a gas, changes color, product, reactant, solid, liquid, and temperature.

1.	2.	3.	4.	5.

Clean Pennies

Science
Standard
I
Objectives
2 & 3
Connections

Science Standard I: Students will understand that chemical and physical changes occur in matter.
Objective 2: Evaluate evidence that indicates a physical change has occurred.
Objective 3: Investigate evidence for changes in matter that occur during a chemical reaction.
Intended Learning Outcome: 1. Use Science Process and Thinking Skills
Content Connections: Language Arts VIII-I, 6

Background Information

Each student needs a penny that is no longer shiny. If the pennies you have are too clean, oxidize the surface in the following manner. Place all the pennies into a cup and pour vinegar over the top. After coating them with vinegar, spread the pennies out on a paper towel to dry overnight. By the time they are dry you will see a green-colored substance called malachite.

When the salt and vinegar are combined, they form a very small amount of hydrochloric acid. This acid removes oxidation from pennies. Removing the copper oxide is a chemical change. The copper molecules in the vinegar and salt solution settle on paper clips after a period of time, but wipe off easily. This is not a chemical change. If the cleaned pennies are allowed to sit without rinsing them off, more malachite forms.

Invitation to Learn

Today we are going to do an activity with money and chemicals. The chemicals are sodium chloride and acetic acid (or salt and vinegar).

Instructional Procedures

1. Give each student a dirty penny. Observe pennies. Stress the importance of using all the senses, except for taste. Students record observations on the *Clean Pennies* data sheet (p. 4-17).
2. Pass out goggles. Students should keep the goggles on until the cups are put away in step six. Give each pair of students a cup with a small amount of salt in the bottom. Students place the pennies in the cup. Allow students to rotate cups. Ask what changes to the penny they see. (none)
3. Add a small amount of vinegar to each of the cups. Allow students to rotate cups and observe changes.
4. Pennies will become bright pink and copper colored. All the discoloration may not be removed, but most pennies will show a dramatic difference.
5. Remove pennies and place them on a paper towel to dry. Continue observations.
6. Place a paper clip in each cup of vinegar and salt solution. Leave the paper clip in the solution overnight. After cups are put away, remove goggles.
7. Observe paper clips next day. Wear safety goggles to avoid splash danger. Allow students to remove the paper clip from solution and handle it. The copper coating will rub off easily. Ask students if the paper clip's change to copper-colored was a chemical or physical change. (It was a physical change. No new substance was formed. The copper was there all the time-dissolved in the solution.)

Materials

- Dirty pennies
- Clean Pennies* data sheet
- Safety goggles
- Cups
- Salt
- Vinegar
- Paper towel
- Paper clips

Possible Extensions/Adaptations/Integration

- Allow students with special needs to list or draw examples of chemical change instead of writing a paragraph.
- Make a list of *Important Science Words* to use in the assigned paragraph.
- Allow students with special needs to dictate their paragraph to another student, an aide, or the teacher.
- To introduce the idea of physical properties, have each student bring an object from home. Each student describes a number of physical properties, such as color, shape, texture, etc. Other students take turns guessing the identity of the item.

Assessment Suggestions

- Create a rubric to score the paragraph including attributes such as, science content, organization, presentation, conventions, and use of science language.
- Make a T-chart with *Physical Changes* on one side and *Chemical Changes* on the other side. Give students a list of changes to categorize. Include examples of change from daily life.

Additional Resources

Books

Writers Express: A handbook/or young writers, thinkers, and learners, by David Kemper, et.al.; ISBN 0669471658

Kitchen Science with over 50 Fantastic Experiments, by Chris Maynard (DK Publishing); ISBN 0-7894-6972-3

Web site

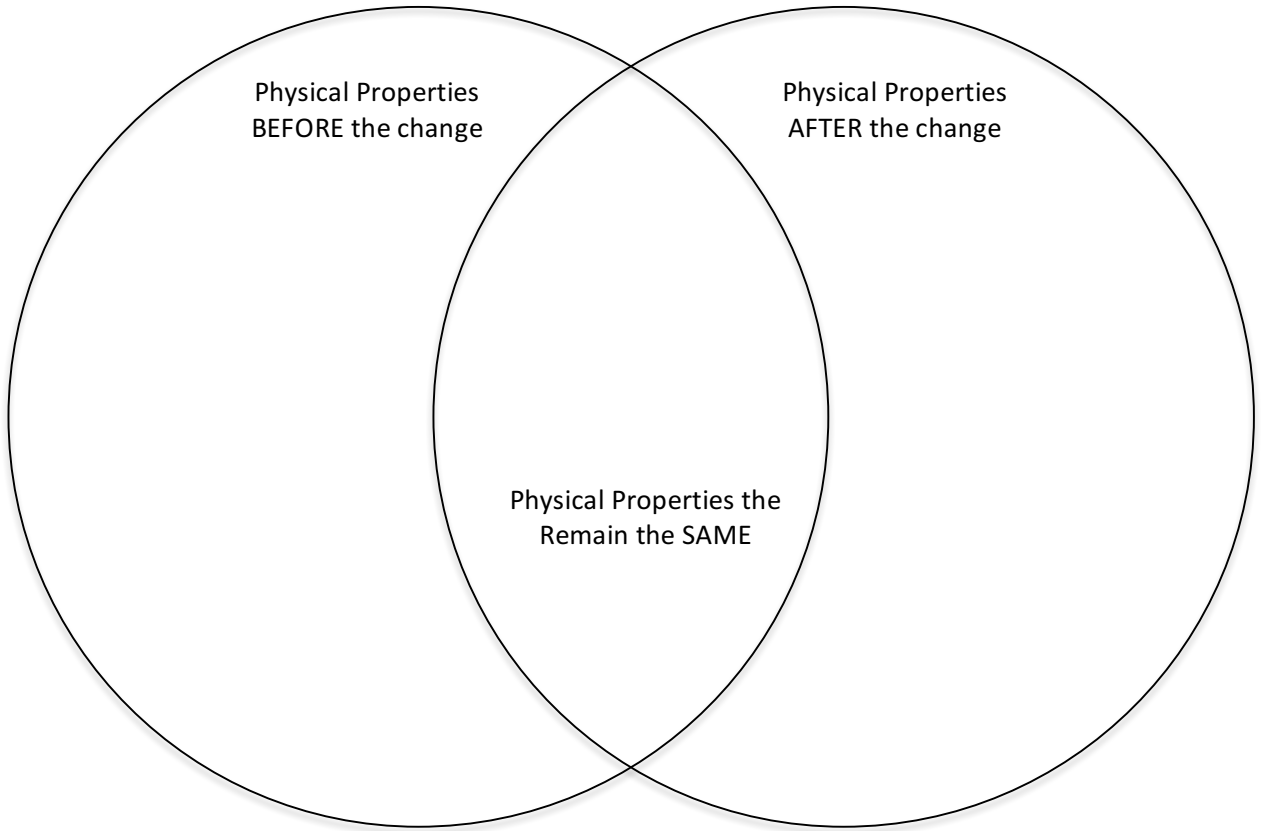
Some good ideas on the USOE science site for ELL students
<http://www.usoe.k12.ut.us/curr/science/core/5th/lep/matter/default.htm>

Family Connections

- Have a mold race! Moisten a slice of bread with a few drops of water and place it into a Ziploc sandwich bag. Place it in a warm, dark place. Keep the bag zipped shut after the mold grows-many people are allergic to mold. Observe the bread once a day and keep a log of the changes that occur. Many of the changes are chemical changes. Design an experiment to investigate questions like: Does white bread or whole wheat bread mold faster? Does homemade bread or store-bought bread mold faster? Does bread get moldy faster in a warm environment or cold environment? Does bread mold faster in sunlight or dark?
- Have students repeat the *Clean Pennies* activity at home with one variation -after removing the pennies from the solution, place a steel screw in the solution instead of a paper clip. They should see bubbles rising from the thread of the screw, which is another indicator of chemical change.

Name _____

Clean Pennies



Write a paragraph using the information from the Venn Diagram above. Discuss the physical properties of the penny before and after the change. Provide evidence that a chemical change took place.
