



Chemistry

BACKGROUND INFORMATION

The Main Points

- Chemistry is the study of the composition, structure, and properties of substances and their behavior under different conditions.
- Each of the more than 100 known elements has a unique kind of atom.
- Elements can combine chemically to form compounds.
- When different substances are put together, but do not combine chemically, a mixture is formed.
- The chemical and physical properties of substances affect their uses.

Activities

5. pHact Finder pHun
6. Testing: One, Two, Three

Chemistry is the study of the composition, structure, and properties of substances and their behavior under different conditions. Many aspects of our daily lives involve chemistry. Cooking and cleaning rely on chemical reactions. The production of food and manufacture of clothing are linked to chemistry. The materials used to construct houses and other buildings, and to build vehicles, appliances, and other goods all use the products of chemistry. It is important for us to know the chemical properties of common liquids and powders.

The way substances are formed, their properties, and their behavior under different conditions are the subjects of the science of chemistry. Some information about the chemical as well as physical properties of substances can be obtained by using our senses of sight, hearing, taste, touch, and smell. In *pHact Finder pHun* and *Testing: One, Two, Three*, participants will use their senses to detect chemical reactions and learn about chemical and physical properties of some common substances. When colors change, gas or an odor is produced, or a temperature change occurs, we know that a chemical reaction has probably occurred. The changes that occur during the chemical reaction provide information about the properties of the substances involved in that reaction. Some changes do not involve chemical changes. When a substance changes, but its chemical makeup is not altered, that change is called a physical change. For example, breaking up a sugar cube changes its form but does not alter the sugar



chemically. However, if you mix that sugar cube, warm water, and yeast together, the sugar will change chemically as the yeast consumes it.

If you were to break a substance into its smallest unit that is still that substance, you would be left with a molecule. If you were to further break the molecule into its parts, you would have the atoms that make up that molecule. For example, a water molecule can be broken down into its components—the atoms of hydrogen and oxygen.

Every living and non-living thing is made up of elements. **Each of the more than 100 known elements has a unique kind of atom.** Each kind of atom contains three parts: protons, neutrons, and electrons. Protons and neutrons are found in the center of atoms (also called the nucleus), and electrons whirl around the nucleus, somewhat like satellites orbiting Earth. The number of protons, neutrons, and electrons that make up the atoms of each element defines that element and gives that element its special properties. Those properties determine how substances change when heated or cooled or when combined with other elements or compounds.

Atoms can be combined to form molecules. New compounds are formed when elements react with one another. These reactions are chemical processes by which the initial substances, called reactants, are changed to create a different compound, called the product.

When different substances are put together, but do not combine chemically, a mixture is formed. A mixture can be separated easily into its components. A solution is a kind of mixture. A solution is formed when one substance dissolves in another substance. The substance that is dissolved is called the solute. The liquid in which the solute is dissolved is called the solvent. For example, a solution of salt and water is a mixture in which salt is the solute and water is the solvent. In this mixture, salt can easily be separated from the water by simply evaporating the water and leaving the salt behind. When a substance will not dissolve in another substance, we say that it is insoluble. Another kind of mixture of solids in a liquid is called a suspension. In a suspension, the solids and the liquid are not evenly mixed. As a result, suspensions often look cloudy when they are stirred. For example, if you put soil in water, the soil is insoluble and will make the water look cloudy. In *Testing: One, Two, Three*, participants will discover that some common household powders are insoluble, whereas others dissolve in water.

In *pHact Finder pHun*, the youth will use indicators to determine if common liquid substances are acids or bases. An acid is a substance that contains unattached, positively-charged hydrogen (H^+) atoms. A base is a substance that has unattached hydroxyl ions (OH^-). A hydroxyl ion is a negatively charged group made up of one atom each of oxygen and hydrogen. Ions are charged atoms (refer to the *Background Information* on Electricity and Magnetism on p. 1). An indicator is a special substance that changes color in the presence of hydrogen ions or hydroxyl ions. The color change tells whether that substance is an acid or a base.

The chemical and physical properties of substances affect their uses. By categorizing liquids and powders by their chemical and physical properties, participants will notice the relationships between those properties and the common uses of the substances tested.

Other Resources

Check out these books for some more fun activities about chemical properties.

Barber, Jacqueline. 1986. *Great Explorations in Math and Science (GEMS) Guide: Chemical Reactions*. Lawrence Hall of Science, University of California, Berkeley, CA.

Bosak, Susan V. 1991. *Science is... A Source Book of Fascinating Facts, Projects and Activities*. 2nd Edition. Scholastic Canada Ltd., Ontario, Canada.

Hixson, B.K. 1989. *Zero to Einstein in 60*. The Wild Goose Company, Salt Lake City, UT.

Sarquis, Jerry L., Mickey Sarquis, and John P. Williams. 1995. *Teaching Chemistry with Toys: Activities for Grades K-9*. Terrific Science Press, Middletown, OH.

Visit these websites to explore pH and other chemistry concepts through a variety of great resources and activities.

<http://www.lhs.berkeley.edu/Exhibitscm.html>

<http://falcon.miamisci.org/ph/>

<http://www.acs.org/edu/gen2/education/ws/wsactiv2/tolumps.htm>

<http://www.rohmhaas.com/company.dir/plabs.dir/plabexp.htm>

This chemistry site was created by high school students.

<http://tqd.advanced.org/3310/>

This site provides links to many other chemistry and related websites.

<http://rampages.onramp.net/~jaldr/item03.html>