LIFEPAC®

SCIENCE

STUDENT BOOK

10th Grade | Unit 10

Alpha Omega
PUBLICATIONS

SCIENCE 1010
Applications of Biology

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

Author:
A. Kenneth Moore, Ph.D.

Editor-in-Chief:
Richard W. Wheeler, M.A.Ed.

Editor:
Mary L. Meyer

Consulting Editor:
Harold Wengert, Ed.D.

Revision Editor:
Alan Christopherson, M.S.

MEDIA CREDITS:
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804 N. 2nd Ave. E.
Rock Rapids, IA 51246-1759

Applications of Biology

Introduction

You are now nearing the completion of your course in biology. The knowledge you have acquired and the concepts you developed during this study represent centuries of scientific observation and research. Although some of the principles are old or have their historical roots in the past ages, most scientific knowledge has been acquired in the last two hundred years.

In this LIFEPAC® you will study the means by which science has developed and expanded man's knowledge of the creation. The basic principles of life you have studied will be reviewed, and you will examine the future for living things on earth should the Lord allow this creation to continue.

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. List three steps in the scientific method and explain how they would be applied in the investigation of a particular scientific problem.
2. Discuss the importance of a controlled experiment in a scientific investigation.
3. State the significance of scientists publishing their research findings.
4. List seven characteristics of living things and explain why a definition of life is difficult to determine.
5. Explain the structure and function of the ten biological levels of organization.
6. Discuss the cell as the basic unit of life.
7. Explain the importance of diversity among the organisms in an ecosystem.
8. Describe the concept of homeostasis and cite an example to illustrate the principle.
9. List the three major parts of a control system.
10. Describe with an example the importance of negative feedback in a homeostatic system.
11. State the significance of reproduction.
12. Compare asexual and sexual reproduction and explain the results of each.
13. Describe the role of growth and differentiation in the development of a new organism.
14. Relate energy flow to the recycling of nutrients within an ecosystem.
15. Compare the food web to the food chain.
16. Describe the basis of the ecological crisis.
17. Explain how the Scriptures and science influence the life of man.

18. Explain the two major causes of genetic defects.

19. Discuss two possible solutions to the problems of genetic disease.

20. Describe the means of predicting chromosomal disorders.

21. Describe the six groups of microorganisms and explain their functions.

22. Define active, passive, and inborn immunity.

23. State the reasons that the practice of eugenics is in opposition to the teachings of the Bible.

24. Explain the "green revolution."

25. State how the "green revolution" could help relieve the world food shortage.

Survey the LIFEPAC. Ask yourself some questions about this study and write your questions here.

1. STUDY OF LIFE

As a child you undoubtedly asked the age-old questions: "What is that?" or "How does it work?" These questions are the driving force of science. Man's curious nature has led him to ask questions and to search for answers to those questions.

Section Objectives

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

1. List three steps in the scientific method and explain how they would be applied in the investigation of a particular scientific problem.
2. Discuss the importance of a controlled experiment in a scientific investigation.
3. State the significance of scientists publishing their research findings.
4. List seven characteristics of living things and explain why a definition of life is difficult to determine.

Vocabulary

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

adaptability
controlled experiment
growth
hypothesis
irritability
metabolism
mobility
reproduction
scientific method
structure
theory

Note: *All vocabulary words in this LIFEPAC 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.*

METHOD OF SCIENCE

Early man tried to explain events or phenomena that he could not understand. Most of the time the answers were either guesswork or logical evaluations of an observation. For example, the air from a marsh was thought to cause malaria; hence, it was called "bad air." Another incorrect assumption was that the sun circles around the earth every twenty-four hours, whereas we now know that the earth is rotating on its axis. Early man assumed that the sun was moving around the earth because he watched it rise in the east and set in the west every day.

The science of the ancient times is very clear in several Biblical passages. In Joshua 10:13 we are told that "... the sun stood still in the midst of heaven, and hasted not to go down about a whole day." The idea that the physical appearance of an unborn animal can be altered by something its mother looks at is suggested in Genesis 30:37-39. These events were described in the "scientific truths" that the readers of those days understood. God revealed His word to man in such a way that people of all centuries could understand. With a knowledge of the historical development of science, we can look back at these events and understand how they were recognized and recorded in the Scriptures. Joshua did not know that the earth rotated on its axis. Jacob did not know about recessive genes or heterozygosity. Both of these men acted according to the information available at that time.

The differences between science and the Scriptures do not represent a real conflict but rather a picture of the developmental nature of man's understanding of the creation. At this point of apparent conflict, some people either reject Christianity or reject science. Those who reject science or Christianity fail to see the

consistency between God's creation and the Truth of Jesus Christ. Those of us who see the harmony, experience a real joy as we study both science and the Bible.

Scientific truths. During the times of the early Christian church, "scientific truths" were not questioned, but were authority. If a person questioned or ridiculed any of these "truths" he was persecuted as a heretic. The church believed that questioning "scientific truths" was questioning God. However, a few men did ask questions and a revision of scientific knowledge took place. The purpose in the revelation of knowledge as stated in John 1:3, is to point out God as the Creator and Sustainer of all that is in the universe.

Complete the following statements.

1.1 Most of the time early man explained observations of nature by either

a. _____ or b. _____ .

1.2 The apparent conflict between the Scripture and science may be _____

_____

_____ .

1.3 During early Christianity _____ were never questioned, but were the authority.

1.4 Today those who see the harmony between God's truth revealed and His truth discovered experience _____ .

1.5 The purpose of man gaining scientific knowledge is to _____

_____

The scientific method. The **scientific method** is a logical and orderly means of inquiry that is different from guesswork or superstition. A person must be careful not to jump to the assumption that the scientific method is a magic formula or that it provides the answer to all questions. Consider the number of times a scientist has a well-planned experiment that he carefully performs, only to have it end in failure. Even in failure a good scientist will evaluate his results looking for new directions in which he can continue his work. Many important discoveries have resulted from this change of direction.

Formulating the problem. The scientific method begins with an observation from which the scientist formulates a problem. Formulating a problem is probably the most difficult part of the process. To illustrate the procedure, assume that you have made the observation that your heart is beating seventy-two times per minute. The problem you formulate is "What controls the rhythmic beating of the heart?"

After defining a problem, the scientist searches to find what is already known about the problem. Other persons may have already studied the problem or parts of the problem. One scientist does not try to solve everything. Science is the process of building on the work of other scientists. This research reduces repetition of work and conserves time and money. To review what others have done before him, the scientist must have an extensive library available that contains scientific journals and reference books. Obviously the scientist cannot read every scientific article to determine whether his problem has been previously examined; therefore, he has aides who can assist in the literature review.

Hypothesis building. Once the problem has been defined, and research has shown that the literature does not provide an answer to that problem, a tentative answer (or **hypothesis**) for the problem must be formulated. Some people have called the hypothesis an educated guess. Although the hypothesis seems to be a reasonable or obvious explanation for the problem, it cannot be accepted until it is supported by a large amount of evidence.

Experimentation. The scientific investigator must then design an experiment to test the hypothesis that he has developed. The most important and most difficult part of the experiment is designing a method for testing only one factor, or variable, at a time. All factors except one must be kept constant. In the experiment the researcher is testing only one factor, the one in the hypothesis. Usually two experiments are performed in duplicate. Both experiments are identical except that one experimental factor is the variable. An experiment of this type is called a **controlled experiment** to demonstrate the importance of the experimental variable, or the hypothesis.

The researcher must observe the experiment and accurately record the results. The observation period is one of the more difficult times in experimentation because the investigator must avoid personal prejudice and use nonbiased observation in recording results.

Theory. Once the experimental data is gathered, it can either support or nullify the hypothesis. Sometimes insufficient data makes additional experiments necessary before the hypothesis can be either proved or disproved. If experimental evidence over a period of time accumulates in support of the hypothesis, the hypothesis becomes a **theory**. If the data disproves the hypothesis, the researcher should develop a new hypothesis.

Many research scientists jointly publish their results in a scientific journal to enable individual scientists to take advantage of the information gathered in other research. Through this means scientists all over the world can keep abreast of research in specific fields of study.

Complete the following activities.

1.6 Read the following paragraph about an observation and formulate a hypothesis: A piece of meat was placed in a jar and allowed to decay in the open. In three days the meat was covered with maggots. The maggots were allowed to continue to live and become hard immobile spheres (a shape resembling the pupae of caterpillars). A few of the pupae were placed in a covered container. In a little over a week the pupae broke open and flies emerged. From the observation, you want to know where the maggots came from. Formulate a hypothesis and write it in this space.

_____

_____

_____

TEACHER CHECK _____ initials _____ date

Your hypothesis may have been, "Rotting meat spontaneously develops into maggots."

1.7 Design a controlled experiment to test the hypothesis.

_____

_____

_____

_____

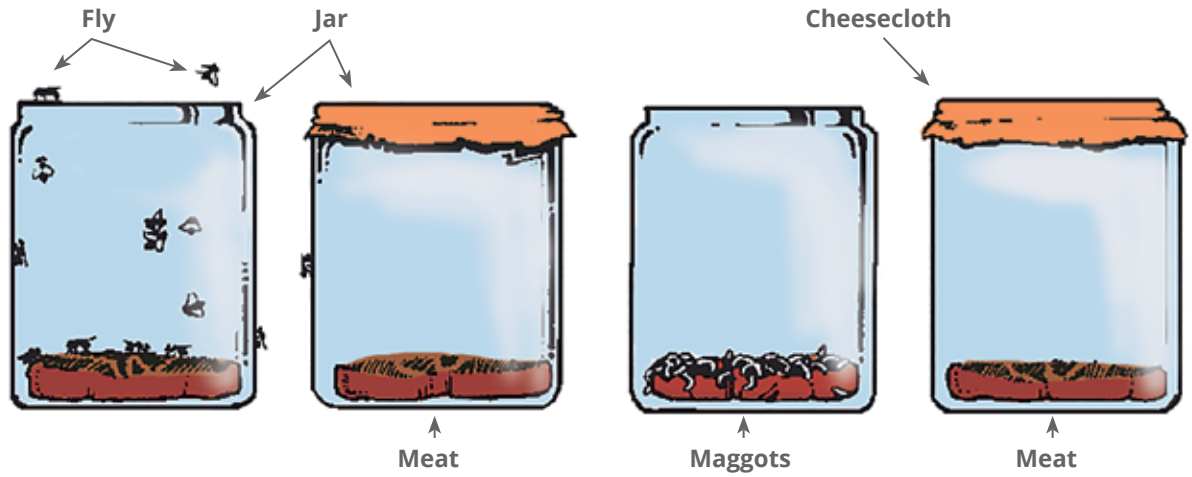
_____

TEACHER CHECK _____ initials _____ date

Your experiment should have included two sets of jars with fresh meat, of which one jar was left open and the other jar was covered with cheesecloth or a piece of screen. This covering will keep flies out, but let air reach the meat. The results obtained from the experiment were these:

covered jars: did not develop maggots
uncovered jars: developed maggots

Do these results support the hypothesis that rotting meat develops into maggots? If not, you need to develop an alternative hypothesis. An alternative hypothesis could be "flies must come into contact with the meat for maggots to develop."



1.8 Does the experimental data support this hypothesis? _____

1.9 Does the data prove the hypothesis? _____

1.10 If not, what else is needed to elevate the hypothesis to a theory? _____

_____

TEACHER CHECK _____ initials _____ date

Complete the following statements.

1.11 The scientific method is a logical and orderly means of a. _____ , but b. _____ (does/does not) always give the answer to an unanswered question.

1.12 A scientist formulates a problem from an _____ .

1.13 After defining the problem, the scientist reads a. _____ and b. _____ to see what other scientists have found about the problem.

1.14 Once a problem is identified, the investigator forms a hypothesis or a _____ _____ for the problem.

1.15 A hypothesis may seem reasonable, but it cannot be accepted until _____ _____ .

1.16 An experiment normally consists of two experiments being performed at the same time. Both experiments are identical except that a. _____ . This type of experiment is called a b. _____ .

1.17 An experiment must be a. _____ and the information must be b. _____ .

1.18 A major condition that may interfere with scientific experimentation is the _____ _____ of the investigator.

1.19 When the evidence gathered from the experiment does not support the hypothesis, the researcher _____ .

1.20 If over a period of time much evidence is gathered that supports the hypothesis, it becomes a _____ .

1.21 If the hypothesis has experimental evidence to support it, the investigator _____ _____ to let other scientists know what he has learned about the problem.

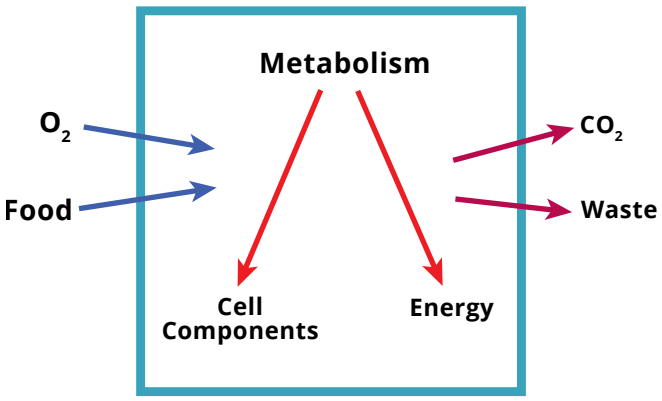
DEFINITION OF LIFE

You have learned that science is the "study of" man's curiosity about nature. This course is specialized in the examination of man's curiosity about himself and other living things. You refer to this study as biology. The word *biology* comes from the Greek word, *bios*, meaning *life*, and the noun ending *-logy*, meaning *science or the study of*. The suffix *-logy* is derived from the Greek word *logos*, which means *word*.

After defining biology we are left with the question, "What is life?" Spiritually, life is in Jesus Christ (John 3:16), but what is the definition of physical life? Biologists think that the answer to that question is difficult. Most of us can tell a dog from an aluminum can. What about the cases that are not so clear-cut? When is a person who has been injured in an automobile accident dead? Is a bouquet of cut flowers dead or alive? The flowers are eventually tossed into the trash can. When did they die? Did the flowers die when they were cut, thrown into the trash, or sometime between? These questions are difficult to answer. Scientists also have difficulty formulating a definition of life that will fit all situations. The solution that biologists have chosen is to describe the *characteristics of life*. If an organism exhibits all of these characteristics, it is considered to be alive. If it does not exhibit each characteristic, it is considered to be either dead or inanimate (a nonliving object).

Metabolism. One of the more important characteristics of life is the organism's ability to carry on metabolic functions. This process, called **metabolism**, includes obtaining nutrients from the environment, taking in oxygen and giving off carbon dioxide, transforming these substances to cellular components and energy for maintenance of the life processes, and excreting wastes.

Reproduction. The ability to produce exact or close copies of the original organism (**reproduction**) is important for the continuation of life.



| Metabolic Functions

Structure and growth. All living things have a basic unity in composition, or **structure**. The basic unit of life is the cell. Cells provide the structure and function of the organism. The organism increases in cell size or in cell number after birth. A change either in cell size or cell number is called **growth**.

Irritability and mobility. A living thing has specialized structures that provide information concerning changes in the environment. The characteristic of becoming aware of environmental change is termed **irritability**. In response to environmental stimuli an organism changes its position in its environment. This ability to move about is called **mobility**.

Adaptability. Living organisms show responses to changes in temperature, light, chemicals, and other aspects of the environment. These characteristic responses are termed **adaptability**. The response may be either internal or external. Living organisms change to *adapt* to an environmental change.

None of the seven characteristics alone is unique to life. Nonliving things can possess any one or two of these traits, but only living things exhibit all of these characteristics at any one time. For example, crystals can grow, iron undergoes a chemical reaction (similar to

metabolic changes) with oxygen to produce rust, large rocks crack and split to produce smaller rocks, and sand moves in response to wind.

How important is a definition of life? To scientists who are studying new substances on earth or other planets, such criteria are needed to compare the known with the unknown.

| Different creatures are able to adapt to different environments by the use of camouflage.

Complete the following activities.

1.22 Scientists distinguish whether an entity is living or nonliving by _____

_____ .

1.23 The ability to obtain nutrients, take in oxygen, and transform these items to energy and cellular components is called _____ .

1.24 Reproduction is essential for the _____ .

1.25 The basic unit of life is the a. _____ , which forms the b. _____ of the organism.

1.26 Another important characteristic of life is _____ , which results in an increase in size of the individual.

1.27 The living organism has specialized structures that provide information about the environment. This characteristic of life is called _____ .

1.28 Responding to a stimulus by changing position is called _____ .

1.29 The ability of an organism to _____ to changes in the environment is seen when the organism makes an internal or external change.

1.30 List the characteristics of life an object must possess for the object to be considered living.

_____

_____

Review the material in this section in preparation for the Self Test. This 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 Knowledge of the "scientific truths" comes from the study of _____ , including biology.

1.02 Biology is the science of _____ .

1.03 All living organisms respond to changes in light, heat, gravity, and other environmental _____ .

1.04 When two experiments are identical except for one variable, the experiment is called a _____ _____ .

1.05 The term *biology* comes from the Greek word *bios*, meaning _____ , and the noun ending *-logy*, meaning *science* or *study of*.

Answer true or false (each answer, 1 point).

1.06 _____ The total of all chemical processes in an organism is termed *metabolism*.

1.07 _____ A hypothesis is a proven fact.

1.08 _____ The fundamental biological unit is the organ.

1.09 _____ All knowledge reveals God as the Creator and Sustainer of all things.

1.010 _____ Early man explained observed events of nature in terms of superstitions, guesses, or logical evaluations.

1.011 _____ God reveals knowledge to man to point out God as the Creator.

1.012 _____ The most difficult part of an experiment is designing an experiment that tests only one factor.

1.013 _____ The avoidance of personal prejudice or bias is an important trait of a scientist.

1.014 _____ A hypothesis is an "educated guess."

1.015 _____ Nonliving organisms can exhibit any of the characteristics of life, but only a living organism exhibits each of the characteristics.

Match these items (each answer, 2 points).

1.016 _____ mosquito

1.017 _____ educated guess

1.018 _____ move about

1.019 _____ aware of change

1.020 _____ exact copies

1.021 _____ more cells

a. irritability

b. reproduction

c. growth

d. malaria

e. hypothesis

f. adaptability

g. mobility

Complete these items (each numbered item, 5 points).

1.022 List the characteristics of life.

_____

_____

1.023 Give three examples of a nonliving organism that can possess a characteristic of life.

a. _____

b. _____

c. _____

1.024 Describe how a hypothesis is elevated to a theory. _____

1.025 The laboratory is critical for scientific research. Explain why the library is equally important. _____

_____

1.026 A man drinks swamp water and later contracts malaria. Does this fact alone provide conclusive evidence that swamp water is responsible for causing malaria?

Explain. _____

_____

_____

48/60 **SCORE** _____ **TEACHER** _____ _____

initials date

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