Chapter 1 Matter

Introduction

Chapter 1 introduces the study of ***matter***. This may be the first exposure that some students have had to chemistry. The chapter begins by defining matter and giving examples. The idea that protons, neutrons, and electrons are joined in various combinations to create all the ***elements*** in the universe is introduced. ***Compounds***, which are two or more elements chemically combined, are contrasted with mixtures, which are two or more elements physically combined. The chapter then moves on to teaching students how to identify the differences between ***chemical changes*** and ***physical changes***. In addition, students learn about solutions, how to calculate the ***density*** of a substance, and trace the movement of energy through a chemical reaction. Factors that affect chemical reactions, such as particle size and temperature, are also discussed along with the fact that matter cannot be created nor destroyed through ordinary processes.

Students Should Understand the Following Concepts

- Matter can exist in three phases: solid, liquid, or gas. Matter is anything that takes up space and has mass.
- Elements are substances that cannot be broken down into simpler substances that retain their characteristics. Compounds are two or more elements that are chemically combined. Compounds can be broken down by chemical reactions.
- *Atoms* are made up of a combination of protons, neutrons, and electrons.
- Matter can change physically or chemically. A chemical change creates a new substance with new properties. Mixtures of elements do not involve chemical changes and therefore do not create new substances. *Solutions* are examples of mixtures. Mixtures, such as solutions, can be separated by physical means, such as evaporating away the *solvent* or filtering out the *solute*.
- The *density* of a substance is calculated by dividing the *mass* of a substance by the *volume* it occupies. The density of water is 1 g/cm^3, or 1 g/mL.
- Matter cannot be created nor destroyed by a chemical reaction. Energy can be transferred between substances in a chemical reaction. The rate of a chemical reaction depends on factors such as temperature and the size of the particles reacting.

Activities to Develop the Topic

Use one or more of the following activities to help your students review this topic.

The idea that matter cannot be created nor destroyed is an important one and possibly a counterintuitive one to students at this age. Everyone has probably observed a log burning in a fire and seen that not much matter appears to remain after the fire. Write the fact that matter cannot be created nor destroyed on the chalkboard before your class comes in. Once class begins, ask them to read the board. Choose a student to measure the mass of a wood splint. Record the mass on the board. Then set the wood splint on fire under controlled conditions. Once the wood splint has finished burning, have the student measure the mass of the remains. Write the mass on the board.

Compare the two masses. Ask the class to explain how the sentence on the board could be correct even though the data seems to indicate otherwise. Allow them some time to think about it and discuss possibilities. Once they arrive at the

correct answer, explain that they have just explained the Law of Conservation of Matter.

Be sure that students consult the Periodic Table while completing this chapter. Explain that everything that they see in the classroom, everything that they see on their walk home from school, and everything that they see on television is made up of the combinations of the elements on the Periodic Table.

Have students research the chemical composition of some common substances such as ammonia, gasoline, chalk, sugar, and salt. Have the students report their results. Discuss compounds and mixtures with numerous examples of each. One good example for solutions and mixtures is iced tea made from canned mix. Ask students to decide whether powdered sugar or sugar cubes would be faster at making the iced tea sweeter. Then discuss the effect that particle size has on reactivity. Next, have students consider hot tea compared with cold tea. Lead a discussion in which they decide which one can be made sweeter and why that result occurs. Finally, discuss why ice floats in iced tea, and talk about density.

Name _____ Date _____

Class _____

Review of Chapter 1

1. Which of the following is not considered to be matter?
   (1) air (3) water
   (2) light (4) rock

2. The subatomic particle that has a positive charge and is found in the nucleus of an atom is the
   (1) proton (3) electron
   (2) neutron (4) compound

3. Which of the following is not considered to be an element?
   (1) Ca (3) Al
   (2) Mg (4) CO

4. The elements on the Periodic Table are arranged according to
   (1) their number of neutrons (3) their atomic numbers
   (2) their atomic masses (4) the alphabet

5. The elements that usually do not react with other elements belong in a group known as the
   (1) nonmetals (3) noble gases
   (2) semimetals (4) isotopes

6. The smallest unit of an element is an atom. The smallest unit of a compound is a
   (1) molecule (3) neutron
   (2) mixture (4) nucleus

7. Which of the following is not a mixture?
   (1) air (3) salt water
   (2) blood (4) ammonia

8. How are respiration and burning similar?
   (1) They both involve the release of energy.
   (2) They both involve a transfer of neutrons.
   (3) They both involve the absorption of energy.
   (4) They both occur regularly inside organisms.

9. What is unique about the element mercury?
   (1) It can change directly from a solid to a gas.
   (2) It does not react with any other element on the Periodic Table.
   (3) It is the only metal that is a liquid at room temperature.
   (4) It contains a great deal of energy stored in chemical bonds.

10. What are the two main differences between the solid and gas phases?
   (1) Solids have definite shapes and volumes whereas gases have definite shapes but no definite volumes.
   (2) Solids have definite shapes and volumes whereas gases have no definite shapes or volumes.
   (3) Solids have definite shapes and volumes whereas gases do not have definite shapes but do have definite volumes.
   (4) Particles in a gas move much slower than those found in a solid.

11. In terms of the gain or loss of energy, the phase change most similar to condensation is
   (1) evaporation
   (2) boiling
   (3) melting
   (4) freezing

12. The temperature at which condensation occurs for a substance is the same as the substance's
   (1) melting point
   (2) freezing point
   (3) boiling point
   (4) solidification point

13. A mixture in which the components remain evenly distributed is called a
   (1) solute
   (2) solvent
   (3) solution
   (4) compound

14. As the temperature of a solvent increases,
   (1) its ability to dissolve solids increases
   (2) its ability to dissolve gases increases
   (3) its reactivity decreases
   (4) the solute will always become insoluble

15. A metal cube has a mass of 16 g and a density of 2 g/cm^3. How much space does the cube occupy?
   (1) 8 cm^3
   (2) 32 cm^3
   (3) 128 cm^3
   (4) 4 cm^3

16. Evaporating and filtering are used to
   (1) chemically separate compounds
   (2) physically separate mixtures
   (3) create new compounds
   (4) determine the density of a compound