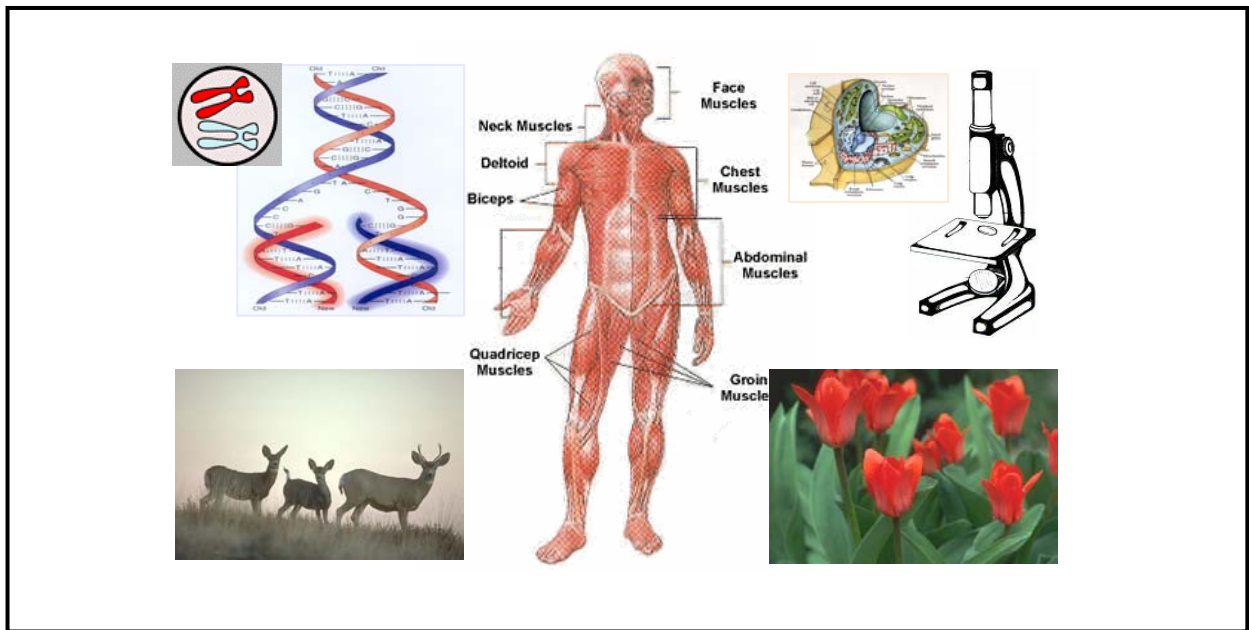


# Project EASE

(Effective Alternative Secondary Education)

## BIOLOGY



### MODULE 9

### *Life Support Systems*



BUREAU OF SECONDARY EDUCATION

Department of Education  
DepED Complex, Meralco Avenue  
Pasig City



# Module 9

## *Life Support Systems*

### *(Nervous and Endocrine Systems)*



#### *What this module is about*

How did you find the last module? Were you surprised at the immense work of the three systems? If so, there are more surprises that await you in this module, and more enjoyable activities, too. Continue studying the modules and see how wonderful the human machine is.

“Keep in touch” is a line you may have used many times before. This means that you want to communicate constantly with friends and relatives. Have you ever thought of how your body communicates with itself or the outside world?

There are two main systems that your body uses to stay in touch. These are the nervous system and the endocrine system.

This module is composed of three lessons:

- **Lesson 1 – Nervous system**
- **Lesson 2 – The Sense Organs**
- **Lesson 3 – Endocrine system**



#### *What you are expected to learn*

After going through this module, you are expected to:

1. Discuss the functions of the nervous system.
2. Name the three parts that compose the nervous system and discuss their functions.
3. Distinguish between stimulus and response.
4. Identify the organs that assist the nervous system.
5. Describe a neuron.
6. Draw and label the parts of the neuron.
7. Discuss the human sense organs.
8. Identify the sense organs of the human body.

9. Discuss the functions of each sense organ.
10. Give the functions of the endocrine system.
11. Identify glands and the roles they play in the human body.
12. Name and locate the endocrine glands.
13. Describe hormones and their actions.



### *How to learn from this module*

In order to achieve the objectives of this module successfully, you have to remember the following:

1. Read and follow instructions carefully.
2. Answer the pre-test before moving on.
3. Take down notes and record points for clarification
4. Take the post test and check your answers with the key at end of the module
5. Remember to get at least 75% level of proficiency in the tests.



### *What to do before (Pretest)*

A. Match the hormones in Column A with the glands that produce them in Column B. Write only the letters of the correct answer.

#### **Column A**

1. adrenalin
2. thyroxine
3. melatonin
4. progesterone
5. testosterone
6. parathormone
7. growth hormone
8. thymusin
9. glucagon
10. oxytoxin

#### **Column B**

- a. pituitary
- b. thyroid
- c. parathyroid
- d. thymus
- e. ovaries
- f. testes
- g. adrenal
- h. pancreas
- i. pineal
- j. hypothalamus

B. Identify the system to which each of the following structures or organs belong.

- \_\_\_\_\_ 1. spinal cord
- \_\_\_\_\_ 2. pituitary
- \_\_\_\_\_ 3. gonads
- \_\_\_\_\_ 4. pancreas
- \_\_\_\_\_ 5. adrenal

- \_\_\_\_\_ 6. brain
- \_\_\_\_\_ 7. thymus
- \_\_\_\_\_ 8. nerves
- \_\_\_\_\_ 9. sympathetic
- \_\_\_\_\_ 10. Autonomic



Key to answers on page 27.

## Lesson 1. The Nervous System

You perform different activities from the time you wake up in the morning to the time you sleep at night. Do you know what coordinates all of these actions? This system makes you feel, know, and do anything. In this lesson, you will study the control system of all your body functions – your nervous system.

Let's look at the parts of the human nervous system in more detail. The nervous system uses special cells to keep in touch. These cells help the body communicate with other body parts.

### The Nerve Cell

The basic unit of the nervous system is the nerve cell. Nerve cells are called NEURONS. Study figure 1 and look at the different parts of the neuron. There are billions of neurons in the body. Some exist alone. Others are joined together to form organs like the brain and spinal cord.

There are billions of neurons in the body. In fact, there are twelve to fourteen billions of neurons in one part of the brain alone. Yet, no two neurons are alike. They are like snowflakes in that they vary in size and shape. But all neurons have a common structure. A neuron has a cell body containing the nucleus. Projecting out from the cell body are root-like threads. These are the DENDRITES and AXON.

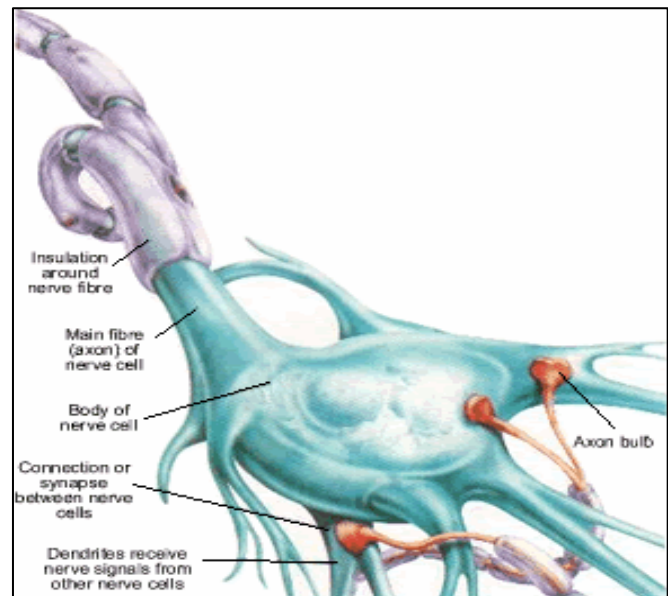


Figure 1. The Neuron

<http://www4.tpgi.com.au/users/amcgann/body/nervous.html>

Dendrites carry impulses towards the cell body. A cell may have as many as 200 dendrites carrying impulses toward the cell body. A single dendrite can be over one meter long. Look at the parts of the nerve cell below.

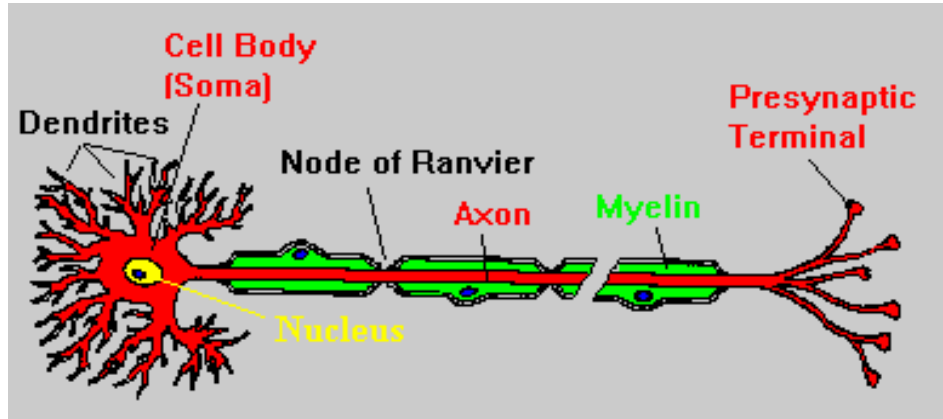


Figure 2. The Nerve Cell  
<http://www4.tpgi.com.au/users/amcgann/body/nervous.html>

Axons carry impulses away from the cell body. Axons pass impulses to the dendrites of other neurons.

THE PARTS OF THE NERVOUS SYSTEM	
Levels of Organization	Example
Cell	Neuron
Tissue	Nerve
Organ	Brain, Spinal Cord

Neurons can be grouped together into bundles called **nerves**. Thus, nerves are tissues. A nerve is like a telephone cable with smaller wires bound together, as shown in figure 2.

**Stimulus** - (plural: stimuli) is any information received by the nervous system about a condition in the environment. The nervous system also receives information about conditions inside the body. In order to survive, an organism must be able to receive stimuli from inside and outside the body.

**Response** - is a reaction to a condition or stimulus. A stimulus is received by the body and a response is made. To survive, an organism must be able to respond to a stimulus.

**A Stimulus Causes A Response**

The nervous system is assisted by five organs - the eyes, ears, nose, tongue, and the skin. The sense organs are constantly receiving information from the environment and sending messages to the brain.

## The Nerve Impulse

Neurons are cells with the special ability to carry signals or impulses. It may be difficult to believe, but thoughts, emotions, learning and many body functions are controlled by nerve impulses. And the nerve impulses are carried by the neurons.

A nerve impulse is a combination of an electrical charge and a chemical reaction. A nerve impulse is not a flow of electricity. It is more correct to say that a nerve impulse is an ELECTROCHEMICAL charge moving along a neuron.

Imagine that you have a board with a row of switches. Quickly click each switch in the row on and off. This will give you an idea of how a nerve impulse travels along a neuron

A nerve impulse cannot jump from one neuron to another. The space between neurons is called SYNAPSE. When a nerve impulse comes to the end of an axon, it causes a chemical to be released. The chemical crosses the synapse and stimulates the nerve impulse to start the next dendrite.

The nervous system is the body's mission control center. The nervous system consists of a BRAIN, a SPINAL CORD, and many NERVES (Figure 1). These organs and tissues form a complex communications network that can send messages very fast and very efficiently. The function of the nervous system is to keep the life-support systems functioning together.

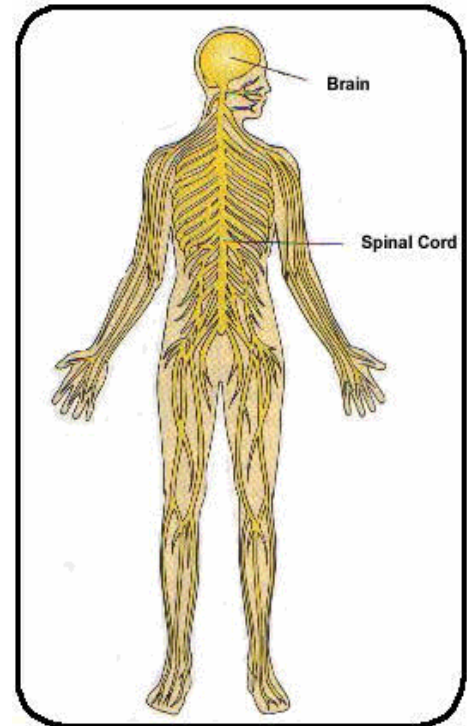


Figure 3. The Nervous System

<http://www4.tpgi.com.au/users/amcgann/body/nervous.html>



### *What you will do*

#### Self-Test 1.1

Let us see how well you remember the concepts in Lesson 1. Answer the following questions.

1. What is the function of the nervous system?
2. Name the three parts of the nervous system.
3. What is the basic unit of the nervous system?
4. What is the difference between a dendrite and an axon?
5. What are nerves?



Key to answers on page 27.



## *What you will do*

### Activity 1.1 How can you measure reaction time?

Materials:

Metric ruler

Data chart

Procedure:

Reaction time is the length of time it takes for a message to travel along your nerve pathways.

1. Construct a data like the one below, to record

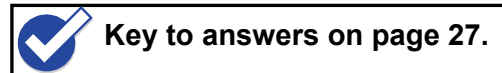
Try outs	Centimeters the ruler fell			
	Eyes close		Eyes open	
	Left hand	Right hand	Left hand	Right hand
1 <sup>st</sup>				
2 <sup>nd</sup>				
3 <sup>rd</sup>				
4 <sup>th</sup>				
5 <sup>th</sup>				
Average				

2. Have your partner hold a metric ruler at the end with the highest number.
3. Place the thumb and forefinger of your left hand close to, but not touching, the end with the lowest number.
4. When your partner drops the ruler, try to catch it between your thumb and finger.
5. Record where the top of your thumb is when you catch the ruler. This number gives how many centimeters the ruler fell.
6. Repeat steps 2 to 5 five more times.
7. Repeat steps 2 to 5 five more times using your right hand to catch the ruler.
8. Repeat steps 2 to 5 five more times using your left hand with your eyes closed. Your partner will signal you by saying "now" when the ruler drops.
9. Repeat steps 2 to 5 five more times using your right hand with your eyes closed.
10. Switch the roles and drop the ruler for your partner.
11. To complete your data chart, change all the centimeters to seconds by multiplying by 0.01.
12. Get the average.

Answer the following questions:

1. Did you catch the ruler faster with your left hand or right hand when your eyes were open? Which hand is your writing hand?
2. Did you catch the ruler faster with your left hand or right hand when your eyes were closed?
3. Did you catch the ruler faster with your eyes opened or closed?
4. Explain why a message moving along nerve pathways takes time.
5. Describe the nerve pathway that the message followed when you saw the ruler fall.

(Answers will depend on whether the person is left or right handed)



Now you know why different pathways carry messages from the brain to the toe and from the toe to the brain. Messages do not travel in both directions along the same neuron. Only the axon of the neuron gives off the chemical that crosses the space between neurons.

## The Brain

The brain is the main control center of coordination. It is about the size of a small head of a cauliflower. In some ways it even looks like a head of cauliflower with ridges and furrows over its surface. The brain weighs about 1.4 kilograms and is protected by the skull.

The brain is made up of three areas. These are the CEREBRUM, CEREBELLUM, and MEDULLA. Each area of the brain controls a specific activity. The cerebrum is the center of intelligence. The cerebellum keeps the muscles coordinated. The medulla controls and coordinates the activities of the internal organs.

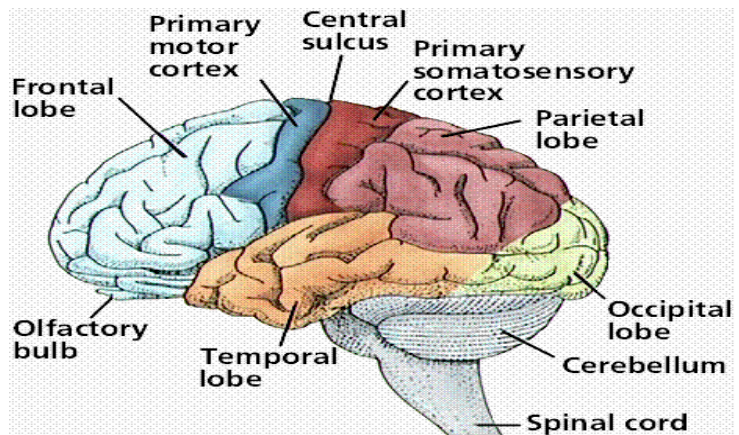


Figure 4. The Brain  
<http://www.sirinet.ml/~jgohnso/biologyII.html>





## What you will do

### Self-Test 1.2

Using the word/ words below, answer the questions that follow.

Muscular	activities of internal organs	cerebrum
Medulla	messages from the sense	cerebellum

1. What are the parts of the brain?
2. What does the cerebrum coordinate?
3. What does the cerebellum coordinate?
4. What does the medulla coordinate?
5. What is the center of intelligence?



Key to answers on page 28.

## The Spinal Cord

Examine the diagram of the human spinal column on the right.

The spinal cord extends down from the medulla. It is an organ made up of tightly packed neurons, which are mostly connecting neurons. It is about forty-five centimeters long and is tapered at both ends. The spinal cord runs down a person's back and is surrounded and protected by the rings of each vertebra.

The spinal cord has two main functions. First, it carries nerve impulses from all over the body to and from the brain. Second, it controls many of the body's INVOLUNTARY ACTIONS. An involuntary action is a movement that does not require any thought or interpretation.

The brain and spinal cord make up the central switchboard, or coordinating center of the nervous system. It is here that messages are interpreted. There are nerves that branch off from the spinal cord. These nerves feed information to the brain and spinal cord and carry messages away from them.

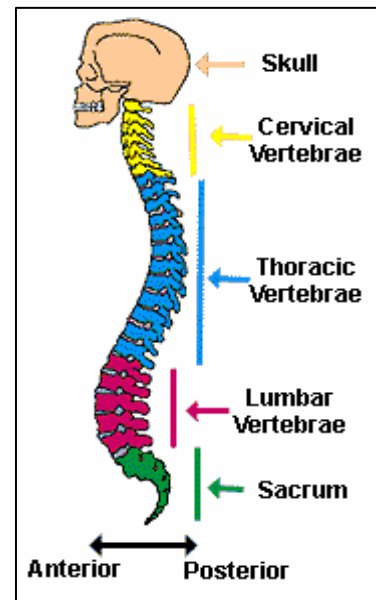


Figure 5. Spinal Cord  
<http://www.innerbody.com>



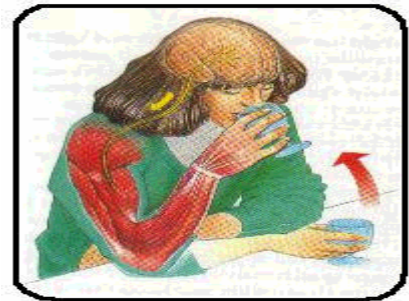
## *What you will do*

### Activity 1.2 Reflex Action

Any message received by your body must go to the brain before you can react to it. Think of what happens when somebody is about to strike you with an object. You raise your arms after the message that is headed your way reaches your brain. Some messages do not make it to the brain. They go directly to the muscles. The body therefore reacts in a very short time. Quick reactions that don't use the brain are called **reflexes**. How does a reflex work?

Imagine what happens when you accidentally touch a hot object.

1. The skin on your finger receives the message that the object is hot.
2. The message goes up your arm by way of a body nerve pathway.
3. The message reaches and enters your spinal cord. The message leaves the spinal cord by way of a different nerve pathway.
4. The message makes your arm muscle contract and your finger is pulled away.



You must remember that reflexes are involuntary, very quick, and help protect the body from further harm.

The central nervous system includes the brain and the spinal cord. The peripheral nervous system includes all the nerves carrying signals to and from the brain and spinal cord. Both divisions have a neuroganglia cell, which protects or assists neurons.

### **Peripheral Nervous System**

The peripheral nervous system of humans has thirty-one pairs of spinal nerves, which connect with the spinal cord. It also has twelve pairs of cranial nerves, which connect directly with the brain. Some nerves of the peripheral system carry only sensory information. Study figure 3. Note how the nerves all over the body are connected to the spinal cord and to the brain.

The optic nerves, which carry visual signals from the eyes are like this. Other nerves contain both sensory and motor axons. For example, the vagus nerves have sensory axons leading into the brain as well as motor axons leading out to the lungs, gut, and heart.

### **Somatic Autonomic Subdivisions**

The peripheral nervous system has two subdivisions called somatic and autonomic.

The somatic is concerned with the movements of the body's head, trunk, and limbs. Its sensory axon carries signals inward from receptors in the skin, skeletal muscles, and tendons while its motor axons carries signals out to the body's skeletal muscles. The autonomic system deals with the "visceral" portion of the body – that is, the internal organs and structures. Its sensory and motor axon carry signals from and to smooth muscles, cardiac (heart) muscle, and the different regions inside the body.

### **The Sympathetic and Parasympathetic Nerves**

The **autonomic nervous system** is entirely involuntary and automatic. It is composed of two parts, one of which is called the **sympathetic system**. This system includes two rows of nerve tissues, or cords, which lie on either side of the spinal column. Each cord has a ganglia, which contains the bodies of neurons. Fibers from the sympathetic ganglia nerve cords enter the spinal cords and connect with it and with the brain, as well as one another. The **sympathetic nervous system** helps to regulate heart action, the secretion of ductless glands, the blood supply in the arteries, the action of smooth muscles of the stomach and the intestine, and the activity of other internal organs.

The **parasympathetic system** opposes the sympathetic system and thus maintains a system of checks and balances. The principal nerve of parasympathetic system is the **vagus nerve**, and abdomen. To illustrate how the check-and-balance system works, when there is fire you can carry heavy loads down your house to save them from getting burned, but you will need the help of several persons to bring back these things after the fire.

Another example is if a person has become instantly mobilized and rushed into a highway to save a child from an oncoming car, he may well faint as soon as the child has been swept out of danger.

## **Lesson 2. Sense Organs**

As a living thing you must know what is going on around you. You use your eyes to do this. But what if you are blind, do you think you still have other ways to keep in contact with your surroundings?

The human body has many sense organs. These are the ear, eyes, nose, skin, & tongue. These sense organs are parts of the nervous system that tell what is going on around you. These sense organs aid in the survival of human beings.

Each sense organ is specialized as to what it can detect. The ears detect moving air molecules. The eyes detect light. The nose and tongue detect chemicals. The skin detects heat, cold, touch and pressure.

## The Ear

The ears are sense organs for detecting sound waves. Sound waves are air molecules in motion. Do you know how the ears detect moving air molecules and enable you to hear?

The human ear is divided into three areas. These areas are called outer ear, middle ear and inner ear. Let's study each area to find out how our sense of hearing works.

The figure shows the three parts of the outer ear. Look at figure 6 at the right as you read points 1, 2 and 3.

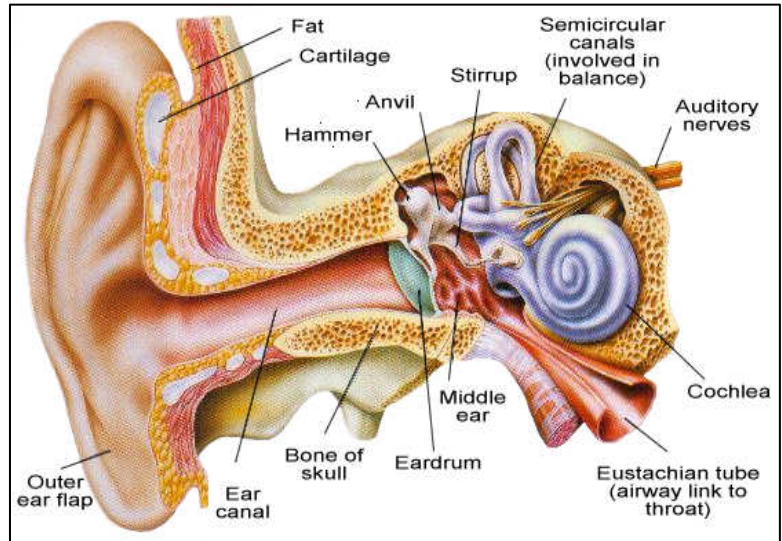


Figure 6. The Ear

<http://www4.tpgi.com.au/users/amcgann/body/nervous.html>

1. The pinna (earflap) catches sound waves and helps direct this to a narrow tube. The pinna is made up of cartilage. It is soft and bends easily.
2. A narrow tube leads into the ear. This tube is the ear canal. This part of the ear carries sound waves to the middle ear.
3. Sound waves which pass through the ear canal bump against a thin membrane called the eardrum. When sound waves strike the eardrum, this vibrates back and forth.

The middle ear has two main parts. Look at figure 6 as you read points 4 and 5.

4. Three small bones make up one of the main parts of the middle ear. Due to their shapes, the bones are called the hammer, anvil and stirrup. These bones are small and are connected to one another. When the eardrum vibrates, the hammer moves. This movement causes the other two bones to move.
5. The stirrup is connected to another membrane, the oval window. The oval window is a membrane in the middle ear that vibrates with the motion of the ear bones.

The inner ear has two main parts. Study figure 6 as you read 6 and 7 to know what they do.

6. This part is called the cochlea. It looks like a small-shell and is filled with liquid. It is a coiled chamber that contains nerve cells. When the oval window vibrates, it makes the liquid in the cochlea move. The nerve cells in the cochlea detect this movement.

7. Each nerve cell in the cochlea is connected to a large nerve, the auditory nerve. The auditory nerve carries messages of sound to the brain. Once these messages reach the brain, they are interpreted. This is the final step in hearing. You hear a person singing, a cat meowing, or some other sound.

## The Eyes

How do your eyes give you information about your surroundings? What are the parts of the human eye?

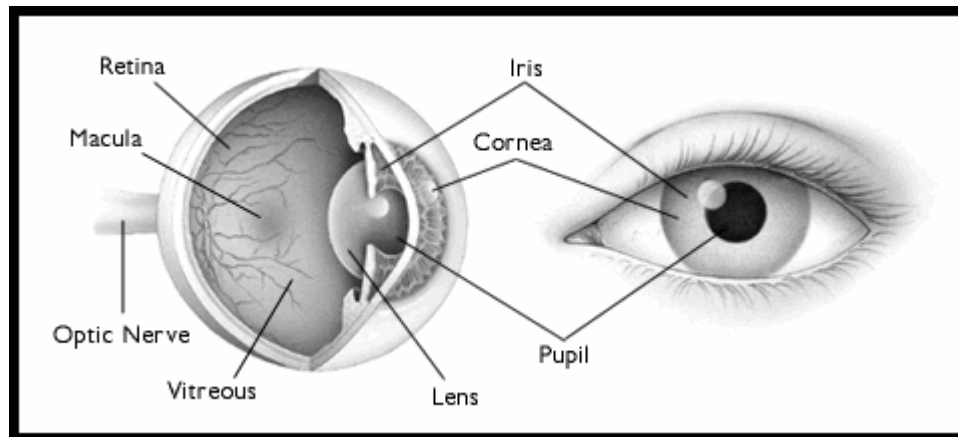


Figure 7. The Human Eye  
<http://www.bartleby.com>

The figure above shows the parts of the human eye. Do you know the work of each part? Continue reading to master the parts and function.

The **eyelids** found outside the eyes are for protection and moistening. Whenever you blink, liquid spreads over the front of your eye.

The **sclera** is the white outer covering of the eye. It protects and holds the eye together.

The **iris** is a muscle. It adjusts the amount of light entering the eye. It is that part that gives the eye its color.

The **pupil** is an opening in the center of the iris. Light enters the eye through the pupil. As the amount of light varies, the size of the iris changes. This causes the pupil to become large or small. This is the reason why we can see in the dark.

The **cornea** is the clear outer covering at the front of the eye. It has two functions. It allows the light to enter the eye through the pupil. It also bends light as it enters the eye so that the object will be in focus.

The **lens muscle** attaches to the lens. It pulls on the lens and changes its shape. This helps you see up close and far away.

The **retina** is a structure in the eye made of light-detecting nerve cells.

The **vitreous humor** is the liquid inside the eye. Its main work is to give the eye its round shape.

The **optic nerve** is a nerve that carries messages from the retina to the brain. When a message reaches the vision center of the brain, the message is interpreted. Then, the brain flips the message right side up.



## *What you will do*

### **Activity 2.1 An Eye Chart Test for Visual Acuity**

What does 20/20 vision mean? The eye doctor uses a chart to measure how sharp a person's eyesight is. The degree of sharpness is called VISUAL ACUITY and this is measured by a SNELLEN Chart.

If you can see a standard-sized letter at 20 feet, you have 20/20 vision. If what you can see at that distance is a letter that is twice as large as the standard-sized letter, then you have 20/40 vision.

Have you ever experienced taking an eye test in school? If so do you still remember what you did? Would you like to try doing the test again?

The purpose of this activity is to show you what happens at an eye doctor's office. The results are approximate. They are not medically reliable.

Procedure:

1. Tape the eye chart (available in the school clinic, or an optical clinic) to a wall at eye level.
2. Stand 20 feet from the chart. If you wear glasses, take them off.
3. Make a copy of the table.
4. Have your lab partner stand next to the chart and record the number of errors you make in the table.
5. Cover your right eye. Read the eye chart starting at the top. Your partner is to record the number of errors you make on each line.
6. Repeat the steps with the left eye covered and then with both eyes open.

Record your findings in the chart provided on the next page:

Letter Size on Chart	Number of Errors		
	Left Eye Open	Right Eye Open	Both Eyes Open
20/100			
20/80			
20/60			
20/50			
20/40			
20/30			
20/25			
20/20			
20/16			

Answer the following questions:

1. What is visual acuity?
2. What does 20/20 mean?
3. What is the size of a 20/40 letter compared to a 20/20 letter?



Key to answers on page 28.

## The Tongue and the Nose

The major sense organ for taste is the tongue. It detects chemicals in the mouth. As the tongue senses different chemicals, you taste the sweetness of sugar and the bitterness of ampalaya.

Notice that the surface of the tongue has many bumps. These bumps are called taste buds. These are special nerve cells in the tongue that detect chemicals. You have about 10,000 taste buds on the surface of your tongue.

Look at the drawing of the tongue. It shows the four different kinds of taste buds on the tongue. Each kind is located in a different area of the tongue. Each area of the tongue detects a certain chemical or taste. The four tastes are sour, salty, sweet and bitter. You know that there are more than four tastes. These are just a combination of the four basic tastes.

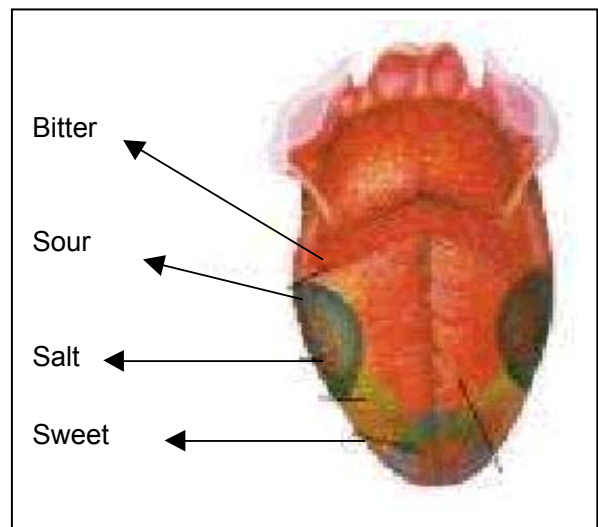
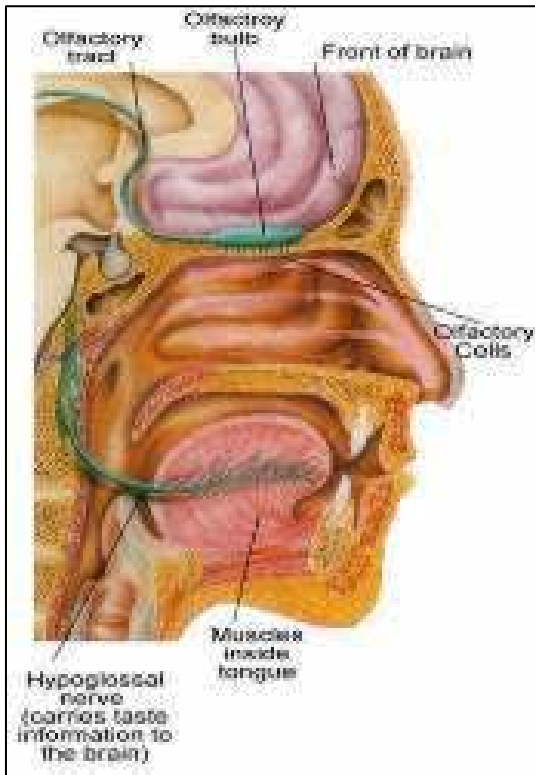


Figure 8. The Tongue  
<http://www4.tpgi.com.au/users/amcgann/body/senses.html>



Have you ever experienced having cold? Did you have trouble tasting things when you have colds? Do you think the nose has something to do with taste? The sense of taste and smell work together. They both detect chemicals. Your sense of smell enables you to detect chemicals in the air, or odors.

Study the illustration on the left. It shows the internal structure of each part of the nose. Chemicals in the form of gas are detected by neurons. These neurons line the top of the nasal chamber. There are different types of nerve cell in the nose. Each type detects one kind of chemical or odor. The olfactory nerve then carries the message of smell to your brain. The brain interprets the message as smoke or perfume or some other odor.

Figure 9. The Nose

<http://www4.tpgi.com.au/users/amcgann/body/senses.html>




*What you will do*

**Self-Test 2.1 Loop a word.**

Encircle the words or group of words in the grid which are related to the sense organs. These maybe spelled horizontally, vertically or partly horizontal and vertical.

L E N S E A R H  
 B O P I N N A E  
 T E S I G H T A  
 O T K E S E O R  
 N E I B M A U I  
 G E N E E R C R  
 U W T L Y C H I  
 E S L S E E R S

 **Key to answers on page 28.**



## Skin

Your skin functions not only for protection but also as a sense organ. It contains many kinds of nerve cells that detect changes around the body. Take a closer look at the structure of the skin found in your other module. Five nerve cell types are shown. Each nerve cell detects a different condition. The nerve cells detect pain, pressure, touch, heat and cold. Observe that most nerve cells are found in the dermis. Only nerve cells that detect pain are found in both the epidermis and the dermis.

To end up the lesson about the sense organs a summary is given below.

### The Sense Organs

---

EYE	—————▶	LIGHT.....	sense of sight
EAR	—————▶	MOVING.....	sense of hearing
		MOLECULES	
NOSE	—————▶	CHEMICAL.....	sense of smell
		ODORS	
TONGUE	—————▶	CHEMICAL.....	sense of taste
		FLAVORS	
SKIN	—————▶	PRESSURE, .....	sense of feel
		TEMPERATURE	

---



### *What you will do*

#### Self-Test 2.2

1. How are stimuli from the environment received?
2. What is the function of the eye?
3. What is the function of the ear?
4. What is the function of the nose? Name the odors
5. What is the function of the tongue? Name the flavors
6. What is the function of the skin? Name the stimuli.



Key to answers on page 28.



## *What you will do*

### **Activity 2.2 Palpation**

We shall make use of palpation to examine some sense organs. Follow the steps below to enjoy the activity.

#### *Ear*

1. Grasp your pinna or auricle, the shell-like part of the external ear. Say ah! remove your hand and say ah! again. Compare the loudness of the sound you hear.
2. Insert your small finger into the ear canal. Was it able to get inside?

Run your hand from your ear toward your eye.

#### *Eye*

1. Trace a finger around the entire margin of the eye region. On the upper part, feel your eyebrows, then your eyelids.
2. On the middle side feel for the bone that contains the tear-gathering sac. This is where your tears come from.

#### *Nose*

1. Touch the upper most part of your nose, its root, between the eyebrows.
2. Trace the bridge of your nose, this is below the root.

Run your index finger and thumb along opposite sides of the bridge of your nose.

## **Lesson 3. The Endocrine System**

Have you ever experienced being chased by a dog or any other animal, or maybe heard somebody shout fire! fire!? What was your reaction? Why did you react that way? Well, in this lesson, you will learn why your reactions in times of emergencies are different from your normal reactions (or from how you would react in normal conditions)

Animals have an additional system for sending messages through their bodies. This system doesn't use nerve cells. It uses chemicals formed in special glands. Blood is used as the pathway for delivering these chemical messages through your body.

The second system that allows different parts of your body to keep in touch is called the endocrine system. The endocrine system is made of small glands that make special chemicals for carrying messages through the body. The glands are found throughout the body. The chemicals made by endocrine glands are called **hormones**. Hormones found in the blood, once in the blood, hormones travel to different organs of the body. Changes take place in the organs when they receive the chemical messages that hormones carry.

Any organ, tissue or group of cells that make a secretion is called a **gland**. There are two kinds of glands: exocrine and endocrine glands.

An **exocrine gland** makes a secretion that travels through a tiny tube called duct. The **ducts** carry the secretions to where they are to go. For instance the sweat gland makes sweat, which reaches the outside of the body through a duct. Gastric juices empty into the stomach through duct. Tears, saliva, digestive juice bile and milk all travel through ducts.

An **endocrine gland** makes a secretion that does not travel through a duct. Endocrine glands don't have familiar shapes like the heart lung, brain, or kidney. Endocrine glands are not very large either. Altogether they have a mass of about 140 grams.

There are six major endocrine glands and they are located in different parts of the body. Look at the diagram on the right. Examine the locations of the different glands of the body.

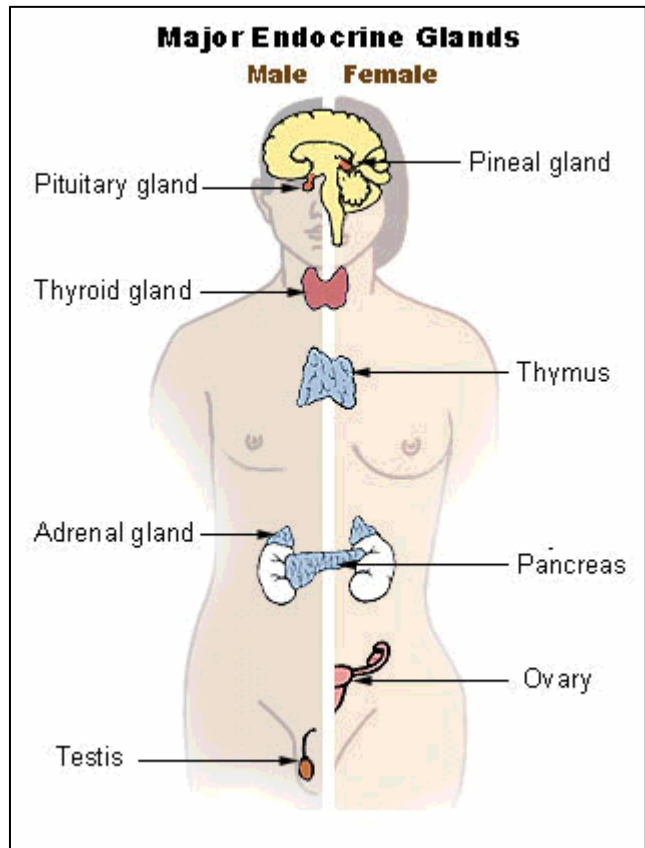


Figure 10. The Endocrine System  
[http://trainingseen.cancer.gov/module\\_anatomy/unit6\\_3\\_endocrine.html](http://trainingseen.cancer.gov/module_anatomy/unit6_3_endocrine.html)



*What you will do*  
**Self-Test 3.1**

Answer the following question:

1. What is a secretion? Give an example.
2. What is a gland? Give an example.

Summarize the endocrine glands and their locations by completing the table on the next page.

Endocrine	Location
1.	
2.	
3.	
4.	
5.	
6.	



Key to answers on page 28.

## Hormones Control by Regulation

A **hormone** is a special chemical substance. The word hormone comes from the Greek word that means “to excite”. In fact, that’s exactly what a hormone does. A hormone excites, or turns on, a body activity.

Hormones do their job by REGULATION. When something is regulated by hormones, it is kept in balance, in a constant state, or homeostasis.

Hormones regulate nearly all the activities in your body. There is an ideal constant state, or homeostasis. For example, body metabolism, growth and blood pressure must be kept at constant states. These and many other body activities are kept at their constant state by hormones. Hormones keep many of the body’s activities at homeostasis by regulation.

### Remember :

#### A HORMONE IS A CHEMICAL SUBSTANCE

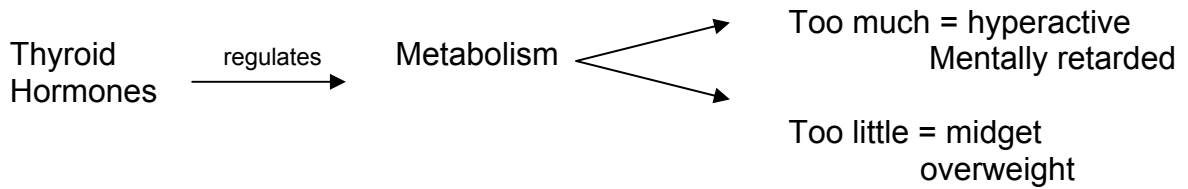
- made by a gland
- secreted directly into the bloodstream
- that acts as a chemical messenger
- that excites a body activity
- that controls by regulation.

Now let’s have a tour of the different glands of the body.

## The Thyroid Gland

The **thyroid gland** is located at the bottom of the neck and secretes a thyroid hormone. The thyroid hormone regulates metabolism, or the release of energy to the body. If too much thyroid hormone is secreted, a person may lose weight because food is burned

up too quickly. Thus the child may be hyperactive or mentally retarded. Study the diagram below. It shows how the thyroid gland works and its possible effects.



On the other hand, if too little thyroid hormone is secreted the child will develop into a midget who is overweight. Too little thyroid hormone results in low metabolism, which slows down the growth and development of tissues.



### *What you will do* Self-Test 3.2

1. What does the thyroid gland secrete?
2. What does the thyroid hormone regulate?
3. What happens if too much thyroid hormone is secreted?
4. What happens if too little thyroid hormone is secreted?



Key to answers on page 29.

### The Parathyroid Glands

Now, examine the thyroid gland in detail and notice the presence of four small **parathyroid glands**. They are located in the thyroid glands, two on each side. The parathyroid glands secrete a parathyroid hormone and calcitonin.

The parathyroid hormone regulates the body's use of calcium. Normal use of calcium is important for the growth of bones and the contraction of muscles.

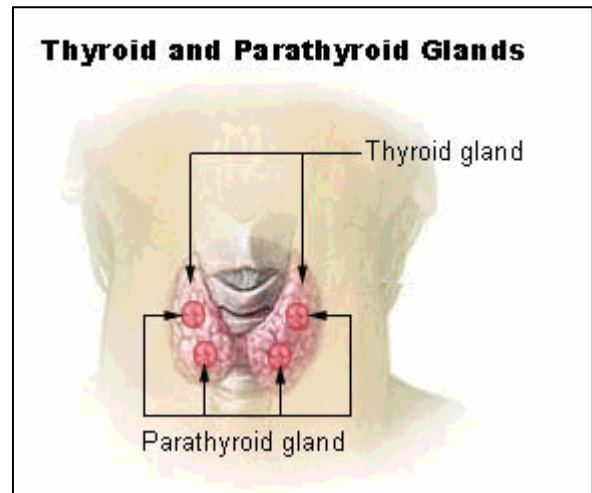


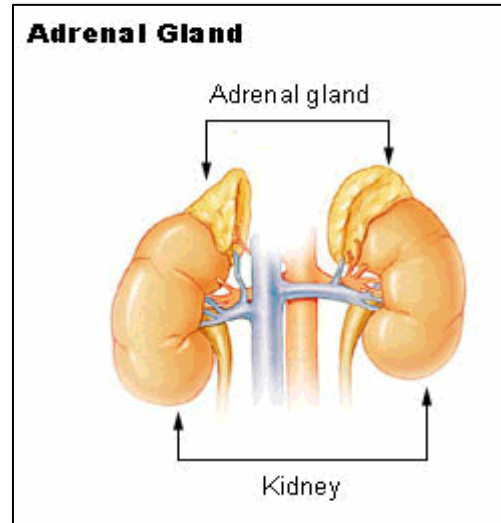
Figure 11

[http://trainingseen.cancer.gov/module\\_anatomy/unit6\\_3\\_glnd1\\_pituitary](http://trainingseen.cancer.gov/module_anatomy/unit6_3_glnd1_pituitary).

## The Adrenal Gland

Move to the lower part of the abdomen and locate the adrenal glands. There are two **adrenal glands**, one on top of each kidney. The adrenal gland secretes **adrenaline** which is called the emergency hormone because you secrete it when you are nervous, angry, or frightened. Adrenalin causes the heart to beat faster, the blood pressure to go up, and the extra sugar to be burned for energy.

Figure 12  
[http://trainingseen.cancer.gov/module\\_anatomy/unit6\\_3\\_gln3\\_adrenal](http://trainingseen.cancer.gov/module_anatomy/unit6_3_gln3_adrenal).



### *What you will do*

#### Self-Test 3.3

1. What do the adrenal glands secrete?
2. What does adrenalin do?



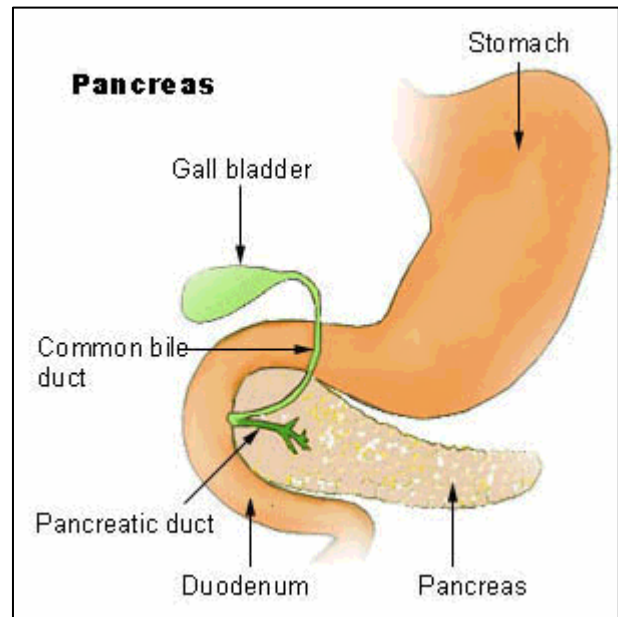
Key to answers on page 29.

## The Pancreas Gland

The **pancreas** lies just below the stomach. The pancreas makes both digestive chemicals and hormones.

The pancreas makes the hormone **insulin and glucagon**. Insulin regulates the burning of sugar and helps the liver to store excess sugar. Insulin controls the ability of the cell to allow sugar to pass through its cell membrane.

Figure 13  
[http://trainingseen.cancer.gov/module\\_anatomy/unit6\\_3\\_gln4\\_pancreas](http://trainingseen.cancer.gov/module_anatomy/unit6_3_gln4_pancreas).



If too little insulin is secreted the person suffers from diabetes. With diabetes, the cells do not get enough sugar, and extra sugar is not stored in the liver. Valuable sugar is then wasted when it is excreted in the urine.

The secretion of insulin is an excellent example of how hormones control by regulation to maintain homeostasis.



## *What you will do*

### Self-Test 3.4

1. What two things does the pancreas secrete?
2. What does insulin regulate?
3. What happens if too little insulin is secreted? Name the disease.



Key to answers on page 29.

## The Sex Glands

The sex glands are the **ovaries** in the female and the **testes** in the male. The ovaries secrete female sex hormones and the testes secrete male sex hormones.

Female sex hormones (estrogen or progesterone) cause girls at puberty to develop female sex characteristics. Female sex hormones cause the breasts to enlarge, the hips to broaden, and hair to grow on the body.

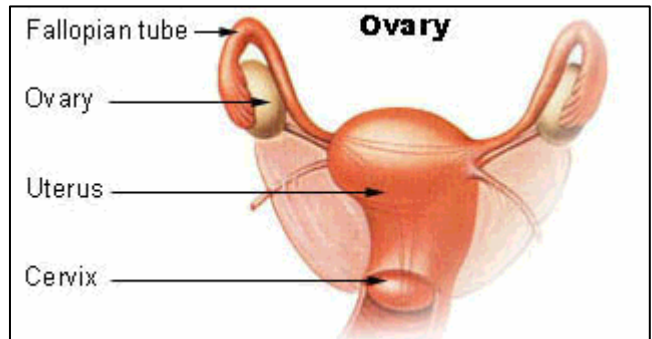
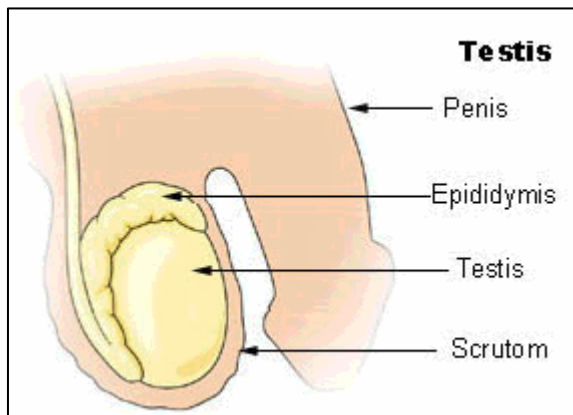


Figure 14

[http://trainingseen.cancer.gov/module\\_anatomy/unit6\\_3\\_gln5\\_gonads](http://trainingseen.cancer.gov/module_anatomy/unit6_3_gln5_gonads).



Male sex hormones (androgen or testosterone) cause a boy at puberty to develop male sex characteristics. Male sex hormones cause the voice to deepen, the shoulders to broaden, and hair to grow on the face and body.

Figure 15

[http://trainingseen.cancer.gov/module\\_anatomy/unit6\\_3\\_gln5\\_gonads](http://trainingseen.cancer.gov/module_anatomy/unit6_3_gln5_gonads).

## The Pituitary Gland

The **pituitary gland** is a pea-sized organ tucked away at the base of the brain. The pituitary gland secretes several hormones, many of which regulate the activities of the other glands. For this reason, the pituitary gland is called the master gland.

The pituitary gland is like the conductor of an orchestra. As a conductor controls musicians, the pituitary gland controls various body functions. The pituitary gland stimulates another gland with a hormone. The stimulated gland secretes a hormone to do its own work.

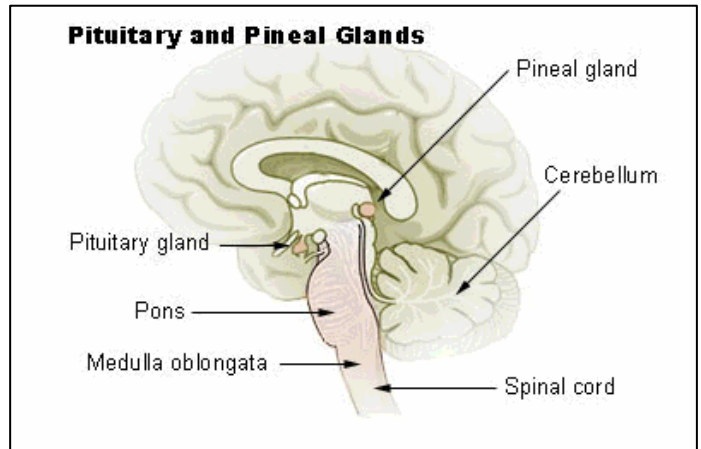
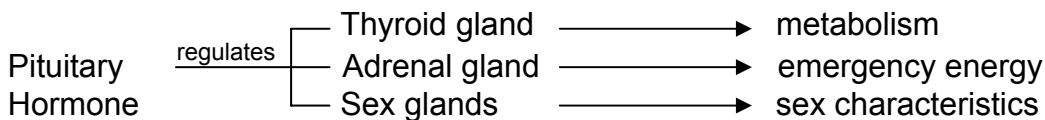


Figure 16

[http://trainingseen.cancer.gov/module\\_anatomy/unit6\\_3\\_glnd1\\_pituitary](http://trainingseen.cancer.gov/module_anatomy/unit6_3_glnd1_pituitary)

The pituitary gland stimulates the thyroid, adrenal, and sex glands to regulate their activities. It also secretes a skin color hormone that regulates skin color and a growth hormone that regulates growth.

To summarize this is how the pituitary gland influences other endocrine glands.



The pineal gland is a small pinecone-shaped structure located on the upper back part of the thalamus of the brain. The pineal gland produces a hormone called melatonin, which is thought to inhibit the functions of the reproductive system. Melatonin may play an important role in the onset of puberty in humans.



*What you will do*

### Self-Test 3.5

1. Why is the pituitary gland called the master gland?
2. What are some glands that the pituitary gland regulates?
3. How is the pituitary gland typical of the endocrine system?



Key to answers on page 29.





## *What you will do*

### **Activity 3.1 Concentration: The Hormone Game**

Materials: Scissors, 30 index cards

This is a variation on the game Concentration. In this game, you are to match a gland with a hormone and with the activity it regulates.

Procedures:

1. Cut each card in half across the width. You now have 60 cards.
2. Write the word thyroid on 2 of the cards.
3. Repeat step 2 for parathyroid, adrenal, pancreas and sex gland.
4. Write the word pituitary on 10 of the cards.
5. Mix these 20 cards up, turn them over and spread them out in a group to the left of the table. Write gland on the back of each card.
6. Write the name of each of the 10 hormones you have studied on 2 cards. You will have used 20 cards when you finish.
7. Write hormone on the back of each card. Mix these 20 cards up, turn them over and spread them out in a group in the center of the table.
8. Write what each hormone regulates on 2 cards. You will have used 20 cards when you finish.
9. Write regulates on the back of each card. Mix these 20 cards up, turn them over, and spread them out in a group to the right of the table.
10. Taking turns, each player turns over 1 card from each group. A match is a gland, its hormone, and what hormone it regulates. If the cards match, pick them up and try for another match.
11. If the cards do not match, the player returns all 3 cards face down and the next player continues.
12. The game ends when all of the cards have been picked up. The winner is the player with the most cards.



## *Let's Summarize*

1. The nervous system consists of the brain, spinal cord and nerves.
2. The nervous system coordinates the life-support system of the body.
3. A stimulus is any information received about a condition in the environment.
4. A response is a reaction to a stimulus.
5. A nerve impulse is a signal that travels along a set of nerves.
6. The nerve is a conductor, an organ that carries the nerve impulse.
7. The brain and the spinal cord are the interpreters; that is, organs that process messages.
8. The nervous system controls by coordination.

9. The basic unit of the nervous system is the neuron. A neuron has three parts: cell body, dendrite, and axon.
10. Dendrites carry impulses toward the cell body.
11. Axons carry impulses toward the cell body.
12. The spinal cord carries nerve impulses from all over the body to and from the brain.
13. The brain is the control center of coordination.
14. Each area of the brain controls a specific activity.
15. The endocrine system regulates all of the body activities to keep them operating at homeostasis.
16. A secretion is any chemical given off by a cell, tissue or organ.
17. Glands produce secretions.
18. An endocrine gland makes a secretion that travels through a duct.
19. An endocrine gland makes a secretion that empties directly into the blood.
20. Hormones are chemical messengers that do their work away from their gland.
21. A hormone excites a body activity.
22. Hormones do their job by regulation.
23. The glands of the body are the thyroid, parathyroid, adrenal, pancreas, sex glands and pituitary.
24. The thyroid hormone regulates metabolism.
25. The parathyroid hormone regulates the amount of calcium in the blood and bones.
26. Adrenalin regulates the burning of sugar.
27. Insulin regulates energy for an emergency.
28. The sex hormone regulates the male and female sex characteristics.
29. The pituitary gland regulates other glands.
30. The female sex hormone is the estrogen or progesterone.
31. The male sex hormone is the androgen or testosterone.



## *Posttest*

**Multiple Choice.** Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. What endocrine gland is located inside the thyroid?
 


a. adrenal	b. gonads	c. parathyroid	d. pineal
------------	-----------	----------------	-----------
2. Which condition is caused by lack of iodine?
 

b. dwarfism	b. giantism	c. goiter	d. tumor
-------------	-------------	-----------	----------
3. Which gland is located on top of both kidneys?
 

a. adrenals	b. gonads	c. parathyroid	d. pineal
-------------	-----------	----------------	-----------

4. Which gland is located behind the stomach?  
 a. pancreas            b. pituitary            c. thyroid            d. testes
5. The growth of the adams apple and hair in the armpit is caused by the secretion of which gland?  
 a. ovaries            b. parathyroid            c. testes            d. thyroid
6. Which is also referred to as the chemical messenger of the body?  
 a. blood            b. bones            c. hormones            d. nerves
7. Which organ does not belong to the human nervous system?  
 a. body nerves            b. brain            c. pancreas            d. spinal cord
8. What is the disease caused by lack of insulin?  
 a. diabetes            b. dwarfism            c. giantism            d. goiter
9. What is the other name of nerve cells?  
 a. axon            b. dendrite            c. neuron            d. pathway
10. What organ sends and receives messages to and from all parts of the body?  
 a. brain            b. cerebellum            c. cerebrum            d. medulla oblongata
11. What do you call any information received by the nervous system?  
 a. news            b. question            c. response            d. stimulus
12. What part of the nervous system connects organ, muscles or skin to the spinal cord?  
 a. brain            b. body nerves            c. body tissue            d. cerebrum
13. Which system enables us to detect and respond to changes?  
 a. circulatory            b. digestive            c. endocrine            d. nervous
14. Which sense organ in humans detects light?  
 a. ears            b. eyes            c. skin            d. tongue
15. What organ below functions as a protection and a sense organ?  
 a. skin            b. ears            c. eyes            d. tongue
16. Which organ detects moving air molecules?  
 a. ears            b. eyes            c. skin            d. tongue
17. What part of the eye regulates the amount of light passing through it?  
 a. lense            b. iris            c. cornea            d. retina
18. What do you call an action to a condition or stimulus?  
 a. experiment            b. reflex            c. response            d. question

19. Which part of the brain controls heart beat breathing and blood pressure?  
 a. cerebellum      b. cerebrum      c. medulla      d. pons
20. Which situation below is an example of a reflex action?  
 a. crying when not happy  
 b. eating food when hungry  
 c. drinking water when thirsty  
 d. putting away your fingers when a pin sticks on it

 **Key to answers on page 29.**



## *Key to Answers*

### Pretest

#### A.

- |      |       |
|------|-------|
| 1. g | 6. c  |
| 2. b | 7. a  |
| 3. i | 8. d  |
| 4. e | 9. h  |
| 5. f | 10. j |

#### B.

- |                         |                      |
|-------------------------|----------------------|
| 11. Nervous System      | 16. Nervous System   |
| 12. Endocrine System    | 17. Endocrine System |
| 13. Reproductive System | 18. Nervous System   |
| 14. Endocrine System    | 19. Nervous System   |
| 15. Endocrine System    | 20. Nervous System   |

## Lesson 1

### Self-Test 1.1

1. body's mission control center
2. brain, spinal cord and nerves
3. nerve cells, neuron
4. dendrite – carry impulses toward the cell body  
 axons – carry impulses away from the cell body
5. Nerves are tissues and are like telephone cable.

### Activity 1.1

- 1&2. Will depend on whether a person is left or right handed
3. Yes, with eyes open. No, when closed
4. Because messages don't travel in both directions along the same neuron.
5. Eyes receive the message, message goes up to the brain, message goes down the brain back to the eyes.

## Self-Test 1.2

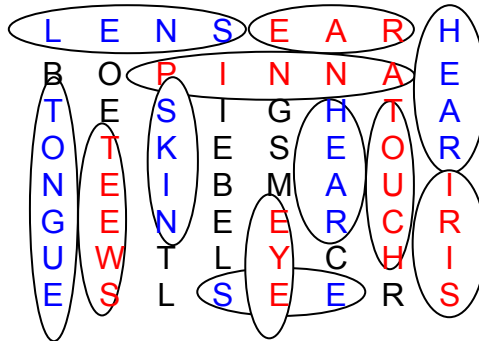
1. cerebrum, cerebellum. medulla
2. intelligence
3. muscular
4. activities of the internal organs
5. cerebrum

## Lesson 2

### Activity 2.1

1. Degree of sharpness of the eyes
2. Normal vision
3. Size of the letter that is twice as big as the standard-sized letter

### Self-Test 2.1



### Self-Test 2.2

1. They are received by the sense organs.
2. Sense of sight
3. Sense of hearing
4. Sense of smell – fragrant, acid, rancid, burnt
5. For tasting – sweet, sour, bitter, salty
6. Sense of feeling – touch, pressure, pain, hot, cold

## Lesson 3

### Self-Test 3.1

1. Secretion is a chemical substance manufactured by cells of glands. Examples: adrenalin, thyroxin
2. Gland is a specialized cell that secretes or excretes substances. Examples: thyroid, adrenal, pituitary

Table:

1. pituitary – brain
2. thyroid – neck
3. thymus – chest cavity
4. adrenals – top of kidneys
5. pancreas – below the stomach
6. testes – below the abdominal cavity
7. ovaries – below the pelvis

### Self-Test 3.2

1. thyroid hormone or thyroxin
2. metabolism or release of energy
3. a person may lose weight; hyperactive
4. child develops into a midget who is overweight

### Self-Test 3.3

1. secrete adrenaline
2. helps us during emergency

### Self-Test 3.4

1. Secretes hormone and digestive chemicals
2. Insulin regulates burning of sugar
3. Cells do not get enough sugar. A person suffers from diabetes.

### Self-Test 3.5

1. Because it secretes several hormones which regulate activities of other glands
2. Thyroid, adrenal and sex glands
3. Stimulates another gland with a hormone

### Posttest

- |      |       |       |       |
|------|-------|-------|-------|
| 1. c | 6. c  | 11. d | 16. a |
| 2. c | 7. c  | 12. b | 17. b |
| 3. a | 8. a  | 13. d | 18. c |
| 4. a | 9. c  | 14. b | 19. c |
| 5. c | 10. a | 15. a | 20. d |

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