LIFEPAC®

SCIENCE

STUDENT BOOK

8th Grade | Unit 1

Alpha Omega
PUBLICATIONS

SCIENCE 801
Science and Society

LIFEPAC Test is located in the center of the booklet. Please remove before starting the unit.

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Science and Society

Introduction

In our world today we are aware of new discoveries and inventions in every area of life. A cure for a disease, a pollution-control device for cars, a new type of toy, all point to the fields of science and technology. We owe most of the comforts, conveniences, and pastimes of modern living to these fields.

In this LIFEPAC® you will learn some of the backgrounds of science and technology and the ways in which scientists and technicians proceed with their work. You will study the history of science and technology, the scientific method, systems of measurement, and advances in science and technology. We will also discuss a few of the great variety of products of science and technology.

You will enjoy this LIFEPAC and the activities it contains. It deals with ideas and experiences that are familiar to you. Science and technology are noble professions when God is given the glory.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAC. When you have finished this LIFEPAC, you should be able to:

1. Define *science* and *technology*.
2. State the major points in the history of science and technology.
3. List the steps of the scientific method.
4. Demonstrate the use of basic principles of scientific measurement.
5. Name at least two goals of science and technology.
6. Explain why science and technology are limited.
7. Discuss at least one problem being created by technology and one problem being solved by technology

1. SCIENCE TODAY

Science today is based on the work of great people in the past. Those individuals did not stand by and allow others to accomplish their tasks, they had ideas, and they put those ideas into action. In this section we will learn what science is and what we owe to the scientists of yesterday. Then we shall consider how scientists do their work today.

SECTION OBJECTIVES

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

1. Define *science* and *technology*.
2. State the major points in the history of science and technology.
3. List the steps of the scientific method.
4. Demonstrate the use of basic principles of scientific measurement.

VOCABULARY

Study these words to enhance learning success in this section.

alchemy (al´ ku mē). The attempt to change base metals into gold by a mixture of science and magic.

atom (at´ um). A building block of all matter.

base metals (bās met´ ulz). Metals less valuable than gold.

electron (i lek´ tron). A negatively charged atomic particle.

evolution (ev u lü´ shun). The theory that all organisms develop from simpler organisms.

experimentation (ek sper´ u men tā´ shun). Doing repeated tests to prove a scientific fact.

exponent (ek spō´ nunt). The power to which a number is raised.

gram (gram). The standard metric unit of mass.

hypothesis (hī poth´ u sis). A probable answer to a scientific problem.

law (lô). A proven scientific fact.

liter (lē´ tur). The standard metric unit of volume.

meter (mē´ tur). The standard metric unit of length.

metric system (met´ rik sis´ tum). A system of measurement based on the number ten.

neutron (nü tron). A neutral atomic particle.

organism (ôr´ gu niz um). An individual animal or plant.

philosopher (fu los´ u fur). A person who is guided in his life by the principle that humans are rational and social beings.

poliomyelitis (po´ lē ō mī´ u lī´ tis). A crippling disease.

proton (prō´ ton). A positive atomic particle.

Renaissance (ren´ u säns). The rebirth of true learning.

scholastics (sku las tiks). Medieval individuals who catalogued the ideas of ancient philosophers.

science (sī´ uns). Orderly knowledge demonstrated by repeatable tests.

scientific method (sī´ un tif ik meth´ ud). The nine steps a scientist uses in his work.

scientific notation (sī´ un tif ik nō tā´ shun). A system of writing numbers less than 0.1 and greater than 100 as a multiple of a power of 10.

second (sek´ und). The standard unit of time.

significant figures (sig nif´ u kunt fig´ urz). Those digits in a number that have true value.

species (spē´ shēz). A group of animals or plants that have characteristics in common and are able to interbreed.

summa (süm´ u). An encyclopedia-like document written by a scholastic.

theory (thē´ ur ē). A probable solution to a scientific problem.

Note: *All vocabulary words in this LIFEPAC appear in* **boldface** *print the first time they are used. If you are not sure of the meaning when you are reading, study the definitions given.*

Pronunciation Key: h**a**t, **ā**ge, c**ã**re, f**ä**r; l**e**t, **ē**qual, t**ėr**m; **i**t, **ī**ce; h**o**t, **ō**pen, **ô**rder; **oi**l; **ou**t; c**u**p, p**u̇**t, r**ü**le; **ch**ild; lo**ng**; **th**in; /*ŦH*/ for **th**en; /*zh*/ for mea**s**ure; /*u*/ represents /*a*/ in **a**bout, /*e*/ in take**n**, /*i*/ in penc**i**l, /*o*/ in lem**o**n, and /*u*/ in circ**u**s.

A DEFINITION OF SCIENCE

Let us develop a definition for the word **science**.

Knowledge. The word *science* comes from a Greek word meaning *knowledge*. It is not enough, however, to state that science is knowledge, for many other areas come under this heading. If we add *orderly* to the word *knowledge*, we have narrowed our definition of science somewhat. Science is orderly knowledge. The statement "Ducks can swim, bears sleep in winter, and skunks smell," is correct; these facts are knowledge. The statement "Different animals have certain characteristics that distinguish them from other animals: for example, ducks can swim, bears sleep in winter, and skunks have an unpleasant odor," is a more orderly way of presenting the same facts. It is more scientific.

Again, science is more than orderly knowledge. Orderly knowledge can be found in fields other than science. The one area in which science differs from other fields of knowledge is **experimentation**. *Experimentation* means *demonstrating a fact by testing to see if the same result occurs repeatedly.* For example, everyone knows ducks can swim. Some people even know that swimming is a characteristic that makes ducks different from most other birds. A scientist, however, would attempt to prove this fact by placing several ducks in a pool of water. He would then watch to see if they could swim. He would be doing a test or **experiment** to prove that ducks can indeed swim. He would also be able to repeat the experiment with other ducks to show the same fact. Thus, science is *orderly knowledge demonstrated by repeatable experiments*.

Doing an experiment to prove something as well-known as the fact that ducks can swim may seem ridiculous but it is not. Without people who were willing to look ridiculous by doing experiments to prove ideas true or false, we might still believe some very false ideas. We will learn about some of these people in the next section.

Write these statements in the proper order.

a. Science is orderly knowledge.
b. Science is orderly knowledge proved by experiments.
c. Science is knowledge.

1.1 _____

1.2 _____

1.3 _____

Complete these statements.

1.4 A scientific test is a(n) _____ .

1.5 Science comes from a Greek word meaning _____ .

1.6 Scientists perform experiments to prove ideas a. _____ or

b. _____ .

Define this term.

1.7 Science _____

_____

Describe how you could prove this statement.

1.8 Cats eat fish. _____

_____

_____

_____

A BRIEF HISTORY OF SCIENCE

When we think of science, usually we think of it as it is today—clean white labs, computers, serious men and women watching video monitors, huge telescopes pointing to the stars. Science, however, is not a new subject. People have been seeking to understand God's creation ever since the Creation.

Ancient Science. Though science began soon after mankind was created, science as an orderly system of thought did not begin until a Greek named Aristotle began to write down his ideas. Aristotle was a **philosopher** who wrote his ideas in an orderly manner. He studied nature and, among other things, tried to figure out a systematic classification for plants and animals. Though his ideas were orderly and written down, Aristotle is not considered a true scientist. He had ideas, but he never investigated to see if they were true. He never performed experiments. Because of this lack of experimentation, many of his ideas were faulty. However, Aristotle's writings still are of value because they have inspired many later scientists.

Another important Greek philosopher was Democritus. He was one of the first men to believe that all things consist of tiny particles of matter. He thought that, if you cut a piece of matter in half and then in half again and again, you would ultimately arrive at a piece so small that it could not be halved. He termed this smallest piece of matter an **atom** which means *not able to be cut*. Atoms are quite small, but we now know that they are made of particles even smaller. Although Democritus' concept was not entirely correct, all our atomic science is indebted to his idea.

Write the letter of the correct answer in the blank.

1.9 Science is a(n) _____ subject.
a. new b. old c. unimportant

1.10 Aristotle was a _____ .
a. Greek philosopher b. Roman politician
c. French scholastic

1.11 Aristotle tried to put facts in _____ .
a. an encyclopedia b. a monastery c. an orderly pattern

1.12 Democritus termed the smallest particle _____ .
a. matter b. an atom c. a molecule

Answer true or false.

1.13 _____ Aristotle did many experiments.

1.14 _____ Democritus was a Greek philosopher.

1.15 _____ Aristotle was the first to have the idea of the atom.

Answer this question.

1.16 What effect did the lack of experimentation have on the work of Aristotle and Democritus?

_____

_____

Medieval science. In the Middle Ages, which followed the barbarian invasions of the Roman Empire, science continued to exist, but not as we know it today. The most common form of science in the Middle Ages was **alchemy**. Alchemists were people who were interested in gaining great wealth. They thought it was possible to turn less valuable metals (**base metals)**—such as tin, copper, and lead—into gold. Of course, we know this process is not possible; but they did follow a somewhat scientific method. They did some reasonable things such as heating metals and pouring acids on them. Other procedures they used, however, were less than scientific. They relied upon magic to do what science seemed unable to accomplish. Of course, the alchemists never succeeded; but they did keep alive the idea of scientific investigation.

Other factors in science at this period in history were the Arabs and the **scholastics**. The Arab Moors tried to invade Europe though Spain. They wished to spread the Muslim religion throughout the world. The Moors brought with them advanced ideas in medicine and other scientific fields. Had they succeeded in conquering Europe, Christianity would have suffered; but Western science might have advanced much more rapidly than it did.

Toward the end of the Middle Ages, people became interested in sorting out facts and writing them down in an orderly way. The scholastics had few new ideas, but they rediscovered the writings of Aristotle and other ancient philosophers. They wrote long works on these ancient writings. These works were called **summas**, or summaries, and they resembled encyclopedias. From this scholastic movement came the people who began the rebirth of science, art, and true learning in general. This rebirth is called the **Renaissance**.

Match these items.

1.17 _____ barbarians

1.18 _____ Moors

1.19 _____ alchemy

1.20 _____ scholastics

1.21 _____ summas

1.22 _____ base metal

a. a combination of science and magic

b. any metal less valuable than gold

c. wrote summaries of ancient writings

d. overran the Roman Empire

e. summaries of ancient writings

f. tried to conquer Europe

g. philosophers of the ancient world

Explain this statement.

1.23 If the Moors had overrun Europe, Western science might have advanced more rapidly.

_____

_____

_____

_____

Renaissance science. This period of history saw a reawakening of true learning and original thought. The scholastics of the later Middle Ages really borrowed most of their ideas from ancient philosophers, but the people of the Renaissance produced new ideas and inventions.

One of the most important pronouncements of the Renaissance was that made by Nicolaus Copernicus. Copernicus was a Polish mathematician and astronomer. He stated the **theory** that the earth is not the center of the universe as the Roman Catholic Church had taught for centuries. He believed the sun to be the center around which the planets revolve. He also maintained that the earth rotates on its axis. This statement was contrary to the prevailing idea that the earth was absolutely still.

Copernicus was loyal to the Roman Catholic Church and so refrained from pushing his revolutionary ideas. His successor, however, was not so quiet. Galileo Galilei was also an astronomer. He studied the heavens through the telescope that he made and came to the conclusion that Copernicus was correct in his theory.

Galileo published a paper stating his findings. The Roman Catholic Church forced him to take back what he said. Even though he recanted, he was imprisoned and was watched closely for the rest of his life. Despite his lack of moral courage to stand up for what he believed, Galileo gave the world a valuable tool with which to work: the knowledge that the planets revolve about the sun and that the earth turns on its axis.

Another scientist of the Renaissance was Sir Isaac Newton. He studied the work of Galileo and figured mathematically that any two bodies of matter in the universe attract each other with a certain force. We call this principle or **law**, the *Law of Universal Gravitation*.

These individuals contributed a great fund of scientific fact upon which modern science is built. The Renaissance merges gradually with modern times. Numerous scientists cannot be classified as strictly Renaissance, but they are not truly modern either. We will study one or two of them in the next section.

Complete these sentences.

1.24 A period of history that saw a reawakening of true learning is called the _____ .

1.25 A Polish mathematician and astronomer who stated that the earth was not the center of the universe was _____ .

1.26 _____ agreed with Copernicus that the earth is not the center of the universe.

1.27 The attraction between any two objects is described by the Law of _____ .

1.28 The law referred to in 1.27 was formulated by _____ .

Post-Renaissance science. Great numbers of new discoveries were made during the Renaissance. Building on these discoveries, the people of the post-Renaissance period formulated theories in various fields.

In the field of the physical sciences (chemistry, physics, and astronomy), John Dalton formed a theory based in part on the work of Democritus. Dalton's atomic theory stated that atoms are tiny, solid spheres which, like Democritus' atom, are indivisible. We now know that atoms are not what Dalton thought, but his work started people thinking about atoms once more.

The field of the biological sciences had many representatives at this time. Scientists were curious about how traits or characteristics are passed from parents to their offspring. They were also curious about how the various types of plants and animals came to be the way they are. These ideas were common at this time because people were questioning the Bible as absolute truth. Some even denied the existence of God, at least as Creator and Controller of the universe. Since they did not accept God's Word, they believed they had to develop a new explanation for the origin of plants and animals. Although this view of life has led to disastrous results, some good ideas have come from it also.

Jean Baptiste de Lamarck (1744-1829) was a French biologist of this period. His theory was accepted as fact for many years and still is thought to be true by some people. He stated that some characteristics which **organisms** acquire after they are born can be passed on to their offspring. The example Lamarck's theory puts forth is the giraffe. In theory, the giraffe once had a short neck, but its need to stretch to reach higher and higher branches caused its neck to become longer. Each generation of giraffes had longer necks than the generation before, resulting in the modern giraffes which have very long necks. Scientists have proved this theory false repeatedly, but some people still insist on believing such statements as these:

> *"The snake didn't use its long legs, so it gradually lost them."*
>
> *"Well, I know she's been here since she was a baby, but all Asians like rice. It's inherited."*
>
> *"I know my little boy has a weak right arm because I broke mine playing baseball when I was fifteen."*

These statements are not based on fact; however, a large number of people hold that they are true.

Another scientist interested in inheritance was Charles Darwin. He formulated the theory of **evolution** which states that all present-day **species** (types) of plants and animals

developed over a long period of time from a few simpler ancestors. In the past 120 years Darwin's theory has been expanded and explained. It now is the basis of most other sciences, as well as biology. Evolutionists now say that all creatures began as microscopic organisms. Darwin's theory and its additions have had a serious impact on the world, but Christians do not accept his theory. First, the Bible teaches an entirely different beginning of life. Second, if human beings gradually evolved from some lower form of life, there was no garden of Eden, no temptation, no Fall. Thus, there is no sin nature in each individual, and Jesus Christ died for no reason. For these reasons, the theory of evolution is treated as just that—*a theory*, which attempts to explain creation without a Creator.

A good representative of the period just preceding modern science of the twentieth century is Louis Pasteur. Pasteur studied the action of microscopic organisms and demonstrated that they can cause disease. He developed a process of *pasteurization* by which harmful organisms in certain foods (for example, milk) can be killed. He also developed a vaccine for rabies.

The people that have been mentioned are only a few of those scientists who gave us useful ideas without which the scientific world of today could not function.

Answer true or false.

1.29 _____ Dalton said the atom was a solid particle.

1.30 _____ It is possible to inherit a broken arm from your parents.

1.31 _____ Darwin's theory states that all animals come from stones.

1.32 _____ Lamarck's theory is still held to be true by some people.

1.33 _____ Pasteur's theory is called the theory of evolution.

1.34 _____ Pasteurization kills microscopic organisms.

1.35 _____ Microscopic organisms can cause disease.

Answer this question using any encyclopedia.

1.36 Who was Gregor Mendel, and what did he discover? (Use full sentences and good paragraphs. Write this exercise on a separate piece of paper.)

TEACHER CHECK _____ initials _____ date

Review the material in this section in preparation for the Self Test. The Self Test will check your mastery of this particular section. The items missed on this Self Test will indicate specific areas where restudy is needed for mastery.

SELF TEST 1

Complete these statements (each answer, 3 points).

1.01 Science is orderly _____ .

1.02 Trying to demonstrate a fact by testing to see if the same result occurs repeatedly is _____ .

1.03 A Greek who tried to develop a systematic classification for plants and animals was _____ .

1.04 Alchemists tried to turn base metals into _____ .

1.05 A probable answer to a scientific problem is a _____ .

1.06 The rebirth of science and learning of the fifteenth century is termed the _____ .

1.07 Copernicus hypothesized that the _____ is not the center of the universe.

1.08 The Law of Universal Gravitation was discovered by _____ .

1.09 _____ formulated the theory of evolution.

1.010 Louis Pasteur demonstrated that _____ can cause disease.

Match these terms (each answer, 2 points).

1.011 _____ Lamarck

1.012 _____ Curie

1.013 _____ Dalton

1.014 _____ Salk

1.015 _____ Einstein

a. polio vaccine

b. inheritance of acquired characteristics

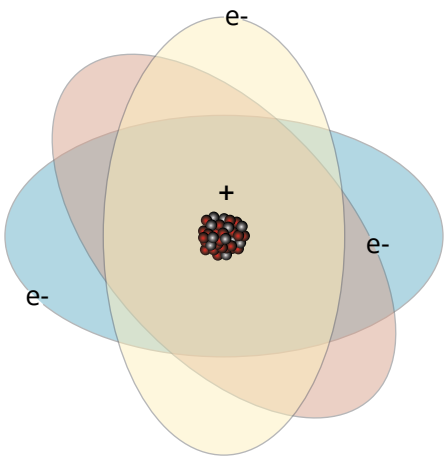
c. $E = mc^2$

d. tiny, solid, spherical atoms

e. evolution

f. radiation

Circle the best answer (each answer, 2 points)



1.016 This diagram is an illustration of _____ .
a. a microorganism b. a cancer cell c. an atom

1.017 A theory that has been proved true many times is called _____ .
a. evolution b. a law c. a guess

1.018 That every object attracts every other object is _____ .
a. the Law of Universal Gravitation
b. untrue
c. the Law of Affinity

1.019 Protons, neutrons, and electrons are part of _____ .
a. the atom b. a polio vaccine c. Pasteur's discoveries

1.020 When matter is destroyed in a nuclear reaction, _____ .
a. a small amount of energy is absorbed
b. a small amount of energy is released
c. a large amount of energy is released

Solve these problems (each answer, 4 points).

1.021 1,000 _____ = 1 liter.

1.022 Write 4,142 in scientific notation _____ .

1.023 Write $5.2 \cdot 10^3$ in numerals _____ .

1.024 Add and round to the correct number of significant figures.

6.3
8.2
5.43
9.671

_____

1.025 How many significant figures does the number 6.640 have? _____

56/70 **SCORE** _____ **TEACHER** _____ _____
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