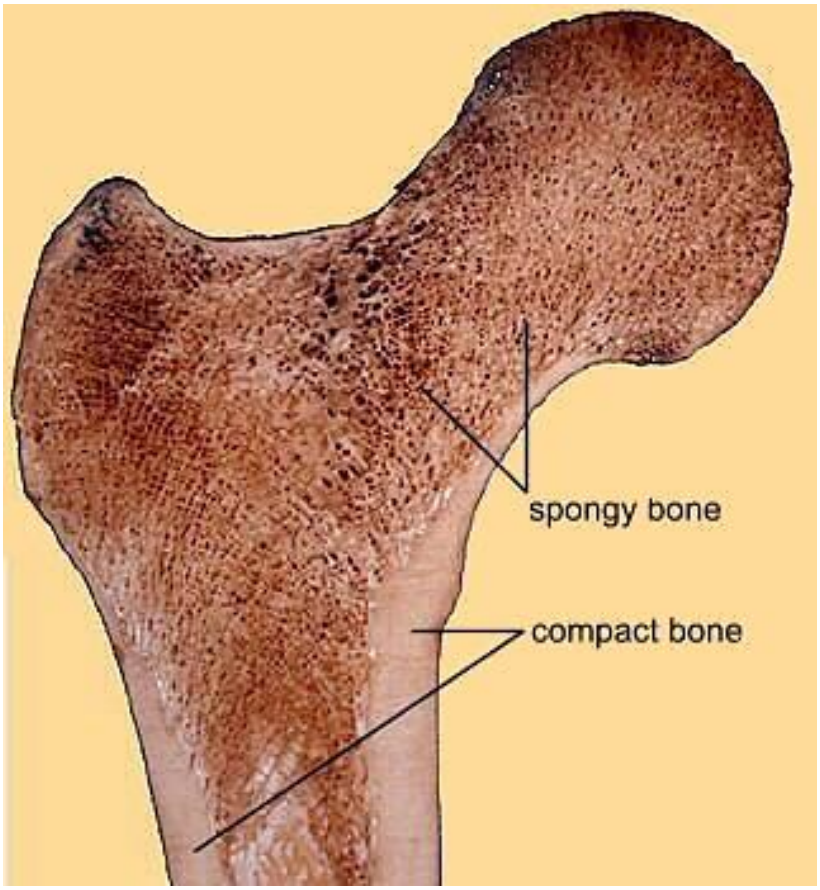
Bone

Bone is a living tissue like other connective tissues, bone consists of cells, fibers, and matrix. It is hard because of the calcification of its extracellular matrix and possesses a degree of elasticity because of the presence of organic fibers.

Bone has a protective function; the skull and vertebral column, for example, protect the brain and spinal cord from injury; the sternum and ribs protect the thoracic and upper abdominal viscera. It serves as a lever, as seen in the long bones of the limbs, and as an important storage area for calcium salts. It houses and protects within its cavities the delicate blood-forming bone marrow. Bone exists in two forms: **compact (cortical)** and **cancellous (spongy).** Compact bone appears as a solid mass; cancellous bone consists of a branching network of *trabeculae*. The trabeculae are arranged in such a manner to resist the stresses and strains to which the bone is exposed.



Classification of Bones

Bones may be classified regionally or according to their general shape.

⛝- Regional Classification of Bones:

❖ **Axial skeleton 80 bones**

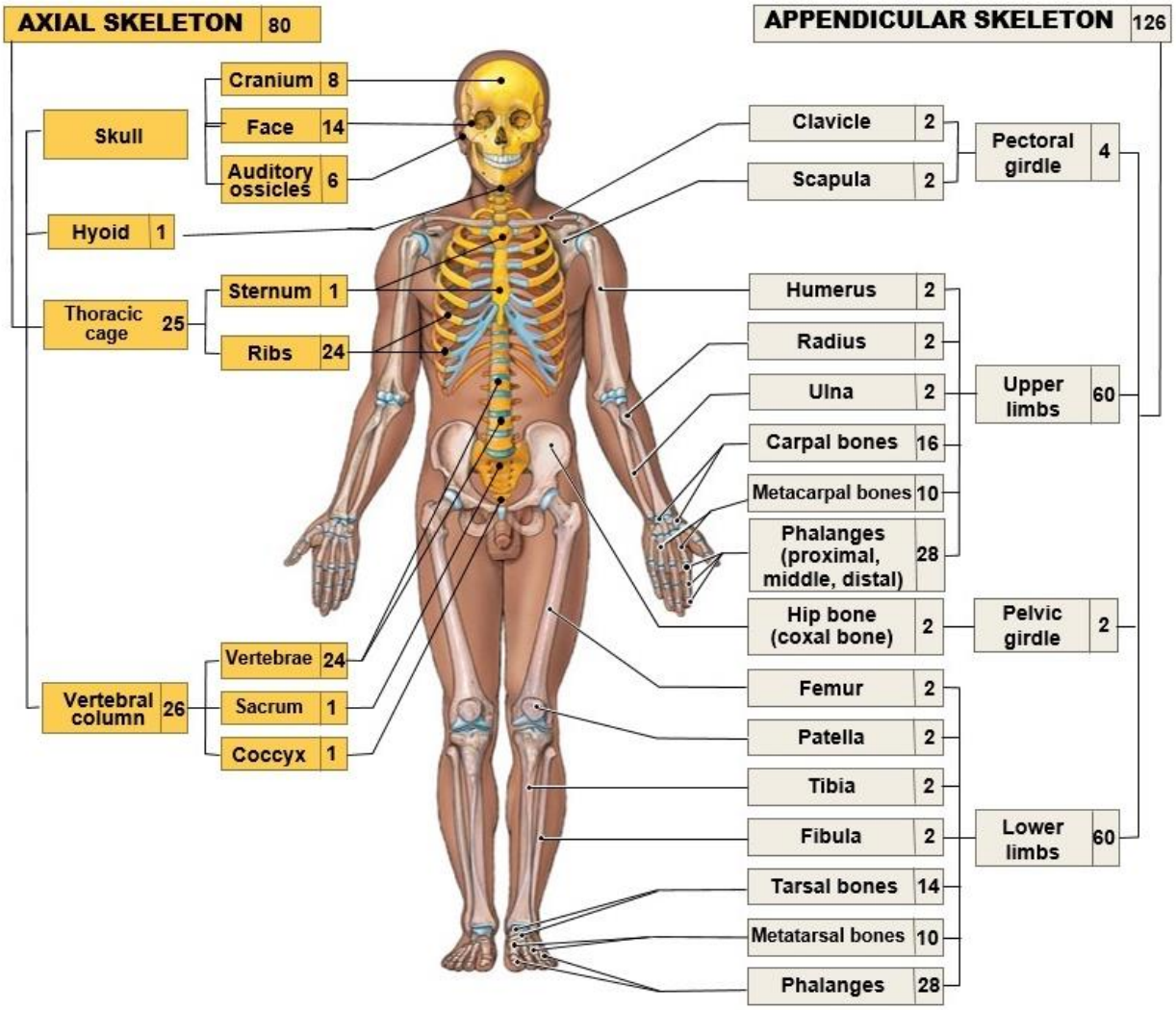
- Skull
  - ☒ Cranium 8
  - ☒ Face 14
  - ☒ Auditory ossicles 6
- Hyoid 1
- Vertebrae (including sacrum and coccyx) 26
- Thoracic cage
  - ☒ Sternum 1
  - ☒ Ribs 24

❖ **Appendicular skeleton 126 bones**

- Shoulder (**Pectoral girdle**)girdles
  - ☒ Clavicle 2
  - ☒ Scapula 2
- Upper extremities
  - ☒ Humerus 2
  - ☒ Radius 2
  - ☒ Ulna 2
  - ☒ Carpals 16
  - ☒ Metacarpals 10
  - ☒ Phalanges 28
- Pelvic girdle
  - ☒ Hip bone 2
- Lower extremities
  - ☒ Femur 2
  - ☒ Patella 2
  - ☒ Fibula 2
  - ☒ Tibia 2
  - ☒ Tarsals 14
  - ☒ Metatarsals 10
  - ☒ Phalanges 28

The adult human body contain 206 bones, 80 in axial skeleton and 126 in appendicular skeleton.

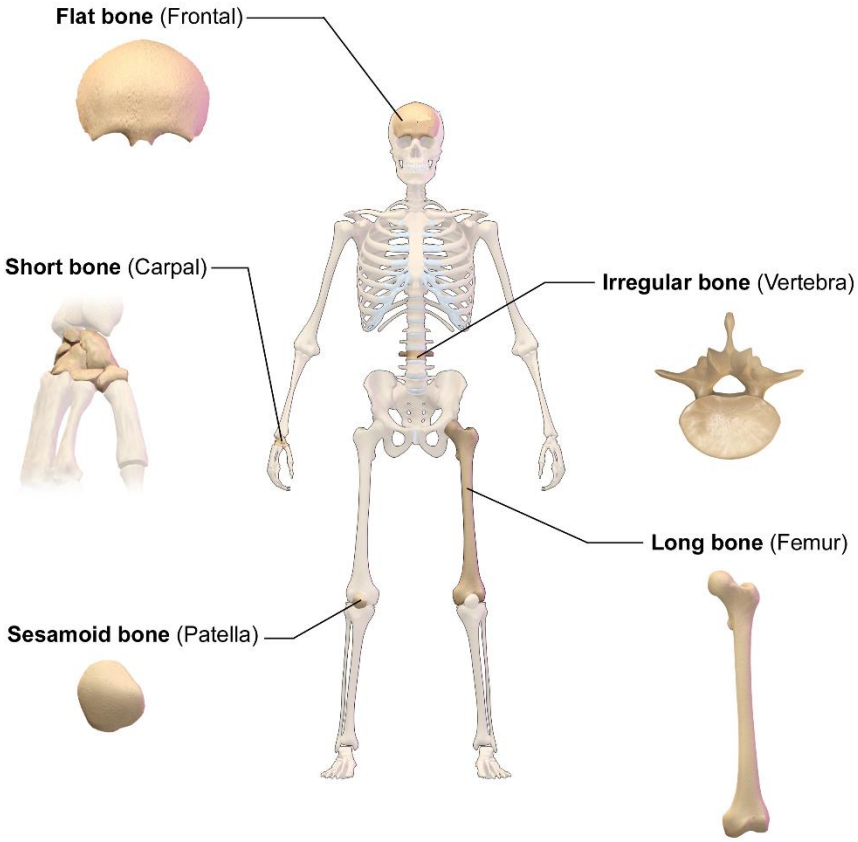
The Axial and Appendicular Divisions of the Skeleton.



- Classification of Bones according to shape:

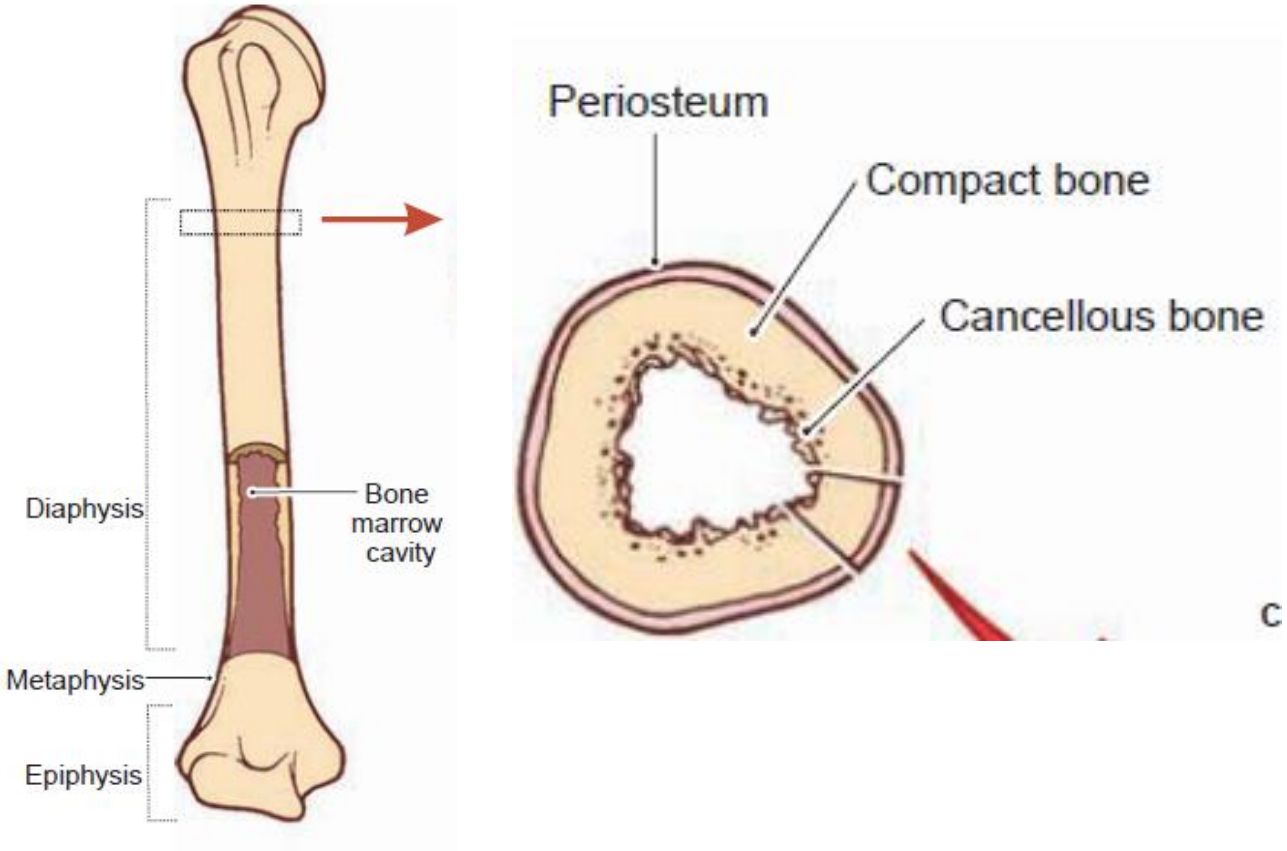
Bones are grouped as follows based on their general shape:

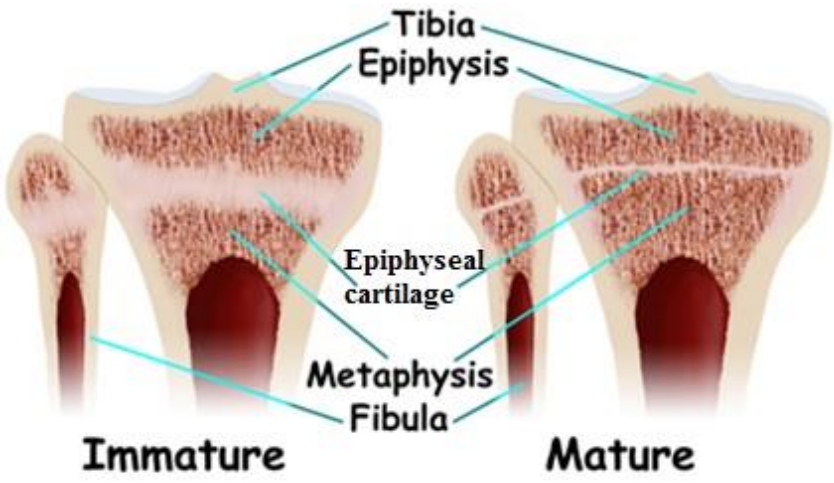
1. **Long bones**
2. **Short bones**
3. **Flat bones**
4. **Irregular bones**
5. **Sesamoid bones**



1. **Long Bones:**

Long bones are found in the limbs (e.g., the humerus, femur, metacarpals, metatarsals, and phalanges). Their length is greater than their breadth. They have a tubular shaft, the **diaphysis,** and usually an **epiphysis** at each end. During the growing phase, the diaphysis is separated from the epiphysis by an **epiphyseal cartilage.** The part of the diaphysis that lies adjacent to the epiphyseal cartilage is called the **metaphysis.** The shaft has a central **marrow cavity** containing **bone marrow.** The outer part of the shaft is composed of compact bone that is covered by a connective tissue sheath, the **periosteum.** The ends of long bones are composed of cancellous bone surrounded by a thin layer of compact bone. The articular surfaces of the ends of the bones are covered by hyaline cartilage.



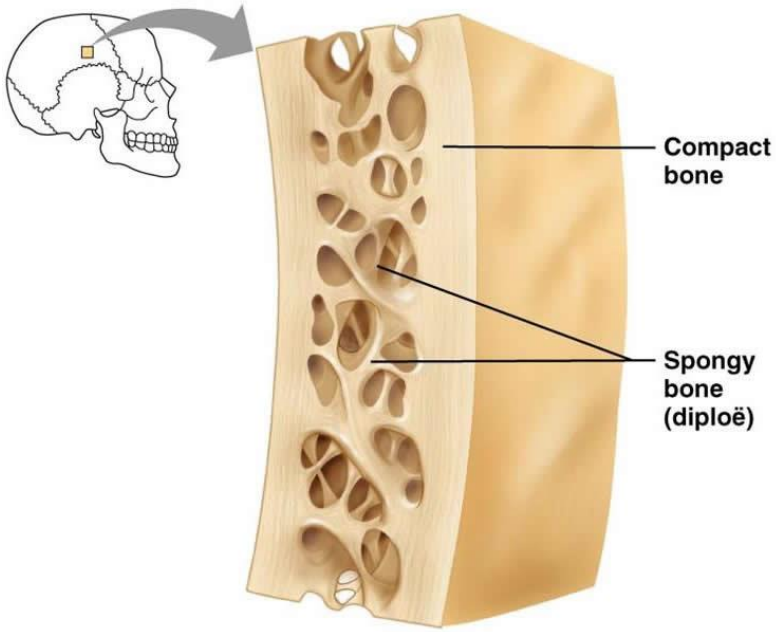


2. Short Bones

Short bones are found in the hand and foot (e.g., the scaphoid, lunate, talus, and calcaneum). They are roughly cuboidal in shape and are composed of cancellous bone surrounded by a thin layer of compact bone. Short bones are covered with periosteum, and the articular surfaces are covered by hyaline cartilage.

3. Flat Bones

Flat bones are found in the vault of the skull (e.g., the frontal and parietal bones). They are composed of thin inner and outer layers of compact bone, the **tables,** separated by a layer of cancellous bone, the **diploë.** The scapulae, although irregular, are included in this group.

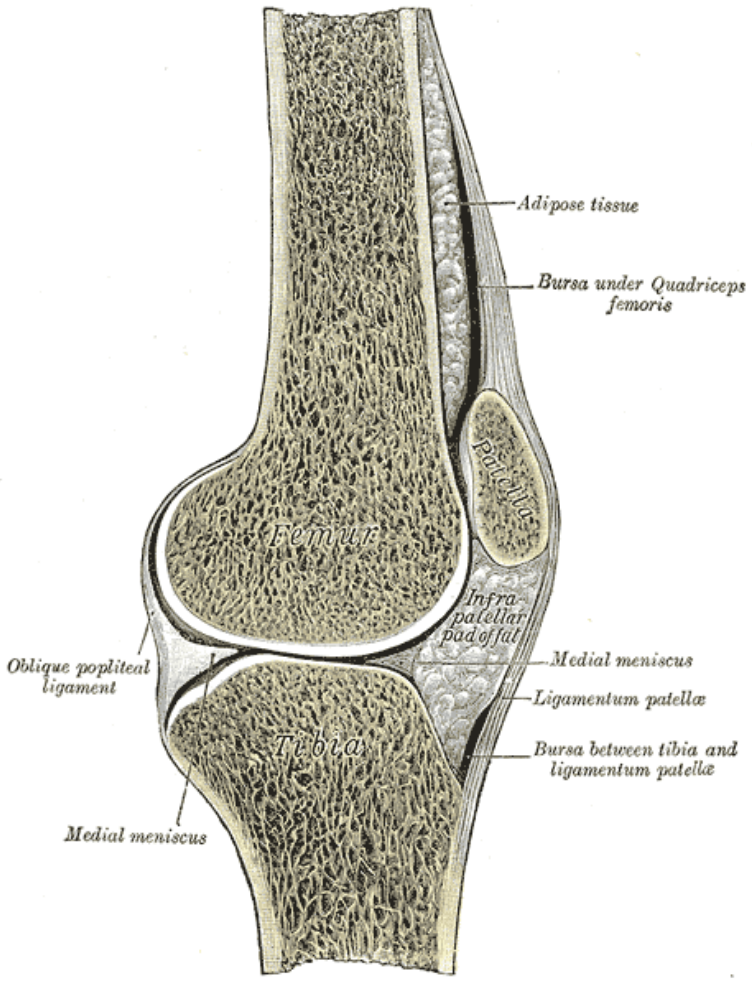


4. Irregular Bones

Irregular bones include those not assigned to the previous groups (e.g., the bones of the skull, the vertebrae, and the pelvic bones). They are composed of a thin shell of compact bone with an interior made up of cancellous bone.

5. Sesamoid Bones

Sesamoid bones are small nodules of bone that are found in certain tendons where they rub over bony surfaces. The greater part of a sesamoid bone is buried in the tendon, and the free surface is covered with cartilage. The largest sesamoid bone is the patella, which is located in the tendon of the quadriceps femoris. The function of a sesamoid bone is to reduce friction on the tendon; it can also alter the direction of pull of a tendon.



Bone Marrow

Bone marrow occupies the marrow cavity in long and short bones and the interstices of the cancellous bone in flat and irregular bones.

All bone surfaces, other than the articulating surfaces, are covered by a thick layer of fibrous tissue called the **periosteum.**

Development of Bone

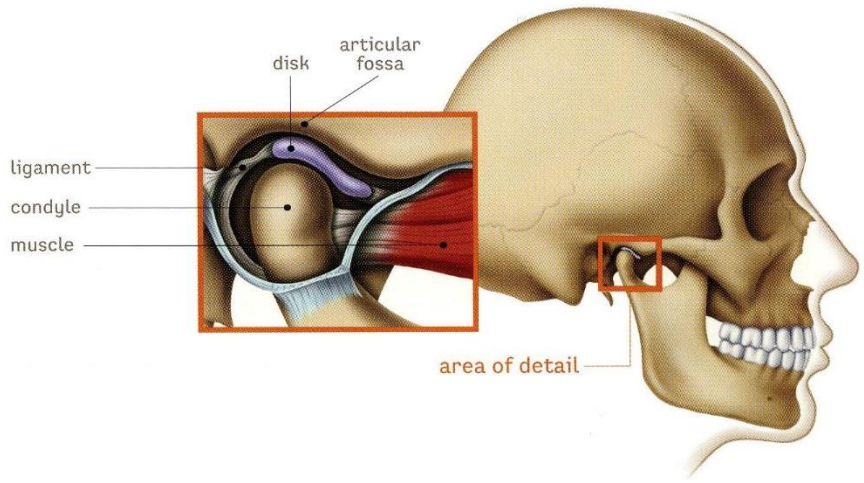
Bone is developed by two processes: membranous and endochondral. In the first process, the bone is developed directly from a connective tissue membrane; in the second, a cartilaginous model is first laid down and is later replaced by bone. The bones of the vault of the skull are developed rapidly by the membranous method in the embryo, and this serves to protect the underlying developing brain.

Cartilage

Cartilage is a form of connective tissue in which the cells and fibers are embedded in a gel-like matrix, the latter being responsible for its firmness and resilience. Except on the exposed surfaces in joints, a fibrous membrane called the **perichondrium** covers the cartilage. There are three types of cartilage:

1. **Hyaline cartilage** has a high proportion of amorphous matrix. Throughout childhood and adolescence, it plays an important part in the growth in length of long bones (epiphyseal plates are composed of hyaline cartilage). It has a great resistance to wear and covers the articular surfaces of nearly all synovial joints.

2. **Fibrocartilage** has many collagen fibers embedded in a small amount of matrix and is found in the discs within joints (e.g., the temporomandibular joint, sternoclavicular joint, and knee joint) and on the articular surfaces of the clavicle and mandible.

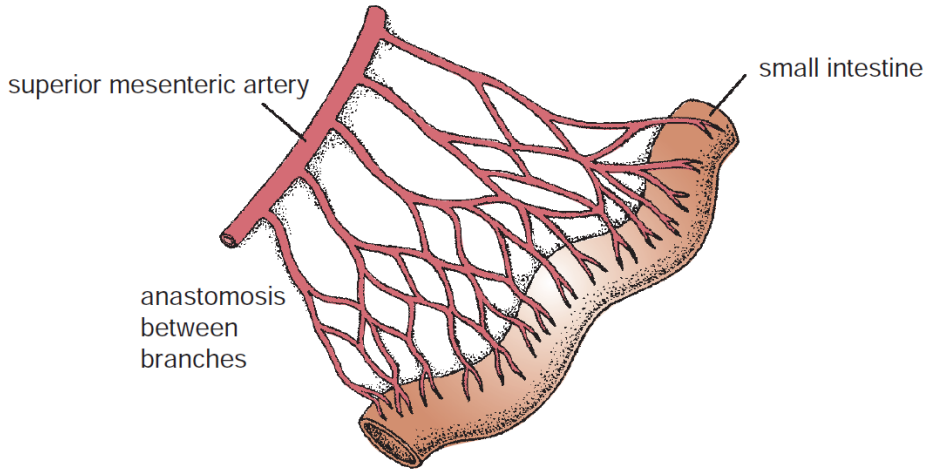


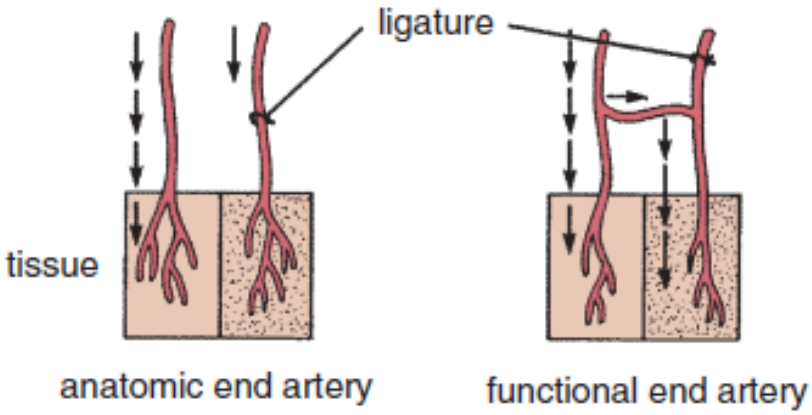
3. **Elastic cartilage** possesses large numbers of elastic fibers embedded in matrix. As would be expected, it is flexible and is found in the auricle of the ear, the external auditory meatus, the auditory tube, and the epiglottis. Hyaline cartilage and fibrocartilage tend to calcify or even ossify in later life.

Blood Vessels

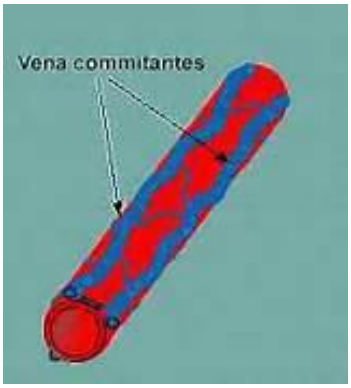
Blood vessels are of three types: arteries, veins, and capillaries.

1. **Arteries** transport blood from the heart and distribute it to the various tissues of the body by means of their **branches**. The smallest arteries, <0.1 mm in diameter, are referred to as **arterioles.** The joining of branches of arteries is called an **anastomosis.** Arteries do not have valves. **Anatomic end arteries** are vessels whose terminal branches do not anastomose with branches of arteries supplying adjacent areas. **Functional end arteries** are vessels whose terminal branches do anastomose with those of adjacent arteries, but the caliber of the anastomosis is insufficient to keep the tissue alive should one of the arteries become blocked.

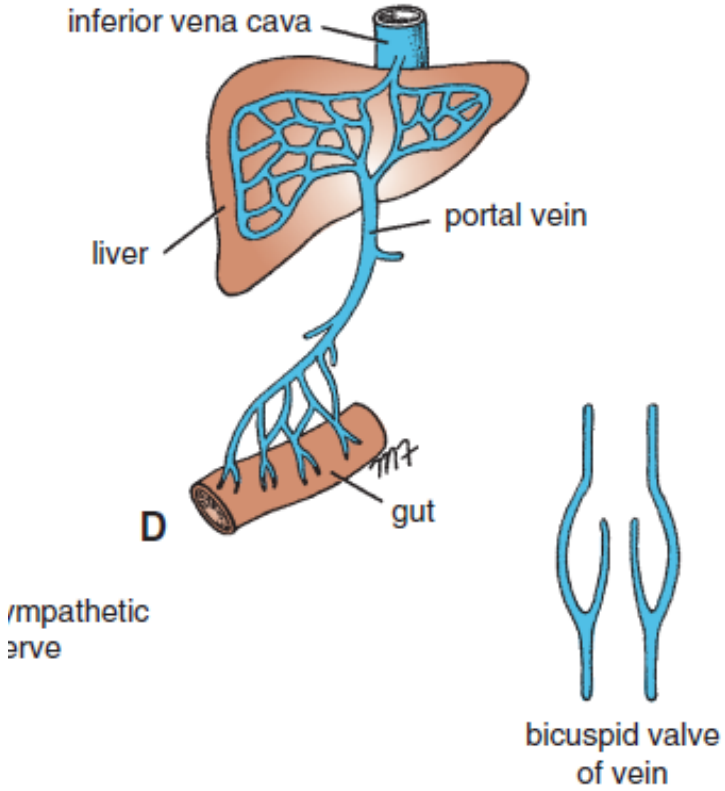




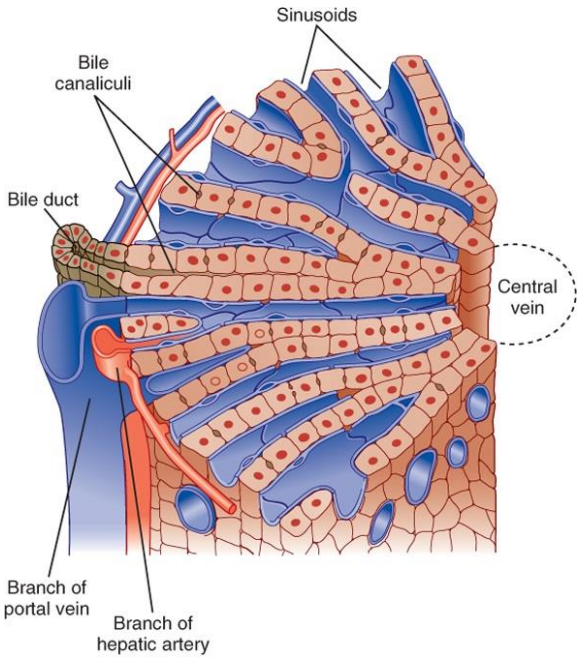
2. **Veins** are vessels that transport blood back to the heart; many of them possess valves. The smallest veins are called **venules**. The smaller veins, or **tributaries,** unite to form larger veins, which commonly join with one another to form **venous plexuses.** Medium-size deep arteries are often accompanied by two veins, one on each side, called **venae comitantes.**



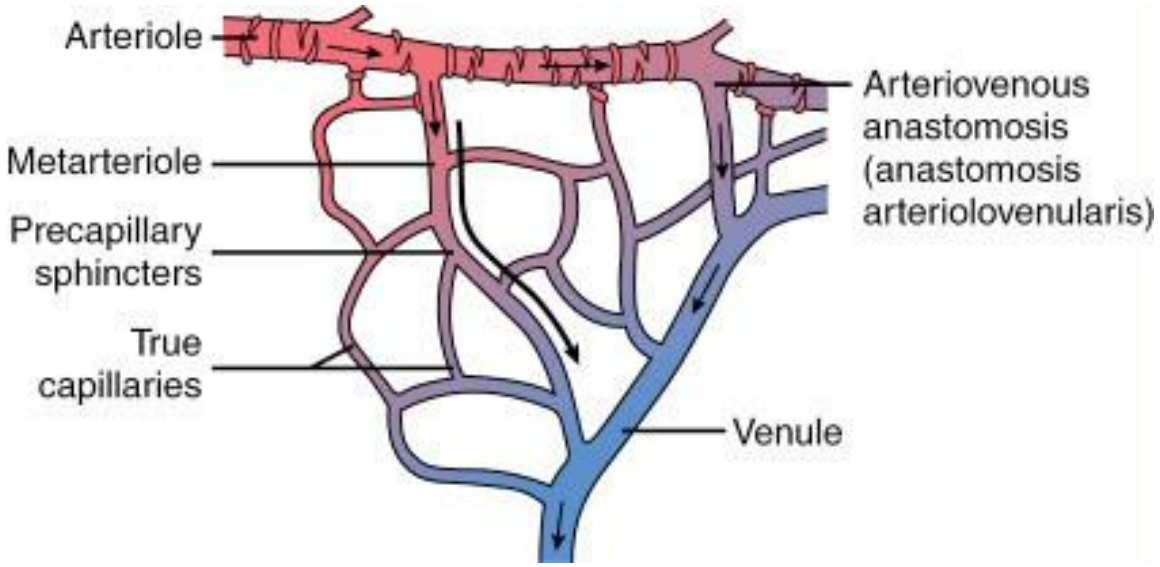
Veins leaving the gastrointestinal tract do not go directly to the heart but converge on the **portal vein;** this vein enters the liver and breaks up again into veins of diminishing size, which ultimately join capillary-like vessels, termed **sinusoids,** in the liver. A **portal system** is thus a system of vessels interposed between two capillary beds.



3. **Capillaries** are microscopic vessels in the form of a network connecting the arterioles to the venules. **Sinusoids** resemble capillaries in that they are thin walled blood vessels, but they have an irregular cross diameter and are wider than capillaries. They are found in the bone marrow, the spleen, the liver, and some endocrine glands.



In some areas of the body, principally the tips of the fingers and toes, direct connections occur between the arteries and the veins without the intervention of capillaries. The sites of such connections are referred to as **arteriovenous anastomoses.**



Lymphatic System

The lymphatic system consists of lymphatic tissues and lymphatic vessels.

- **Lymphatic tissues** are a type of connective tissue that contains large numbers of lymphocytes. Lymphatic tissue is organized into the following organs or structures: the thymus, the lymph nodes, the spleen, and the lymphatic nodules. Lymphatic tissue is essential for the immunologic defenses of the body against bacteria and viruses.

- **Lymphatic vessels** are tubes that assist the cardiovascular system in the removal of tissue fluid from the tissue spaces of the body; the vessels then return the fluid to the blood. The lymphatic system is essentially a drainage system, and there is no circulation. Lymphatic vessels are found in all tissues and organs of the body except the central nervous system, the eyeball, the internal ear, the epidermis of the skin, the cartilage, and the bone.

Lymph is the name given to tissue fluid once it has entered a lymphatic vessel.

Lymph capillaries are a network of fine vessels that drain lymph from the tissues. The capillaries are in turn drained by small lymph vessels, which unite to form large lymph vessels. Lymph vessels have a beaded appearance because of the presence of numerous valves along their course. Before lymph is returned to the bloodstream, it passes through at least one **lymph node** and often through several. The lymph vessels that carry lymph to a lymph node are referred to as **afferent** vessels; those that transport it away from a node are **efferent** vessels.
At the root of the neck the lymph reaches the bloodstream by large lymph vessels called the **right lymphatic duct** and the **thoracic duct**.