

# The Human Body

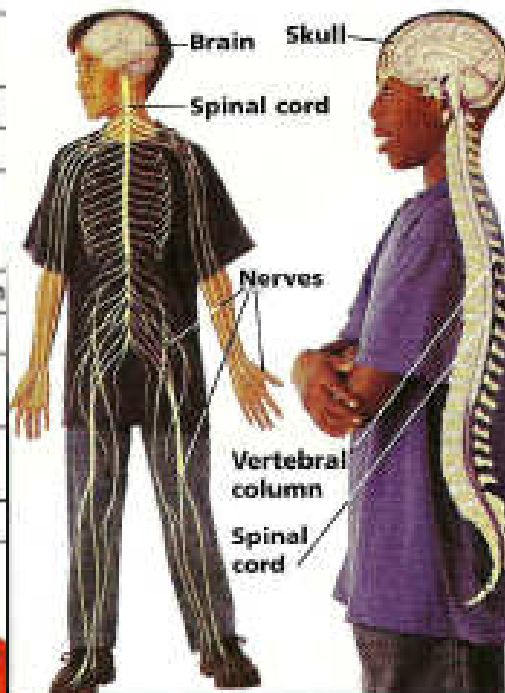
Like all organisms, humans are made up of cells. In fact, the human body is made of trillions of cells. These cells are organized into tissues, a group of similar cells that perform a specific function. Tissues, in turn, form organs. Your heart and lungs are examples of organs. Finally, organs work together as part of organ systems. Your heart, for example, is part of the circulatory system.

## Levels of Organization

- Cells
- Tissues
- Organs
- Organ Systems
- Organism

Including the skin, or integumentary system, the human body has 11 major organ systems. These body systems each have specific functions, and they also work together as parts of the human body as a whole.

Human Body Systems	
System	Function
Nervous System	control
Skeletal System	support
Integumentary System	protection
Muscular System	movement
Circulatory System	transport
Respiratory System	oxygen/ carbon dioxide exchange
Digestive System	food absorption
Excretory System	waste removal
Endocrine System	regulation and control
Reproductive System	reproduction
Immune System	protection



# The Nervous System

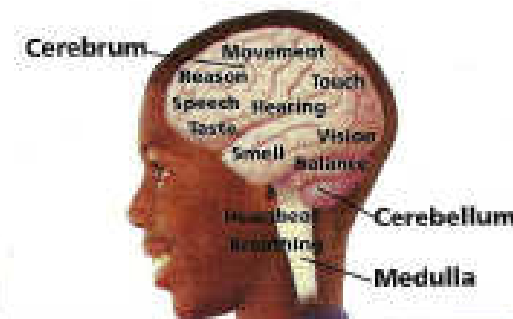
The nervous system has two parts. The brain and the spinal cord are the central nervous system. All other nerves are the outer, or peripheral, nervous system.

The largest part of the brain is the cerebrum. A deep groove separates the right half, or hemisphere, of the cerebrum from the left half. Both the right

and left hemispheres of the cerebrum contain control centers for the senses.

The cerebellum lies below the cerebrum. It coordinates the skeletal muscles so they work smoothly together. It also helps in keeping balance.

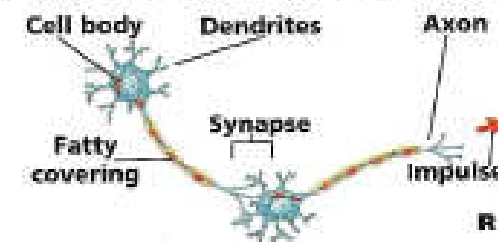
The brain stem connects to the spinal cord. The lowest part of the brain stem is the medulla. It controls heartbeat, breathing, blood pressure, and the muscles in the digestive system.



## Parts of a Neuron

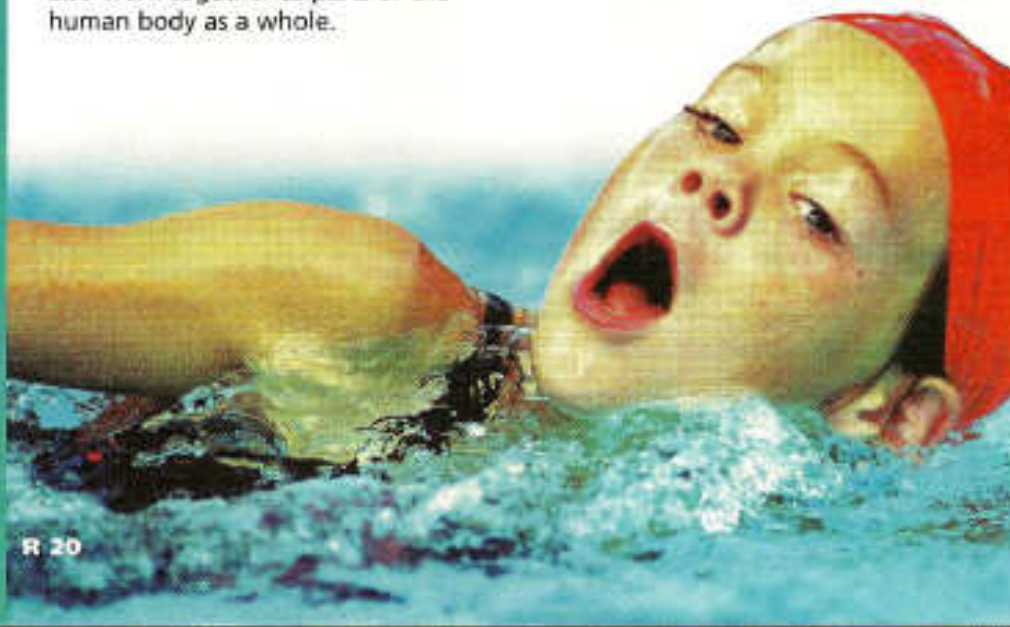
The nerves in the nervous system are made up of nerve cells called neurons. Each neuron has three main parts—a cell body, dendrites, and an axon. Dendrites are branching nerve fibers that carry impulses, or electrical signals, toward the cell body. An axon is a nerve fiber that carries impulses away from the cell body.

When an impulse reaches the tip of an axon, it must cross a tiny gap to reach the next neuron. This gap between neurons is called a synapse.



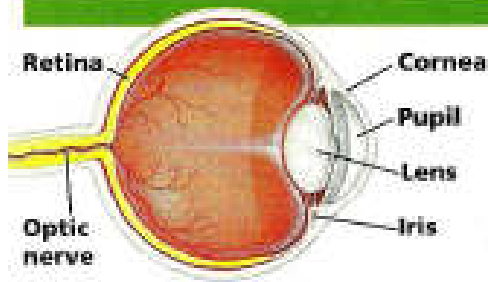
## CARE!

- Wear protective headgear when you play sports or exercise.
- Stay away from drugs, such as stimulants, which can speed up the nervous system.
- Stay away from alcohol, which is a depressant and slows down the nervous system.

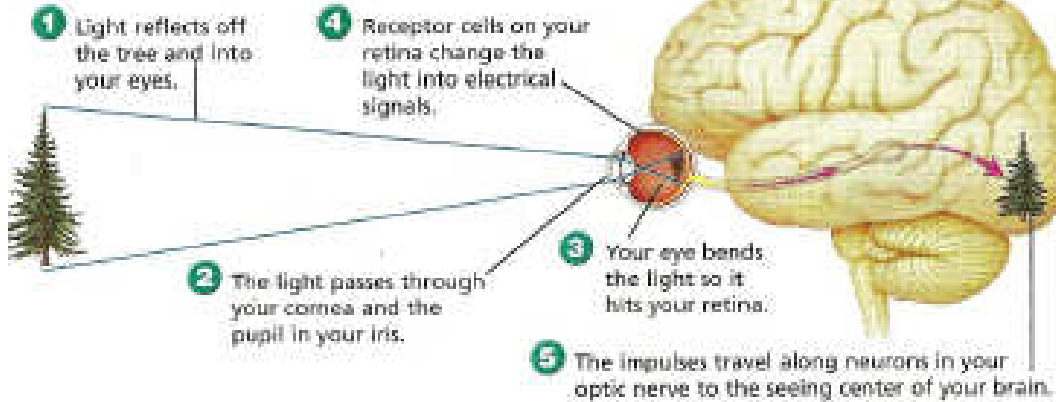


# The Senses

## Seeing

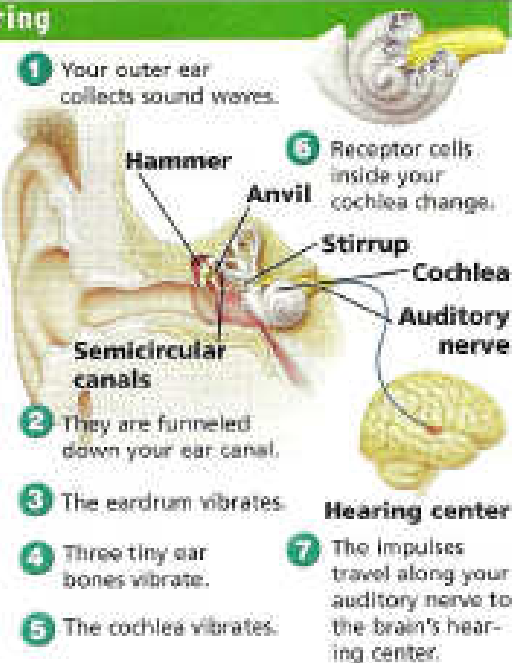


Light reflected from an object enters the eye and falls on the retina. Receptor cells change the light into electrical signals, or impulses. These impulses travel along the optic nerve to the vision center of the brain.



## Hearing

Sound waves enter the ear and cause the eardrum to vibrate. Receptor cells in the ear change the sound waves into impulses that travel along the auditory nerve to the hearing center of the brain.



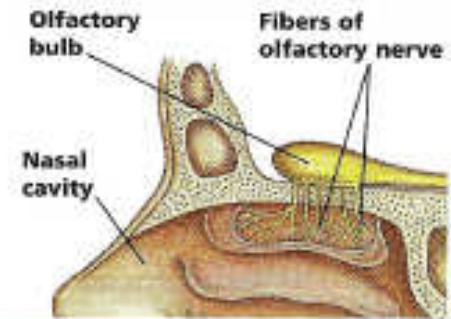
## CARE!

- To avoid straining your eye muscles, don't sit too close to the TV screen or computer monitor.
- Avoid loud music. Turn down the volume when wearing headphones.

# The Senses

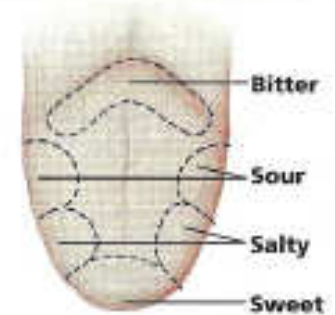
## Smelling

The sense of smell is really the ability to detect chemicals in the air. When a person breathes, chemicals dissolve in mucus in the upper part of the nose. When the chemicals come in contact with receptor cells, the cells send impulses along the olfactory nerve to the smelling center of the brain.



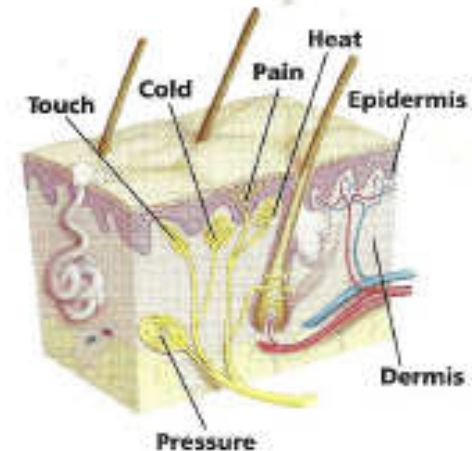
## Tasting

When a person eats, chemicals in food dissolve in saliva. Saliva carries the chemicals to taste buds on the tongue. Inside each taste bud are receptors that can sense the four main tastes—sweet, sour, salty, and bitter. The receptors send impulses along a nerve to the taste center of the brain. The brain identifies the taste of the food, which is usually a combination of the four main tastes.



## Touching

Receptor cells in the skin help a person tell hot from cold, wet from dry, and the light touch of a feather from the pressure of stepping on a stone. Each receptor cell sends impulses along sensory nerves to the spinal cord. The spinal cord then sends the impulses to the touch center of the brain.



## CARE!

- To prevent the spread of germs, always cover your mouth and nose when you cough or sneeze.



# The Skeletal System

The body has a supporting frame, called a skeleton, which is made up of bones. The skeleton has several jobs.

- It gives the body its shape.
- It protects organs in the body.
- It works with muscles to move the body.

Each of the 206 bones of the skeleton is the size and shape best fitted to do its job. For example, long and strong leg bones support the body's weight.

## CARE!

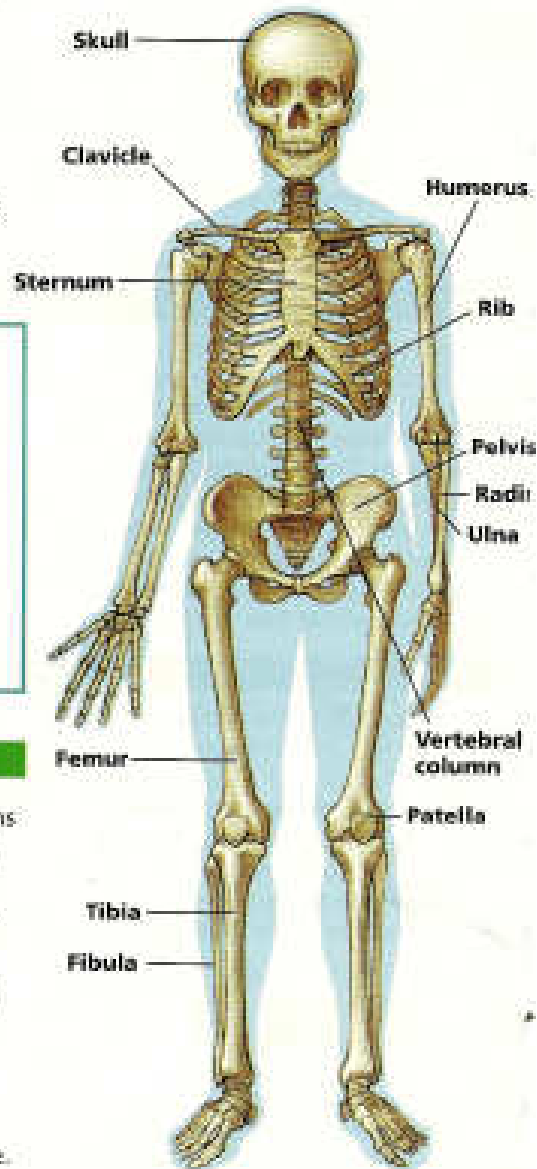
- Exercise to keep your skeletal system in good shape.
- Don't overextend your joints.
- Eat foods rich in vitamins and minerals. Your bones need the minerals, calcium, and phosphorus to grow strong.

## The Integumentary System

The skeleton and the organ systems are covered by an outer layer of skin. The skin is the largest organ of the human body. It is part of the integumentary system. Other parts of the integumentary system are your hair, nails, and glands in the skin. The skin has several functions.

- It protects your internal organs.
- It protects your body from injury and infection.
- It helps regulate body temperature.
- It helps remove wastes.

### The Skeleton



# Joints

The skeleton has different types of joints. A joint is a place where two or more bones meet. Joints can be

classified into three major groups—immovable joints, partly movable joints, and movable joints.

## Types of Joints

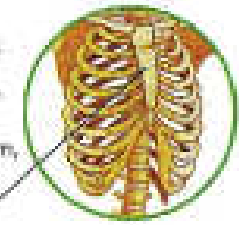
### Immovable Joints



Head

Immovable joints are places where bones fit together too tightly to move. Nearly all the 29 bones in the skull meet at immovable joints. Only the lower jaw can move.

### Partly Movable Joints



Partly movable joints are places where bones can move only a little. Ribs are connected to the sternum, or breastbone, with these joints.

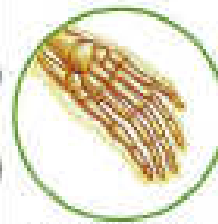
Sternum

Ribs

### Movable Joints

Movable joints are places where bones can move easily.

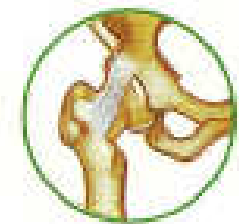
#### Gliding joint



Hand and wrist

Small bones in the wrists and ankles meet at gliding joints. The bones can slide against one another. These joints allow some movement in all directions.

#### Ball-and-socket joint



Hip

The hips are examples of ball-and-socket joints. The ball of one bone fits into the socket, or cup, of another bone. These joints allow bones to move back and forth, in a circle, and side to side.

#### Hinge joint



Knee

The knees are hinge joints. A hinge joint is similar to a door hinge. It allows bones to move back and forth in one direction.

#### Pivot joint



Neck

The joint between the skull and neck is a pivot joint. It allows the head to move up and down, and side to side.

# The Muscular System

Three types of muscles make up the body—skeletal muscle, cardiac muscle, and smooth muscle.

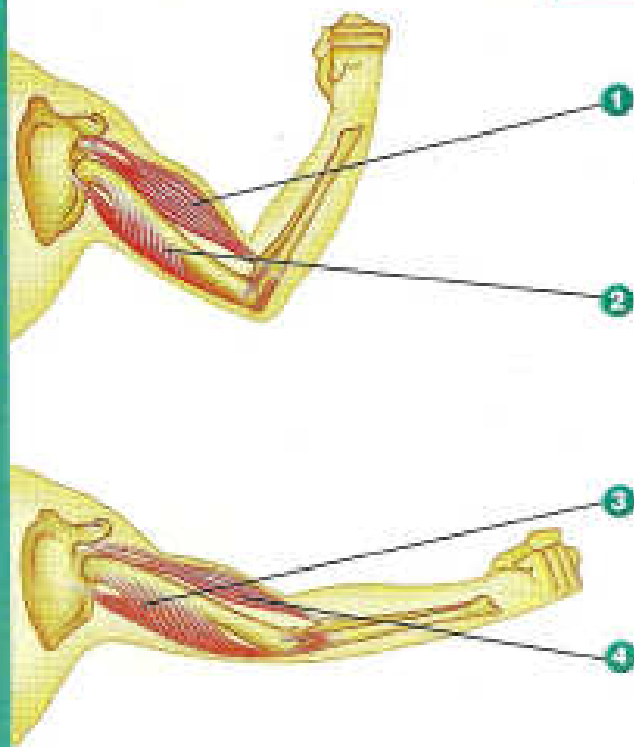
The muscles that are attached to and move bones are called *skeletal muscles*. These muscles are attached to bones by a tough cord called a *tendon*. Skeletal muscles pull bones to move them. Muscles do not push bones.

Cardiac muscles are found in only one place in the body—the heart. The walls of the heart are made of strong cardiac muscles. When cardiac muscles contract, they squeeze blood out of the heart. When cardiac muscles relax, the heart fills with more blood.

Smooth muscles make up internal organs and blood vessels. Smooth muscles in the lungs help a person breathe. Those in the blood vessels help control blood flow around the body.

## CARE!

- Exercise to strengthen your muscles.
- Eat the right foods.
- Get plenty of rest.
- Never take steroids unless your doctor tells you to.



- 1 A message from your brain causes this muscle, called the biceps (BIGH-seps), to contract. When a muscle contracts, it becomes shorter and thicker. As the biceps contracts, it pulls on the arm bone it is attached to.
- 2 Most muscles work in pairs to move bones. This muscle, called the triceps (TRIGH-seps), relaxes when the biceps contracts. When a muscle relaxes, it becomes longer and thinner.
- 3 To straighten your arm, a message from your brain causes the triceps to contract. When the triceps contracts, it pulls on the bone it is attached to.
- 4 As the triceps contracts, the biceps relaxes. Your arm straightens.

# Stimulus and Response

The nervous system, the skeletal system, and the muscular system work together to help you adjust to your surroundings. Anything in the environment that requires your body to adjust is called a *stimulus* (plural: stimuli). A reaction to a stimulus is called a *response*.

As you learned, nerve cells are called *neurons*. There are three kinds of neurons: sensory, associative, and motor. Each kind does a different job to help your body respond to stimuli.

- The job of your sensory neurons is to collect information from stimuli and send it to your brain and spinal cord. When you touch a sharp tack, sensory neurons alert your brain. The sensory neurons carry the

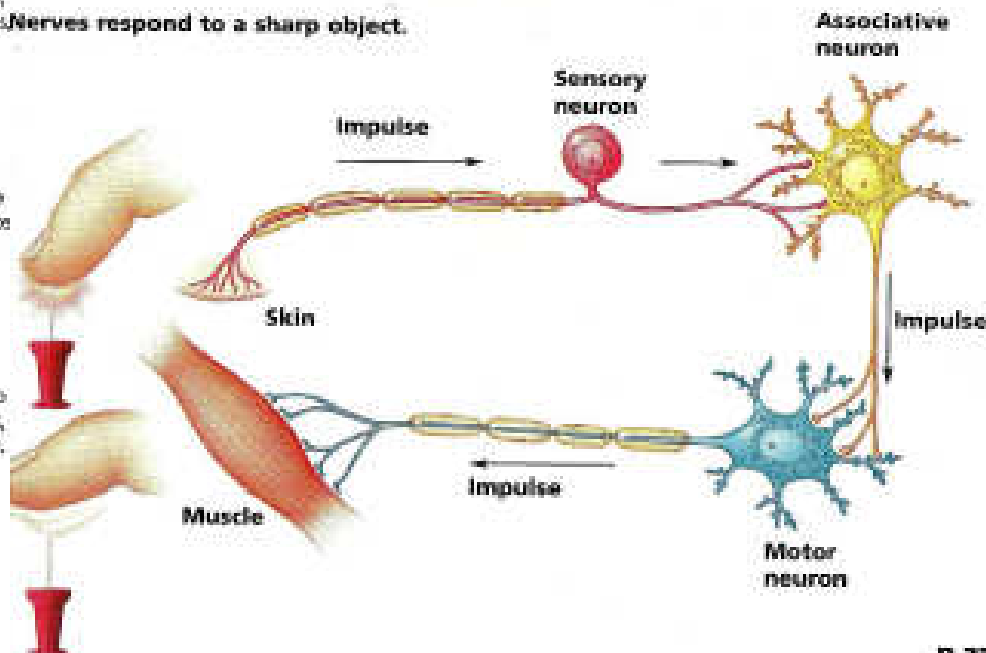
message that your finger has touched a tack (stimulus) to the associative neurons in the brain and spinal cord.

- Associative neurons pass impulses from sensory to motor neurons. The message is interpreted and sent to the motor neurons.
- Motor neurons carry impulses from your brain and spinal cord to your muscles. The motor neurons cause your finger to move away from the tack (response).

In addition to responding to external stimuli, your body also responds to internal changes. Your body regulates its internal environment to maintain a stable condition for survival. This is called a *steady-state condition*.

## Nerve Response

Nerves respond to a sharp object.



# The Circulatory System

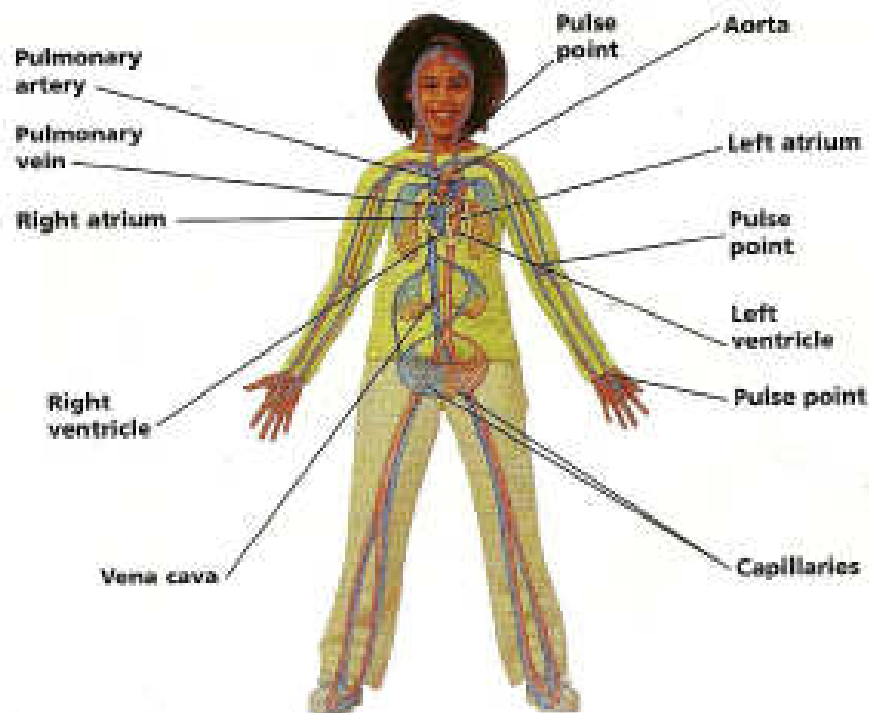
The circulatory system consists of the heart, blood vessels, and blood. Circulation is the flow of blood through the body. Blood is a liquid that contains red blood cells, white blood cells, and platelets. Red blood cells carry oxygen and nutrients to cells. White blood cells work to fight germs that enter the body. Platelets are cell fragments that make the blood clot.

The heart is a muscular organ about the size of a fist. It beats about 70 to 90 times a minute, pumping blood through the blood vessels. Arteries carry blood away from the heart. Some arteries carry blood to the lungs, where the cells pick up oxygen. Other arteries carry oxygen-rich blood from the lungs to all other parts of the body. Veins

carry blood from other parts of the body back to the heart. Blood in most veins carries the wastes released by cells and has little oxygen. Blood flows from arteries to veins through narrow vessels called capillaries.

## Pulse Rate and Pulse Points

You can tell how fast your heart is beating by checking your pulse rate. Take your pulse by putting the first and second fingers of one hand on the inside of the wrist of the other hand, just below the thumb. What you feel is the blood being pumped by your heart through arteries that lie close to the surface of the skin. Count the number of times you feel your heart pump in one minute. This is your pulse rate.



# The Heart

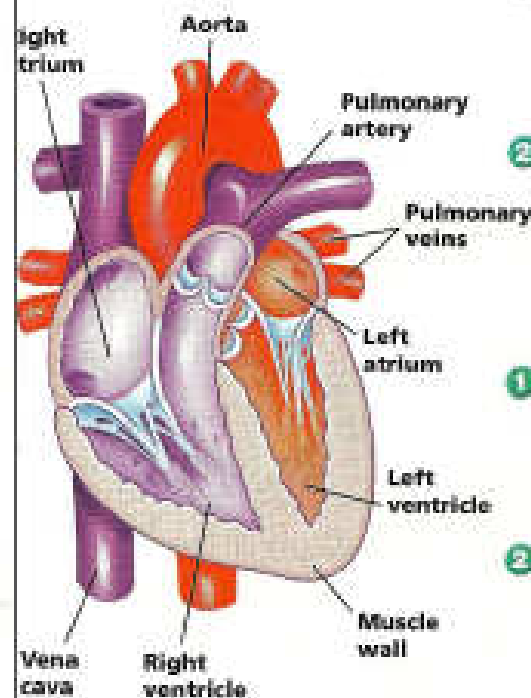
The heart has two sides, right and left, separated by a thick muscular wall. Each side has two chambers for blood. The upper chamber is the atrium. The lower chamber is the ventricle. Blood enters the heart through the vena cava. It leaves the heart through the aorta.

The pulmonary artery carries blood from the body into the lungs. Here carbon dioxide leaves the blood to be exhaled by the lungs. Fresh oxygen enters the blood to be carried to every cell in the body. Blood returns from the lungs to the heart through the pulmonary veins.

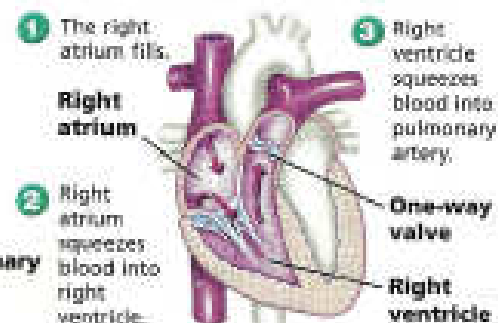
## CARE!

- Don't smoke. The nicotine in tobacco makes the heart beat faster and work harder to pump blood.
- Never take illegal drugs, such as cocaine or heroin. They can damage the heart and cause heart failure.

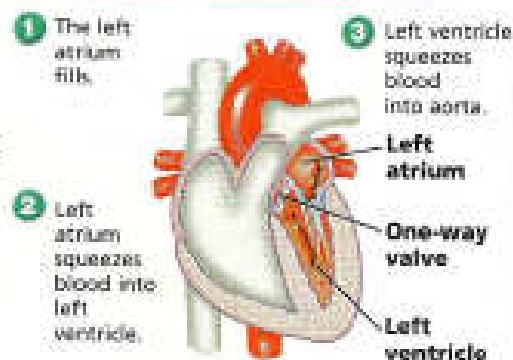
## How the Heart Works



## To the Lungs



## From the Lungs



# The Respiratory System

The process of getting and using oxygen in the body is called respiration. When a person inhales, air is pulled into the nose or mouth. The air travels down into the trachea. In the chest the trachea divides into two bronchial tubes. One bronchial tube enters each lung. Each bronchial tube branches into smaller tubes called bronchioles.

At the end of each bronchiole are tiny air sacs called alveoli. The alveoli exchange carbon dioxide for oxygen.

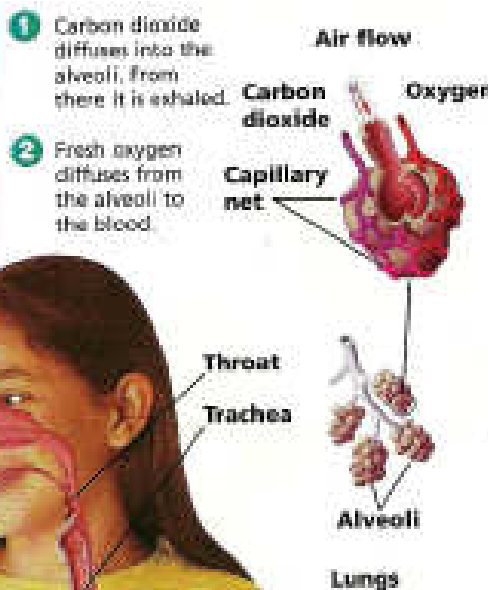
Oxygen comes from the air a person breathes. Two main muscles control breathing. One is located between the ribs. The other is a dome-shaped sheet of muscle called the diaphragm.

To inhale, the diaphragm contracts and pulls down. Other muscles pull the ribs up and out. This makes more room in the chest. Air rushes into the lungs and fills the space.

To exhale, the diaphragm relaxes and returns to its dome shape. The lungs get smaller and force the air out.

## CARE!

- Don't smoke. Smoking damages your respiratory system.
- Exercise to strengthen your breathing muscles.
- If you ever have trouble breathing, tell an adult at once.



The air you breathe is about 21 percent oxygen.

The blood in the capillaries of your lungs has very little oxygen.

The blood has a higher concentration of carbon dioxide than air.

# Effects of Exercise

Any type of exercise uses your muscles. When you exercise, your muscles need three things:

- They need oxygen.
- They need to remove wastes.
- They need to get rid of heat.

When you exercise, several things happen to your body. Your heart beats faster, you breathe heavier and faster, and you sweat.

If you are going to be exercising for more than a couple of minutes,

your body needs to get oxygen to the muscles or the muscles will stop working. Your body increases the flow of oxygen-rich blood to working muscle as follows:

- Your rate and depth of breathing increase to take in more oxygen.
- Your heart beats faster so that it can pump more oxygen-rich blood to the muscles.

Sweating helps remove both wastes and heat that result from exercise.



# The Digestive System

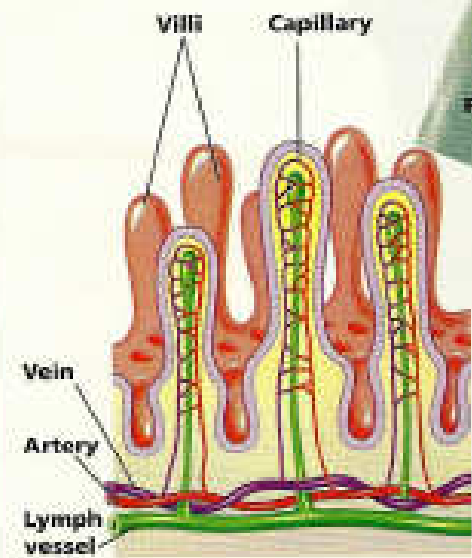
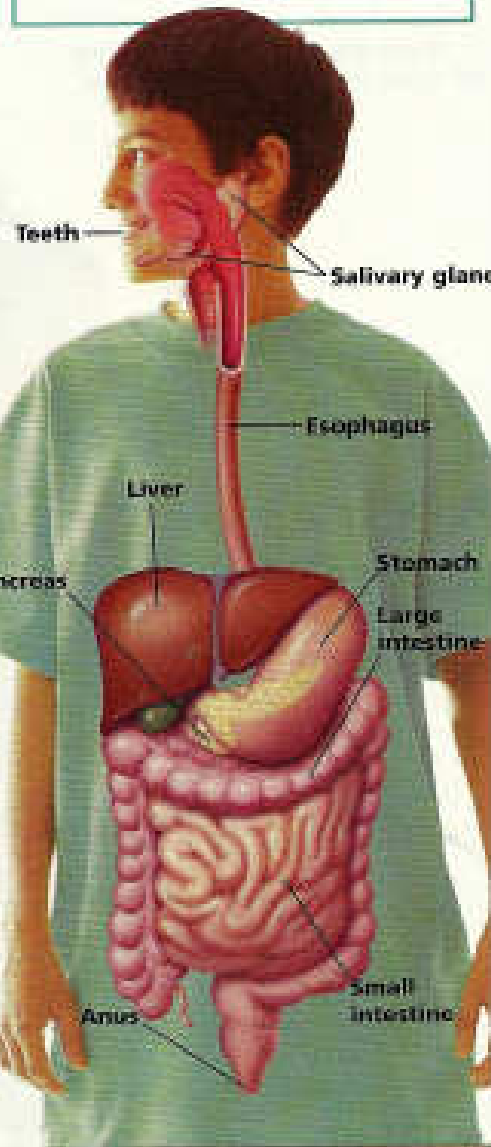
Digestion is the process of breaking down food into simple substances the body can use. Digestion begins when a person chews food. Chewing breaks the food down into smaller pieces and moistens it with saliva. Saliva is produced by the salivary glands.

Digested food is absorbed in the small intestine. The walls of the small intestine are lined with villi. Villi are tiny fingerlike projections that absorb digested food. From the villi the blood transports nutrients to every part of the body.

The shape of the small intestine's villi increases the amount of nutrients that can be absorbed from the food.

**CARE!**

- Chew your food well.
- Drink plenty of water to help move food through your digestive system.

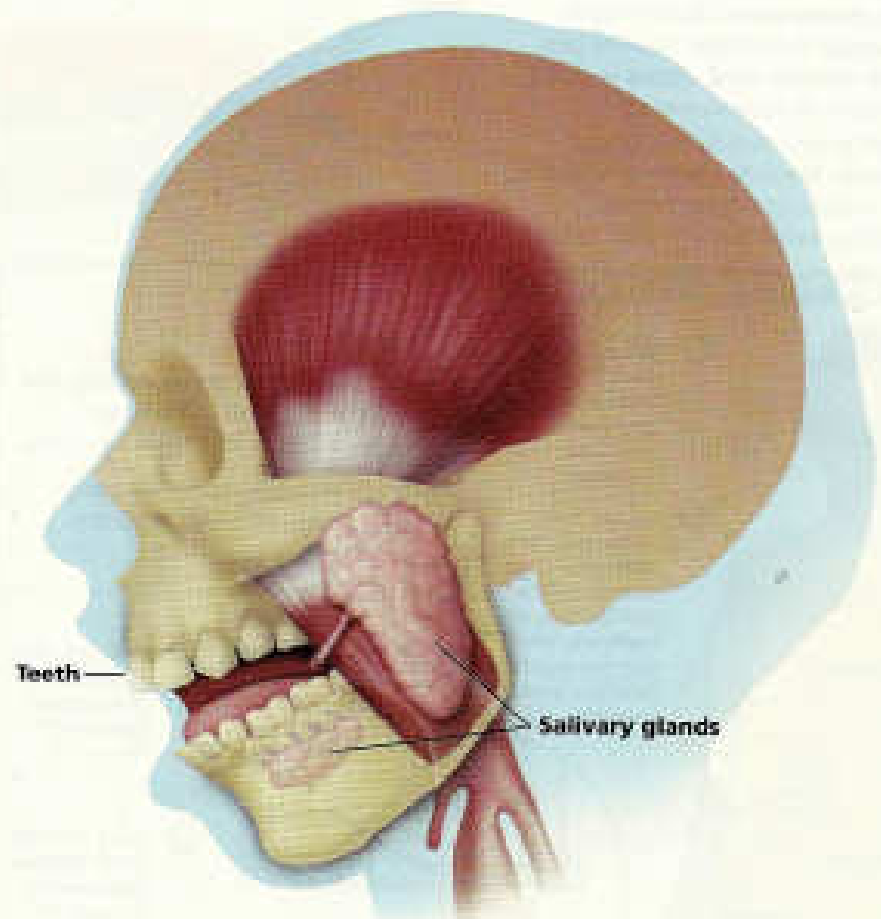


# The Digestive System

## Mechanical and Chemical Digestion

Digestion is both mechanical and chemical. Chewing is the first step in digestion. Chewing is *mechanical digestion*, the physical process of breaking food down into smaller pieces. As you chew, saliva begins to break the food into simpler molecules. This is *chemical digestion*.

After you swallow your food, both mechanical and chemical digestion continue in the stomach. Stomach muscles churn food particles into smaller pieces. Glands lining the stomach produce strong digestive juices.



# The Excretory System

Excretion is the process of removing waste products from the body. The liver filters wastes from the blood and converts them into urea. Urea is then carried to the kidneys for excretion. Each kidney contains more than a million nephrons. Nephrons are structures in the kidneys that filter blood.

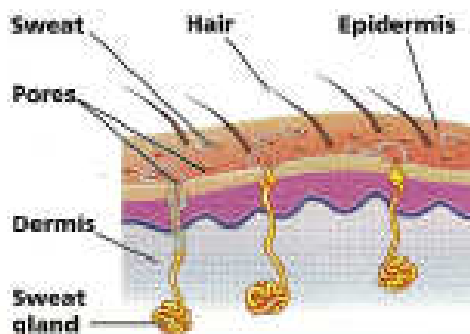
The skin takes part in excretion when a person sweats. Glands in the inner layer of the skin produce sweat. Sweat is mostly water. Sweat tastes salty because it contains mineral salts the body doesn't need. There is also a tiny amount of urea in sweat.

Sweat is excreted by the sweat glands onto the outer layer of the skin. There it evaporates into the air. Evaporation takes place in part because

of body heat. When sweat evaporates, a person feels cooler. On hot days or when exercising, a person sweats more to keep the body from overheating.

## How You Sweat

Glands under your skin push sweat up to the surface, where it collects.



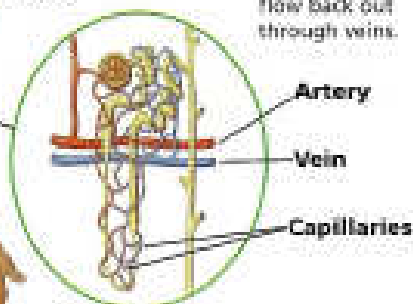
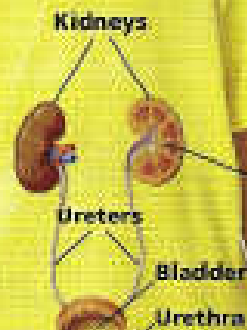
## How Your Kidneys Work

- 1 Blood enters the kidney through an artery and flows into capillaries.
- 2 Sugars, salts, water, urea, and other wastes move from the capillaries to tiny nephrons, which sort out wastes from the useful nutrients.

## CARE!

- Drink plenty of water to help the kidneys do their job and to replace water loss from sweating.
- Wash regularly to avoid body odor, clogged pores, and skin irritation.

- 3 The nutrients return to the blood and flow back out through veins.
- 4 Urea and other wastes become urine, which flows down the ureters.
- 5 Urine is stored in the bladder and excreted through the urethra.

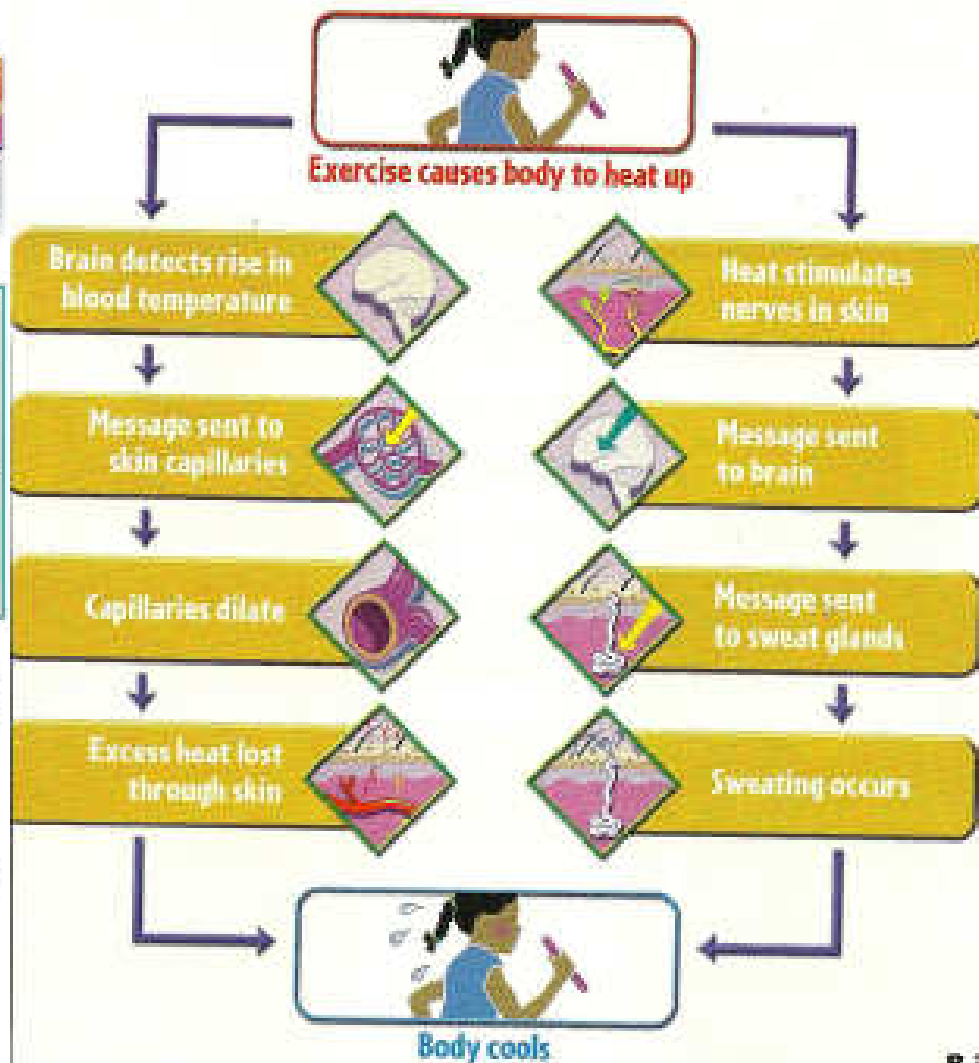


# The Excretory System

## Removing Excess Heat

In addition to waste removal, one of the skin's most important jobs is to maintain internal body temperature. The skin does this by removing excess heat. Two things happen when you exercise: your face gets red and you sweat. Both are ways of getting rid of excess heat.

The nervous system, the circulatory system, and the skin all work together to regulate body temperature. The diagram below shows what happens when your body heats up as a result of exercise.





# The Endocrine System

Hormones are chemicals that control body functions. A gland that produces hormones is called an endocrine gland. Sweat from sweat glands flows out of tubes called ducts. Endocrine glands have no ducts.

The endocrine glands are scattered around the body. Each gland makes one or more hormones. Every hormone seeks out a target organ, the place in the body where the hormone acts.

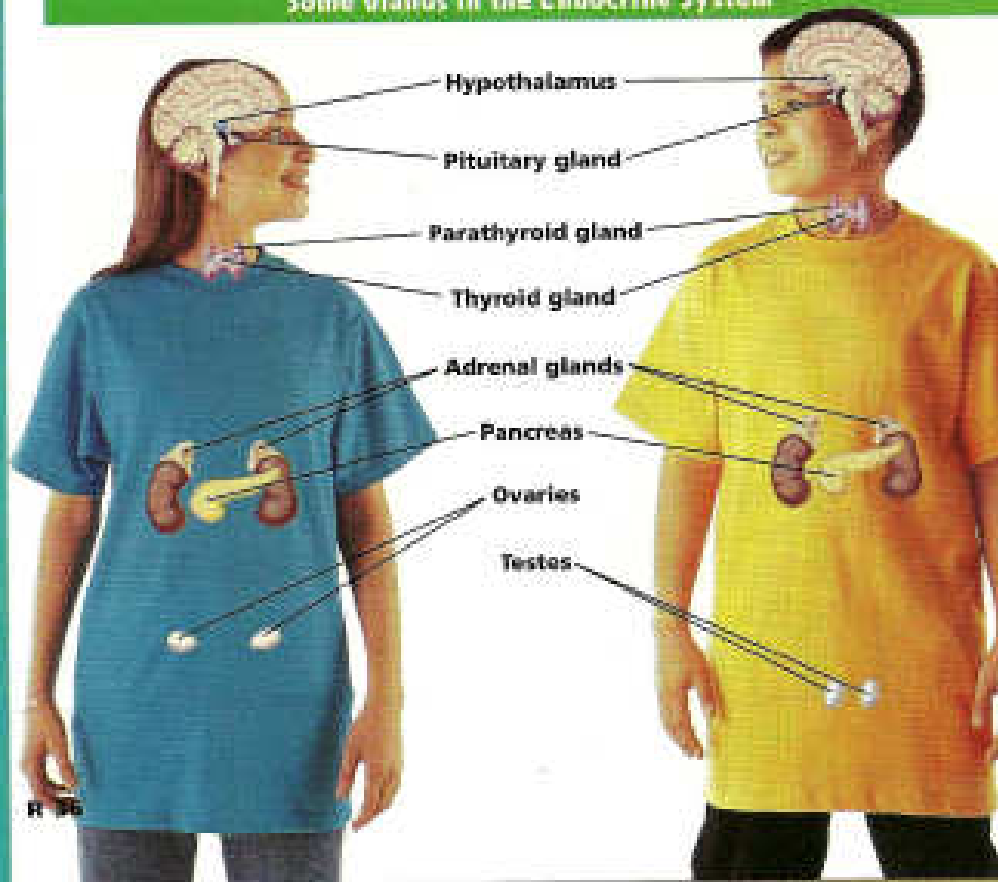
The endocrine glands help to maintain a steady-state condition in

your body. They can turn the production of hormones on or off when they sense that too little or too much is being produced.

## CARE!

- Doctors can treat many diseases, such as diabetes, caused by endocrine glands that produce too little or too much of a hormone.

### Some Glands in the Endocrine System



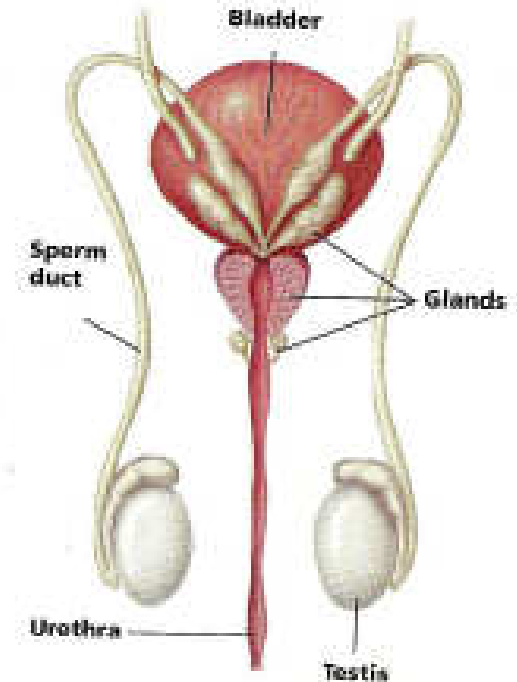
# The Reproductive System

The testes are the male reproductive organs. At puberty the testes begin to produce sperm. Sperm move through sperm ducts, where they mix with fluid from endocrine glands.

The ovaries are the female reproductive organs, which contain eggs. After puberty one mature egg is released about once every 28 days. The egg moves to the oviduct, a narrow tube leading from the ovary.

### The Male Reproductive System

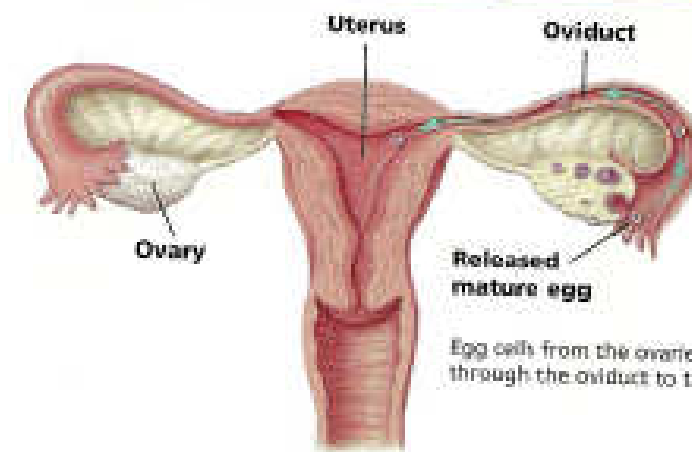
Sperm move from the testes through sperm ducts, where they mix with fluid from the glands. The sperm and fluid move through the urethra.



## CARE!

- Abstinence is the only sure way to avoid sexually transmitted diseases.

### The Female Reproductive System



Egg cells from the ovaries move through the oviduct to the uterus.

# The Immune System

The immune system helps the body fight disease. Inside some bones is a soft tissue known as red marrow that fills the spaces in spongy bone. Red marrow makes new red blood cells, platelets that stop a cut from bleeding, and germ-fighting white blood cells.

There are white blood cells in the blood vessels and in the lymph vessels. Lymph vessels are similar to blood vessels. Instead of blood, they carry lymph. Lymph is a straw-colored fluid surrounding body cells.

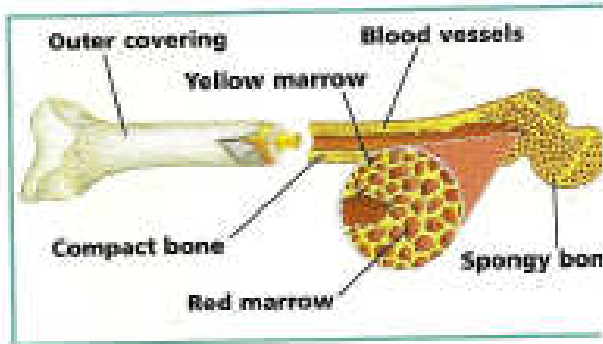
Lymph nodes filter out harmful materials in lymph. Like red marrow, they also produce white blood cells to fight infections. Swollen lymph nodes in the neck are a clue that the body is fighting germs.



## CARE!

- Be sure to get immunized against common diseases.
- Keep cuts clean to prevent infection.

- 1 A bone is covered with a tough but thin membrane that has many small blood vessels. The blood vessels bring nutrients and oxygen to the living parts of the bone and remove wastes.
- 2 Inside some bones is a soft tissue known as marrow. Yellow marrow is made mostly of fat cells and is one of the body's energy reserves. It is usually found in the long, hollow spaces of long bones.
- 3 Part of the bone is compact, or solid. It is made up of living bone cells and nonliving materials. The nonliving part is made up of layers of hardened minerals such as calcium and phosphorus. In between the mineral layers are living bone cells.
- 4 Red marrow fills the spaces in spongy bone. Red marrow makes new red blood cells, germ-fighting white blood cells, and platelets that stop a cut from bleeding.
- 5 Part of the bone is made of bone tissue that looks like a dry sponge. It is made of strong, hard tubes. It is also found in the middle of short, flat bones.



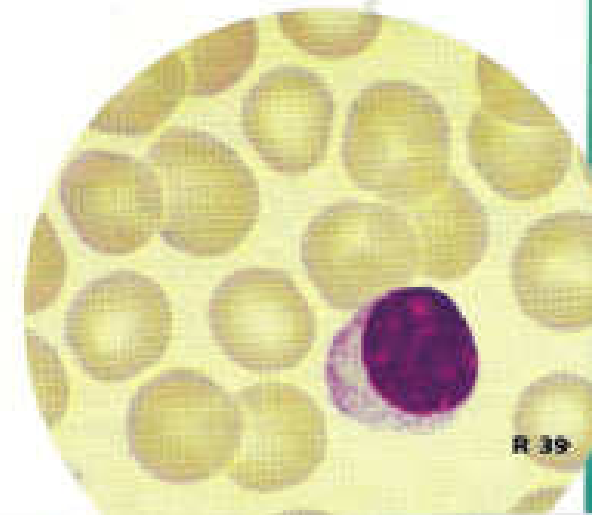
# Infectious Diseases

A disease is anything that breaks down the normal functions of the body. Some diseases are inherited. Others are caused by harmful materials in the environment. Many diseases, however, are caused by organisms,

Disease-causing organisms include bacteria and viruses. Diseases caused by these organisms are called *infectious diseases* because the organisms enter, or infect, the body.

Human Infectious Diseases		
Disease	Caused by	Organ System Affected
Chicken pox	Virus	Skin
Smallpox	Virus	Skin
Polio	Virus	Nervous system
Rabies	Virus	Nervous system
Influenza	Virus	Respiratory system
Measles	Virus	Skin
Mumps	Virus	Salivary glands
Tuberculosis	Bacteria	Respiratory system
Tetanus	Bacteria	Nervous system
Food poisoning	Bacteria	Digestive system

White blood cells are your body's main protection against infectious disease. The white blood cells leave the blood vessels or lymph vessels to fight disease organisms in your tissues.

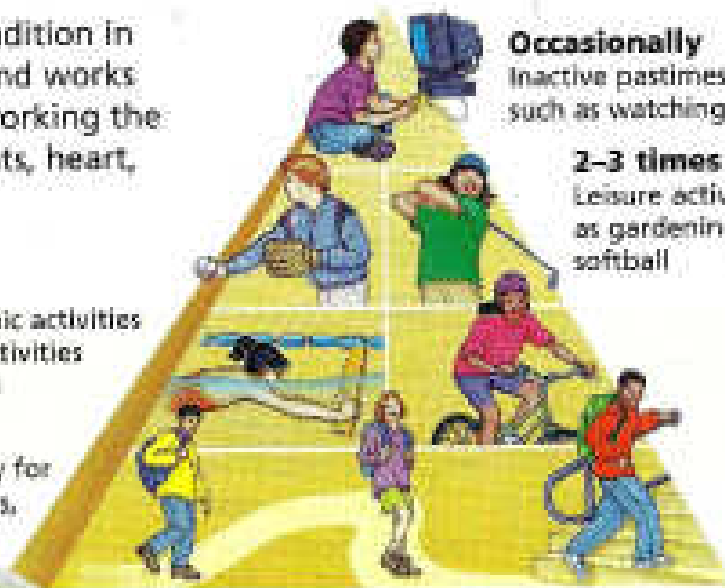


# Staying Healthy

Physical fitness is the condition in which the body is healthy and works the best it can. It involves working the skeletal muscles, bones, joints, heart, and respiratory system.

**3–5 times a week** Aerobic activities such as swimming; sports activities such as basketball, handball

**Daily** Substitute activity for inactivity—take the stairs, walk instead of riding



**Occasionally**  
Inactive pastimes  
such as watching TV

**2–3 times a week**  
Leisure activities such  
as gardening, golf,  
softball

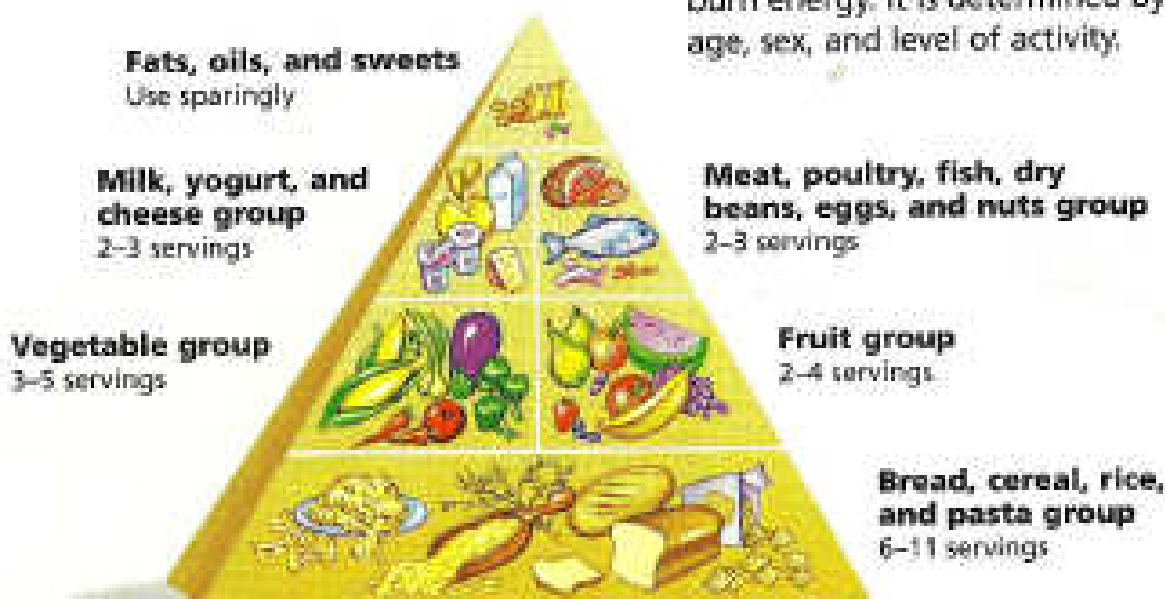
**Activity Pyramid**

## CARE!

- Stay active every day.
- Eat a balanced diet.
- Drink plenty of water—6 to 8 large glasses a day.

There is more to fitness than exercise. To make sure your body gets all the nutrients you need, you should eat a balanced diet. A *balanced diet* includes all the major food groups.

A balanced diet provides the calories, or energy from food, that you need to stay healthy. The number of calories needed varies from person to person, depending on their metabolism. *Metabolism* is the rate at which you burn energy. It is determined by weight, age, sex, and level of activity.



**Fats, oils, and sweets**  
Use sparingly

**Milk, yogurt, and  
cheese group**  
2–3 servings

**Meat, poultry, fish, dry  
beans, eggs, and nuts group**  
2–3 servings

**Vegetable group**  
3–5 servings

**Fruit group**  
2–4 servings

**Bread, cereal, rice,  
and pasta group**  
6–11 servings

**Food Guide Pyramid**