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SCIENCE

STUDENT BOOK

6th Grade | Unit 3

Alpha Omega
PUBLICATIONS

SCIENCE 603

Plant and Animal Behavior

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Plant and Animal Behavior

Introduction

God has created plants, animals, and other living things in a wonderful way. In the previous LIFEPACs of this science series, you have learned about several *systems* that God has provided for plants and animals. In this LIFEPAC® you will learn about some systems in plants, animals, and other living organisms that allow them to respond to their environments. We often refer to these response actions of animals and plants as their *behavior*. You will examine some of the parts of animals and plants that allow these response actions and behavior. In particular, you will learn more about the *nervous system* of human beings because it plays such an important role in the behavior and responses of humans. Other animals and living organisms have nervous systems, too, but ours is the most highly developed of all living things created by God.

In addition, you will examine more about the interaction between plants and animals. You will also explore how the physical environment affects the behavior and interactions of plants and animals. Finally, you will learn more about some of the cycles in nature and the balance of nature.

Objectives

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

1. Identify the structure and functions of parts of the nervous system.
2. Define and identify reflex, instinct, and learned responses.
3. Define and identify the three types of learned responses.
4. Describe examples of human intelligence.
5. Identify the three major tropisms of plants.
6. Describe how tropisms work in plants.
7. Describe the characteristics of the two major types of biomes.
8. Identify and describe the parts of a food chain.
9. Examine some of the natural cycles in nature.
10. Define and describe the balance of nature.

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

1. ANIMAL AND HUMAN BEHAVIOR

Animals are a special part of God's creation. They are living things that can move in their environments and interact with them. Although they have some similarities with animals, human beings are the most wonderful creatures of all the living things that God has created! Both humans and animals are able to interact with their environments. They respond to a variety of conditions and stimuli. These responses of man and animals to their environment are called behaviors. Most animals have a nervous system that allows them not only to respond to the environment, but also to move and interact with the environment. Human beings have the most highly developed nervous system of all the animals that God has created.

In this section of the LIFEPAC, you will learn more about the nervous system of animals and of humans. By studying the nervous system of humans in more detail, you will be able to appreciate the wonderful design that God has provided to His creation. In addition, you will learn about several types of responses that man and animals make to their environment.

Section Objectives

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

1. Identify the structure and functions of parts of the nervous system.
2. Define and identify reflex, instinct, and learned responses.
3. Define and identify the three types of learned responses.
4. Describe examples of human intelligence

Vocabulary

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

axon (ak son). Sending end of neuron cells; neuron end with little knobs on each branch.

cerebellum (ser ə bel əm). Lower back of brain; coordinates muscle movements.

cerebrum (ser ə brəm, sə rē brəm). Front part of brain; seat of all intelligence and thought.

cortex (kôr teks). Thin gray layer over brain; responsible for high level thought.

dedrite (den drīt). Receiving end of neuron; many pointed branches.

ganglia (gang lē ə). Clusters of individual neurons.

hormones (hôr mōnz). Substances produced by glands of the body which are carried to other organs or tissues where they influence growth, development, etc.

medulla (mi dul ə). The lowest part of the brain; the top of the spinal cord.

neurons (nūr on, nyū ranz). Nerve cells.

parasympathetic (par ə sim pə thet ik). Part of the autonomic nervous system that tends to slow down heartbeat and decrease body activities.

plexus (plek səs). One of four major bundles of ganglia gathered near the spinal column.

stimuli (stim yə lī). Plural of *stimulus*. Something that rouses or causes activity.

sympathetic (sim pə thet ik). Part of the autonomic nervous system that helps the body during times of emergency and increased activity.

synapse (sin aps, si naps). Region between neurons that chemically passes on messages.

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**ė**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; /ŦH/ for **th**en; /zh/ for mea**s**ure; /u/ or /ə/ represents /a/ in **a**bout, /e/ in tak**e**n, /i/ in penc**i**l, /o/ in lem**o**n, and /u/ in circ**u**s.

NERVOUS SYSTEM

Almost all animals, except the very simplest kinds, have a *nervous system*. The nervous system is something like an "electronic communications network" within the animal that allows it to respond and adjust to changes in its environment.

Invertebrates (animals without a backbone) have a nervous system that ranges from a simple set of nerves to a highly organized system of nerve cords and a simple brain. Vertebrates (animals with a backbone) have a nervous system that consists of three main parts. They are:

1. The *central nervous system* consists of the brain, spinal cord, and nerves.
2. The *autonomic system* is made up of nerves that control the involuntary actions of the heart, lungs, digestive system, and other parts of the body which must operate automatically and continually without interruption. The autonomic system normally operates without the animal or the human being aware of its action.
3. The *sense organs* (like the eyes, ears, nose, tongue, and skin) involve the total action of the nervous system, from initial input (stimulus) to final action (response).

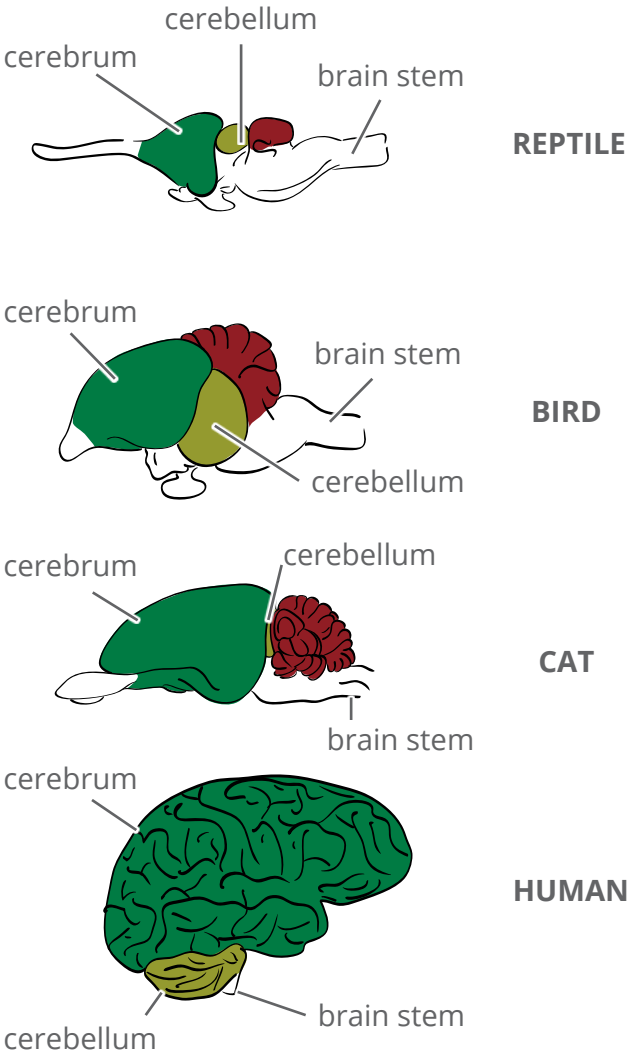
The human nervous system sets people apart from all of the other creatures that share planet earth. God gave humans a very highly developed brain. The human brain functions something like—but much greater than—a highly developed "computer." The human brain allows us to speak, to solve difficult problems, and to be creative with ideas and activities. Our brain also allows us to know and love God and to make choices for or against the way of life that God wants us to live. Truly, the human nervous system is the most complex and marvelous part of the human body!

Let's take a look at the three main parts of the nervous system of vertebrates. We will focus in this LIFEPAC primarily on the human nervous system, since it is the most highly developed of all the nervous systems in nature.

Central nervous system. The central nervous system of humans, and most animals, consists of the brain, the spinal cord, and the nerves. It functions like an electronic communications and control network that directs and coordinates the activities of the entire nervous system and the body. We will examine each part of the central nervous system, especially focusing on the brain as the key to the operation of the entire nervous system.

The brain. The *brain* is the "central control system" of the entire nervous system and body. The brain is an extremely complex organ. It directs the activity of over ten billion (10,000,000,000 +) nerve cells! It constantly receives current information from the senses about conditions both inside and outside the body. It rapidly processes all this information and transmits messages that control the body's activities and functions. The brain also stores bits of information from past learning experiences in the form of memory. This makes learning and remem- bering possible. The brain is also the source of thoughts, moods, and emotions. Using the resources of the brain, human beings can imagine, dream, think, reason, and respond. We can create, invent, examine, and logically solve problems by using our brains.

The brain in simple animals such as worms and insects (invertebrates) consists of small groups of nerve cells. Vertebrates (animals with a backbone) have a more complicated brain made up of three parts: the **cerebrum**, the **cerebellum**, and the *brain stem*. Animals with a more highly developed brain include apes, dolphins, and whales. Human beings have the most highly developed brain of all. The human brain consists of billions of interconnected cells. You will learn more about the three main parts of the human brain in the next part of this section of the LIFEPAC.



| Brains of vertebrates

Write the correct letter and answer in each blank.

1.1 We often refer to the response actions of plants and animals as their _____ .
a. characteristics b. behavior c. ideals d. cycles

1.2 Animals are living things that can move around in their _____ .
a. homes b. bodies c. ponds d. environments

1.3 The _____ allows humans and animals to respond to their environments and to move and act in their environments.
a. nervous system b. respiratory system c. green chlorophyll d. backbone

1.4 _____ have a nervous system that consists of three main parts.
a. Protists b. Invertebrates c. Vertebrates d. Monerans

1.5 The most highly developed brain is in _____ .
a. fish b. human beings c. monkeys d. elephants

Answer true or false.

1.6 _____ The central nervous system consists of the brain, spinal cord, and nerves.

1.7 _____ The autonomic system is part of the nervous system that controls involuntary actions in the body.

1.8 _____ A fish has a more highly developed brain than an ape.

1.9 _____ The spinal cord is part of the respiratory system.

1.10 _____ The three main parts of the brain in vertebrates are the cerebrum, the cerebellum, and the brain stem.

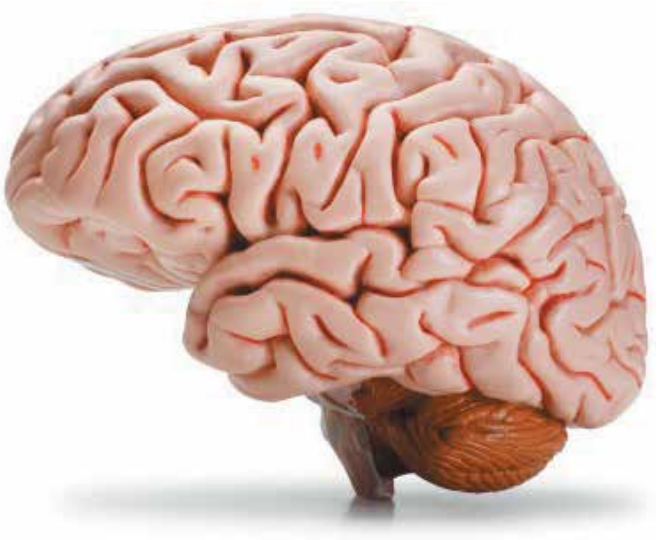
The human brain, like all vertebrate brains, has three main sections. They are the cerebrum, the cerebellum, and the brain stem. Each part consists mainly of nerve cells, called **neurons**, and supporting cells, called glia (which comes from a Greek word meaning "glue"). The human brain is grayish-pink in color. It looks something like a "mushroom," in that it is like a cap on top of a stem. The brain is also a jelly-like ball that has many ridges and grooves on its surface. Let's explore each of the three main parts of the human brain in more detail.

Cerebrum. The cerebrum makes up about 85 percent of the weight of the human brain. It is the seat of our intelligence and thought. It gives us the ability to learn, reason, remember, create, and think. The cerebrum handles thousands of messages from all parts of our body at the same time! It is greater than the most sophisticated computer built by man.

The cerebrum is divided into two halves called *hemispheres*. A large groove called the *longitudinal fissure* divides these two halves of the cerebrum. One of these halves is called the *left cerebral hemisphere*, and the other half is called the *right cerebral hemisphere*. The two hemispheres are connected by bundles of nerve fibers. The largest of these nerve fibers connecting the two hemispheres of the cerebrum is called the *corpus callosum*. Each hemisphere of the cerebrum is divided into four *lobes* (regions). The four lobes, and their locations, are as follows:

1. the *frontal lobe*, at the front of the cerebrum;
2. the *temporal lobe*, at the lower side;
3. the *parietal lobe*, in the middle; and
4. the *occipital lobe*, at the rear.

The surface of the two hemispheres of the cerebrum is covered with a layer of grey matter called the **cortex** (or the *cerebral cortex*). It is a thin layer of nerve cell bodies about 3.2 mm (1/8 inch) thick. The cortex has many folds and creases called *convolutions*. The cortex is responsible for all higher thought and



reasoning. The greater the amount of convolutions of the cortex, the higher the intelligence.

The cerebrum is connected to the sensory organs throughout the nervous system. The cerebrum interprets the messages sent to it from each one of these organs. The cerebrum is the part of the brain that allows us to *see, smell, hear, taste,* and *feel* our surroundings. The location centers for these sensory parts are located in different parts and lobes of the cerebrum; however, a blow to the head to one of these areas can cause our sensing and the messages from our sense organs to get mixed up. That is why we can "see stars" when we receive a blow to the back of the head where our vision is controlled in the occipital lobe. If the blow to the head is severe enough, we can even lose our sight, hearing, or any one of our senses. The skull or *cranium* is designed to protect the entire brain from most damage.

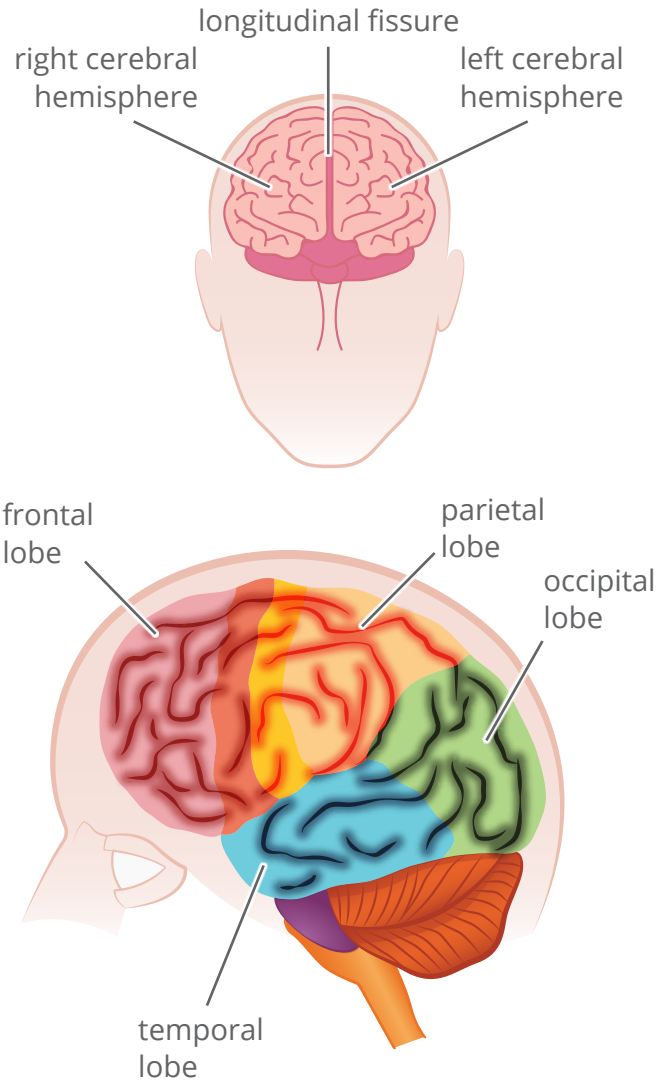
The cerebrum also controls the muscles of the body. The nerves carrying the messages cross over from the left side of our body to the right side of our brain and from the right to the left. A stroke in one part of the brain can cause paralysis in various parts of the body when a portion of this motor area of the brain gets damaged.

Cerebellum. The second main part of the brain is called the *cerebellum*. It is located in the lower back part of the brain. Its primary function is to coordinate all the muscles so that they work together. If the cerebellum is undeveloped, like it is in a newborn baby, muscular movements are jerky and uncoordinated. As the child grows, the cerebellum develops and causes all the muscles to act together in coordinated movements. This part of the brain also controls our sense of balance so we can walk or run straight.

Brain stem. The third main part of the brain is called the *brain stem*. It is located on the back underside of the brain. It is a stalk-like structure that connects the cerebrum with the spinal cord. The brain stem consists of several different parts. The bottom part of the brain stem is called the **medulla**. The medulla has nerve centers that control breathing, heartbeat, and many other vital body functions.

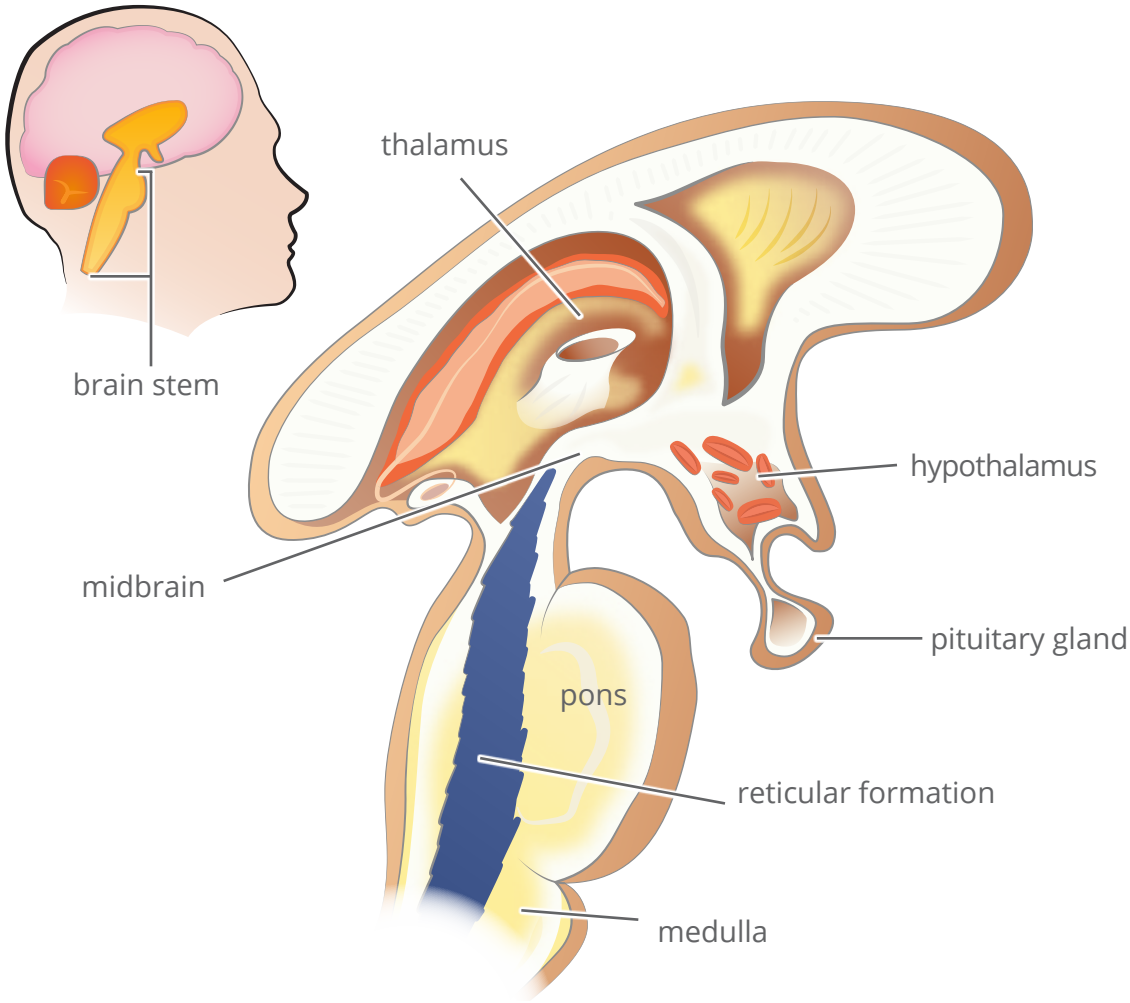
Above the medulla, in the brain stem, is the *pons*. It contains nerve fibers that connect the cerebrum and the cerebellum. Above the pons is the *midbrain*. It contains nerve centers to help control movements of the eyes and the size of the pupils.

The upper part of the brain stem contains the *hypothalamus* and the *thalamus*. There are actually two thalami, one on the left and one on the right. The thalamus receives nerve impulses from various parts of the body and connects them to the appropriate areas of the cortex. The thalamus also relays impulses from one part of the brain to another. The hypothalamus



| The hemispheres and lobes of the cerebrum

regulates body temperature, hunger, and other internal conditions of the body. The hypothalamus also controls the activity of the nearby *pituitary gland*.



| The brain stem

Deep within the brain stem is a network of nerve fibers called the *reticular formation*. The reticular formation helps regulate and maintain the brain's awareness level. Sensory messages that pass through the brain stem stimulate the reticular formation. In turn, this stimulates the alertness and activity throughout the cortex covering the cerebrum.

Now, you understand more about the complexity of the brain and its three main parts: the cerebrum, the cerebellum, and the brain stem. From the brain stem, the brain sends out twelve pairs of nerve bundles that move from the brain to the body. These nerves connect to the sense organs, muscles, facial glands, and vital organs. These nerve bundles are like many tiny strands of wire wrapped together and wrapped with a cover. These twelve pairs of nerve bundles then branch out from the spinal cord to thirty-one pairs of special nerve bundles that connect every part of the brain.

Complete the following activities.

1.11 The three main parts of the brain are the a. _____ , the b. _____ , and the c. _____ .

1.12 All the parts of the brain consist of nerve cells, called a. _____ , and supporting cells, called b. _____ .

1.13 Label the parts of the brain shown in the illustrations shown.

a. _____

b. _____

c. _____

d. _____

e. _____

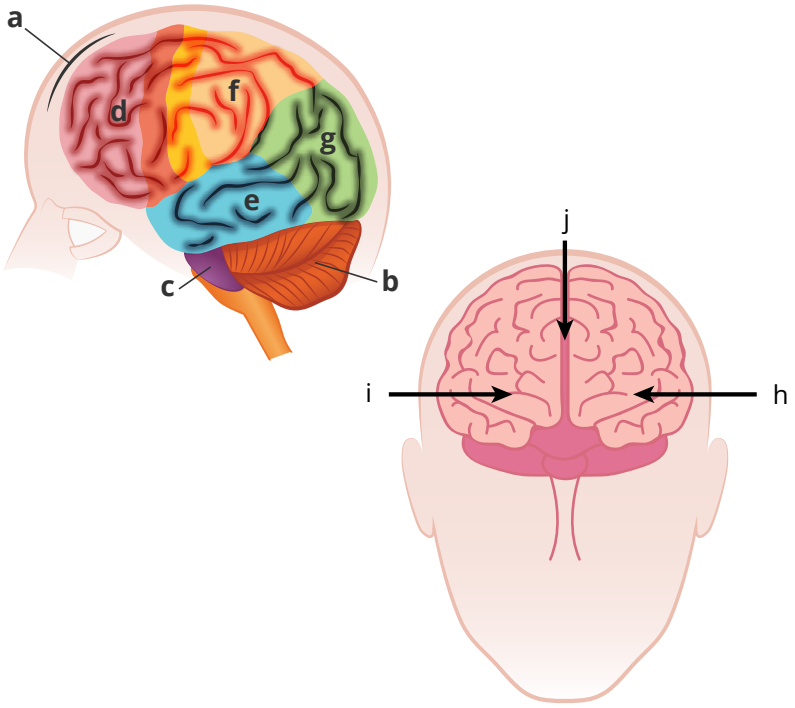
f. _____

g. _____

h. _____

i. _____

j. _____



1.14 The _____ is a stalk-like structure that connects the cerebrum with the spinal cord.

1.15 From the brain stem, the brain sends out twelve pairs of _____ that move down from the brain to the body.

Match these activities and functions with the parts of the brain. Note that the name of one part of the brain may be used for more than one activity or function.

1.16 _____ controls muscles of the body

1.17 _____ coordinates muscles so they work together

1.18 _____ controls breathing, heartbeat, and other vital body functions

1.19 _____ controls movement of the eyes and size of pupils

1.20 _____ contains nerve fibers that connect the cerebrum and cerebellum

1.21 _____ interprets messages sent to it from sense organs

1.22 _____ responsible for all higher thought

1.23 _____ responsible for ability to remember

1.24 _____ responsible for ability to learn

1.25 _____ connects cerebrum with spinal cord

1.26 _____ regulates and maintains brain's awareness level

1.27 _____ controls the activity of the pituitary gland

1.28 _____ relays impulses from one part of the brain to another

1.29 _____ regulates body temperature, hunger, and other internal body conditions

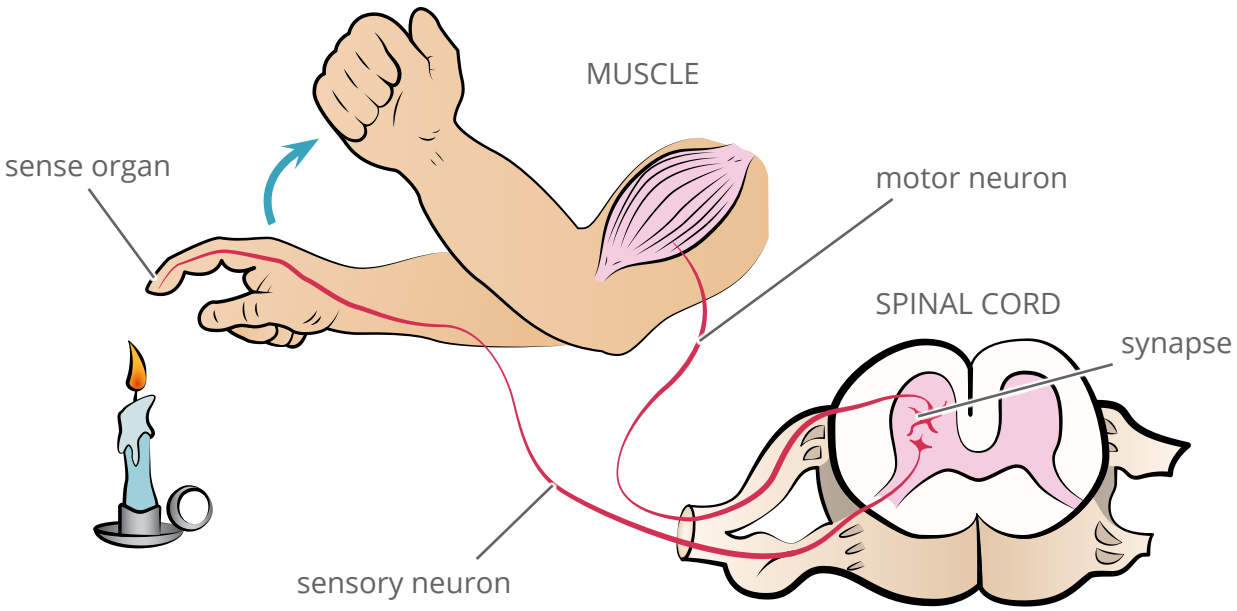
1.30 _____ connects nerve impulses from body to cortex

a. cerebrum
b. cortex
c. cerebellum
d. brain stem
e. medulla
f. pons
g. midbrain
h. thalamus
i. hypothalamus
j. reticular formation

The spinal cord. The *spinal cord* is the second main part of the central nervous system. It contains all the nerve bundles ("electrical wiring") of the body and is protected inside the spinal column (the backbone). The spinal cord extends from the brain stem and runs through the center of the spinal column. Its length is about two-thirds of the length of the spinal column.

One function of the spinal cord is to carry nerve messages from various body parts to the brain. If the spinal column, made up of the vertebrae, gets out of alignment or twisted, the spinal cord can be pinched. As a result, these nerve messages from the various parts of the body do not reach the brain as they should. Paralysis and pain can result.

Another function of the spinal cord is to intercept and interpret danger signals from various parts of the body. These danger signals cause the spinal column to react by sending a return message to the danger spot without the brain receiving the message. Our brains are built to react to danger or pain instantly. If the message of pain in your hand had to travel all the way to your brain and back before you reacted to a hot pan which you had picked up, your hand would be severely burned. However, since the spinal cord can intercept the message and send the message to the hand to "let go," the burn would not be so serious.



| The spinal cord receives danger signals and responds.

The nerves. The *nerves* are the third part of the central nervous system. Nerve cells are called *neurons*. Each nerve cell, or neuron, consists of three main parts: the *cell body*, the **axon**, and the **dendrites**. The entire nerve cell, or neuron, is surrounded by a very thin membrane called the nerve membrane. Let's explore the three main parts of a nerve cell, or neuron.

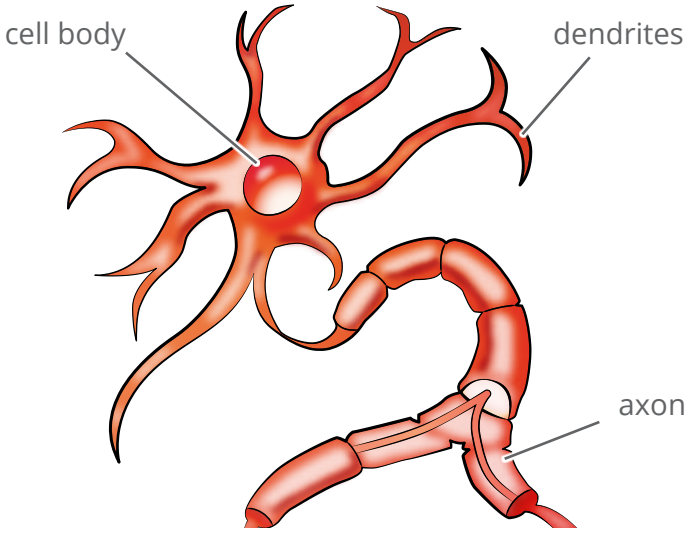
The *cell body* of a neuron is shaped somewhat like a small ball. It is only about 1/1000 of an inch wide (0.025 mm). The cell body is the "brain" for each neuron to receive and send nerve impulses. The cell body is also responsible for making proteins and using energy for growth and maintenance of the nerve cell.

The *axon*, also called the *nerve fiber*, is a tubelike extension coming from the cell body. The axon's specialty is to carry and transmit messages. The end of the axon branches out into many smaller branches. In fact, the axon of just one neuron may have enough branches to make contact with as many as 1,000 other neurons! Most of the axons in the central nervous system are less that 1/25 of an inch long (1 mm). However, axons in other parts of the nervous system (described elsewhere in this section) can be much longer. For instance, the axons that run from the spinal cord to the muscles in the feet may be as much as 30 to 40 inches long (70 to 100 cm)!

What we commonly call *nerves* in the body are actually *bundles of axons* lying next to one another in a cordlike formation. It is like a telephone cable with a lot of wires in it.

The *dendrites* are the third part of a nerve cell, or neuron. They are the smaller branching, tubelike structures coming from the cell body. Most neuron cell bodies have about six main dendrites. Each of these dendrites is about two or three times thicker than the axon of the cell. Each dendrite may also branch slightly at the end. The dendrites are usually shorter than the axon. They are about 1/50 of an inch long (0.5 mm) from the cell body to the tips of the dendrites.

The purpose of the dendrites is to receive impulses, mostly from the axon of another neuron. The dendrites of one neuron do not

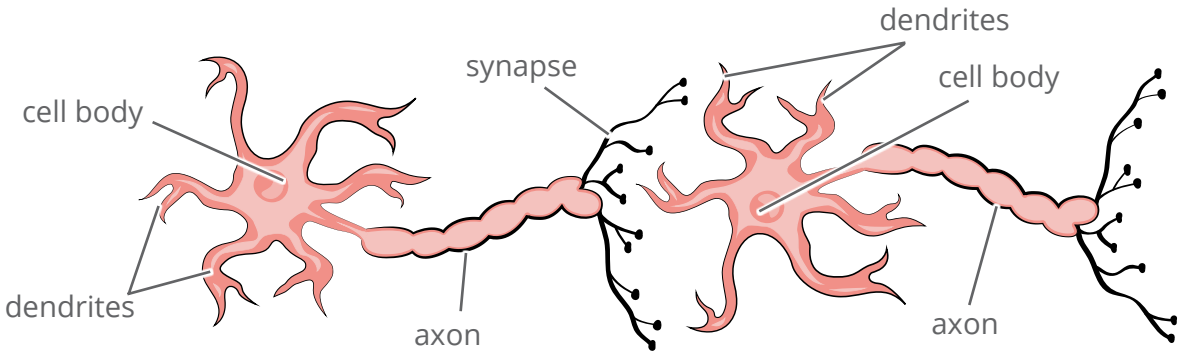


| The nerve cell, or neuron

quite touch the axons of other neurons, but they are very, very close. A tiny gap where the dendrites and axons come close together and transmit nerve impulses is called the **synapse**. The nerve impulses are transmitted from one neuron to another over the extremely narrow space called the *synaptic cleft*.

How are the nerve impulses transmitted from neuron to neuron? Basically, it is an electro-chemical process occurring slightly outside and inside each neuron. Tiny chemical reactions occur that excite the neurons. These trigger tiny electrical signals that can be generated, transmitted, and received by the neurons. These impulses are transmitted rapidly from neuron to neuron until a message gets to the spinal cord or the brain for coding or decoding. Then, an action message is sent back along another neuron to a neuron pathway. The neurons responsible for receiving sensory information are called *sensory neurons*. Those responsible for carrying messages back for the muscles or organs to take some kind of action are called *motor neurons*.

The message carried along these nerve pathways are transmitted very fast! They go as fast as 300 feet (100 meters) per second. This means that a signal generated in your toe could be sent to your brain and back again thirty times in one second! God has designed our central nervous system with great detail and wisdom. It is an extremely complicated system that shows the power and loving care of God our Father toward all human beings.



| Nerve impulses are transmitted from neuron to neuron at the synapses

Answer the following questions.

1.31 What are two functions of the spinal cord?

a. _____

_____

b. _____

_____

1.32 How are nerve impulses (messages) sent from one nerve cell (neuron) to another in the nervous system?_____

_____

_____

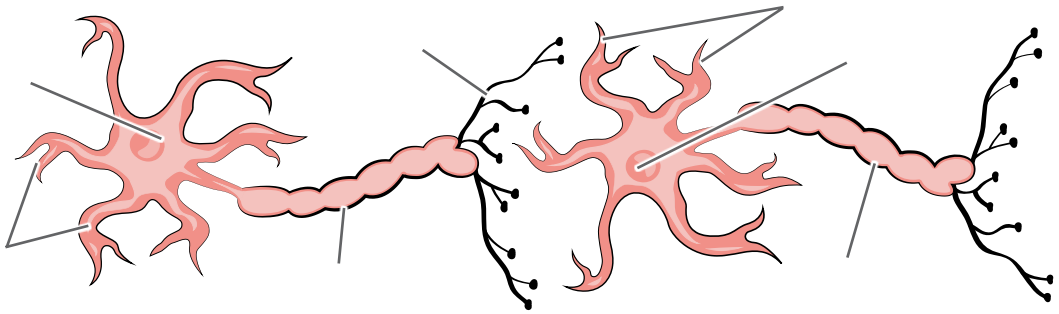
1.33 What are the two parts of neurons for sensing and returning nerve impulses in the body?

a. _____

b. _____

Complete the following activities.

1.34 Label the drawing of the neurons with the correct names of the parts.



1.35 List the purposes of the following parts of a neuron:

a. cell body _____

_____

b. axon _____

_____

c. dendrite_____

_____

TEACHER CHECK _____ initials _____ date

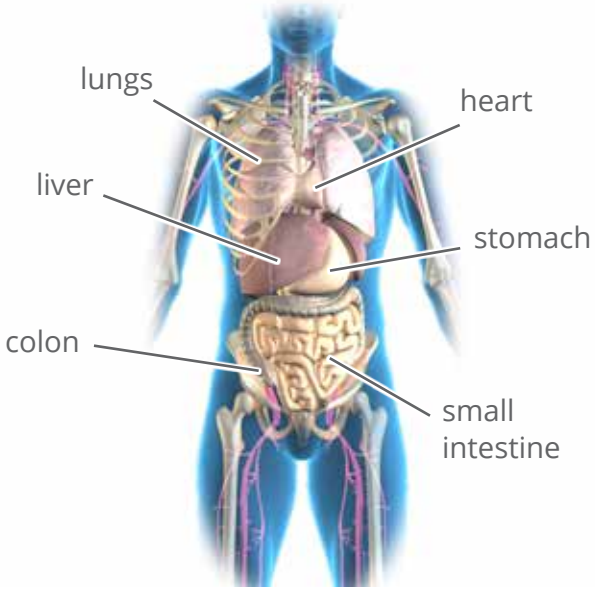
Autonomic nervous system. The *autonomic nervous system* regulates certain body functions without the conscious control of the brain. Many of the things that our body does throughout the day happen without our thinking about them. For example, breathing, sneezing, digestion, heartbeat, and the size of the eye pupil are all done without our thinking about them. These are involuntary actions of our body. They are controlled by the autonomic nervous system. The autonomic nervous system provides a constant regulation of certain body functions in order to maintain a stable environment within our body.

In the autonomic nervous system, *clusters* of neurons come together near the spinal cord from various parts of the body. These clusters are called **ganglia**. These nerve centers help control the involuntary actions of our muscles, organs, and glands. In many places of the body, clusters of ganglia come together to form a **plexus**. For example, one of these is located near the stomach and is called the solar plexus. Sometimes a person receives a blow in this region and "gets the wind knocked out of him." This means that there is a temporary upset in the nerve system that controls breathing, so the person experiences a short difficulty in breathing. However, it is soon restored to balance again.

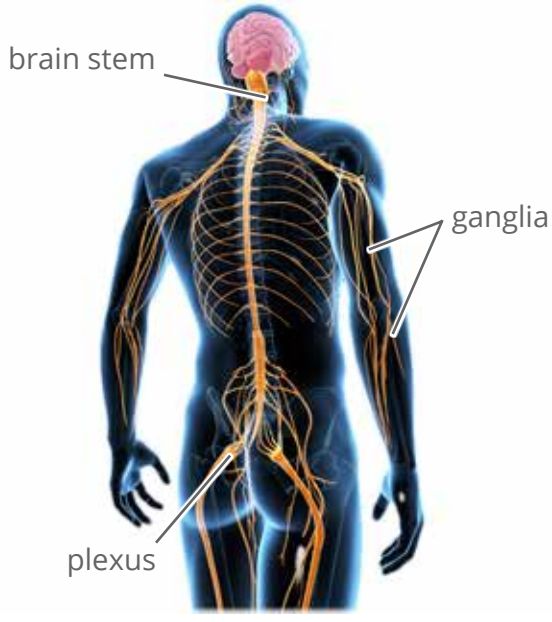
The autonomic nervous system has two parts: (1) the **sympathetic system** and (2) the **parasympathetic system**. The sympathetic system helps the body during emergencies and times of increased activity. For example, its actions include speeding up the heartbeat, sending additional blood to the muscles, and enlarging the pupils of the eyes to use available light.

The parasympathetic system works just the opposite way most of the time! Its functions include slowing down the heartbeat, diverting blood from the muscles to the stomach and intestines, and making the pupils smaller. The overall balance between the sympathetic and the parasympathetic nervous systems is controlled by the central nervous system.

Sense organs. The third and final part of our nervous system involves the sense organs, such as the eyes, ears, nose, tongue, and skin. These organs have a unique set of nerves that control them. In fact, between humans and



| Organs and systems contolled by the autonomic nervous system



| Some clusters of the autonomic nervous system

animals, the differences in the nerves of these sense organs can account for major variations in their abilities to sense things. For example, the owl has a keen sense of sight. The fish has a keen sense of smell. The fox has a keen sense of hearing. Without these keen senses, animals could not survive as well in their environments.

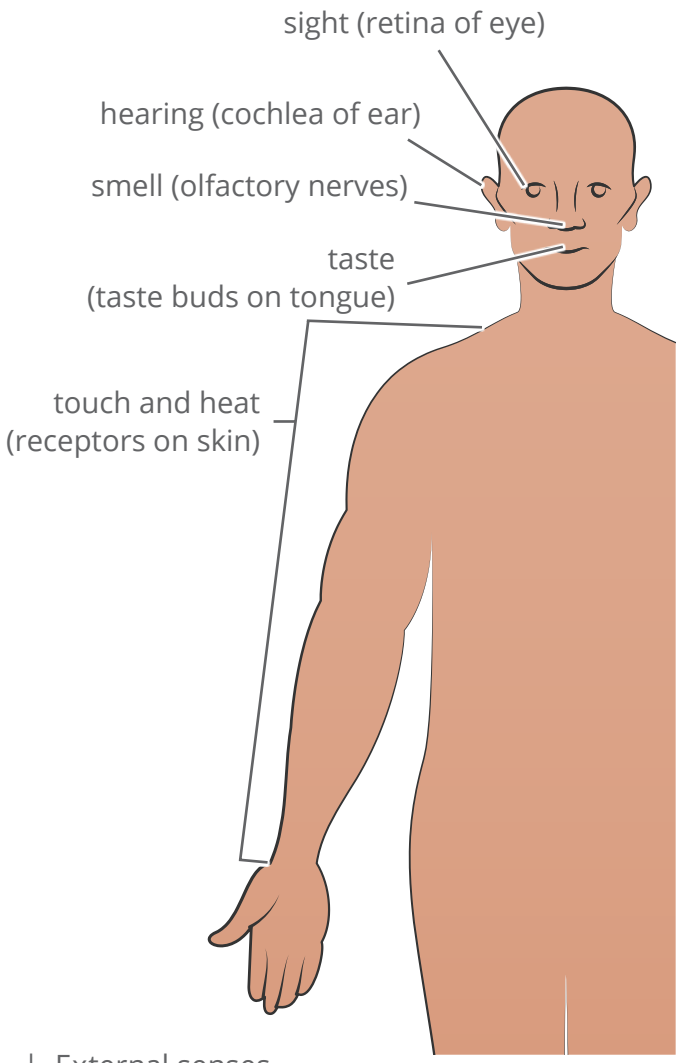
There are two groups of senses within humans: *external* and *internal*. The *external senses* respond to stimuli *outside* the body. The external senses are things like sight, hearing, smell, taste, and touch. There are special receptor nerves for each one of these external senses. *Internal senses* respond to conditions inside the body and detect changes that occur in the body's organs and tissues. These internal senses come from special receptor nerves located within internal tissues and organs.

The inside lining of the nose is the location of the olfactory nerves that help us with the sense of smell. The olfactory nerves pick up different smells and send signals to the cerebrum for interpretation.

The sense of taste comes from special nerves called "taste buds" on our tongues. Again, signals received on the taste buds are sent to the cerebrum for interpretation. Different flavor stimuli to the taste buds give foods different "tastes."

Our sense of sight comes from light sensitive receptors in the retina of our eyes. These receptors connect to the optic nerve, which sends messages to the brain.

Our hearing comes from the complicated organization of the ear and its response to sound waves. Deep inside the ear are the cochlea and the auditory nerve, that allow the message for hearing to be sent to the brain. Within the skin are receptor nerves which help us with the sense of touch. The sensations these receptor nerves sense are interpreted in the brain when signals are sent through the nervous system.



| External senses

The internal senses are often connected to the autonomic nervous system. The internal senses are special receptor nerves that respond to chemical and physical stimuli in the circulatory, digestive, respiratory, excretory, and central nervous system. Some of the internal senses help us to feel hunger, fatigue, pain, and thirst. The internal senses help our bodies work with both our autonomic and central nervous systems to maintain a proper balance and environment within our bodies.

Write the correct letter and answer on each blank.

1.36 The _____ regulates certain body functions without the conscious control of the brain.

a. central nervous system
b. auditory nerve
c. autonomic nervous system
d. ganglia

1.37 Examples of body activities controlled by the autonomic nervous system are _____ .

a. breathing, digestion, heartbeat
b. writing, thinking, speaking
c. running, walking, diving
d. sitting, standing, bending

1.38 Clusters of neurons near the spinal cord are called _____ .

a. nerve endings
b. internal organs
c. ganglia
d. cerebellum

1.39 The _____ are things like sight, hearing, smell, taste, touch, and the sense of heat.

a. internal senses
b. external senses
c. natural talents
d. natural behaviors

1.40 The two parts of the autonomic nervous system are the sympathetic system and the _____ .

a. neurological backdraft
b. circulatory system
c. brain stem extension
d. parasympathetic system

1.41 A cluster of ganglia near the stomach is the _____ .

a. glia
b. frontal lobe
c. solar plexus
d. anterior node

1.42 The sympathetic system helps to _____ the heartbeat.

a. slow down
b. speed up
c. monitor
d. listen to

Do the following activity.

1.43 Using the internet, library, or other reference books, choose one of the following sense organs, draw a detailed picture of how it's made, and write a brief report (less than one page) on how it works. Be sure to include how the sense organ is able to send messages to the brain.

- ☐ eye (sight)
- ☐ ear (hearing)
- ☐ nose (smell)
- ☐ tongue (taste)

TEACHER CHECK _____ initials _____ date

RESPONSE AND BEHAVIOR

All living things have ways to respond to their environments. We call these response actions the *behavior* of living things. Simple organisms (like protozoa, amoeba, and even earthworms) respond to their environments without thinking or being taught. Their response is part of their nature and is not learned. Simple organisms respond to light, heat, pollution, and food without using a brain to process the information received from the senses. Their responses are *reflex actions*. These reflex actions of simple organisms are "born" within them. They are due to the very simple nervous systems of these organisms. Reflex responses help the organisms protect and preserve themselves. Humans and other animals also exhibit behavior due to reflex actions.

Humans and most animals have more complex nervous systems than simple organisms. They are able to respond and behave in a greater variety of ways. Many animals have another inborn behavior "programmed" within them. This is called *instinct*. However, some of their responses and behaviors are developed after birth and are called *learned responses*. Humans are also capable of learned responses. There are a variety of learned responses, including *conditioned responses*, *trial and error*, and *habit*.

In this part of the LIFEPAC, you will learn more about the main types of responses and behaviors of animals and humans.

Reflex action. Have you ever accidentally touched something hot? What happened? You probably jerked your hand away suddenly before even thinking about it. In fact, you probably jerked your hand away from the hot item before you even felt the pain. Actions of the body like these, which are not planned or decided beforehand, are called *reflex actions*. Reflex actions are very simple. They involve some stimulus to the body, and the body automatically responds to the stimulus without thinking or deciding what to do.

Sometimes a doctor will test a person's reflex actions in the following way. The patient is asked to sit with his or her legs crossed. The doctor taps a point just below the knee cap of the leg that is crossed over the other. This causes the person's foot to kick out suddenly. This is called the *patellar reflex*, or "knee jerk." You may hear someone say they had a "knee jerk reaction" to something. What they mean is

| Simple organisms have reflex responses only

| A doctor tests reflex actions

that they had a sudden reaction to a stimulus without really thinking about it.

Reflex actions occur in every average person and most animals. They require no previous experience or learning. The stimulus goes from the sense receptors in your body to the spinal cord and back to your motor nerves and muscles. The spinal cord also sends a signal to the brain telling the brain of its action, but the message in the brain is usually received just after the response in the muscles has already taken place. This type of behavior and response is inborn and natural to us and to almost all animals. It is part of the "survival mechanism."

Instinct. Some behavior in animals does not appear to be reflex action, but it is "inborn." The animal does it right the first time. It is not a result of experience or learning. Such behavior in animals is called *instinct*. It is behavior that appears to be independent of learning and experience. Instinct is a part of the animal's nature.

The migration of birds is one of the best examples of instinct. Many species of birds migrate very long distances (hundreds or even thousands of miles) in the fall of the year. In the spring, these birds return the same distance to the same place they lived before. Often, they return to the same field, backyard, or even nest year after year. How do they do this? The best explanation is that the animals do this by *instinct*.

Instinct is apparently triggered in the animals by some kind of stimulus, either external or internal. For example, birds may sense the days growing shorter or the temperature getting cooler in the fall. These seasonal changes affect the glands of some kinds of birds. The glands secrete fluids called **hormones**. A change in the amount of hormones secreted stimulates the bird to migrate.

We can observe instinctive behavior all around us. A spider spins a web perfectly the first time. A honey bee stores honey in the cells of a hive which has been constructed by great precision. Birds build nests of a particular type by specifically selecting certain materials such as twigs, thread, feathers, moss, and hair. We can even identify specific species of birds by the way they build their nests. Finally, human infants appear to exhibit certain types of instinctive behavior, including smiling and sucking. These instincts help them grow and survive.

| Birds migrate by instinct

Answer true or false.

1.44 _____ Behavior is the response actions of living things to their environment.

1.45 _____ Simple organisms need a highly developed brain to respond to light, heat, and food.

1.46 _____ Reflex actions must be learned by living things.

1.47 _____ Reflex actions are part of the "survival mechanism."

1.48 _____ A "knee jerk reaction" can be an example of a reflex action.

1.49 _____ A signal must go to the brain before our body can perform a reflex action.

1.50 _____ Instinct is inborn and is not a result of experience or learning.

1.51 _____ The migration of birds is not an example of instinct.

1.52 _____ A change in the amount of hormones in some birds causes them to migrate.

Do the following activity.

1.53 Using the Internet, the library, or other resource books, find an example of instinct in a particular species of animal. Write a short report (about 200 words) on the activity and behavior of the animal as it follows its instinct. Share your finding with a friend and give the report to your teacher.

TEACHER CHECK _____ initials _____ date

Learned responses. Much animal and human behavior is learned. We call these actions *learned responses*. As mentioned previously, these *learned responses* can be one of several types, including (1) *conditional response*, (2) *trial and error*, and (3) *habit*. Let's explore each of these three types of learned responses.

Conditional response. A conditional response is the first type of learned response. This would be the response your dog would exhibit if you trained him to bark when you say "speak" to him. Probably you trained your dog by saying the word "speak," and when the dog barked, you would give him something to eat as a reward. Your dog would slowly learn to bark when you say "speak." Eventually, you would not have to reward your dog with food. The dog would be conditioned to bark when you say "speak." The dog's barking behavior would be a *conditional response* when you tell him to "speak."

Humans also have conditional responses. Frequently, when one thing happens, we expect something else to happen as a result. For example, if your science class is right before lunch each day, you might find yourself feeling hungry during the science class period. You would slowly be *conditioned* to associate feeling hungry with your science class period! If, on one day, your science class were held earlier in the morning, you might find yourself feeling hungry again during the science class, even though lunchtime is still far off. This is because the science class (stimulus) has conditioned you to feel hungry (response). Your hunger during the early science class would be a *conditional response*.

Scientific studies on conditional responses were performed by a Russian physiologist named Ivan P. Pavlov in the early 1900s. Pavlov trained dogs to salivate when such signals (stimuli) as lights, tones, or buzzers were activated as he gave food to the dogs. The dogs learned to associate the sights or sounds with salivating and feeding. Eventually, when Pavlov merely turned on the lights, or sounded the tones or buzzers, the dogs would salivate. Pavlov called the learned response of the dogs a *conditional response* because the response depended on the condition of the stimulus. In popular culture, people sometimes refer to this experiment as "Pavlov's dogs." You can try something similar with fish in the following experiment.

Try this experiment to learn about conditional responses.

Overview. Use goldfish to demonstrate the idea of *conditional response*.

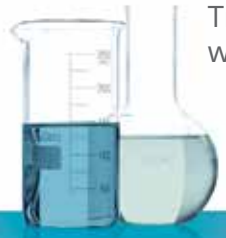
These supplies are needed:

- several goldfish in bowls of water
- fish food

Follow these directions. Check the box when each step is completed.

- ☐ 1. Feed a fish a little at a time and tap the side of the bowl at the same time while you are feeding the fish.
- ☐ 2. Continue this procedure for about 10 days.
- ☐ 3. At the end of 10 to 14 days, the tapping alone should cause the fish to rise to the top of the water to feed. Try it by tapping the bowl with no food.

Note: This experiment can be adjusted to be used with other types of animals.



Experiment 603.A Conditional Response

Record your observations.

1.54 What did you observe in this experiment?_____

_____

_____

_____

_____

TEACHER CHECK _____ initials _____ date

Trial-and-error learning. The second type of learned response is called trial and error. This kind of learning takes place by trying many things in a variety of ways in order to produce the desired results. Some of the things work, some don't. By trying things over and over, an animal or human will learn what works and what doesn't.

An example of *trial-and-error learning* is the way a child works a jigsaw puzzle. The child tries one piece after another. Mistakes (errors) are made as the child tries to figure out (trials) how the pieces fit together. Eventually, the child succeeds in putting all the pieces together in the right way. After playing with the same puzzle for several days, the child can put the puzzle together quickly without any mistakes. Learning has occurred through trial and error.

Much of the early learning that humans and animals accomplish is by trial and error. Many things are tried at first, and mistakes are made. Eventually, the tasks can be accomplished with few or no mistakes. Learning to walk, to eat, and to ride a bicycle are all examples of tasks that were learned by trial and error. The following experiment will demonstrate trial-and-error learning.

Try this experiment to learn about trial-and-error.

Overview. Use a simple puzzle to demonstrate trial-and-error learning.

These supplies are needed:

- a piece of card stock or heavy paper (10 cm x 10 cm)
- scissors

Follow these directions. Check the box when each step is completed.

☐ 1. Mark out a letter "L" that is 2.5 cm wide, with one arm 10 cm long and the other arm 7.6 cm long (*see illustration below in Step 2).

☐ 2. Draw lines on the "L" as shown and cut out the pieces along the lines.

☐ 3. Shuffle the pieces together and give them to someone. Have them put the four pieces of the "L" back together. Time how long it takes them to put the pieces back together. Record the time in the chart located in activity 1.55 below.

☐ 4. Shuffle the pieces again and repeat the task and timing with the same person for a total of ten trials. Record the results in the table as before.

☐ 5. Repeat steps 4 and 5 with other students or adults. Record the results in the table of number 1.55 below. Put the name of each person at the top of each column of the table.

Experiment 603.B Trial and Error Learning

Record your observations and conclusion.

1.55 Record your results in this table for each person and their trial times.

Trial					
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

1.56 What do you conclude from the data of this experiment? _____

_____

_____

_____

_____

TEACHER CHECK _____ initials _____ date

Habit. The third type of learned response is called *habit*. This is something that a person learns to do over and over again without thinking about how to do it. It is learned behavior that happens automatically without consciously thinking about it. It is similar to a reflex action; however, it is not inborn but must be learned initially. We must learn a habit by repeatedly doing the same thing over and over.

We develop habits because we want to do them or because we enjoy them. To learn the habit, we repeat the actions and behavior many times. Some examples of habits are tying your shoelaces, brushing your teeth, opening a door, and getting dressed. Developing habits frees our minds to think of other things while we do the actions of the habit. We can be more efficient when we have good habits. A habit is usually performed quickly and accurately and is done the same way each time we do it.

Try this experiment to learn about habits.

Overview. You will observe some aspects of habits by writing your name with each hand.

These supplies are needed:

- pencil or pen
- watch or clock

Follow these directions. Check the box when each step is completed.

☐ 1. Using your normal writing hand, write your name as many times as you can in thirty seconds in the left column of the data chart in activity 1.57 below.

☐ 2. Now using your other hand, write your name in the right column of the chart as many times as you can in thirty seconds.

Results of the experiment and conclusions.

1.57 My name written in thirty seconds.

Dominant hand	Non-dominant hand

Experiment 603.C Habits Experiment (continued on next page)

1.58 What conclusions do you have about your habit of writing? _____

1.59 List some of the habits that you or others have. _____

TEACHER CHECK _____ initials _____ date

Experiment 603.C Habits Experiment

There are two types of habits. One type of habit is called a *simple motor act*. This type of habit is very simple and only requires movements of the muscles. For example, to open a door, a person simply grasps the doorknob, turns the handle, and swings open the door. Even though the person usually does this without thinking and does it quite naturally, this action and habit had to be learned at one time.

Other habits are of a second type. They are more than simple motor acts. They usually involve thoughts, attitudes, and a sense of right and wrong. These are called *habits of adjustment*. Some of these habits of adjustment are "good" and some of them are "bad." These habits are good or bad depending upon whether they follow God's will or the way they affect us or other people. For example, keeping a neat appearance and having pleasant manners are considered "good habits." Examples of bad habits would be smoking cigarettes or gossiping about other people. People usually learn "bad" habits because they think it will bring them pleasure or something can be gained from them. But these "bad" habits usually bring bad results to us, or they are offensive to God and others.

Fortunately, "bad" habits can be broken or discontinued. Just as habits can be learned, "bad habits" can be broken and "good" habits learned to replace the old "bad" ones. Several steps are necessary to successfully break a

"bad" habit and to form a new "good" habit. As you go through these steps, always remember that God loves you and wants to help you. The steps can be written as follows:

Step 1. Desire to change. If you really don't want to change, you probably won't succeed in breaking the bad habit.

Step 2. Admit that the habit is bad or wrong.

Step 3. Concentrate on changing the habit so that you don't unconsciously continue to do it. Pray. Ask God to remind you of the habit you wish to change and the benefits that result from changing.

Step 4. Be thankful every time you break the pattern of the habit or change your behavior rather than follow the bad habit.

Step 5. If possible, avoid putting yourself in situations where the "bad" habit is likely to occur. For example, if the bad habit is eating too many sweets, don't go near where the sweets are sold or kept.

Step 6. Never make any exceptions to your plan to break the bad habit. Making exceptions lets you make excuses, and soon you will have more excuses than successes.

Step 7. Don't give up. If at first you don't succeed, try, try again. If you fail to break the "bad" habit at times, pick yourself up, dust yourself off, and try again. With God, all things are possible.

Answer the following questions.

1.60 What are the three types of learned responses?

a. _____

b. _____

c. _____

1.61 Who were "Pavlov's Dogs" and what did they demonstrate? _____

_____

_____

_____

1.62 What is "trial-and-error" learning and what is an example? _____

_____

_____

_____

1.63 What are the two types of habits?

a. _____

b _____

1.64 What are two examples of good habits and two examples of bad habits?

Good Habits	Bad Habits
a. _____	c. _____
b. _____	d. _____

Put these "steps to breaking bad habits" in proper order by writing the correct number on each blank space. (Note that some of these may not apply. If not, put an "X" in the blank.)

1.65 The steps to breaking a bad habit are:

a. _____ Ask a friend to change the habit for you.

b. _____ Concentrate on changing the habit so that you don't unconsciously continue to do it. Pray. Ask God to remind you of the habit you wish to change and the benefits that result from changing.

c. _____ Admit that the habit is bad or wrong.

d. _____ Be thankful every time you break the habit pattern or change your behavior rather than follow the bad habit.

e. _____ Desire to change. If you really don't want to change, you probably won't succeed in breaking the bad habit.

f. _____ Don't worry about it. Everyone can do their own thing.

g. _____ Don't give up. If in the beginning you don't succeed, keep trying. If you fail to break the "bad" habit pattern at times, pick yourself up, dust yourself off, and try again. With God, all things are possible.

h. _____ Never make any exceptions to your plan to break the bad habit. Making exceptions lets you make excuses, and soon you will have more excuses than successes.

i. _____ If possible, avoid putting yourself in situations where the "bad" habit you want to avoid is likely to occur. For example, if the habit is eating too many sweets, don't go near where the sweets are sold or kept.

TEACHER CHECK _____ initials _____ date

INTELLIGENCE, FREE WILL, AND CHOICE

God created human beings in His own image. Man was created out of the dust of the earth in a very close, precious, and loving way by God. Man is unique among all living things that God created. Only man was created in God's image and likeness. This means that we can love, reason, and think. Man has the greatest *intelligence* of all living things on earth. Our intelligence allows us to know much about God and His Creation. It allows us to create and to solve complex problems. It allows us to communicate in a great variety of ways.

Like God, we also have a free will, and this free will allows us to make choices, especially moral choices. Among other things, this means that we, as Christians, can choose to love God and obey Him, or we can reject His love and disobey Him. Only man, among all living things on earth, can choose to do good or evil.

The fact that we have the ability to make moral choices is clearly presented in the Scripture

| Jonah tells the people to make a choice

Read Genesis 1:26-29 and 2:7

Read Joshua 24:15

from the Book of Joshua. The people of Israel had entered the promised land. Now, Joshua was telling them that they had to make a clear choice: either serve the One True God of Israel, or choose to worship false gods. Joshua made a clear choice: he and his family would serve the Lord.

As human beings, we have been created specially by God among all creatures. We, as Christians, have also been given great responsibilities by God. God wants us to freely love Him and serve Him. We have the ability to make choices. Our behavior, our actions, and our responses can all be indicators as to whether or not we are choosing to love and serve God. As God's beloved children, we have special dignity among all His creatures. We should always be grateful to God for this privilege and show Him our love and gratitude by the way we live.

Complete the following activities.

1.66 Read Psalm 8:3-9. Copy the verses of this passage in the spaces below.

a. Verse 3 _____

_____

_____

b. Verse 4 _____

_____

_____

c. Verse 5 _____

_____

_____

d. Verse 6 _____

_____

_____

e. Verse 7 _____

_____

_____

f. Verse 8 _____

_____

_____

g. Verse 9 _____

_____

_____

1.67 Reread verses 3 and 4. What do you think they mean? _____

1.68 Reread verse 5. What does it mean? _____

1.69 What is the position of mankind with regard to angels in verse 5? _____

1.70 Reread verses 6, 7, and 8. What responsibility did God give to man? _____

1.71 What is David saying in verse 9 and why does he say it? _____

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

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

1.01 _____ Both humans and animals are able to interact with their environments.

1.02 _____ The central nervous system consists of the brain, spinal cord, and nerves.

1.03 _____ The brain stores information from past experience.

1.04 _____ The layer of gray matter covering the cerebrum is called the cortex.

1.05 _____ The top part of the brain stem is called the medulla.

1.06 _____ The reticular formation helps regulate and maintain the brain's awareness level.

1.07 _____ The autonomic nervous system regulates certain body functions without conscious control of the brain.

1.08 _____ "Knee jerk" is a conditional response.

1.09 _____ Behavior is the response action of living things to their environment.

1.010 _____ An example of "trial-and-error" learning is Pavlov's dogs.

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

1.011 _____ habit

1.012 _____ simple motor act

1.013 _____ habits of adjustment

1.014 _____ man

1.015 _____ migration of birds

1.016 _____ upper part of brain stem

1.017 _____ axon

1.018 _____ dendrites

1.019 _____ synapse

1.020 _____ trial-and-error learning

a. has greatest intelligence of earth's creatures

b. instinct

c. carry and transmit messages

d. learn by doing over and over

e. a very simple habit involving muscle movement

f. hypothalamus and thalamus

g. good and bad habits

h. "glue" that holds nerve cells together

i. small space between axon and dendrite of different neurons

j. lower part of backbone

k. receive nerve impulses

l. putting a puzzle together

1.021 Label the correct parts of the brain in the illustrations (each answer, 3 points).

a. _____

b. _____

c. _____

d. _____

e. _____

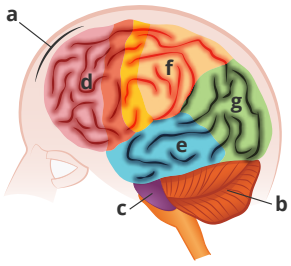
f. _____

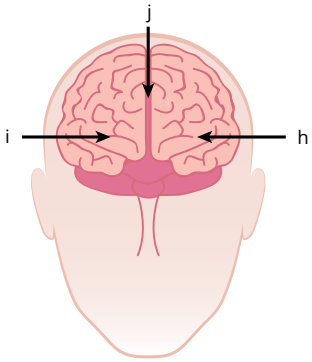
g. _____

h. _____

i. _____

j. _____





Write the correct letter and answer on each blank (each answer, 2 points).

1.022 Examples of body activities controlled by the autonomic nervous system are _____ .

a. breathing, digestion, heartbeat
b. writing, thinking, speaking
c. running, walking, diving
d. sitting, standing, bending

1.023 Clusters of neurons near the spinal cord are called _____ .

a. nerve endings
b. internal organs
c. ganglia
d. cerebellum

1.024 The parasympathetic system helps to _____ the heartbeat.

a. slow down
b. speed up
c. monitor
d. listen to

1.025 Reflex actions are part of the _____ of animals and humans.

a. survival mechanisms
b. conditioned response
c. circulatory system
d. intelligence

1.026 The three main parts of our nervous system are the central nervous system, the autonomic nervous system, and the _____ .

a. distant nervous system
b. lungs
c. sense organs
d. heart

Complete the following lists (each answer, 2 points).

1.027 List three main parts of a neuron.

a. _____

b. _____

c. _____

1.028 List the two parts of neurons for sensing and returning nerve impulses in the body.

a. _____

b. _____

Answer the following questions (each answer, 5 points).

1.029 What is an example of a conditional response and how is it learned? _____

_____

_____

_____

_____

_____

1.030 In what ways are human beings and animals similar and different? _____

_____

_____

_____

_____

_____

_____

80/100 **SCORE** _____ **TEACHER** _____ _____
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