5th Grade - Lesson 3.5
Different Substances React Differently
Teacher Background

In Lesson 3.5, students investigate the difference in reactions between citric acid and calcium chloride when they are reacted with baking soda in a universal indicator solution. Students see the production of a gas and the formation of a precipitate, color change, and changes in temperature. All of these changes indicate that a chemical reaction occurred in both containers.

Clues of Chemical Change

The classic observable clues that a chemical reaction has occurred are:

- Production of a gas
- Temperature change
- Formation of a precipitate
- Change in color

Observing one or more of these changes is a clue that a chemical reaction may have taken place but may not be definitive. Sometimes a version of these clues can be the result of a *physical* change. The following are examples of physical changes that may seem to be clues of chemical change:

Production of a gas

Bubbles of carbon dioxide gas form when a carbonated beverage is poured into a glass. The bubbles rise to the surface of the glass and escape. It may look like gas is being produced, and one could easily believe that a chemical change is occurring. But this is a *physical* phenomenon of dissolved gas coming out of solution and rising as bubbles. No new substance is created, so a chemical reaction has not occurred.

Color change

Adding food coloring to water causes a change in color. The pigment molecules from the food coloring dissolve into the water and cause the color change. This is a *physical* change. Since no new substances are produced, no chemical reaction has taken place.

Change in temperature

If heat is added or removed from a substance, its temperature changes. But temperature change is not always a result of breaking or making bonds (a chemical reaction). When a substance is heated or cooled with an outside source, the particles move faster or slower resulting in an increase or decrease in temperature. Changing the speed of the particles in this way is a *physical* change. No new substances are produced; therefore, no chemical change occurred.

Precipitate

Sometimes combining two liquids, such as lemon juice and milk, can produce a curd-like solid. The acid in the lemon juice changes the pH of the milk. This causes proteins in the milk to clump together, creating curds. It could be argued that this change is mostly *physical* since it mainly involves the clumping together of proteins that are already in the milk. It could also be argued that there is no chemical change because no new substances are formed.

The production of a gas, a color change, a change in temperature, or the formation of a solid from two liquids indicates that a chemical reaction may have occurred. To find the definitive answer, further investigation is required.