Clues of a Chemical Reaction

Think about This

Molly thought it was confusing trying to tell the difference between physical and chemical changes. She knew chemical reactions were changes that produced new chemicals. She found it helpful to look for the clues of a chemical reaction: temperature changes, bubbles, color changes, and chemicals that won't dissolve. Keep these clues in mind as you do these activities.

Combustion is an example of a chemical change.

Procedure & Observations

Part I:

Place about ½ cup of water in a clear glass container. The water should be room temperature. Feel the container. Add a piece of an effervescent tablet to the water. After about 15 seconds, feel the container again. Is it warmer or cooler than it was before?

Write your observations of what happened when you added the effervescent tablet to the water.

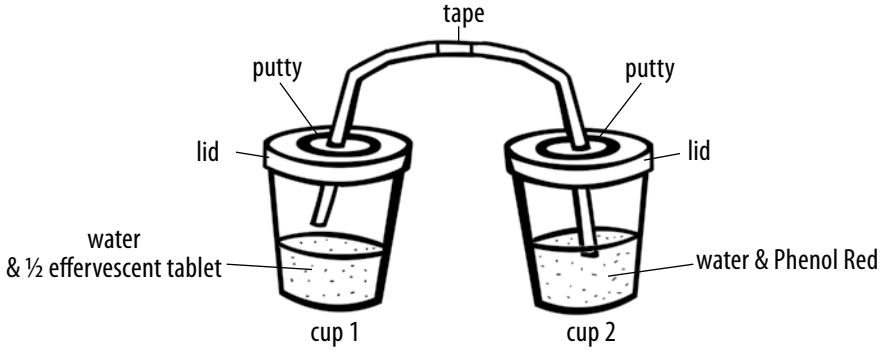
What are two clues that would make you think a chemical reaction had taken place?

The Investigative Problems

What are some examples of chemical reactions? What are some clues that a reaction has occurred? What clues do you observe?

Part II:

Insert a straw into the cup lid. Seal the space around the straw with putty or soft modeling clay. Fill the cup half full of water. Prepare a second cup in the same way, but add a few drops of Phenol Red to the water. Put the lid on the second cup. Push the two straws together and connect them with a piece of tape, so that there won't be a leak. Put ½ of an effervescent tablet into the first cup. Quickly put the lid and straw over the opening.



As much as you can, observe evidence of bubble formation and color changes. Note any sounds you hear as well. After a few minutes, remove the lid to the cup with the Phenol Red. What color is the solution now?

Can you tell that changes occurred in both cups? Record your observations.

What clue would make you think a chemical reaction had taken place in the cup with the Phenol Red?

Part III:

Your teacher will give you two liquids. One of these was produced by soaking three tea bags in a steel wool pad in a cup of vinegar overnight. The other one is a strong solution of tea made by steeping a cup of hot water. After recording your observations of the two liquids, mix a little of each in a clear plastic cup. What clue would make you think a chemical reaction had taken place? (Caution: Be careful when handling this. It is like permanent ink that doesn't wash out of clothing!)

Part IV:

Add a spoonful of liquid dishwasher detergent to a half cup of water. Add a spoonful of Epsom salts to another half cup of water. Combine the two solutions in a clear plastic cup. Observe how the two solutions look before they are combined. Then observe how the solution looks after they are combined.

The Science Stuff

Both physical and chemical changes occur all around us. In **physical changes**, the substance keeps its primary properties. The arrangement of the substance's atoms and molecules remain the same. In **chemical changes**, there is a rearrangement of the **atoms** and **molecules**. These new substances will have different properties than the original chemicals.

There are four clues that are often present when a chemical change (reaction) takes place. These clues are a temperature change, formation of bubbles, a color change, and the formation of a chemical that won't dissolve in the solution. Changes in chemical indicators may also be a clue of a chemical change.

When you added an effervescent tablet to water, the temperature changed and the liquid became colder. At the same time, you saw bubbles rising to the surface, indicating that a gas had formed during the reaction.

When effervescent tablets and water react, carbon dioxide gas is formed. You should remember that carbon dioxide and water react to form carbonic acid, a weak acid. When carbon dioxide is transferred to a solution of water and Phenol Red, carbonic acid begins to form. This causes the Phenol Red indicator to change colors. The color change in this case showed that the solution changed from a neutral solution to a weak acidic solution.

Soaking a steel wool pad in vinegar frees up particles of iron and keeps the iron from combining with oxygen to make iron rust. When the tannic acid in the tea combines with iron, it forms a compound called ferrotannate, similar to a chemical that was used for hundreds of years as ink for quill pins. The color change is a clue that a chemical reaction took place. **Be careful not to get this chemical on your clothes!** (Optional: Use a cotton swab to write something on a piece of paper with the steel wool solution. After its dries, put another cotton swab in the tea and rub all over the paper. The writing will appear. Let this dry and see if you can wash the writing off with a little water.)

When a solution of Epsom salts is combined with liquid dishwasher detergent, a new chemical forms that doesn't dissolve in the solution. The formation of an insoluble chemical is another clue that a chemical reaction occurred.

Dig Deeper

The chemical that was used for many years as an ink for writing on paper was ferrogallotannate. It was produced by grinding up oak galls with iron in a liquid solution. The oak galls contained gallic and tannic acids. The ink darkened as it further reacted with oxygen in the air. Various writing instruments have been used in American history. See if you can find more about what was used in the 1700s to write letters, to make documents, and to do homework.

Hundreds of years ago, the field of chemistry was advanced by an unlikely group known as alchemists. They performed many experiments trying to turn iron and other metals into gold. Even though the alchemists were wrong about many of their ideas, they still contributed to the field of science. See if you can find some of the ways they helped to advance science.

Put an unbroken, uncooked egg in a pint of vinegar. Put another unbroken, uncooked egg in a pint of water. Observe for several minutes. Leave the eggs in the liquids for a day or two until the shell of one of the eggs is removed. Take the eggs out of the containers and observe them carefully while wearing safety glasses. Write your observations. The eggshells are made of calcium carbonate. Find the name of the acid in vinegar. On the basis of what you learned in this lesson, in which container was there a chemical reaction? Tell why you think this. Try to determine what changes may have taken place. **CAUTION: Raw eggs that are left outside of the refrigerator can be a source of bacterial growth. Wash your hands with antibacterial soap any time you contact the eggs and dispose of the eggs properly when you finish your experiment.**

Making Connections

There are chemical changes all around you. Burning a candle, the rusting of iron, baking a cake, and combining a metal with an acid are all examples of chemical changes. Although you can't see this, the process of digestion in your body involves a series of chemical changes. Other chemical changes also occur as your body combines food and oxygen to release energy. Green plants combine carbon dioxide and water in a complex series of chemical changes to make glucose and other foods. The processes of making nylon, synthetic rubber, Styrofoam, and plastics also involve chemical changes.

What Did You Learn?

1. State which of the following changes are chemical changes: boiling water, freezing water, adding vinegar to baking soda, dissolving salt in water, combining an acid and a base.
2. A forensic scientist wants to know if a certain chemical is present. When a few drops are added to a solution, an insoluble substance forms that is a bright yellow. Is it likely that a chemical change occurred?
3. What is the difference between a physical change and a chemical change?
4. A piece of zinc is added to a test tube containing hydrochloric acid. Bubbles start to rise in the tube and the tube begins to feel warm. Is it likely that a chemical change occurred?
5. Suppose you have an unknown gas and you allow a small amount of the gas to bubble through a solution of limewater. What would happen if the gas was carbon dioxide?
6. What are four clues that a chemical reaction has taken place?