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II. BODY FRAMEWORK AND REPRODUCTION

This section considers the skeletal and the muscular systems. Together, these two systems provide for our shape, our mobility, and our

function. The centerfold insert deals with the reproductive system.

SECTION OBJECTIVES

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

1. To identify the anatomy of the various parts of the human body.
2. To describe the function of the various parts of the human body.
3. To group the organs of the body into their body systems.
8. To identify many of the structures of the body as shown in diagrams.
9. To relate the form and function of the body to Biblical truth and instruction.



VOCABULARY

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

Achilles tendon

electrocardiograph

pelvic girdle

pectoral girdle

SKELETAL SYSTEM

Just as the metal frame of a skyscraper gives stability to the whole structure, so a skeleton gives support and form to the body. The 206 named bones of the adult human skeleton provide for body movement, protection of vital organs, and formation of blood.

Bones. The structure of the skeleton will be considered first. The skeleton can be divided into two basic parts: the *axial skeleton*, which consists of the skull, vertebral column, and ribs; and the *appendicular skeleton*, which includes the bones of the arms and legs and their supporting bones. Check Figure 14 for the bones being mentioned. The bones supporting the arms are called the **pectoral girdle**. The horizontal front bones are called *clavicles* (collarbones). The large flat bones on the back of your shoulders, commonly called shoulder blades, are the *scapulae* (sing., *scapula*). Locate these bones on your own body using your fingers to trace their outline. The three bone types supporting the legs are collectively called the **pelvic girdle**. You can locate these bones on the side of your body around the level

of the navel. The pelvic girdle is commonly called the “hipbone.”

The bones of the skull (cranial bones) are made up of flat bones that have been fused together since early childhood and that give protection to the delicate brain tissue. (See Figure 15.) There are six bones that encase the brain: one *frontal bone* in the front of the skull; two *parietal bones* in the upper back portion of the skull, one on each side; two *temporal bones*, one on each side of the head; and one *occipital bone* in the lower back part of the skull. The zigzag joints of these bones are called *sutures*. They are designed to absorb shock to help protect the brain. The so-called “soft spots” (*fontanelles*) of a young child’s skull result from the undeveloped fusion of the cranial bones. The only movable bone in the cranium is the *mandible*, the lower jawbone. The upper jawbone, the *maxillary*, is fixed.

The many hollow bones stacked on top of each other in the spine tie the whole skeletal system together. (See Figure 16.) You can feel these *vertebrae* by moving your fingers up and down the centerline of your back. The top two bones of the vertebral column are the *atlas* and the *axis*, respectively. The atlas allows the

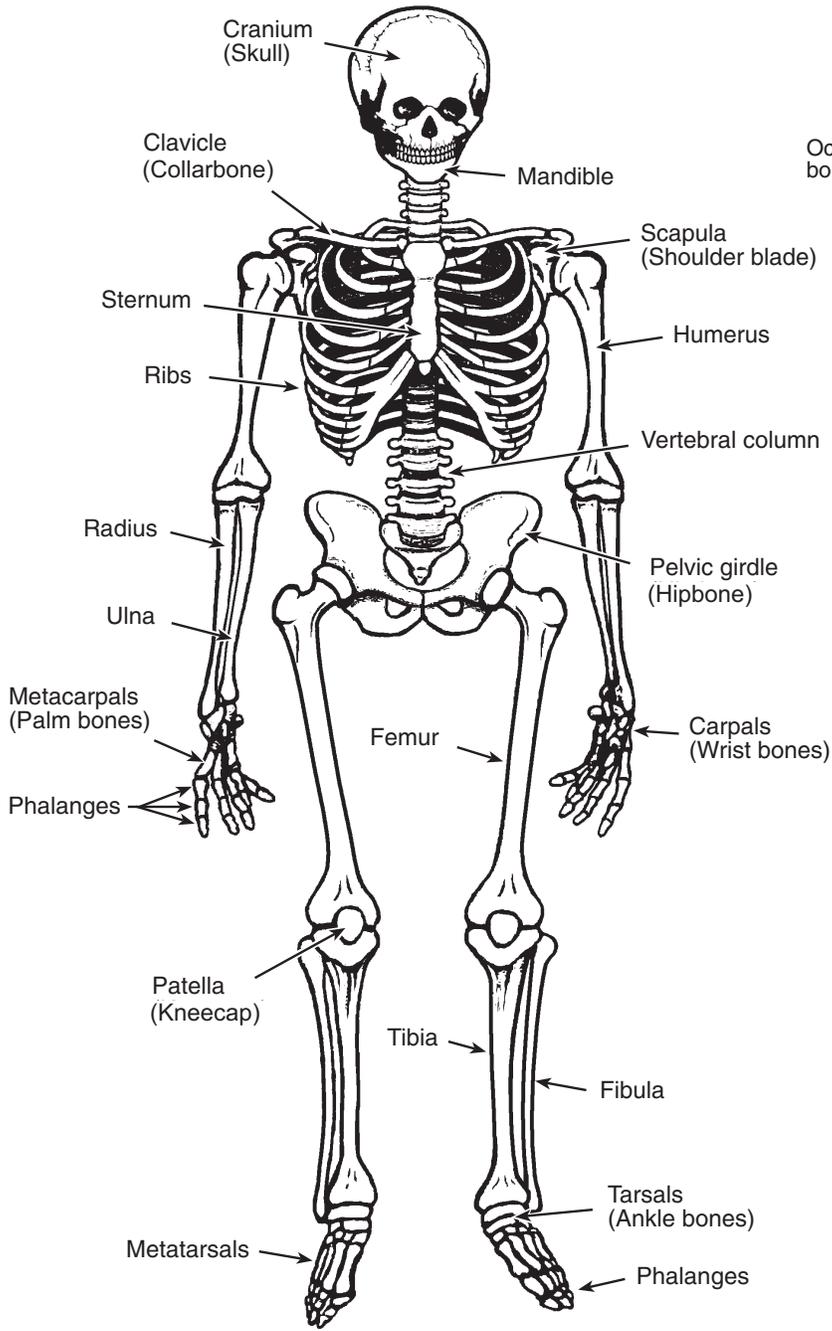


Figure 14:
The Human Skeleton

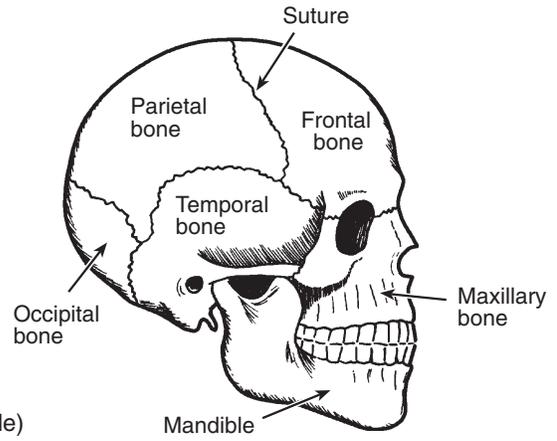


Figure 15:
The Human Skull

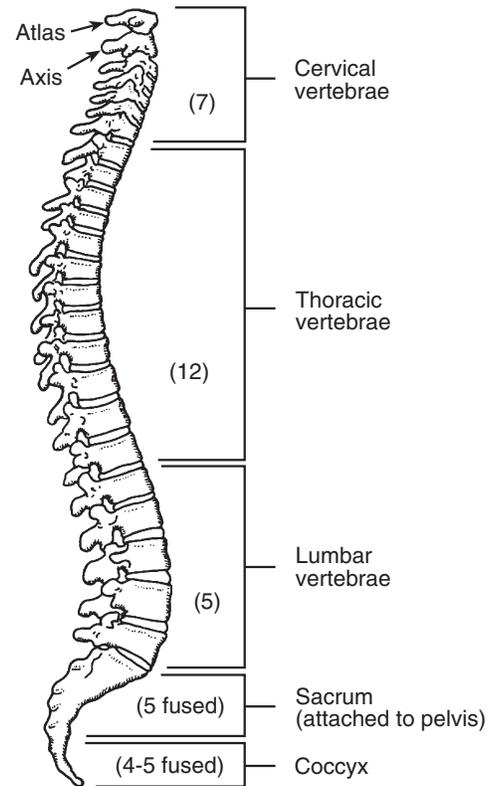


Figure 16:
The Human Vertebral Column

head to nod up and down, while the axis permits the head to shake from side to side. Most of the individual bones are separated by disks of cartilage that act as shock absorbers by allowing limited sliding movement of the vertebrae. Your spinal cord is protected in the center of this stack of bones, and nerves branch out from it to all parts of the body.

The spine is straight when viewed from the front but has a slight curvature when viewed from the side. This slight curve is a God-given design that allows the body to support its own weight without putting too much stress on one part. Standing erect and maintaining good posture when sitting, without slouching, helps to preserve that natural curvature. *Scoliosis* is a condition in which the spine is curved unnaturally from side to side. A hunchback or sway-back condition is an exaggerated natural curve from front to back.

The ribs are attached to the upper spine below the neck. These flat bones encircle the chest cavity to join to the *sternum*, protecting the soft, vital organs of the body such as the heart and the lungs.

Three major long bones give support and form to the arms. The *humerus* is the only bone in the upper arm. There are two bones in the forearm. The lower bone, of which the elbow is a part, is the *ulna*; the upper bone is the *radius*. The radius attaches to your wrist on the same side as the thumb. Find these three bones on your arm. Grip the middle of your right forearm with your left hand so that you can feel the radius and ulna at the same

time. Now turn your right palm up and down several times and notice how this action causes the radius to move over the ulna.

The *carpals* form the bones of the wrist, and the *metacarpals* are palm bones. The finger bones (as well as the toe bones) are called *phalanges*.

The bones of the legs consist of the *femur* in the upper leg; the *tibia*, often called the “shinbone,” in the front part of the lower leg; and the *fibula* in the back of the leg. You will be able to feel the front part of your tibia; but to locate the fibula and femur is more difficult because of the large, thick muscles around them. The kneecap bone is the *patella* and is easily found. The patella is an unusual bone because it is not attached to any other bones.

The bones in the foot are named similarly to the bones of the hand. The *tarsals* are the ankle bones, the *metatarsals* the foot bones, and the *phalanges* the toe bones. God designed the foot bones in such a way as to give the foot a natural spring with an arch side to side (transverse arch) and an arch end to end (longitudinal arch). A flat foot develops when a person has lost the natural arch. The body’s weight is divided between the front of the foot and the heel. No part of the foot has to do the job alone. Care should be taken when buying shoes to select ones that help to strengthen the foot’s arch and that do not put most of the body’s weight on only one part of the foot. Walking is good exercise that can also strengthen foot arches.



Complete these activities.

2.1 Name the two major divisions of the skeletal system and tell which bones are included in each category.

Division	Bones
a. _____	a. _____
b. _____	b. _____

2.2 Give the scientific names for the following bones.

a. collarbone _____	f. kneecap _____
b. shoulder blade _____	g. shinbone _____
c. hipbone _____	h. jawbone _____
d. chest bone _____	i. backbone _____
e. elbow (one part) _____	

- 2.3 Explain what can be done to maintain a healthy skeletal system in relation to each item mentioned, and name a condition that may result from carelessness in each.
- a. vertebral column _____
- _____
- b. the foot _____
- _____

Joints. The points where the bones come together are called *joints*. Fluid-containing sacs called *bursae* (sing., *bursa*) give lubrication around the joint area. Sometimes these sacs become infected and inflammation results in a painful condition called *bursitis*. Another condition which can infect the joints is *arthritis*. Arthritis involves the inflammation of the joints and can be very painful. This can even result in the disfigurement and stiffness of the joint(s) involved.

Several different kinds of joints can be found in the body. Some are immovable joints, such as those holding the plates of the skull together. Others are partially movable, such as those between the ribs and vertebrae, which allow expansion of the thoracic cavity for breathing. Still other joints are movable: (1) *ball and socket joints*, such as those between the arms and legs and their respective girdles; (2) *hinge joints*, such as the joint at the elbows and knees; (3) *gliding joints*, such as the wrist and ankle, and joints between the vertebrae of the backbone; and (4) *pivot joints*, such as the joint between the atlas and the skull which allows the head to turn. Tough connective tissues called *ligaments* hold the bones together at the joints.

Bone tissue. Look carefully at Figure 17 and see how a cross section of a long bone would look under the microscope. Notice the outer covering called the *periosteum*. This covering helps protect and nourish the bone tissue. The central canal (marrow cavity) contains one of two types of marrow. The *yellow marrow* consists mostly of fat cells; the *red marrow* has already been mentioned relative to its role in the production of blood cells. Red marrow is mostly found in flat bones, such as the ribs and sternum, and in the ends of the

long bones, such as the femur.

Around each of the tiny *Haversian canals* are concentric rings of a calcium compound that is secreted by the bone cells. Haversian canals contain the blood vessels that bring food and oxygen to the living cells within the bone. One good food material for healthy bones is milk because it contains both calcium, which is the building material of bones, and vitamin D, which enables your body to absorb the calcium into your bloodstream.

Cartilage. Feel the hard material of your nose, ears, and larynx (Adam's apple region) and notice that it is more flexible than bone tissue. These structures are made of a hard

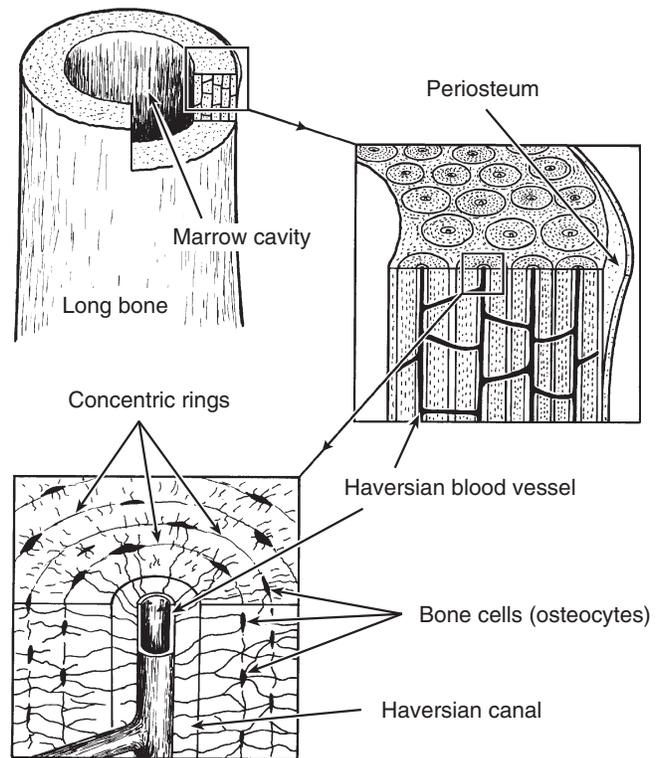


Figure 17: Microstructure of a Long Bone

but flexible tissue called *cartilage*. Cartilage is also the substance that forms the rings around your trachea to keep it wide open at all times. An unborn baby has a skeleton made up of cartilage. As the unborn baby continues to develop within the mother, the cartilage begins to be replaced by bone in all the structures except those which are to remain as cartilage permanently. This process is called *ossification*.

Teeth. Human beings have two sets of teeth throughout life. The first set, called the *primary teeth*, appear in a baby in about six or seven months after birth. The *secondary teeth* replace the primary ones in about five or six years. The mouth can be divided into *quadrants*, or quarters. Take the lower left quadrant as a representative region. Two sharp-edged teeth known as *incisors* are found in the front of the mouth and are used for cutting food. The *cuspid* in each quadrant is a pointed tooth and is used for tearing food. Behind this tooth are two *bicuspid*s, and then two or three *molars*, which are flat and are used for grinding food. If three molars are in a quadrant, the third molar is called the *wisdom tooth*. This tooth does not usually appear until after seventeen years of age. It may cause pain and problems when coming in from beneath the gum line.

Count your teeth in one quadrant and multiply that number by four. If you have twenty-eight teeth, your wisdom teeth (third molars) have not yet come in.

Notice in Figure 19 a hard-ridged upper roof called the *hard palate*. Farther back is the *soft palate*, which is smoother and fleshier.

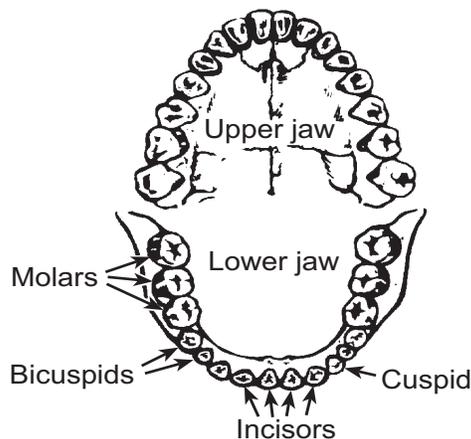
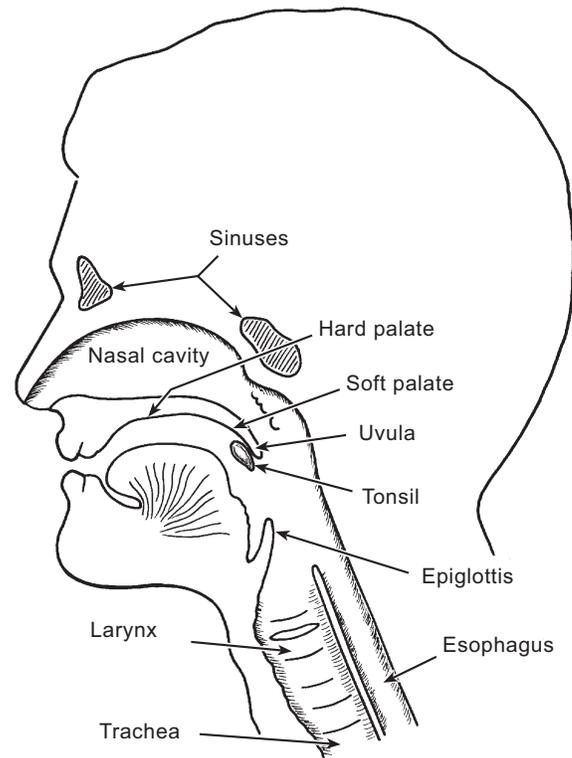


Figure 18: The Teeth

Hanging down from the back of the soft palate is a projection called the *uvula*, which covers the opening from the nasal cavities to the back of the throat. On each side of the back portion of the mouth are *tonsils*, which can become infected and may need to be surgically removed. See if you can see your uvula and tonsils by looking in a mirror.



**Figure 19:
The Mouth, Nose, and Throat**

The basic structure of the tooth can be seen in Figure 20. The part of the tooth above the gums is called the *crown*, and the part below is called the *root*. Notice that the hard, shiny covering of the crown is called *enamel*. This enamel is the hardest material of the body. The softer material within the tooth is called *dentin*. Within the dentin is a *pulp cavity*, which contains both blood vessels and nerve fibers. Irritation of the pulp cavity causes the pain you experience when your teeth are drilled by a dentist.

The most common problem with teeth are *caries*, or dental cavities. The word *caries* means *to rot* and involves the disintegration of the teeth. Caries are caused when bacteria in the mouth break down certain foods, especially

sugar, and form acids that “eat” through the enamel. To cut down on caries, lessen your intake of sugary foods, brush after each meal, and use dental floss daily to remove food from between your teeth. Putting a small amount of fluoride into public drinking water has been found to cut down on dental cavities.

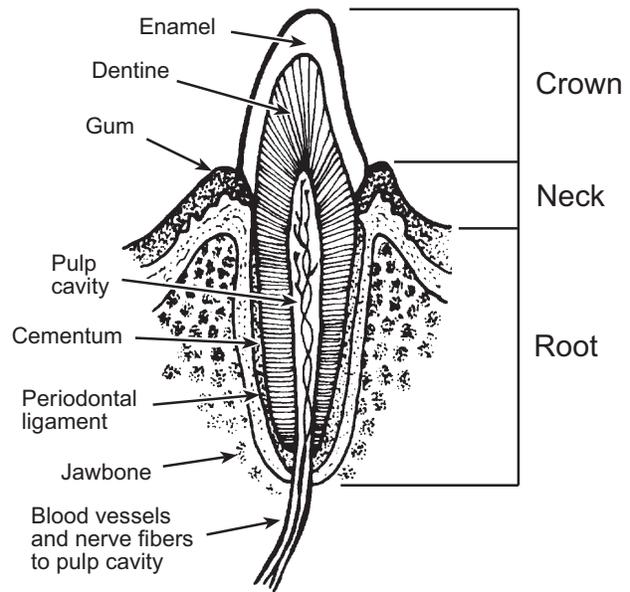


Figure 20: The Tooth



Complete these activities.

△ 2.4

Describe the motion of the following joint types by moving the parts of your body that are examples of each.

- a. ball and socket: _____
- b. hinge joint: _____
- c. gliding joint: _____
- d. pivot joint: _____

△ 2.5

Name some body structures that are made of cartilage. _____

2.6

Complete the following chart.

Tooth Type	Function	Number per Quadrant	Total Number
a. _____	_____	_____	_____
b. _____	_____	_____	_____
c. _____	_____	_____	_____
d. _____	_____	_____	_____



Make the following drawings.

○ 2.7

Draw and label a cross section of a bone. Include the following structures: *periosteum*, *marrow cavity*, *bone cells*, *Haversian canal*, *Haversian blood vessel*, and *concentric rings*.