

PHYSICAL AND CHEMICAL CHANGES

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Tennessee 4-H Youth Development

Physical and Chemical Changes

Skill Level
Beginner

Learner Outcomes

The learner will be able to:

Explain the difference between a physical and chemical change.

Educational Standard(s) Supported

- 5.PS1.4: Evaluate the results of an experiment to determine whether the mixing of two or more substances result in a change of properties.

Success Indicator

Learners will be successful if they:

- Identify the five factors that indicate a chemical change has occurred.
- Give at least two examples of a physical change.
- Classify a change as either physical or chemical.

Time Needed
15-20 Minutes

Materials List

Playdough, M&M's, 6 percent hydrogen peroxide, 16 oz. water bottle, dry yeast, warm water, liquid dish soap, food coloring, pie pan, funnel, small cup or bowl.

Introduction to Content

A physical change is any change in a substance's form that does not change its chemical makeup. Examples of physical changes are breaking a stick or melting ice.

A chemical change, or chemical reaction, occurs when atoms of a substance are rearranged, and the bonds between the atoms are broken or formed. During a chemical reaction, the structure or composition of the materials change.

When a chemical change is complete, the resulting substance(s) is/are different from the original substance(s). As a result of a chemical reaction, new substances with new properties are formed.

Introduction to Methodology

In this lesson, students will learn about physical and chemical changes. Physical changes will be demonstrated with playdough and/or M&M's Candy. The chemical change will be demonstrated by making "Elephant's Toothpaste."

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Terms and Concepts Introduction

Physical Change — Change in form or appearance that can be undone.

Chemical Change — Formation of new substances that cannot be undone.

Catalyst — A substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change.

Exothermic Reaction — A chemical reaction that releases energy in the form of heat or light.

Endothermic Reaction — A reaction in which the system absorbs energy.

Setting the Stage and Opening Questions

- Have students watch the YouTube video “*Everything is changing! (Parody of bruises by Train). A song about physical and chemical changes.*” ([youtube.com/watch?v=RG8VHqHgF44](https://www.youtube.com/watch?v=RG8VHqHgF44)) Use video as a springboard to start discussion on chemical and physical changes. Begin discussion by having students repeat the differences in the two changes heard in the song.
- Provide a more detailed explanation of physical vs. chemical changes. Write differences on the board. Have students write differences in their science journals or on a clean sheet of paper.
 - Physical Change — A change that does not result in the production of a new substance. Physical changes result only in a change in the form (i.e., solid, liquid, gas) or appearance of a substance, but not the chemical composition of the substance. The substance will still ultimately be the same. Once a physical change occurs, it can be reversed.
 - Example — You take an ice cube out of the freezer and put it in your glass. Whoops! You forget to pour your drink. You come back a couple of hours later and find your ice has melted. This change in the state of water is an example of a physical change. When your ice melted, it became water. Can you reverse this change by refreezing the water? Yes!
 - Chemical Change — A change that results in the production of a new and different substance. These changes are often indicated by one of these factors: color change, a gas is given off, a new substance is formed, heat is given off (. . . we call this an exothermic reaction), and/or heat being absorbed (. . . we call this an endothermic reaction). Chemical reactions, once they occur, are irreversible.
 - Example — I eat an apple. When I am finished with the apple, I put the core in the compost pile. Over time the apple rots and becomes compost material. This is an example of a chemical change because you cannot change the compost back into an apple core.
- Reshow the YouTube video to reinforce the concepts of physical and chemical changes.
- After video is shown, have students quickly illustrate in their science journal notes the examples of physical and chemical changes that were in the song.
- Ask students: “*What are some examples of physical changes? What about chemical changes? What makes a physical change different from a chemical change? Are physical changes reversible? What about chemical changes?*”

Experience

- Demonstrate a couple of physical changes.
 - You have a pile of brown M&M’s and a pile of red M&M’s. You slowly add the red M&M’s to the brown M&M’s pile. Ask students, “*Did this change result in the formation of a new substance?*” No! The M&M’s are still M&M’s after adding the red ones. The only difference is the appearance has changed. “*Could you reverse this change?*” YES!
 - You take playdough and roll it out into a snake-like shape. You decide to cut the snake in three smaller pieces. Ask students to identify what type of change this is. This is a physical change because you changed only the shape and size of the snake.

Tips for Engagement

Introduction of basic concepts is necessary before beginning demonstrations. This helps students mentally process what they are seeing. While doing demonstrations, point out at each stage how what is happening makes the reaction a chemical or physical reaction.

- Demonstrate a chemical change with the Elephant's Toothpaste Experiment.
 - Empty a full packet of dry yeast into a separate cup or bowl.
 - Add 4 tablespoons of warm water and stir until the yeast and water are well mixed (30 seconds).
 - Use a funnel to pour $\frac{1}{2}$ cup of 6 percent hydrogen peroxide into the empty soft drink or water bottle that is placed in an empty pie pan.
 - Add a large squirt (1 tablespoon) of dishwashing liquid to the hydrogen peroxide in the soft drink bottle. Swirl the bottle to mix the detergent into the hydrogen peroxide.
 - Add 4-6 drops of food coloring to the soft drink bottle. Swirl the bottle to mix the food coloring into the solution.
 - Use the funnel to pour all of the yeast solution into the bottle. Quickly remove the funnel and observe the reaction! Allow students to touch the bottle to feel any changes taking place and to touch the foam that forms from the reaction.
 - Rinse all the materials and the pie pan after the demonstration.

Life Skill(s) from TIPP's for 4-H

5th Grade

Participate in 4-H club meetings by saying pledges, completing activities and being engaged. (Head)

Share

Have students share about the following question. *“What did you observe in the chemical reaction?”*

Process

Ask students: *“What is the difference between an endothermic and an exothermic reaction?”*

Generalize

Have students brainstorm about this question: *“How do we know a chemical reaction occurred in the Elephant's Toothpaste experiment?”*

Ask the students: *“What was the purpose of the yeast in the experiment?”*

Apply

Share with the students: *“The rate at which hydrogen peroxide decomposes depends on temperature, the concentration of the hydrogen peroxide, and light. So what special precautions are taken with hydrogen peroxide to keep it from spoiling?”*

References

You Be the Chemist: Lesson Plans for Making Chemistry Fun. The Chemical Education Foundation. Retrieved July 23, 2015. <http://www.tangischools.org/cms/lib3/LA01001731/Centricity/Domain/857/Experiments.pdf>
Elephant's Toothpaste. Ruben Meerman. ABC Science Online. Retrieved July 23, 2015. <http://www.abc.net.au/science/surfindscientist/pdf/teachdemo26.pdf>

Supplemental Information

Physical and Chemical Changes

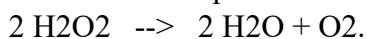
What is happening in the Elephant's Toothpaste Experiment?

The solution will begin to rapidly produce foam with a much greater volume than the original ingredients. The tiny bubbles that are produced are oxygen gas (not air). The hydrogen peroxide breaks down into water and oxygen gas. The reaction occurs naturally, but yeast is added as a catalyst. A catalyst is a substance that helps to increase the rate of a reaction. (Note: A catalyst is never consumed during a reaction.) The soap is used to help us “see” the reaction. Bubbles of oxygen released by the reaction become trapped in the soap, creating a foam. The reaction occurs so quickly, releasing so much gas and creating so much foam, that the foam begins to flow out of the bottle. The result of this reaction looks like toothpaste being squeezed out of a tube. The foam will be warm to touch because the underlying chemical reaction is exothermic (releases heat).

What is hydrogen peroxide?

Hydrogen peroxide (in a much stronger 6 percent concentration) is a chemical well-known to hairdressers as a bleaching agent. It is also used to bleach paper and many other industrial chemical processes. In hair dressing bleach, the liquid is incorporated into a thick gel, which clings to hair preventing contact with the scalp. The chemical symbol H₂O₂ for hydrogen peroxide is very similar to water's H₂O. The H₂ represents two hydrogen atoms while the O₂ represents two oxygen atoms. Hydrogen peroxide molecules are very unstable and naturally decompose into water and oxygen gas.

The chemical equation for this decomposition is:



The equation above represents two hydrogen peroxide molecules decomposing into two water molecules and one oxygen molecule. The decomposition of hydrogen peroxide also releases a small amount of heat, so the reaction is exothermic. Hydrogen peroxide is stored in opaque plastic or brown glass bottles to minimize exposure to light, which accelerates the natural decomposition of hydrogen peroxide

Why does yeast accelerate hydrogen peroxide decomposition?

Hydrogen peroxide is a natural byproduct of metabolism. All known animals that metabolize oxygen produce a natural enzyme called catalase, which catalyzes the decomposition of hydrogen peroxide into harmless water and oxygen gas. Catalase is found in every organ in the body and in particularly high concentrations in the liver. Hydrogen peroxide is harmful to living things because it is a strong oxidizer that can cause damage to living cells at the molecular level.

Yeast is a fungi that also produces the catalase enzyme. Adding yeast to hydrogen peroxide rapidly increases (catalyzes) the decomposition of hydrogen peroxide into water, oxygen gas and heat (you will notice that the foam produced feels warm).