Gizmos

Name: _____ Date: _____

# Student Exploration: Chemical Changes

**Vocabulary:** acid, base, catalyst, chemical change, coefficient, conservation of matter, decomposition, dissolve, double replacement, endothermic, exothermic, indicator, ion, physical change, product, reactant, single replacement, subscript, synthesis

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

1. A student mixes baking soda and vinegar in a glass. The results are shown at left. Do you think any new substances are being created in this mixture? If so, how do you know?

   _____

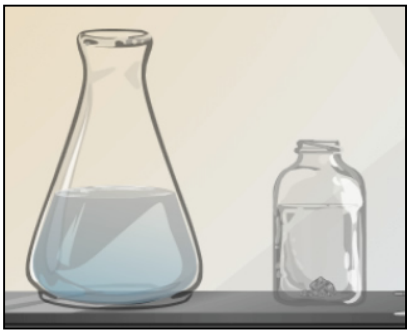
   _____

2. Suppose this was done on top of a balance. Do you think the mass would change as the reaction proceeded? _____

3. What do you think would happen to the mass if the reaction took place inside a sealed plastic bag? _____

**Gizmo Warm-up**

A **chemical change**, (or chemical reaction) occurs when one or more substances, called **reactants**, are transformed into different substances, or **products**. In the *Chemical Changes* Gizmo, you will look for evidence of chemical changes by looking at changes you can see, touch, or smell.



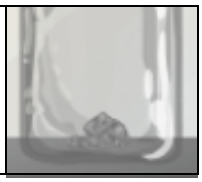
To begin, check that **Reactant 1** is **Sodium** and **Reactant 2** is **Water**. Sodium is a metal so soft you can cut it with a knife.

1. Click **Play** ( ). What do you observe? _____

   _____

2. Do you think a chemical reaction has taken place? Explain. _____

   _____

| **Activity A:**<br><br>**Observing chemical changes** | Get the Gizmo ready:<br>• Click **Reset** ( ). Check that the reactants are still **Sodium** and **Water**.<br>• Turn on the **Label reactants** checkbox. |  |
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**Introduction:** It is important to distinguish chemical changes, in which new substances are formed, from **physical changes**, which do not create new substances. In this activity, you will look at many kinds of evidence that chemists use to see if a chemical change has taken place.

**Question: What kinds of evidence indicate a chemical change has taken place?**

1. Observe: Some chemical reactions release heat, and others absorb heat. In an **exothermic** reaction, heat is released and the temperature of the system rises. In an **endothermic** reaction, heat is absorbed and the temperature of the system decreases.

   In the Gizmo, drag the **Thermometer** into the flask of water.

   A. What is the starting temperature? _____

   B. Click **Play**, and wait for the reaction to end. What is the final temperature? _____

   C. Was this reaction exothermic or endothermic? _____

2. Observe: Two families of chemicals are **acids** and **bases**. Acids and bases can be detected by an **indicator**, which is a substance that changes color in the presence of an acid or a base. Phenol red is an indicator that is yellow in an acid, orange in a neutral solution, and pink in a base.

   A. Click **Reset**. Drag the **Phenol red** next to the flask of water. What does the indicator show? _____

   B. Click **Play**, and wait for the reaction to end. What does the indicator show now?

   _____

3. Observe: Click **Reset**. Select the **Gas collection** setup. Chemists use this apparatus to collect any gases produced in the reaction. From the reaction flask, gases travel through a long tube and into a cylinder of water. As gases bubble into the cylinder, the water is displaced (removed) until the cylinder is filled with gas.

   Click **Play** and observe the cylinder. Was any gas produced in the reaction? _____

   How do you know? _____

**(Activity A continued on next page)**

**Activity A (continued from previous page)**

4. Analyze: One way to test what kind of gas is in the cylinder is to use a glowing splint. A glowing splint is a wooden stick that has been lit on fire and then blown out, resulting in a glowing, red-hot tip. The table shows how a glowing splint reacts to some common gases:

| **Gas:** | Carbon dioxide ($CO_2$) or ammonia ($NH_3$) | Oxygen ($O_2$) | Hydrogen ($H_2$) |
|---|---|---|---|
| **Splint reaction:** | Goes out | Burns brightly | Small explosion and "pop" sound |

   A. Drag the glowing splint next to the cylinder, and observe. What do you see?

   _____

   B. Based on the table above, what gas do you think was produced in this reaction?

   _____

5. Interpret: Turn on **Show chemical equation**. A chemical equation is a shorthand way to describe a chemical reaction. Symbols represent the elements: H for hydrogen, O for oxygen, and Na for sodium. The reactants are to the left of the arrow, and the products are to the right. For example, the equation $H_2 + O_2 \rightarrow H_2O$ shows that the reactants hydrogen and oxygen combine to form the product $H_2O$, or water.

   A. Look at the reaction shown in the Gizmo. What are the reactants in this reaction?

   _____

   B. What are the products in this reaction? _____

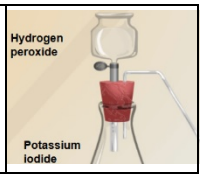
   These symbols represent sodium hydroxide and hydrogen gas. Sodium hydroxide is a strong base. (Chemicals that contain the hydroxide **ion** ($OH^-$) are bases.)

   C. How do the products of the reaction relate to the phenol red test and the splint test?

   _____

   _____

   _____

| **Activity B:**<br><br>**Conservation of matter** | Get the Gizmo ready:<br>• Click **Reset**. Select **Hydrogen peroxide** for **Reactant 1** and **Potassium iodide** for **Reactant 2**. |  |
|---|---|---|

**Goal: How does the mass change (or not change) during a chemical reaction?**

1. Review: In this reaction, hydrogen peroxide is added to a potassium iodide solution. Click **Play** and observe the reaction.

   A. What do you observe? _____

   B. What evidence do you see that a chemical reaction is taking place? _____

   _____

   C. Replay the reaction and use the available tools (**Thermometer**, **Phenol red**, and **Glowing splint**.) What do these tools indicate? (Note: You will need to switch to the **Gas collection** setup to use the splint.)

   Thermometer: _____

   Phenol red: _____

   Glowing splint: _____

2. Record: Click **Reset**, and change back to the **Normal setup**. Notice the mass shown on the electronic balance.

   A. What is the starting mass for this reaction? _____

   B. Click **Play**. What is the mass when the reaction has finished? _____

   C. How does the mass change in this reaction? _____

3. Record: Click **Reset**, and select the **Gas collection** setup. Notice that this setup is heavier than the normal setup, but the amounts of reactants is the same.

   A. What is the starting mass for this reaction? _____

   B. How do you think the mass will change during the reaction? _____

   _____

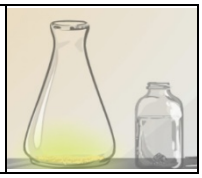
   C. Click **Play**. What is the mass when the reaction has finished? _____

**(Activity B continued on next page)**

**Activity B (continued from previous page)**

4. Explain: Why do you think that mass was lost when the reaction was done in the normal setup, but stayed the same when the reaction was done in the gas collection setup?

A fundamental law of chemistry is **conservation of matter**. This law states that, in a chemical reaction, matter can neither be created nor destroyed. That means that, as long as nothing escapes from the system, the total mass measured at the start of the reaction will be the same as the total mass at the end of the reaction.

| | | |
|---|---|---|
| **Activity C:**<br><br>**Role of Energy** | Get the Gizmo ready:<br>• Click **Reset**. Select **Normal setup**.<br>• Select **Sodium** for **Reactant 1** and **Chlorine** for **Reactant 2**. |  |

**Goal: Explore, observe, and classify a variety of chemical reactions.**

1. Observe: In this reaction, a small piece of sodium is added to a flask containing poisonous chlorine gas which has a yellowish color, and sand. Water is added to start the reaction.

   A. Click **Play**. What happens? _____

   _____

   B. Try the experiment with the **Thermometer**. What happens to the temperature? What does this indicate? _____

   C. Run the experiment one more time, this time watching the mass. What do you notice? _____

   D. Repeat the experiment, this time in the **Closed system**. How does the mass change during the reaction now? _____

2. Challenge: Turn on **Show chemical equation**. In this reaction, solid sodium reacts with chlorine gas to form solid sodium chloride (NaCl), also known as table salt.

   How does this explain the normal setup increase in mass during the reaction? _____

   _____

3. Observe: Select **Ammonium nitrate** for **Reactant 1** and **Water** for **Reactant 2**. Add the **Thermometer** to the flask and click **Play**.

   A. What do you observe? _____

   B. Whet happens to temperature? _____

   C. What is the equation for this process? _____

   In this example, ammonium nitrate ($NH_4NO_3$) **dissolves** in water, producing ammonium ($NH_4^+$) and nitrate ($NO_3^-$) ions. Chemists do not all agree about whether this is an example of a physical change or a chemical change.

**(Activity C continued on next page)**

**Activity C (continued from previous page)**

4. Demonstrate learning: Choose an interesting reaction in the Gizmo. Use the available tools to make observations, and use what you have learned so far to draw conclusions about the reaction. Describe your findings below. (If necessary, continue on a second sheet of paper.)

   Reaction: _____

   Findings: _____

   _____

   _____

   _____