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What’s in a Change?

The terms physical change and chemical reaction are thrown around a lot in science class, but what do each of these terms really mean?

During a physical change a new substance is not created. At the molecular level, the molecules you start with will not change. This means that the material you start with is the same as the material you end up with. Even though the material is the same it might have undergone a change in size, by crushing or cutting it, or a change in state of matter, starting as a solid but melting to a liquid. Sometimes we can observe a physical change when molecules dissolve in one another. For example, when we dissolve sugar in water, the water and sugar molecules are unchanged, but are now suspended next to one another.

Chemical reactions are different because the materials that go in are different from the materials that come out. This means that the starting materials, or reactants, can combine and rearrange themselves to make entirely new products. We can tell those new products apart because they will have different properties than the materials we started with. These changes can be indicated by a change in color, change in temperature, change in smell, formation of a gas, or formation of a precipitate. A precipitate is a product that is insoluble in the liquid, like when lemon is added to milk and the milk curdles. Precipitates can make the reaction turn cloudy, and if left in the liquid long enough, they will fall to the bottom of the reaction vessel.

While clues like change in smell and formation of a gas can be useful to indicate a chemical reaction, the only way to tell for sure is to test the properties of the reactants and the products. These properties can be physical, like the way it looks, or chemical, how it reacts with other substances. If a new substance is created it will have different physical and/or chemical properties from the reactants.

In the activities below, we will observe two combinations of materials: amylose ((C₆H₁₀O₅)ₙ) with water (H2O) and acetic acid (CH3COOH) with calcium carbonate (CaCO3). We will make observations to help us tell the difference between a physical change versus a chemical reaction.

Question:

If the reactant has the same properties as the product of an interaction, did a physical or chemical change occur? Why?

Materials Needed:

* Peg rack
* Amylose
* Water
* Calcium carbonate, rock and powdered
* Acetic acid
* Limewater
* Iodine
* ¼ tsp measure
* Funnel
* 2 Small bottles
* White weigh boat
* Rubber stopper with vinyl tubing
* Transfer pipettes
* Graduated cylinder
* Test tubes
* Permanent Marker

## PART 1 – Amylose ((C₆H₁₀O₅)ₙ) and Water (H2O)

Observing Physical and Chemical Properties of Reactants

1. View the amylose ((C 6H 10O 5) n ) and water (H2O) and record physical observations in Table 1 under “Physical Properties”.
2. With the ¼ tsp measure, sprinkle a small amount of amylose onto the white weigh boat.
3. Take two transfer pipettes and label one “I” for iodine and one “W” for water.
4. With the “I” pipette, add one drop of iodine to the white weigh boat.
5. Observe the iodine’s interaction with the amylose. Record the observed color in Table 1 under “Observed Color with Iodine”.
6. Take one test tube and label it “W” for water.
7. With the “W” pipette, add 1mL of water to tube “W”.
8. With the “I” pipette, add one drop of iodine.
9. Observe the iodine’s reaction with the water. Record the observed color in Table 1 under “Observed Color with Iodine”.

Observing Physical and Chemical Properties of Products

1. Take one new test tubes and label it “U” for the unknown product.
2. With ¼ tsp measure and funnel, add ¼ tsp of amylose to the small bottle.
3. With a graduated cylinder, measure 10mL of water. Pour this into the small bottle. Swirl to mix.
4. Record your physical observations of the unknown product in Table 2 under “Physical Properties”.
5. With the pipette labeled “W”, add 1mL of the unknown product from the bottle into test tube “U”.
6. With the “I” pipette, add 1 drop of iodine to test tube “U”.
7. Observe the reaction with iodine. Record the observed color in Table 2 under “Observed Color with Iodine”.

Quick Check:

Does the product have similar chemical properties to either of the reactants?

Can you still see the amylose when it was added to the water? When combined what did it make?

(Hint: Think of other times a powder is added to water, what is created?)

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| Table 1 | Physical Properties | Chemical Properties |
| Reactant | Color | State of Matter | Observed Color with Iodine? |
| Amylum ((C 6H 10O 5) n ) |  |  |  |
| Water (H2O) |  |  |  |

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| Table 2 | Physical Properties | Chemical Properties |
| Product | Color | State of Matter | Observed Color with Iodine? |
| Unknown |  |  |  |

## PART 2 – Calcium Carbonate (CaCO3) and Acetic Acid (CH3COOH)

Observing Physical and Chemical Properties of Reactants

1. View the calcium carbonate (CaCO3) and acetic acid (CH3COOH) and record your physical observations in Table 3 under “Physical Properties”.
2. Take two test tubes and label one “A” for acetic acid and the other “C” for calcium carbonate.
3. Take one pipette and label it “A” for acetic acid.
4. With the pipette labeled “L”, add 3mL of limewater into each test tube.
5. With the pipette labeled “A”, add 1mL of acetic acid to tube “A”. Record your observations in Table 3 under “Color Observed with Limewater”.
6. Add a small piece of calcium carbonate rock to tube “C”. Record your observations in Table 3 under “Color Observed with Limewater”.

Observing Physical and Chemical Properties of Products

1. Take a new test tube and label it “U2” for the unknown product.
2. With the pipette labeled “L”, add 3mL of limewater to tube “U2”.
3. With a graduated cylinder, measure 5mL of acetic acid. Pour this into the small flask/bottle.
4. Place the tubing from the rubber stopper into test tube “U” so it sits within the solution.
5. With ¼ tsp measure and funnel, add ¼ tsp of *powdered* calciumcarbonate to the screw top bottle and immediately cover it with the rubber stopper and view tube”U2”
6. Record your observations for “Color Observed with Limewater” in Table 4.
7. If necessary, add more acetic acid and powdered calcium carbonate to the small flask/bottle to observe the physical properties of the unknown product.

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| Table 3 | Physical Properties | Chemical Properties |
| Reactant | Color | State of Matter | Color Observed with Limewater |
| Calcium carbonate (CaCO3) |  |  |  |
| Acetic acid (CH3COOH) |  |  |  |

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| Table 4 | Physical Properties | Chemical Properties |
| Product | Color | State of Matter | Color Observed with Limewater |
| Unknown |  | Gas |  |

Quick Check:

Compare the unknown products to the reactants. Does the unknown product have different properties than the reactants? What type of change occurred: chemical or physical? Why?