

21.3: Evidence of a Chemical Reaction

Learning Objectives

- Identify the evidence for chemical reactions.

In a chemical change, new substances are formed. In order for this to occur, the chemical bonds of the substances break, and the atoms that compose them separate and rearrange themselves into new substances with new chemical bonds. When this process occurs, we call it a chemical reaction. A **chemical reaction** is the process in which one or more substances are changed into one or more new substances.

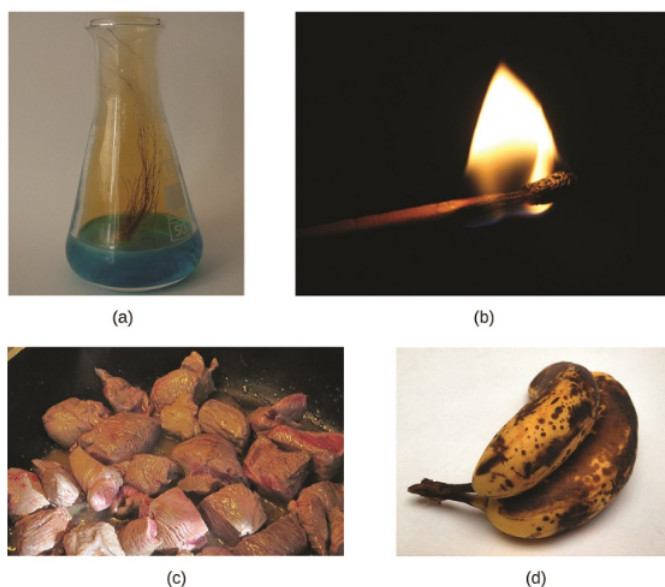


Figure 21.3.1: (a) Copper and nitric acid undergo a chemical change to form copper nitrate and brown, gaseous nitrogen dioxide. (b) During the combustion of a match, cellulose in the match and oxygen from the air undergo a chemical change to form carbon dioxide and water vapor. (c) Cooking red meat causes a number of chemical changes, including the oxidation of iron in myoglobin that results in the familiar red-to-brown color change. (d) A banana turning brown is a chemical change as new, darker (and less tasty) substances form. (Credit b: modification of work by Jeff Turner; credit c: modification of work by Gloria Cabada-Leman; credit d: modification of work by Roberto Verzo.)

To identify a chemical reaction, we look for a **chemical change**. A chemical change always produces one or more types of matter that differ from the matter present before the change. The formation of rust is a chemical change because rust is a different kind of matter than the iron, oxygen, and water present before the rust formed. The explosion of nitroglycerin is a chemical change because the gases produced are very different kinds of matter from the original substance. Other examples of chemical changes include: reactions that are performed in a lab (such as copper reacting with nitric acid), all forms of combustion (burning), and food being cooked, digested, or rotting (Figure 21.3.1).



Video 21.3.1: Evidence of a Chemical Reaction

✓ Example 21.3.1: Evidence of a Chemical Reaction

Which of the following is a chemical reaction?

- a. Freezing liquid mercury.
- b. Adding yellow to blue to make green.
- c. Cutting a piece of paper into two pieces.
- d. Dropping a sliced orange into a vat of sodium hydroxide.
- e. Filling a balloon with natural air.

Solution

A, B, C, & E involve only physical changes. A sliced orange has acid (citric acid) that can react with sodium hydroxide, so the answer is D.

? Exercise 21.3.1

Which of the following is a chemical reaction?

- a. Painting a wall blue.
- b. A bicycle rusting.
- c. Ice cream melting.
- d. Scratching a key across a desk.
- e. Making a sand castle.

Answer

B

✓ Example 21.3.2: Evidence of a Chemical Reaction

Which of the following is not a chemical reaction?

- a. Shattering glass with a baseball.
- b. Corroding metal.
- c. Fireworks exploding.
- d. Lighting a match.
- e. Baking a cake.

Solution

Shattering glass with a baseball results in glass broken into many pieces but no chemical change happens, so the answer is A.

? Exercise 21.3.2

Which of the following is NOT a chemical reaction?

- a. Frying an egg.
- b. Slicing carrots.
- c. A Macbook falling out of a window.
- d. Creating ATP in the human body.
- e. Dropping a fizzy tablet into a glass of water.

Answer

B and C

Summary

Chemical reactions can be identified via a wide range of different observable factors including change in color, energy change (temperature change or light produced), gas production, formation of precipitate and change in properties.

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