

SCIENCE 803

CHANGING MATTER

CONTENTS

I. MATTER AND CHANGE	2
Physical Change	4
Chemical Change	12
Nuclear Change	19
II. ACIDS	24
Properties of Acids	25
The Hydrogen Ion	26
Indicators	28
PH of Acids	31
III. BASES	33
Properties of Bases	34
The Hydroxyl Ion	35
Indicators	36
PH of Bases	39
IV. SALTS	42
Neutralization	42
Uses of Salts	44

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CHANGING MATTER

In Science LIGHTUNIT 802 you learned something about the structure of matter and the different properties of various kinds of matter. Frequently when you put two kinds of matter together, a definite change occurs. These changes are sometimes simple and sometimes very complex. Although only 106 elements are known, these elements combine with each other to form thousands of compounds. Compounds combine to form still other compounds. The study of chemistry attempts to unfold the many ways matter changes as it combines. In this LIGHTUNIT you will learn about matter in change and about three common chemical compounds: acids, bases, and salts.

Are you matter? You surely are! You are made up of a variety of compounds which contain the elements carbon, hydrogen, oxygen, and nitrogen. Are you changing?

The answer again is yes! Your body is in constant change, particularly as you pass through the teens. What about your spiritual growth? If you are a Christian, are you growing? Do you have areas in your life you would like to have changed? Most people do. Since God's Word is the source of truth and life, why don't you do a spiritual experiment as you progress through this LIGHTUNIT? Read Joshua 1:8* once a day while you are working on this LIGHTUNIT and do what it says. First, repeat this prayer to your heavenly Father right now.

Dear heavenly Father, I thank You for Your Word and for sending the Saviour. Guide me as I read and say Your Word each day. I believe that as I meditate and obey I will be successful. As I study about Your great Creation in change, I believe Your Spirit will reveal areas in my life that You would like to help me change. Thank You for doing this. In Jesus' name, . . . Amen.

*Joshua 1:8—This book of the law shall not depart out of thy mouth; but thou shalt meditate therein day and night, that thou mayest observe to do according to all that is written therein: for then thou shalt make thy way prosperous, and then thou shalt have good success.

OBJECTIVES

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIGHTUNIT.

When you have finished this LIGHTUNIT, you should be able:

1. To define physical change.
2. To list three examples of physical change.
3. To define chemical change.
4. To describe a way by which a liquid may be tested to see if it is acid, base, or neither.
5. To state the differences among evaporation, condensation, dissolving, and distillation.
6. To define nuclear change.
7. To list three kinds of radiation given off by radioactive matter.
8. To compare and contrast fission and fusion.
9. To name an instrument used to detect and study radiation.
10. To state two properties of an acid.

11. To identify the chemical formula for several acids.
12. To list three examples of an acid.
13. To name three common uses of acids.
14. To explain two properties of a base.
15. To list three examples of a base.
16. To identify the chemical formula for several common bases.
17. To explain neutralization.
18. To list four uses of salts.
19. To explain the difference between hard and soft water.

Survey the LIGHTUNIT. Ask yourself some questions about this study. Write your questions here.

I. MATTER AND CHANGE

Change is all around us. The world is constantly changing. In winter, water changes from a liquid to a solid on lakes and streams. Clothes on the wash line change from wet to dry. Lead solder changes when heated. Silver tarnishes from shiny to black. Dead plants and animals change with decay. Your body grows and you change to larger clothes. A popsicle melts in the sun. All these examples describe changes in matter.

Matter changes in many different ways. Scientists put all changes in matter into three groups: physical changes, chemical

changes, and nuclear changes. Describing physical, chemical, and nuclear changes is what this section is about. As you learn how matter changes, think about how you are changing. You are certainly growing physically. Are you growing spiritually? God wants us to grow and change spiritually as well as physically. Ephesians 4:15 states that we are to grow up in all aspects unto Him, who is the head, even Christ. "But speaking the truth in love, may grow up into him in all things, which is the head, even Christ."

SECTION OBJECTIVES

Read these objectives. When you have completed this section, you should be able:

1. To define physical change.
2. To list three examples of physical change.
3. To define chemical change.
4. To describe a way by which a liquid may be tested to see if it is acid, base, or neither.
5. To state the differences among evaporation, condensation, dissolving, and distillation.
6. To define nuclear change.
7. To list three kinds of radiation given off by radioactive matter.
8. To compare and contrast fission and fusion.
9. To name an instrument used to detect and study radiation.

VOCABULARY

Study these words to enhance your learning success in this section.

calorie (kal' or ē). The quantity of heat required to raise the temperature of 1 gram of water 1° C.

composition (kom' pu zish' un). The makeup of anything.

condensation (kon' den sā' shun). Act of changing a vapor or gas to a liquid.

decompose (dē' kum pōz'). To decay, rot.

dissolve (di zolv'). To become liquid by breaking up into parts.

distillation (dis' tu lā' shun). To heat and condense the vapor (gas) given off.

electron (i lek' tron). A small particle of an atom with a negative charge.

evaporation (i vap' u rā' shun). To change from a liquid to a vapor or gas.

fission (fish' un). The splitting of the nucleus of an atom into two parts.

fusion (fyū' zhun). A joining together of two lightweight atoms with an energy release.

nuclear (nü' klē ur). Having to do with the nucleus of an atom.

oxidation (ok' su dā' shun). Process of combining an element with oxygen.

product (prod' ukt). The end result of a chemical reaction.

radioactive (rā' dē ō ak' tiv). Giving off radiant energy in the form of alpha particles, beta particles, or gamma rays.

soluble (sol' yu bul). Capable of being dissolved in a liquid.

subscript (sub' skript). Written underneath or below.



Note: All vocabulary words in this LIGHTUNIT appear in **boldface** print the first time they are used. If you are unsure of the meaning when you are reading, study the definitions given.

Pronunciation Key: hat, āge, cāre, fār; let, ēqual, tèrm; it, ĭce; hot, ōpen, ōrder; oil; out; cup, pūt, rŭle; child; long; thin; /FH/ for then; /zh/ for measure; /u/ represents /a/ in about, /e/ in taken, /i/ in pencil, /o/ in lemon, and /u/ in circus.

PHYSICAL CHANGE

Have you had to cut up wood into small pieces for a fire? Cutting the larger pieces of wood into smaller ones changed the appearance of the original piece of wood. This kind of change is called a physical change. In this section you will study various ways changes occur and how heat is important in many of these changes.

Change in the properties. A physical change can be a change in the size and shape of a substance. Hardness, mass, and

density are physical properties, which may be involved in a physical change. Sodium metal can be cut with a knife because it is very soft. Hydrogen is a light gas. Chlorine is a green gas that is heavier than air. Sugar is sweet. These properties are physical. In a physical change, the kind of matter does not change. No new substance is formed. No properties are changed. Therefore, a physical change is a change in the physical properties of a substance without a change in its chemical **composition**.



Try this activity.



These supplies are needed:

paper
lump or spoonful of sugar
small glass of drinking water

soda cracker
stirring rod or spoon



Follow these directions and answer the questions. Put a check mark in the box when each step is completed.

- ☐ 1. Get a glass of safe drinking water and take a swallow. (Note the taste, if any.)
- ☐ 2. Place a lump of sugar in the remaining water.
- ☐ 3. Stir the water a few times.
- ☐ 4. Taste the water. (Note taste and difference, if any.)
- ☐ 5. Now tear a piece of paper into several pieces.
- ☐ 6. Crumble a soda cracker over a sheet of paper.

1.1 Explain the change that occurred in each case (4, 5, 6)? Use complete sentences. _____

1.2 a. What are these kinds of changes called? _____

b. Why do you say this? _____



Follow these directions.

1.3 List four physical properties of matter.

a. _____

c. _____

b. _____

d. _____

Δ1.4 Write one example of a physical change. _____



Write true or false.

1.5 _____ A physical change involves a change in composition.

1.6 _____ A physical change creates a new substance.

1.7 _____ A change in appearance is a part of a physical change.

Physical states. All substances exist as either a solid, liquid, or gas. Some substances may exist at one time or another as all three states—gas, liquid, or solid. When the liquid (water) freezes, it becomes the solid state (ice). When the solid melts, it becomes a liquid. The liquid state (water) escapes into the air in the form of the gaseous state (water vapor). Water vapor in the air can change to liquid water inside a car and fog the windows. Each case is a physical change of the state of matter.

A change in the state of a substance is explained by the *kinetic theory*. The kinetic theory states that the particles of a substance are in motion. When heat is added to matter, the particles, atoms, or molecules, move faster. If heat is removed, the particles in the substance slow down. In a change of state,

particles either separate or move closer together. They may become more attracted to each other or less.

Physical properties can change *without* a change of state occurring.

Change within a state. If you hold a copper wire in a flame, the wire gets hot; but that isn't the only effect of heat. If you were to measure the copper wire before and after it was heated, you would have found that the heated wire is a little longer and thicker while it is hot. When a solid such as copper wire is heated, it *expands*. Different solids expand different amounts. Figure 1 shows how different solids expand when heated. Each of the rods expanded to a different length. The taller the column, the more the solid listed expanded.

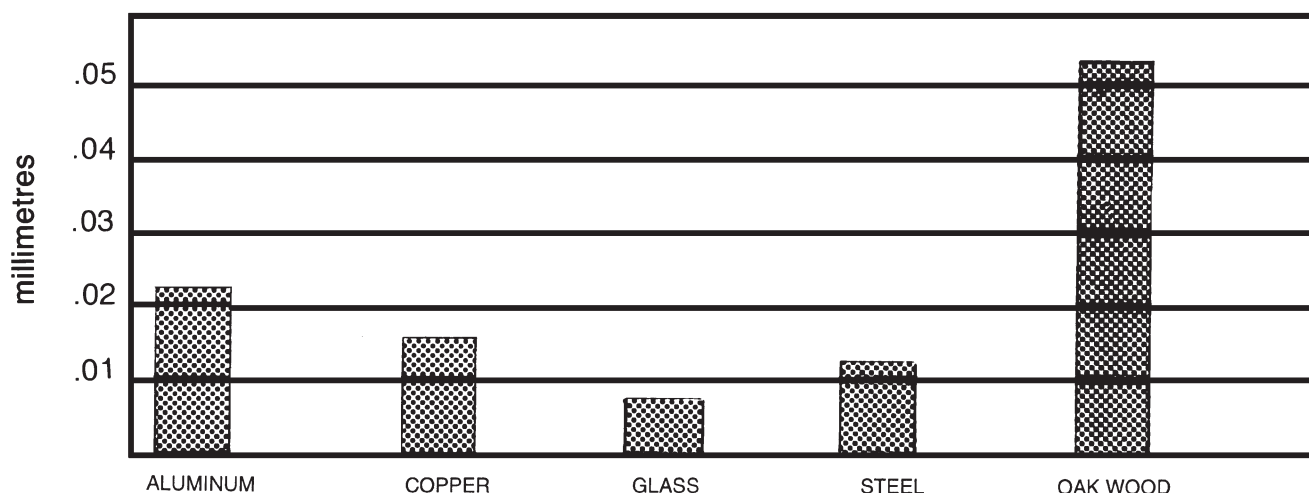


Figure 1: Thermal Expansion of Solids