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PhD_ Anatomy & Histology

Lecture 3 Human Anatomy

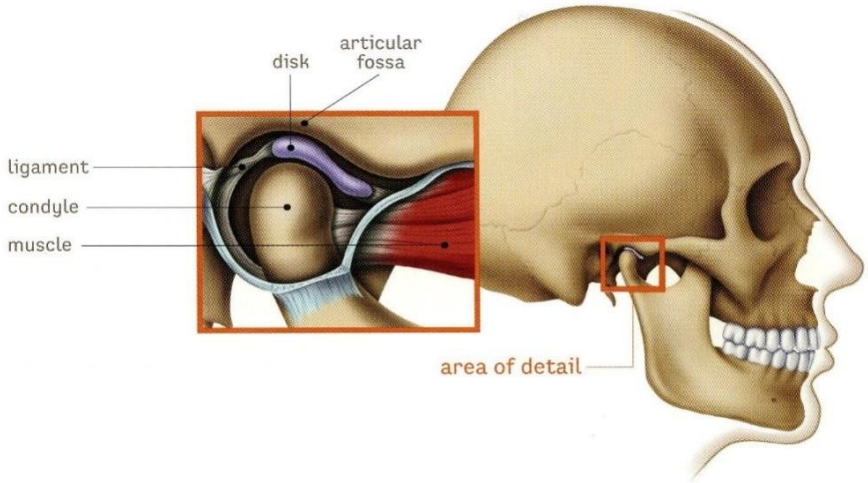
Basic Structures: Part 2

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. 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 and knee joint) and on the articular surfaces of the clavicle and mandible.

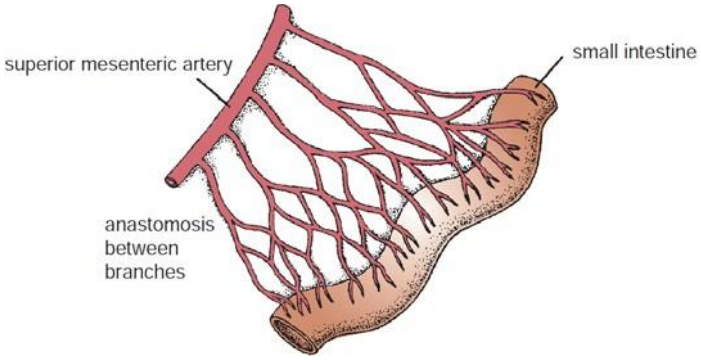


3. **Elastic cartilage** possesses large numbers of elastic fibers embedded in matrix. As would be expected, it is flexible and is found in the auricle of the ear, the external auditory meatus, the auditory tube, and the epiglottis. Hyaline cartilage and fibrocartilage tend to calcify or even ossify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

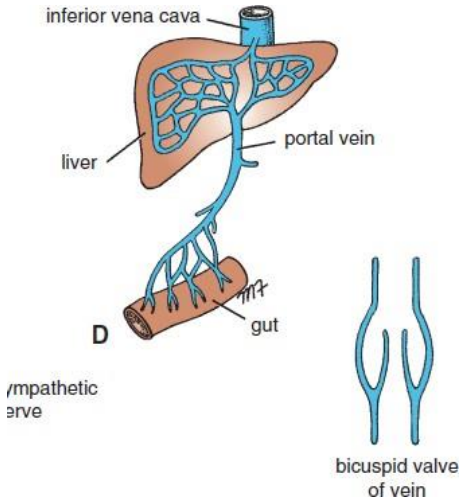
Blood Vessels

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

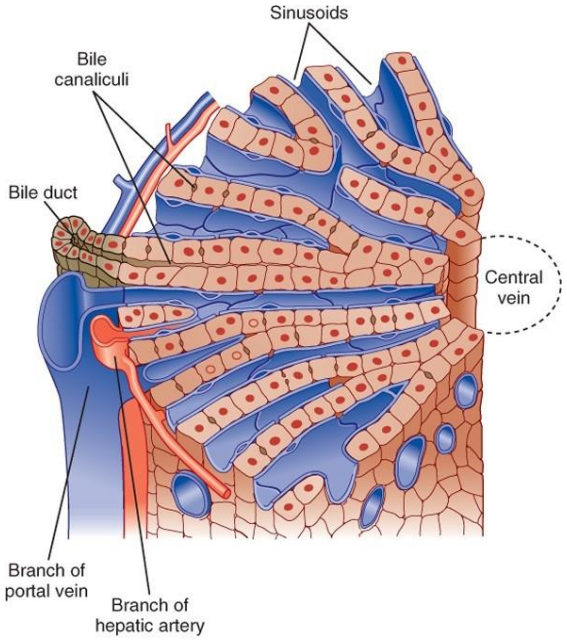
1. **Arteries** transport blood from the heart and distribute it to the various tissues of the body by means of their **branches**. The smallest arteries,<0.1 mm in diameter, are referred to as **arterioles.** The joining of branches of arteries is called an**anastomosis.** Arteries do not have valves.



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.** 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.



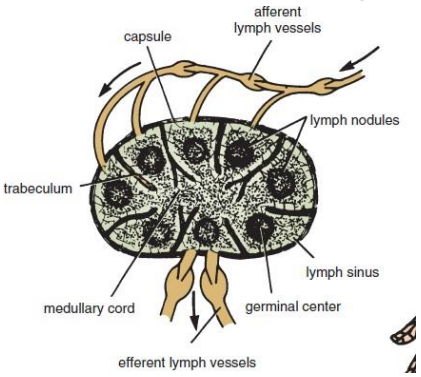
Lymphatic System

The lymphatic system consists of lymphatic tissues, lymphatic vessels, and lymph.

- **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.

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.



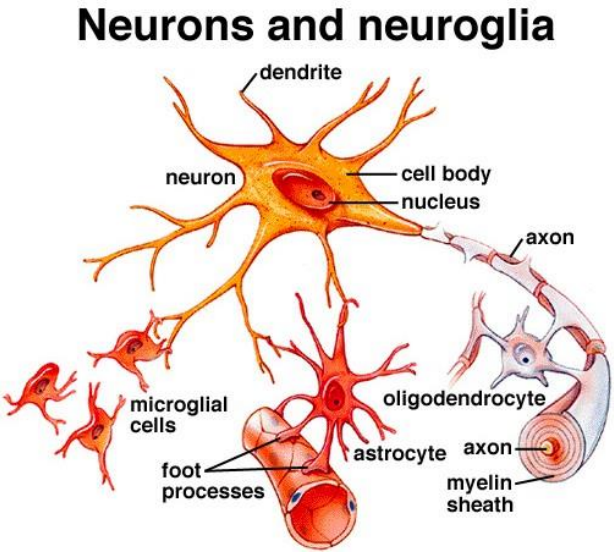
At the root of the neck the lymph reaches the Blood stream by large lymph vessels called the **right lymphatic duct** and the **thoracicduct**.

Nervous System

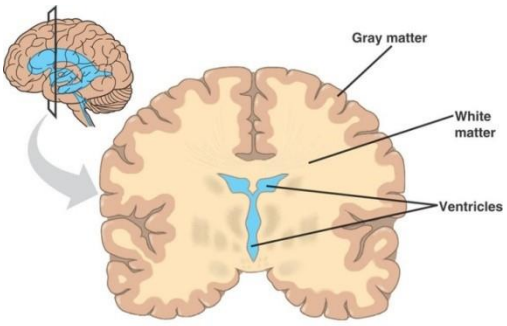
The nervous system is divided into two main parts: the **central nervous system,** which consists of the brain and spinal cord, and the **peripheral nervous system,** which consists of 12 pairs of cranial nerves and 31 pairs of spinal nerves and their associated ganglia. Functionally, the nervous system can be further divided into the **somatic nervous system,** which controls voluntary activities, and the **autonomic nervous system,** which controls involuntary activities. The nervous system, together with the endocrine system, controls and integrates the activities of the different parts of the body.

❖ Central Nervous System

The central nervous system (which consists of the brain and spinal cord) is composed of 2 major cell types; the neuron and the neuroglia. **Neuron** represents the structural and functional cells in the nervous system consist of nerve cells and their processes, **neuroglia** supporting nervous tissue for neurons. The Neurons have 2 types of processes that extend from the nerve cell body, called **dendrites** and an **axon.** Dendrites are the short processes of the cell body that carries nerve impulses toward the nerve cell body; neurons may have multiple dendrites; the axon is the longest process of the cell body that carries nerve impulses away from the nerve cell body; neurons can have only 1 axon.



The interior of the central nervous system is organized into gray and white matter. **Gray matter** consists of nerve cells embedded in neuroglia. **White matter** consists of nerve fibers (axons) embedded in neuroglia.



❖ Peripheral Nervous System

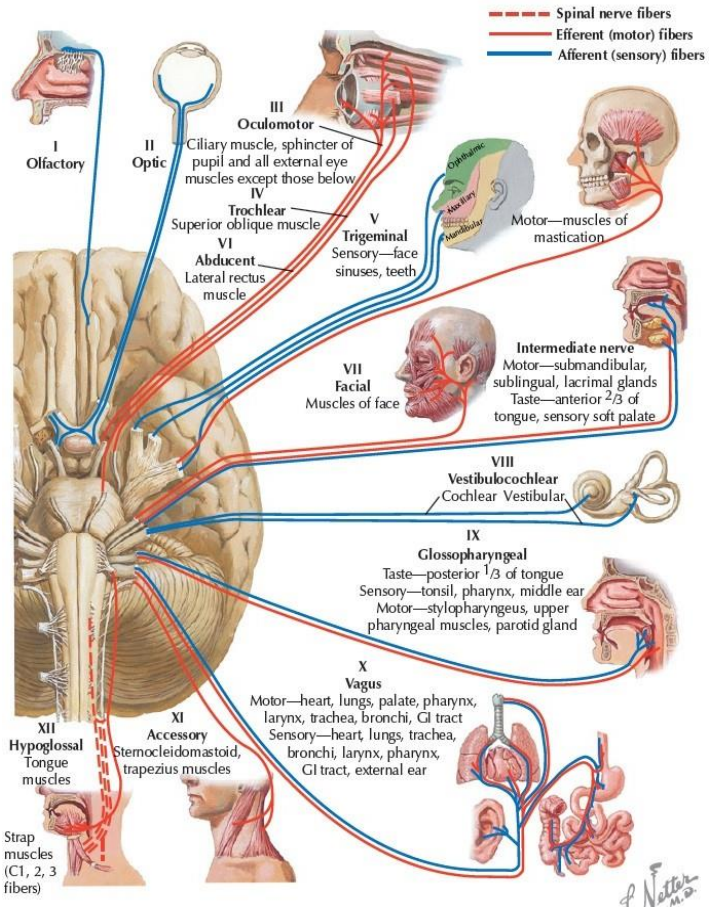
The peripheral nervous system consists of the cranial and spinal nerves and their associated ganglia. On dissection, the cranial and spinal nerves are seen as grayish white cords. They are made up of bundles of nerve fibers (axons) supported by delicate areolar tissue.

▪ Cranial Nerves

There are 12 pairs of cranial nerves that leave the brain and pass through foramina in the skull. All the nerves are distributed in the head and neck except the Xth (vagus), which also supplies structures in the thorax and abdomen.

The cranial nerves are named as follows:

I. Olfactorynerve – sensory for smell
II. Opticnerve – sensory for vision
III. Oculomotornerve – motor fibers to eye muscles
IV. Trochlearnerve – motor fibers to eye muscles
V. Trigeminalnerve – sensory for the face; motor fibers to chewing muscles
VI. Abducentnerve – motor fibers to eye muscles
VII. Facialnerve – sensory for taste; motor fibers to the face
VIII. Vestibulocochlearnerve – sensory for balance and hearing
IX. Glossopharyngealnerve – sensory for taste; motor fibers to the pharynx
X. Vagusnerve – sensory and motor fibers for pharynx, larynx, and viscera
XI. Accessorynerve – motor fibers to neck and upper back
XII. Hypoglossalnerve – motor fibers to tongue



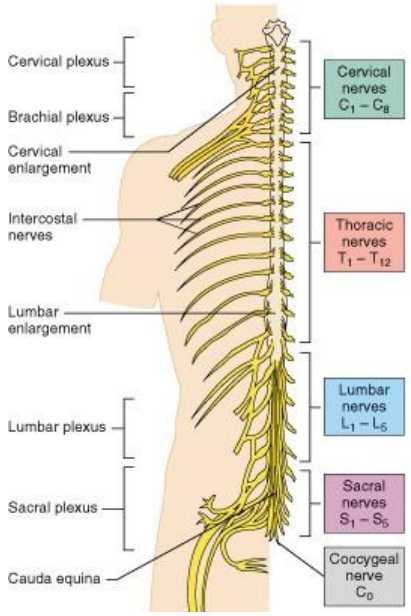
The olfactory, optic, and vestibulocochlear nerves are entirely sensory; the oculomotor, trochlear, abducent,accessory, and hypoglossal nerves are entirely motor;andthe remaining nerves are mixed.

Note: each cranial nerve (CN) has its specific number (No.) e.g. CN I is Olfactory nerve.

- **Spinal Nerves**

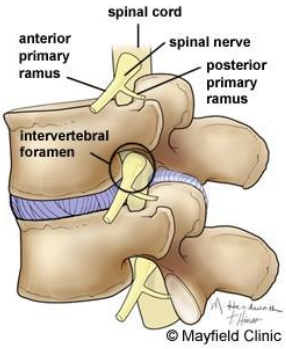
A total of 31 pairs of spinal nerves leave the spinal cord and pass through intervertebral foramina in the vertebral column. The spinal nerves are named according to the region of the vertebral column with which they are associated:

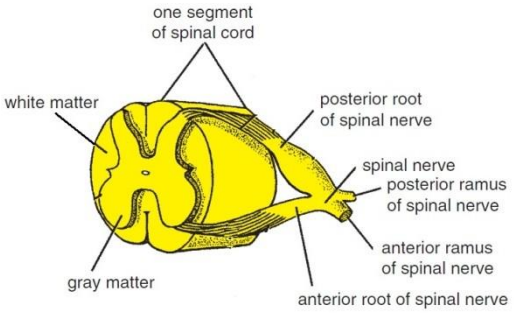
8 cervical (C1-C8), 12thoracic (T1-T12), 5 lumbar (L1-L5), 5 sacral (S1-S5), and **1coccygeal (Co).**



Each spinal nerve is connected to the spinal cord by two roots: the **anterior root** and the **posterior root**. The *anterior root* consists of bundles of nerve fibers carrying nerve impulses away from the central nervous system. Such nerve fibers are called **efferent** fibers. Those efferent fibers that go to skeletal muscle and cause them to contract are called **motor fibers.** The *posterior root* consists of bundles of nerve fibers that carry impulses to the central nervous system and are called **afferent** fibers. Because these fibers are concerned with conveying information about sensations of touch, pain, temperature, and vibrations, they are called **sensory fibers.** At each intervertebral foramen, the anterior and posterior roots unite to form a **spinal nerve**. Here, the motor and sensory fibers become mixed together, so that a spinal nerve is made up of a mixture of motor and sensory fibers.

On emerging from the foramen, the spinal nerve divides into a large **anterior ramus** and a smaller **posterior ramus.** The posterior ramus passes posteriorly around the





vertebral column to supply the **muscles and skin of the back**. The anterior ramus continues anteriorly to supply the **muscles and skin over the anterolateral body wall** and all the **muscles and skin of the limbs**.

Plexuses

At the root of the limbs, the anterior rami join one another to form complicated nerve plexuses. The **cervical** and **brachial plexuses** are found at the root of the upper limbs, and the **lumbar** and **sacral plexuses** are found at the root of the lower limbs (as shown in previous diagram).

❖ Autonomic Nervous System

The autonomic nervous system is the part of the nervous system concerned with the innervation of involuntary structures such as the heart, smooth muscle, and glands throughout the body and is distributed throughout the central and peripheral nervous system.

The autonomic system may be divided into two parts—the **sympathetic** and the **parasympathetic**—and both parts have afferent and efferent nerve fibers.

The hypothalamus of the brain controls the autonomic nervous system and integrates the activities of the autonomic and neuroendocrine systems, thus preserving homeostasis in the body.

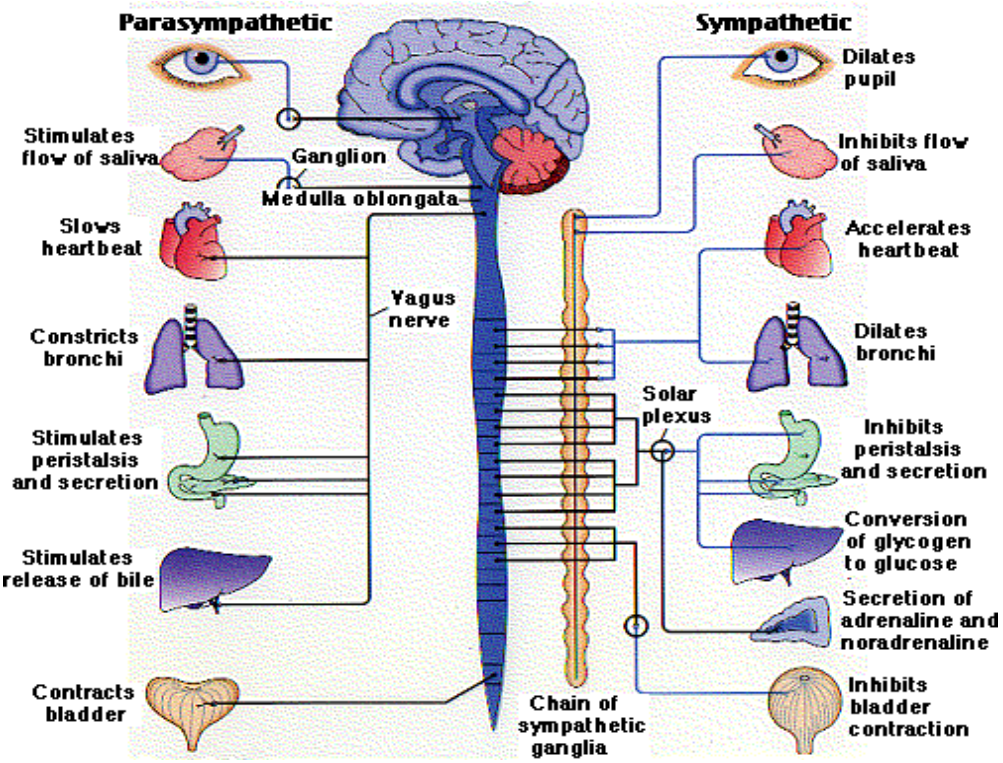
▪ Sympathetic System

The activities of the sympathetic part of the autonomic system prepares the body for action and an emergency—as in the "fight or flight" response—by increasing heart rate, respiration, blood pressure (by constriction of the peripheral blood vessels), and also increase blood flow to the brain, heart, and skeletal muscles; dilating the pupils; and it inhibits peristalsis of the intestinal tract "shutting down" visceral activity and closes the sphincters. Neurons of the sympathetic system originate in the intermedia lateral cell column of the spinal cord in the thoracic and upper lumbar segments (T1to L3). Thus, they are often referred to as the thoracolumbar outflow of visceral efferent fibers.

▪ Parasympathetic System

The activities of the parasympathetic part of the autonomic system aim at conserving and restoring energy and functions to calm the body— as in "rest or digest"— by decreasing heart rate, respiration, and blood pressure; constricting the pupils; and increase peristalsis of the intestine "increasing visceral activity" and glandular activity, and open the sphincters. Neurons of the parasympathetic system originate either in the brain in certain nuclei of cranial nerves III, VII, IX, and X(cranial outflow) or in the sacral spinal cord from the intermediolateral cell column of spinal nerves S2–S4 (sacral outflow).Together, this system is known as the craniosacral outflow. Both systems (sympathetic and para sympathetic) innervate many organs of

the body where their antagonistic actions serve to balance functioning to maintain homeostasis.

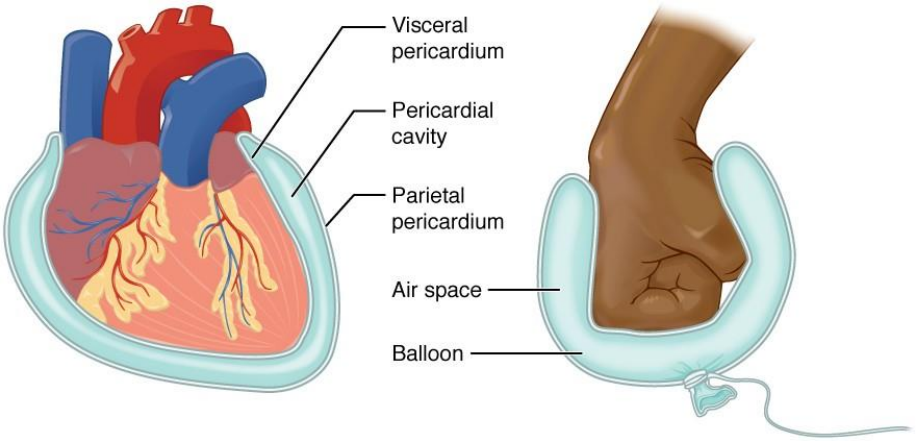


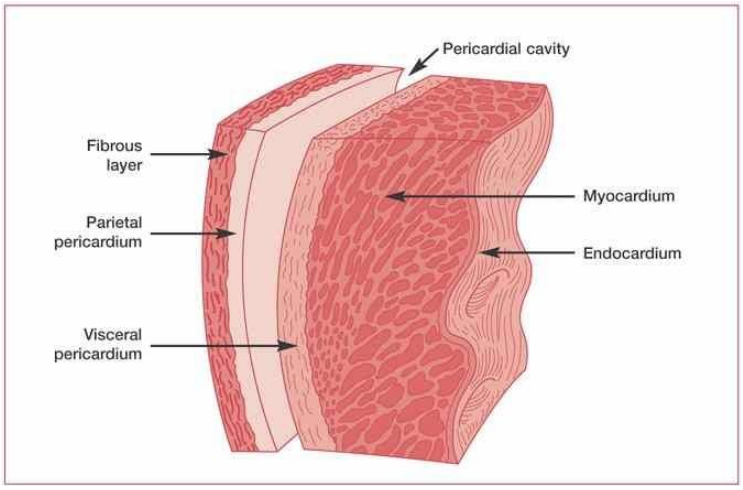
Mucous Membranes

Mucous membrane is the name given to the lining of organs or passages that communicate with the surface of the body. A mucous membrane consists essentially of a layer of epithelium supported by a layer of connective tissue (**lamina propria).** Smooth muscle, called the **muscularis mucosa,** is sometimes present in the connective tissue. A mucous membrane may or may not secrete mucus on its surface.

Serous Membranes

Serous membranes line the cavities of the trunk and are reflected onto the mobile viscera lying within these cavities. The serous membrane lining the wall of the cavity is referred to as the **parietal layer,** and that covering the viscera is called the **visceral layer.** The narrow, slit like interval that separates these layers forms the **pleural, pericardial,** and **peritoneal cavities** and contains a small amount of serous liquid, the **serous exudate.** The serous exudate lubricates the surfaces of the membranes and allows the two layers to slide readily on each other.


Visceral pericardium
Pericardial cavity
Parietal pericardium
Air space
Balloon


Pericardial cavity
Fibrous layer
Parietal pericardium
Visceral pericardium
Myocardium
Endocardium