LIFEPAC®

SCIENCE

STUDENT BOOK

6th Grade | Unit 10

Alpha Omega
PUBLICATIONS

SCIENCE 610

The Earth and the Universe

LIFEPAC Test is located in the center of the booklet, as well as a periodic table for reference. Please remove before starting the unit.

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The Earth and the Universe

Introduction

God has created a fascinating universe! It is full of wonder and beauty. The book of Genesis describes the creation of the world and all things in it (Genesis 1-2). When God finished creation, He said that it was very good. People can get some understanding of the beauty, power, and majesty of God simply by observing His creation. As St. Paul wrote in his letter to the Romans, "For the invisible things of him from the creation of the world are clearly seen, being understood by the things that are made, even his eternal power and Godhead; so that they are without excuse:" (Romans 1:20) God's power and divinity can be known by observing the things that He has made, that is, all things in His creation!

In the previous nine books of this Science LIFEPAC ® series, you have studied some of the wonders of the earth and the universe that God has made. You have studied plant and animal systems, aspects of chemistry and physics, "spaceship earth," the solar system, and the stars. In this LIFEPAC, you will get an overview of the material covered in the previous nine LIFEPACs of this series. By reviewing the material in this one LIFEPAC, you will hopefully grow in your appreciation and love of God who created all these things in His wisdom and love. In addition, you will discover that God's detailed plan can be seen within all of His Creation, from tiny DNA molecules to the vast galaxies of the universe.

The new vocabulary in this LIFEPAC is limited. Instead, most of the vocabulary to be covered in this LIFEPAC will be reviewed in the vocabulary presented in the previous LIFEPACs. As you go through this LIFEPAC, you may need to refresh your memory of topics and information covered in earlier LIFEPACs. By reviewing this material, your understanding and **retention** of these important science topics should be increased.

Objectives

Read these objectives. These objectives tell what you should be able to do when you have completed this LIFEPAC. When you have completed this LIFEPAC, you should be able to do the following:

1. Describe the plant processes of photosynthesis, transport, and regulation.
2. Describe the digestive, excretory, skeletal, and nervous systems of humans.
3. Discuss genetics and aspects of reproductive systems in plants and animals.
4. Give some examples of biomes and cycles in nature.
5. Explain the nature of matter and relate the various particles to the structure of matter.
6. Explain the main divisions of the Periodic Table of the Elements and identify common chemical symbols.
7, Explain the basic concepts of light and the ways that colors are produced.
8. Explain how sound is produced and describe the characteristics of sound.

9. Explain some basic components of motion such as force, work, laws of motion, and changes in motion.
10. Describe the various motions of earth.
11. Name and describe the various parts of our Solar System.
12. Identify important people, events, and observing equipment in the history of astronomy.
13. Describe how stars differ and identify some of their main characteristics.

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

1. PLANT AND ANIMAL SYSTEMS

Within all plants and animals, there are many complex processes occurring that allow the organism to live, grow, and reproduce. Many parts of plants and animals work together to perform a common function or purpose. We call these complex, interacting parts "systems." When considered carefully, these systems indicate the intelligent design of a loving and wise God.

In this section of the LIFEPAC, you will review some of the complex systems in plants and animals (primarily humans). You will also review information on biomes and cycles in nature. Finally, you will review information on genetics and how various traits are inherited in plants and animals.

| Plants and animals have complex systems!

Section Objectives

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

1. Describe the plant systems of photosynthesis, transport, and regulation.
2. Describe the digestive, excretory, skeletal, and nervous systems of humans.
3. Discuss genetics and aspects of reproductive systems in plants and animals.
4. Give some examples of biomes and cycles in nature.

Vocabulary

Review the vocabulary words in Science LIFEPACS 601, 602, 603, and 604.

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

cytokinins (sī tō kī nənz). A chemical regulator found in coconut milk that causes roots, stems, leaves, and buds to form from one piece of plant tissue.

framework (frām wėrk). A basic structure.

interrelate (in tər ri lāt). To have a mutual relationship.

retention (ri ten shən). The act of retaining, especially the ability to keep things in mind.

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**e**rm; **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; */TH/* for **th**en; */zh/* for mea**s**ure; */u/* represents */a/* in **a**bout, */e/* in tak**e**n, */i/* in penc**i**l, */o/* in lem**o**n, and */u/* in circus.

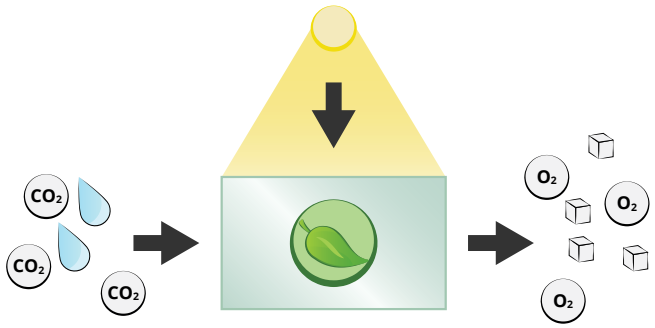
PLANT SYSTEMS

God created a great variety of plants. Yet, many plants have common systems that help them live, grow, and reproduce. There are three systems common to many plants: the *photosynthesis* system, the *transport* system, and the *regulatory* system. Let's review the components and processes involved in each one of these plant systems.

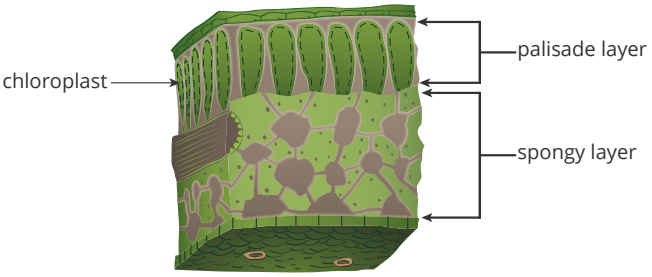
Photosynthesis system. *Photosynthesis* is a process in green plants where food is produced with the help of sunlight. The primary location of photosynthesis in green plants is the leaves. That is why we call this location the "leaf factory." Just as industrial factories produce goods in the industrial world, the "leaf factory" takes raw materials and combines them with sunlight to produce food. Green stems in plants can also produce food. In fact, any cell that contains *chlorophyll* can make food.

All factories need a source of energy to produce finished products. This energy could come in the form of electricity, oil and gas, or even water and wind power. The leaf factory also needs a source of energy. Its source of energy is light from the sun. Utilizing the sun's energy, it makes food from water, minerals and other nutrients from the soil, and carbon dioxide, and releases oxygen as a by-product. The oxygen is used by animals for breathing. The "food" produced is initially a sugar called *glucose*. This sugar can be changed into other foods within the plant such as fats, oils, proteins, and vitamins. Some of it gets stored as starch.

As mentioned previously, the primary location of the photosynthesis process within green plants is in the leaf. Within the leaf, photosynthesis takes place primarily in the *palisade* layer. This layer consists of cells lined up like fence posts. These cells are called *chloroplasts* and contain chlorophyll. Cells arranged in this manner get more exposure to sunlight. The



| Photosynthesis process in the leaf factory



spongy layer in the leaf has some chlorophyll and can make food. It does not make nearly as much food as the palisade layer. The spongy layer has many holes and open spaces which allow gases (carbon dioxide and oxygen) to be exchanged. Generally, water vapor, carbon dioxide, and oxygen are found within the spaces between the cells. Small openings known as *stomata* are located on the underneath side of the leaf. These openings allow gases to enter the spongy layer. The most important function of the spongy layer is the exchange of gases.

The leaf is covered with a protective layer of cells known as the *epidermis*. The cells of the epidermis are covered with a thin waxy layer known as the cuticle. The cuticle is a waxy coat which prevents the loss of water. All of these structures are parts of the *photosynthesis system* within plants.

Complete the following statements.

1.1 The photosynthesis system is located primarily in the _____ .

1.2 The green substance necessary for photosynthesis is called _____ .

1.3 A product made during photosynthesis is a carbohydrate (simple sugar) known as _____ .

1.4 Sugar is transported to parts of the plant and stored as _____ .

1.5 An important by-product of photosynthesis is _____ .

1.6 The energy for photosynthesis comes from the _____ .

1.7 In addition to glucose and starch, plants can also make other foods such as

a. _____ , b. _____ ,

c. _____ , and d. _____ .

Match the following items.

1.8 _____ the waxy protective coating on leaves

1.9 _____ openings that are most frequently foundon the underside of a leaf

1.10 _____ the outer layer of cells of a leaf that has a waxy coating

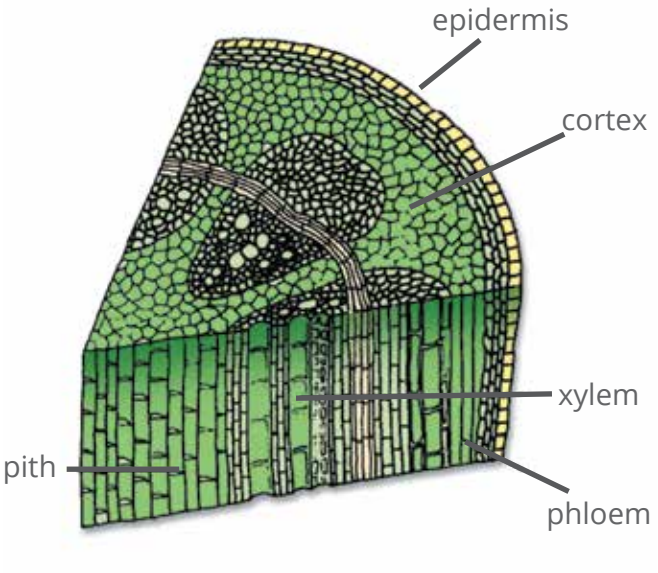
1.11 _____ the layer within the leaf that has many holes and spaces for gases to exchange

1.12 _____ the layer in the leaf that is the primary location of photosynthesis

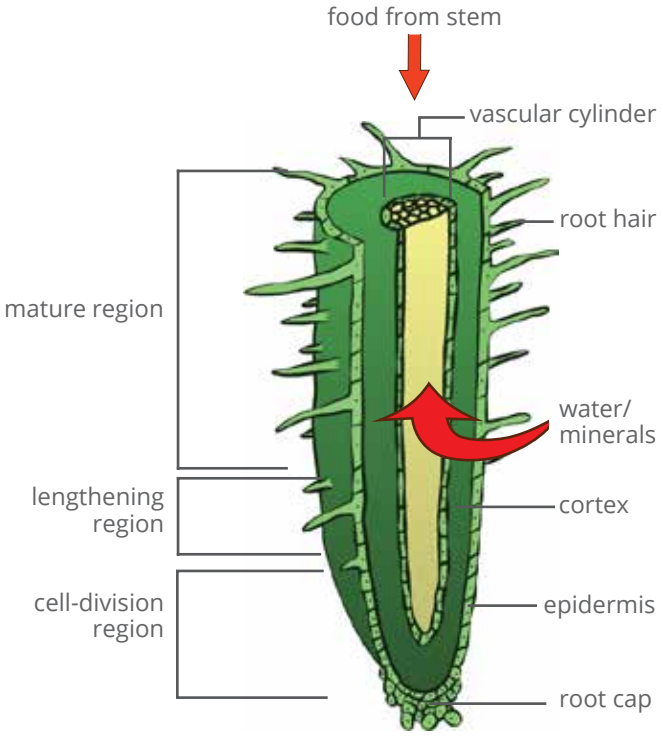
a. spongy layer
b. palisade layer
c. epidermis
d. stomata
e. cuticle
f. chlorophyll

Transport system. The *transport system* of plants involves three main structures: the roots, the stems, and the leaves. These three structures have a system of tubes which make up the transport system. The tubes that transport water and minerals in this system are known as *xylem*. Tubes that transport food to various parts of the plant are called *phloem*. Together in the stem, the xylem and the phloem are known as a *vascular bundle*. In the root, the xylem and phloem together are known as the *vascular cylinder*. In the leaf, this bundle is called the *vein*. The vascular tissues, regardless of whether they are called the vascular bundle, the vascular cylinder, or the vein, are all composed of xylem and phloem.

Plants must have a continuous supply of water and minerals. Their root hairs take in water and minerals from the soil. These minerals go up the xylem to the stem and leaves. Food is manufactured in the leaves and then transported down the phloem to various parts of the plant. There, it is converted to starch and stored. Storage of foods is an important function of roots. Plants, such as yams, carrots, beets, radishes, and turnips, store food in their roots. Stems and leaves may also act as storage places for food. Storage materials are not limited to starch. Plants may also store fats, oils, vitamins, and proteins.



| Stems



| Roots

Complete the following statements.

1.13 Plants frequently convert glucose into _____ (for storage).

1.14 Plants can also make and store other foods such as a. _____ ,

b. _____ , c. _____ , and d. _____ .

1.15 The three main structures of the plant which are involved in transport are the

a. _____ , b. _____ , and the

c. _____ .

Match the following items.

1.16 _____ the tubes that transport water and minerals

1.17 _____ the tubes that transport food

1.18 _____ one of the important functions of roots

1.19 _____ the name of the xylem and phloem in the stem

1.20 _____ the name of the xylem and phloem in roots

a. vascular cylinder

b. vascular bundle

c. vein

d. phloem

e. xylem

f. storage of food

Regulatory system. The *regulatory system* of a plant has to do with the processes and chemicals (*regulators*) that help the plant grow. The two types of regulatory chemicals are natural and artificial.

Natural regulators are chemicals normally produced by plants. At just the right time and in just the right place, the plant makes these growth chemicals. For example, when a new root is needed, just the right chemicals are produced to start a new root. When a bud or a flower is needed, just the right chemicals are made by the plant in that spot. *Auxins*, *gibberellins*, and **cytokinins** are three "families" of these regulator chemicals.

Artificial regulators are chemicals produced by humans. Through their use over the years, it has been found that some artificial chemical regulators are helpful to plant growth and have no harmful side effects, while others help regulate plant growth but have harmful effects to humans or the environment. For example, the regulator *2,4-D* can be used to control weeds and dandelions in other crops and breaks down to form harmless chemicals. But other regulators contain chemicals, such as arsenic and lead, that can have long-term harmful effects in the environment or to humans.

Scientists are exploring and investigating ways to care for and protect the environment. People must use the information learned by scientists to help protect the planet we live on.

Answer true or false.

1.21 _____ The *regulatory system* of a plant has to do with the processes and chemicals (*regulators*) that help the plant grow.

1.22 _____ The two types of regulators for plants are (1) natural and (2) artificial.

1.23 _____ Three "families" of natural regulator chemicals are *auxins*, *gibberellins*, and *cytokinins*.

1.24 _____ Artificial chemical regulators are found naturally in plants.

1.25 _____ Artificial chemical regulators have both helpful and harmful effects.

1.26 _____ We need to use science and the information we learn from it to take better care of the environment we live in.

Complete the following activity.

1.27 Write a half-page report on a natural or artificial chemical regulator for plants. You may choose one of those mentioned in this section, or you may write about another regulator that you discover while doing your research. You may find the information contained in Section 3 of the Science 601 LIFEPAC to be helpful. You should also use information that you can find on the Internet, in a library, or from other resources to help you. Be sure to mention the effects that the chemical has on plants and how it is used. Also discuss whether or not the regulator may have any harmful effects.

TEACHER CHECK _____ initials _____ date

Tropisms. Chemical regulators, especially *auxins*, affect *tropisms* in plants. A *tropism* is the name given to the plant's response that causes it to grow either toward or away from a stimulus. If the plant grows *toward* something, it is a *positive tropism*. If the plant grows *away* from something, it is called a *negative tropism*. There are three basic types of tropisms: (1) *phototropisms*, (2) *geotropisms*, and (3) *hydrotropisms*.

Plants show positive *photo*tropisms because they turn toward *light*. Plants show both positive and negative *geo*tropisms in relation to the *earth*. The roots show a positive geotropism in growing toward the earth. The leaves show a negative geotropism by growing away from the earth. Finally, *water* causes a *hydro*tropism in plants. The roots of plants show a positive hydrotropism because they grow toward water.

Complete the following statements.

1.28 A plant that grows toward a stimulus has a _____ tropism.

1.29 A plant that grows away from a stimulus has a _____ tropism.

1.30 A hydrotropism is a plant's response to _____ .

1.31 A geotropism is a plant's response to _____ .

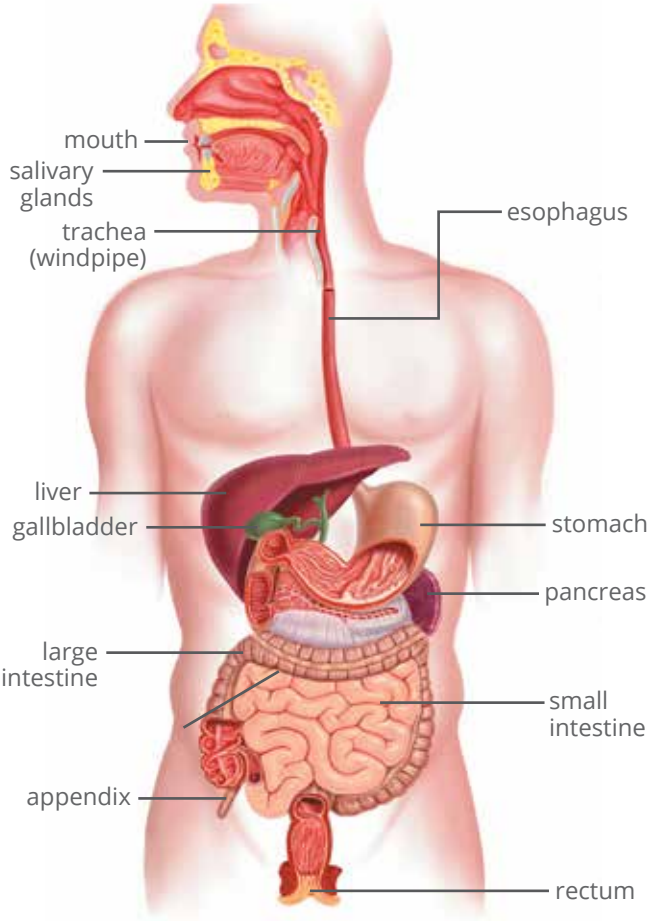
1.32 A phototropism is a plant's response to _____ .

ANIMAL AND HUMAN SYSTEMS

Plants are designed in a marvelous way. You have reviewed some of the main "systems" that make up most plants. Animals have been created with various body parts that **interrelate** in a complex fashion. We call these various related parts of animal bodies "animal systems." For example, there is a way for animals to eat and digest food in their bodies. We call this the "digestive system." All animals have a digestive system. Human beings have a digestive system, too. In fact, if we examine the various "systems" within the human body, we can get a good idea of the basic operation of most of the "animal systems."

The human body is among the most wonderful parts of nature. The various parts of the human body are very complex and orderly. In this part of the LIFEPAC, we will explore four major "systems" of the human body. They are the digestive system, the excretory system, the skeletal system, and the nervous system. By examining these four systems of the human body in some detail, you will learn about the main body systems common to all animals.

Digestive system. The digestive system acts like a chemical laboratory. It breaks down food into simple chemicals that can be absorbed by other parts of the body. These chemical substances are used as energy sources and building materials for the body. Animals such as worms, insects, mammals, birds, fish, and



| The digestive system

people all have digestive systems. Their digestive systems have similar parts and purposes. For the sake of our discussion, we will cover the human digestive system, shown in the illustration. Study this illustration and be sure that you

can identify the parts of the digestive system and the pathway of food through the system.

The *alimentary canal* is composed of the parts of the digestive system through which food passes. It consists of the mouth, esophagus, stomach, small intestine, large intestine, and rectum. As food moves through the body, digestive juices are added. This addition of juices helps break down the food into substances that can be absorbed by the body.

Each part of the alimentary canal has a special task to perform. The mouth has two functions. They are to chew and grind the food and to add saliva to help digestion. The esophagus is a tube that allows food to pass from the mouth to the stomach.

The stomach churns the food and adds digestive juices. Digestive juices are rich in *enzymes* that help break down the food into chemicals that can be absorbed.

The liver and pancreas are located close to the small intestine. They open into the small intestine and add substances that aid in the breakdown of food. The pancreas adds enzymes. The gallbladder adds *bile* to the process of digestion. Bile turns fats into an *emulsion*. This is very important in the process of breaking fats into smaller particles.

The small intestine functions to absorb food. Fingerlike projections on the small intestine are able to absorb food. These fingerlike projections are known as *villi*. Villi have an abundance of capillaries, which pick up the nutrients from the food and circulate them to the cells. The large intestine and rectum carry away undigested waste materials from the body. Any excess water is absorbed by the large intestine.

Complete the following activities.

1.33 List these parts of the digestive system or alimentary canal in their proper order: rectum, esophagus, small intestine, mouth, large intestine, and stomach.

a. _____ b. _____ c. _____

d. _____ e. _____ f. _____

1.34 Define the *alimentary canal*. _____

_____

1.35 What are the main functions of the stomach in digesting food? _____

_____

_____

Write the correct letter and answer in each blank.

1.36 The main function of the large intestine is to _____ .

a. absorb food
b. absorb water
c. add digestive juices
d. secrete bile

1.37 The main function of the small intestine is to _____ .

a. absorb food
b. absorb water
c. add digestive juices
d. secrete bile

1.38 The function of bile is to _____ .

a. break down sugar
b. digest protein
c. add enzymes to the stomach
d. make an emulsion of fats

1.39 The pancreas functions in digestion by _____ .

a. producing bile
b. absorbing fat
c. producing enzymes
d. helping the liver

1.40 Which one of the following is not part of the alimentary canal? _____

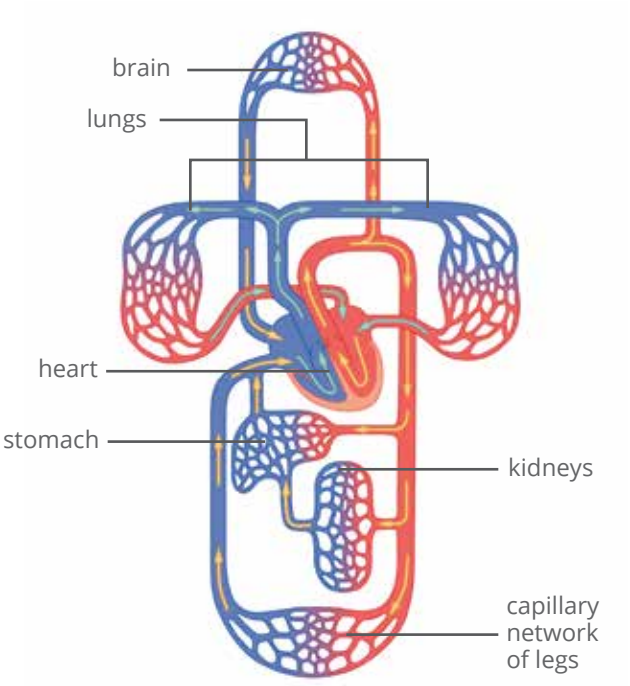
a. mouth b. small intestine c. liver d. rectum

Excretory system. There are four main parts to the human *excretory system*. They are the blood circulation system, the lungs, the kidneys, and the skin. All of these parts must work together to get rid of the body's waste materials. The *blood circulation system* carries nutrients and oxygen to all of the body's cells. At the same time, it picks up waste materials and carbon dioxide.

In the blood circulation system, the blood takes oxygen from the lungs and carries it to each cell in the body. It also carries nutrients from the villi of the small intestine to feed each body cell. Villi is explained in LIFEPAC 602, Section 1. At the same time, it removes all excess wastes such as water, carbon dioxide, poisons, and urea. The blood disposes of the excess water, urea, poisons, and other liquid wastes through the kidneys. The carbon dioxide gas is removed through the lungs.

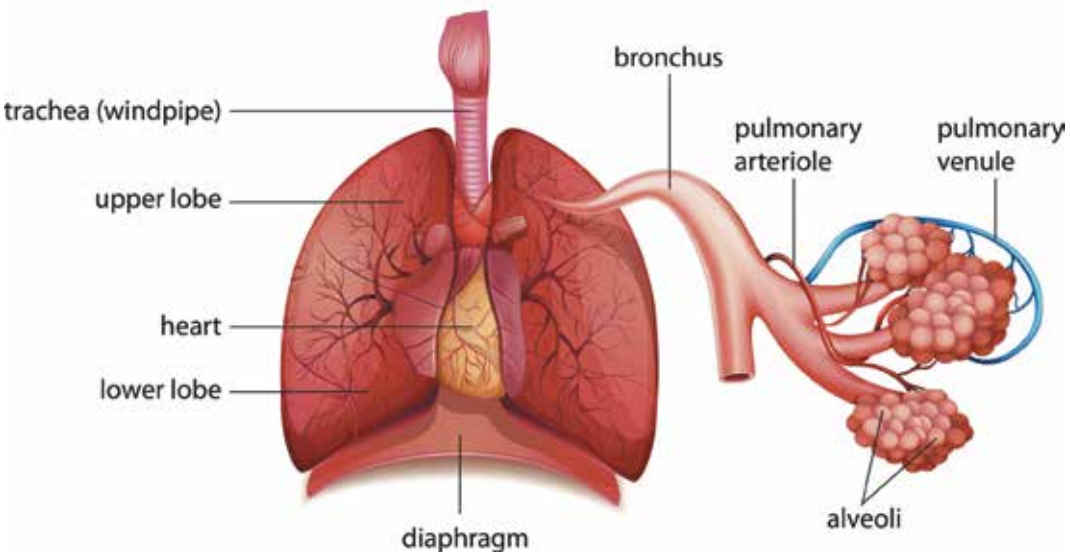
Your blood circulation system contains about 12 pints of blood. Your heart beats about 72 times per minute to pump blood through your blood circulation system. Your heart is the finest pump in the world. Nothing that human beings have developed can compare with the reliability of the heart pump.

Arteries are tubes that carry fresh blood away from the heart. They have thick muscular walls that help to force the blood along its path.



| Blood circulation system

Veins are tubes that carry used blood back to the heart. Veins have thin walls. They also have valves that prevent the blood from flowing backward. Capillaries are very thin tubes, which are only about one cell thick. These tiny tubes unite the arteries and veins. Capillaries make contact with the body's cells. Here, the nutrients and oxygen are supplied to the cells and the wastes removed.



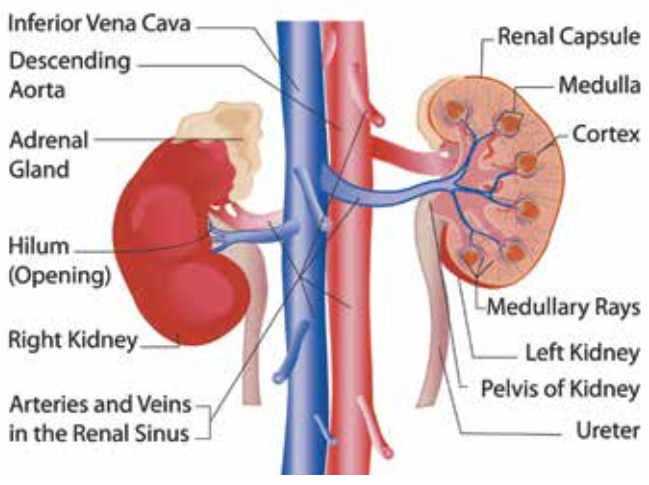
| Lungs

The *lungs* are a second part of the excretory system. The major function of the lungs is to purify the blood of gases. The lungs supply oxygen to the blood and get rid of carbon dioxide.

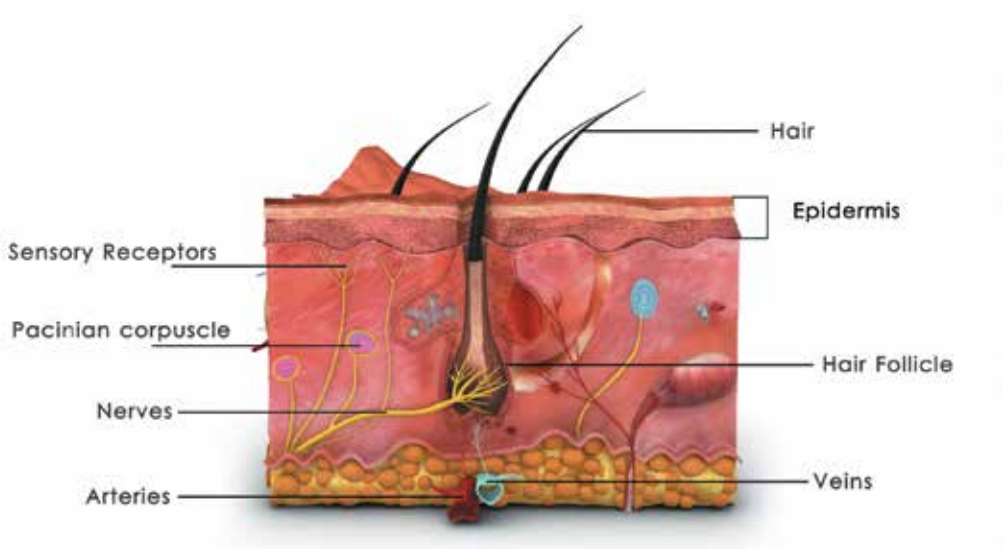
To help the lungs function, air enters the nasal passage and goes down the trachea (windpipe) to the lungs. Air sacs in the lungs are the places where the exchange of gases occurs. Capillaries line the air sacs to bring the red blood cells to this area. The red blood cells pick up oxygen in the air sacs and carry it to the body's cells. The oxygen is carried on *hemoglobin*, an iron-rich protein that makes up a large part of the red blood cells. Oxygen attaches to the hemoglobin and circulates with the blood to the body's cells.

A third part of the excretory system is the *kidneys*. The kidneys purify the liquid part of the blood. Thousands of filters in each kidney purify the blood. All of the blood passes through this purification system. The kidneys remove poisons, salts, water, urea, and other waste materials. Waste material removed from the blood is called urine. The bladder serves as a storage area for this waste urine. It is necessary to drink plenty of water for this filtering system to work properly and to carry off the wastes.

The fourth and final part of the excretory system is the *skin*. The skin helps us to get rid of waste through perspiration. It also functions as a protective coating and cooling system for the body. Evaporation of moisture helps to cool the body. The skin prevents germs and dirt from entering our bodies. It must be kept clean if it is to function properly. Oil and sweat will clog the pores of the skin and cause skin disorders. Also, the skin is important to keep us in contact with our environment by sensing stimuli, such as hot or cold. Throughout the skin, tiny nerve endings perform this function.



| Kidneys



| Skin

Complete the following statements.

1.41 The first line of protection, which prevents germs and dirt from entering the body, is the _____ .

1.42 The major waste product eliminated by the lungs is _____ .

1.43 Hemoglobin is an iron-rich protein that carries _____ to the cells.

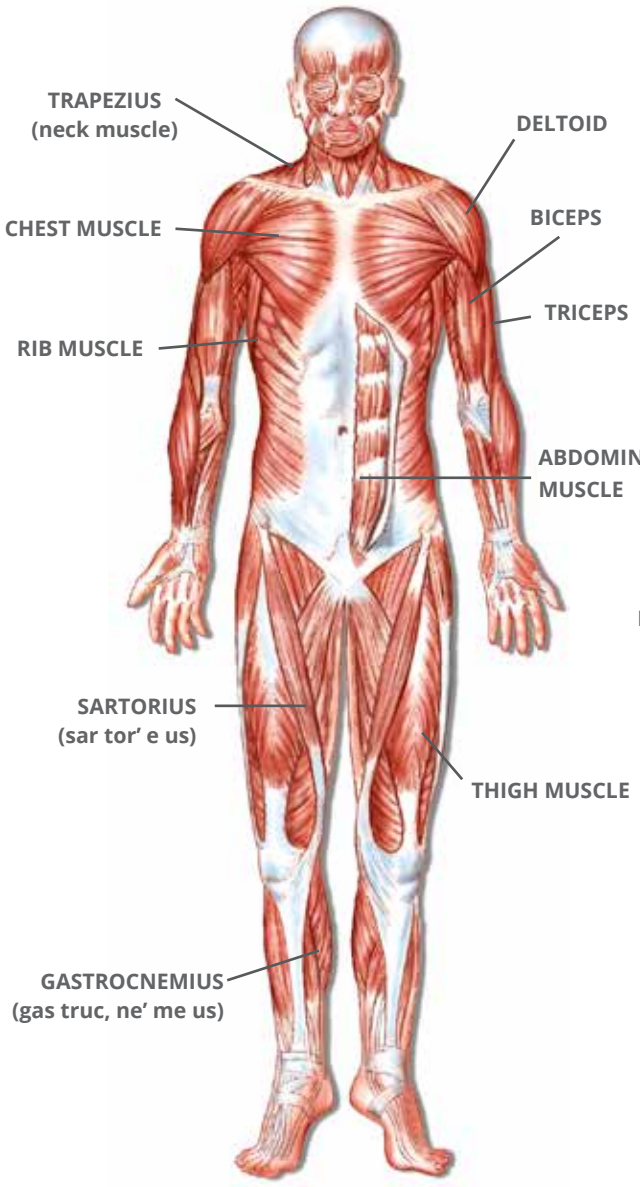
1.44 Urea is one of the major waste products that is removed by the _____ .

1.45 The blood picks up nutrients from the _____ of the small intestine.

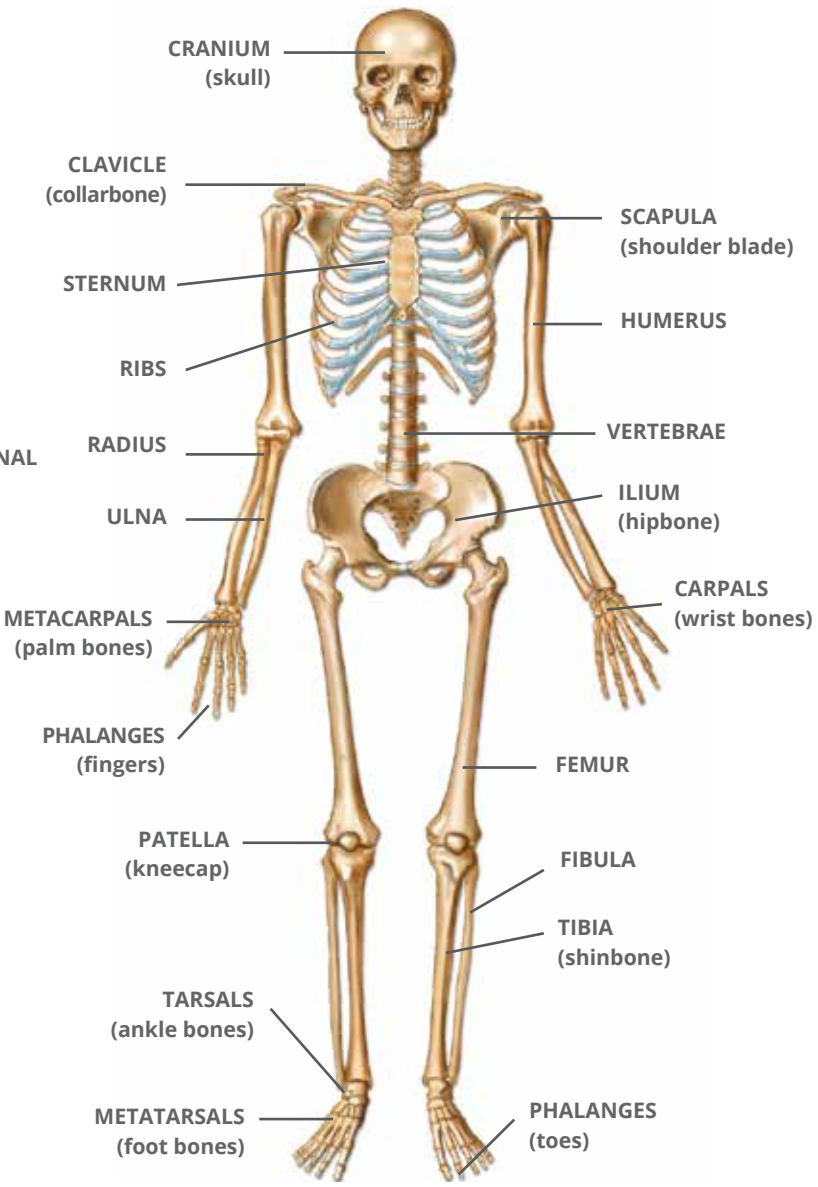
1.46 The organ that serves as a cooling system for the body by means of evaporation is the _____ .

1.47 The major difference between arteries and veins is the thick muscular walls in the a. _____ and valves in the b. _____ .

1.48 Tiny tubes that unite arteries and veins are known as _____ .



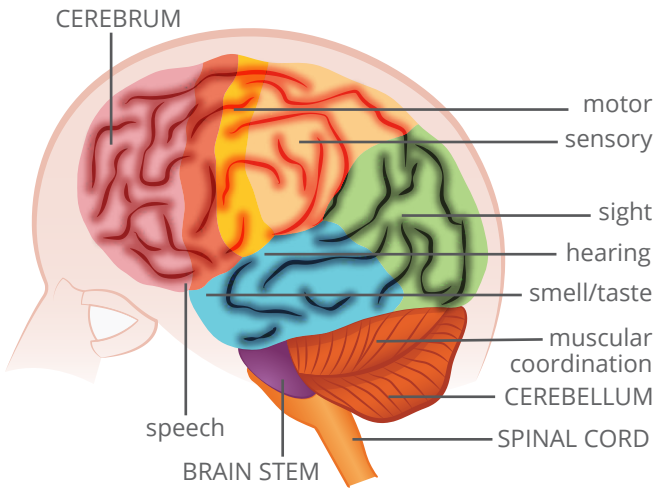
| Skeletal muscles



| Major bones of the skeleton

Skeletal system. Another major system of the human body is the *skeletal system*. The skeletal system is composed of the *muscles* and *bones*. This system gives form to the body and allows movement. The body has 206 bones. These bones provide support like a **framework**. Some bones are hollow. These bones are unusually strong. They carry the body weight. Leg bones are examples of very strong, hollow bones. Bones carry out another important function. Red blood cells and some white cells are made in the region inside the bone called the *marrow*. Marrow is the spongy inner portion of certain bones. The major bones of the body are shown in the illustration "Major bones of the body skeleton." Take some time now to review these bones and their locations.

Muscles fit over the body's skeleton. They allow movement and motion of the body. Some of the major muscles of the body are shown in the illustration "Skeletal muscles." Take some



| Parts of the brain

time now to review these muscles and their locations.

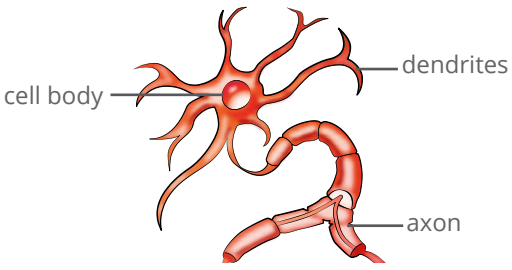
Muscles are voluntary or involuntary. Both voluntary and involuntary muscles are operated from the brain. You can control some parts of your body by thinking about them and moving them. The involuntary actions of your body are operated by the medulla, which is part of the brain stem. They control necessary life processes such as digestion, circulation, breathing, and heartbeat. These processes continue even while we are asleep.

Nervous system. The *nervous system* enables people and animals to respond to their environment. The *central nervous system* consists of the brain, the spinal cord, and nerves. Our human brain is different from those of animals. We are capable of abstract thoughts, reasoning, creative thinking, and logical solution of problems. We are also able to project our thoughts into the future and to use symbols.

The human brain has three main sections: (1) the cerebrum, (2) the cerebellum, and (3) the brain stem. These sections control various functions. The cerebrum is the location of intelligence and thought. It gives us the ability to learn, reason, remember, create, and think. It also controls the senses and the muscles. The cerebellum coordinates all the muscles so that they work together. The brain stem, is a stalk-like structure that connects the brain with the spinal cord. It has several different parts that control various functions in the body. Among these functions controlled by the brain stem are breathing, heartbeat, and reflexes such as sneezing, blinking of the eyes, and swallowing. Body temperature, hunger, and other internal conditions of the body are controlled by the parts of the brain stem.

From the brain stem, twelve pairs of nerve bundles move down the spinal cord to the rest of the body. These nerves are connected to the sense organs, muscles, facial glands, and vital organs. They are like many tiny strands of wire bundled together and wrapped with a cover. The twelve pairs of nerve bundles branch out as they come up the spinal cord to the brain stem into thirty-one pairs of special nerve bundles that connect every part of the brain.

The nervous system is like a large broadcasting system that transmits messages throughout the body. The *neuron*, or nerve cell, acts to transmit these electrical signals. A nerve cell has three basic parts. They are the *axon*, the *dendrite*, and the *synapse*. The axon is the transmitting end of the neuron. The dendrite is the receiving end. The dendrites of one neuron do not quite touch the axons of other neurons, but they are very close. The synapse is the small space between the dendrites and axons where the nerve impulses are electrically transmitted.



| The nerve cell or neuron

Place the correct letter in each blank.

1.49 The clavicle is the _____ .
a. arm b. skull c. leg d. collar bone

1.50 The cranium is a bone of the _____ .
a. arm b. skull c. leg d. chest

1.51 The carpals are bones which make up the _____ .
a. fingers and toes b. wrist c. knee d. ankle

1.52 The patella is a bone of the _____ .
a. knee b. ankle c. hip d. neck

1.53 The phalanges are bones which make up the _____ .
a. fingers and toes b. wrist c. spine d. vertebrae

1.54 The gastrocnemius is a muscle located in the _____ .
a. arm b. chest c. leg d. neck

1.55 The biceps and triceps are muscles of the _____ .
a. leg b. arm c. neck d. stomach

1.56 The trapezius muscle is located in the _____ .
a. leg b. arm c. stomach d. neck

Match the following items.

1.57 _____ the part of the brain that controls breathing, heartbeat, and reflexes such as sneezing, blinking, and swallowing

1.58 _____ the location of intelligence and thought

1.59 _____ the transmitting end of a neuron

1.60 _____ the receiving end of a neuron

1.61 _____ the small space between neurons where nerve impulses are passed from one neuron to another

1.62 _____ the area of the brain that controls muscle coordination

a. synapse
b. dendrite
c. axon
d. cerebrum
e. cerebellum
f. brain stem
g. neuron

GENETICS AND REPRODUCTION

One of the most striking things about people, animals, and plants is the fact that each reproduces its own kind. Each inherits traits from its parents. This transfer of traits is due to a special molecule in cells known as the *DNA molecule*. A study of this molecule and how it dictates traits in cells is known as *molecular genetics*.

Gregor Mendel discovered the principle of *dominance* in his work with garden peas. Certain traits like color, size, shape, and texture influence other traits. Carl Correns used four-o'clocks to demonstrate a blending of traits called *incomplete dominance*.

Genes carry a message for each trait in molecules of DNA. One of the main parts of the DNA molecule is sugar-phosphate. A change in a gene that produces a new, inheritable trait is called a *mutation*.

R. C. Punnett suggested a system of squares that helps organize genetic data. Punnett Squares are used to predict the characteristics of offspring. A cross between a male hybrid black guinea pig (Bb) and a female hybrid black guinea pig (Bb) produces young with the following genetic make-up:

Cells reproduce themselves by splitting apart. This kind of cell division is called mitosis. They have the same number of chromosomes as the parent cell. Mitosis is the type of cell division that occurs both as organisms grow larger and when worn-out cells are replaced.

	B	b	
B	BB	Bb	50% hybrid black
b	Bb	bb	25% purebred white

25% purebred black

Most multicellular plants and animals reproduce themselves by a process called *sexual reproduction*. Cells called sperm and egg are part of sexual reproduction. The sperm cell from a male parent and an egg from a female parent join together. This process begins a new life. For example, in plants, the sperm in pollen unites with the egg in the plant ovule. Before pollen and egg unite, the cells must undergo a special kind of division known as *reduction division*. Reduction division is a type of cell division in which chromosomes are reduced. In a plant that has fourteen chromosomes, the chromosomes in the pollen will be reduced to seven and the chromosomes in the egg will be reduced to seven. When the pollen and egg unite, the chromosomes unite and the plant embryo that is formed will have fourteen chromosomes. Also, the plant that develops will have the constant number of chromosomes, which is fourteen in this example.

Reduction division assures that the plant will be restored to the constant number of chromosomes. It will receive traits from both parents. This method of reduction occurs only in reproductive cells. All other cells reproduce by mitosis. These methods of cell reproduction give a plant or animal a constant number of chromosomes.

Complete this reading assignment.

Locate your Science 604 LIFEPAC on Molecular Genetics. Carefully review and study the topics listed below, found in Sections 2 and 3 of the Science 604 LIFEPAC, and place a check mark in the box when you have completed each step. You may want to obtain additional information on these topics from the Internet, library, or other resources if you need to better understand these topics.

- ☐ 1. Be sure you can summarize Gregor Mendel's work with tall and dwarf garden peas.
- ☐ 2. Review the system of genetic symbols and the method of setting up a Punnett Square.
- ☐ 3. Carefully study the meaning of *incomplete dominance*.
- ☐ 4. Study the role of the DNA molecule in transmitting traits.
- ☐ 5. Be sure you can define a *mutation*.
- ☐ 6. Learn the major parts of the DNA molecule: (a) the deoxyribose sugar, (b) the phosphate, (c) the spiral shape, and (d) the importance of the base pairs in forming the alphabet to spell out traits.

Complete the following activity when you have finished the above review.

1.63 Solve this problem. Mendel discovered that the purple-colored pea flowers dominated recessive white ones. Let the large P represent purple and small p represent white flowers. Assume that a hybrid plant with Pp (dominant purple and recessive white) is selfpollinated.

What fraction of the new flowers would be white (recessive pp)? _____

(If you have difficulty solving this problem, review the appropriate parts of Section 2 in the Science 604 LIFEPAC. The problem is set up and solved like the sample problem of Mendel's tall and dwarf peas. Remember you are crossing Pp with Pp just as the sample problem was Tt and Tt.)

Match the following items.

1.64 _____ cell division in which new cells have the same number of chromosomes as the parent cell

1.65 _____ cell division in which the new cells have one-half of the original number of chromosomes

1.66 _____ a condition in which neither gene of a pair is dominant; instead, they show a blended effect

1.67 _____ a change in a gene that forms a new trait that can be inherited

1.68 _____ the person who devised a system of squares used to record genetic problems

1.69 _____ the person who discovered the principle ofdominance

1.70 _____ the person who experimented with four-o'clocks

1.71 _____ the special molecule that is able to store and recover information about traits

1.72 _____ one of the main parts of the DNA molecule

a. sugar-phosphate

b. Carl Correns

c. mutation

d. mitosis

e. Gregor Mendel

f. DNA

g. traits

h. incomplete dominance

i. R. C. Punnett

j. reduction division

ECOLOGICAL SYSTEMS

An *ecological system* involves the plants, animals, people, environment, and all the interactions that occur between them in a given area of the earth. Ecological systems are often subdivided into groupings called *biomes*. A biome may be defined as a major ecological grouping of plants and animals. Each biome has its own special groups of plants and animals. In this portion of the LIFEPAC, you will review six of the major terrestrial biomes. *Terrestrial biomes* are groups that occur on earth (land). Those which occur in water are called *aquatic biomes*.

The kinds of plants and animals found within a biome are largely determined by the climate. For example, a *tropical rain forest* with all of its inhabitants is quite different from a forest of hardwoods in the mountainous temperate zone. Furthermore, these also are different from a *tundra biome*. The kinds of life found in a tundra biome are different because of the harsh climate. The tundra is treeless. Plants found there are mostly lichens, mosses, and a few that bear flowers. Animal life of the tundra includes the polar bear, caribou, snowshoe hare, and some birds.

The *northern coniferous forest* comprises the northernmost forests of conifers. It contains moose, black bears, wolves, rodents, and birds. The *deciduous forests* contain trees that shed their leaves. *Grasslands* are the plains and prairies. *Deserts* are dry and are characterized by specialized plants, principally types of cacti.

In contrast, a *tropical rain forest* has a hot and humid climate. Plant life there is abundant. Many species of animals are found in a tropical rain forest. The lush vegetation in such a forest can support many kinds of animals.

Complete the following reading assignment.

Read and review the part on "Terrestrial biomes" in Section 3 of the Science 603 LIFEPAC. As you read it, complete the following activity.

Complete the following activity.

1.73 Write a brief description of each of these terrestrial biomes.

a. tundra _____

_____

_____

_____

_____

b. northern coniferous forest _____

_____

_____

_____

c. deciduous forest _____

_____

_____

_____

_____

_____

d. grassland _____

_____

_____

_____

_____

e. tropical rain forest _____

_____

_____

_____

_____

f. desert _____

_____

_____

_____

_____

Aquatic biomes are those that occur in bodies of water. A biome in salty ocean water has different plants and animals than that of a freshwater pond. Even the different depths of the ocean have different groups of plants and animals.

One of the major characteristics of aquatic biomes is the presence of a food chain. A typical food chain from an ocean biome might read this way:

algae › protozoa, tiny crustaceans › small fish › larger fish

Another characteristic common to all biomes, both terrestrial and aquatic, is the presence of *cycles*. Within any biome is a constant turnover, or circulation, of substances. This turnover is referred to as a *cycle*. Cycles of minerals, carbon, water, nitrogen, and many other substances are common. Two cycles that are characteristic of every biome are the *nitrogen cycle* and the *carbon-oxygen-hydrogen cycle* (also called the *carbon cycle*).

In the nitrogen cycle, legumes like alfalfa, soybeans, and peas take and hold atmospheric nitrogen so that it can be used by plants. When plants die, bacteria and fungi release the nitrogen compounds back into the atmosphere.

In the carbon-oxygen-hydrogen cycle, animals consume oxygen and release carbon dioxide and water. During decay, the same products are given off. Plants take up the carbon dioxide and water, produce carbohydrates for food, and give off oxygen.

Complete the following activities. (It will be helpful to review the part of "Cycles" in Section 3 of the Science 603 LIFEPAC.)

1.74 What plants are capable of fixing atmospheric nitrogen into a form that can be used by plants? _____

_____

_____

1.75 What organisms are able to degrade the decaying material to allow nitrogen to be returned to the atmosphere? _____

_____

_____

1.76 What group of organisms produce oxygen for the carbon cycle? _____

1.77 What group of organisms produce carbohydrates for the carbon cycle? _____

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

Match the following items (each answer, 2 points).

1.01 _____ the location of most photosynthesis

1.02 _____ a by-product of photosynthesis

1.03 _____ openings found on the underside of a leaf

1.04 _____ a common storage product of plants

1.05 _____ the first stable product made during photosynthesis

1.06 _____ the name of the tubes that transport food in plants

1.07 _____ the name of the tubes that transport water and minerals in plants

1.08 _____ the name of the vascular bundle in the leaf

1.09 _____ a natural plant regulator

1.010 _____ a response to gravity

1.011 _____ the main function of the large intestine

1.012 _____ the main function of the small intestine

1.013 _____ an iron-rich protein that carries oxygen to the cells

1.014 _____ a liquid waste product eliminated from the blood

1.015 _____ a change in a gene that forms a new trait that can be inherited

a. hemoglobin
b. urine
c. mutation
d. absorbs food
e. absorbs water
f. geotropism
g. xylem
h. phloem
i. starch
j. glucose
k. stomata
l. leaf
m. oxygen
n. vein
o. vascular cylinder
p. auxin
q. carbon dioxide

Answer true or false (each answer, 2 points).

1.016 _____ Bacteria on legumes are able to release nitrogen into the air.

1.017 _____ Carl Correns devised the Punnett Square.

1.018 _____ Mitosis results in new cells with the same number of chromosomes as the parent cell from which they came.

1.019 _____ The tundra biome does not have trees.

1.020 _____ Bile breaks down proteins for digestion.

1.021 _____ A characteristic common to all biomes is the presence of cycles such as the nitrogen cycle.

1.022 _____ The DNA molecule has a sugar-phosphate structure.

1.023 _____ The cerebellum is the location of intelligence and thought.

1.024 _____ The brain stem controls breathing and heartbeat.

1.025 _____ A dendrite is the "sending end" of a neuron.

1.026 _____ The cerebrum controls the coordination of muscles.

1.027 _____ The bone marrow makes red blood cells.

1.028 _____ The skin acts as a cooling system by means of evaporation.

1.029 _____ Digestive juices are rich in enzymes.

1.030 _____ Gibberellin is an artificial plant regulator made by man.

Complete the following statements (each answer, 3 points).

1.031 The patella is a bone located in the _____ .

1.032 The energy for photosynthesis comes from the _____ .

1.033 Food tubes that make up the transport system of plants are called _____ .

1.034 Phototropism is a response to _____ .

1.035 Hydrotropism is a response to _____ .

1.036 The gallbladder secretes a substance known as _____ , which emulsifies fat.

1.037 Arteries are tubes that carry blood _____ (direction) the heart.

1.038 The kidneys purify the liquid part of the _____ .

1.039 The collar bone is known as the _____ .

1.040 The gastrocnemius muscle is located in the _____ region.

1.041 The cranium is a bone located in the _____ .

1.042 The name given to the nerve cell is a _____ .

1.043 The area between the axon and dendrite that carries nerve impulses is known as the _____ .

1.044 The person who discovered the principle of dominance was _____ .

1.045 The special molecule which is able to store and recover information about genetic traits is _____ .

Complete the following activities (each answer, 5 points).

1.046 Distinguish between voluntary and involuntary muscles. _____

_____

_____

_____

_____

1.047 Describe how plants, animals, and humans benefit each other in the carbon-oxygen-hydrogen cycle. _____

_____

_____

_____

_____

80/100 **SCORE** _____ **TEACHER** _____ _____
initials date

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