Human biology

Tissues

A **tissue** is composed of similarly specialized cells that perform a common function in the body. The tissues of the human body can be categorized into four major types:

Types of Tissues

1-epithelial tissue, which covers body surfaces and lines body cavities;

2- connective tissue, which binds and supports body parts;

3- muscular tissue, which moves body parts;

4- nervous tissue, which receives stimuli and conducts impulses from one body part to another.

A-Epithelial tissue:

also called epithelium, consists of tightly packed cells that form a continuous layer or sheet lining the entire body surface and most of the body's inner cavities.

On the external surface, it protects the body from injury, drying out, and possible pathogen (virus and bacterium) invasion.

On internal surfaces , epithelial tissue may be specialized for other functions in addition to protection .

For example , epithelial tissue secretes mucus along the digestive tract and sweeps up impurities from the lungs by the cilia.

It efficiently absorbs molecules from kidney tubules

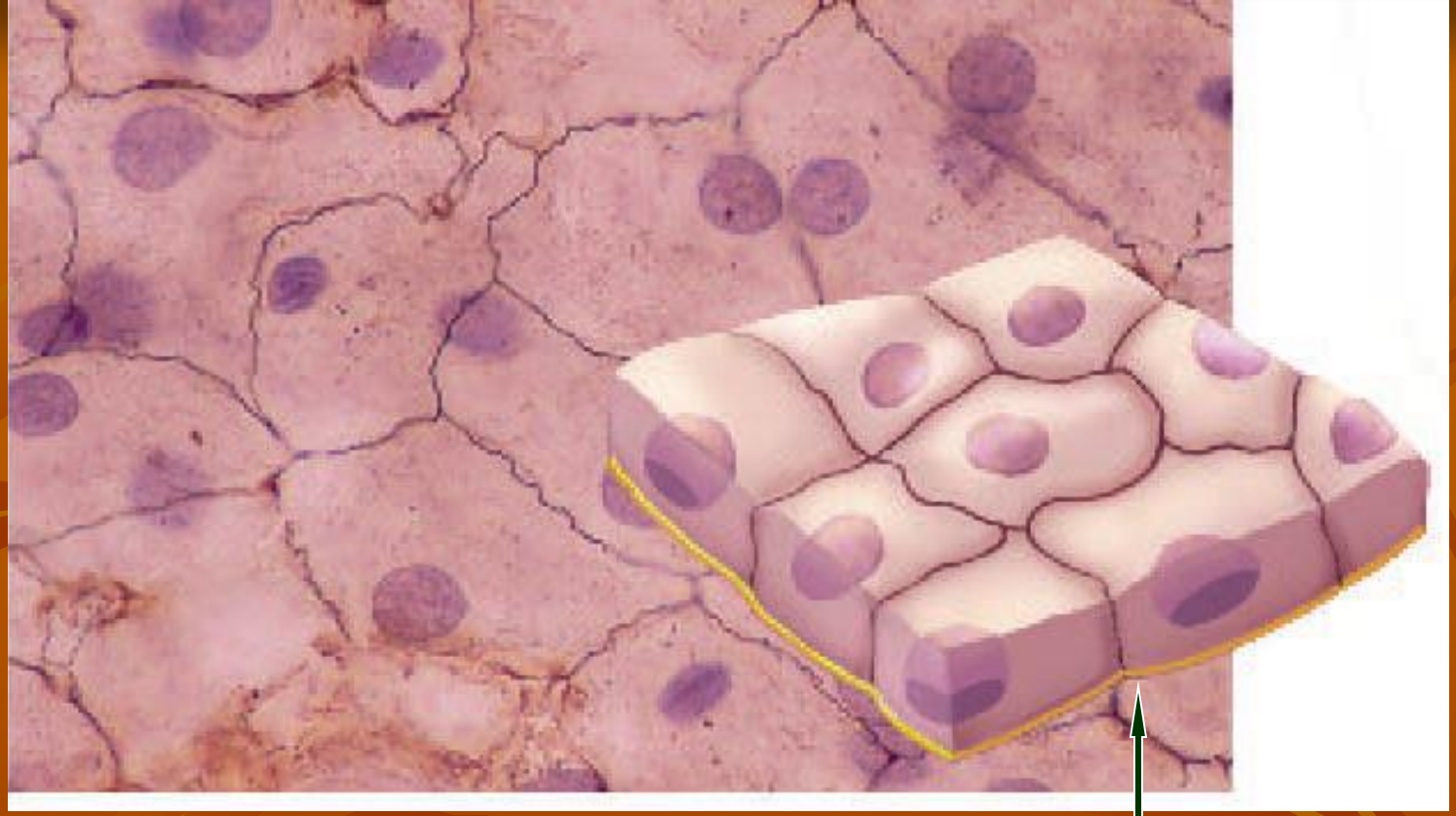
and from the intestine due to presence of minute cellular extensions called microvilli.

There are various types of epithelial tissue

1- **Squamous epithelium :** is composed of flattened cells and is found lining the lungs and blood vessels.

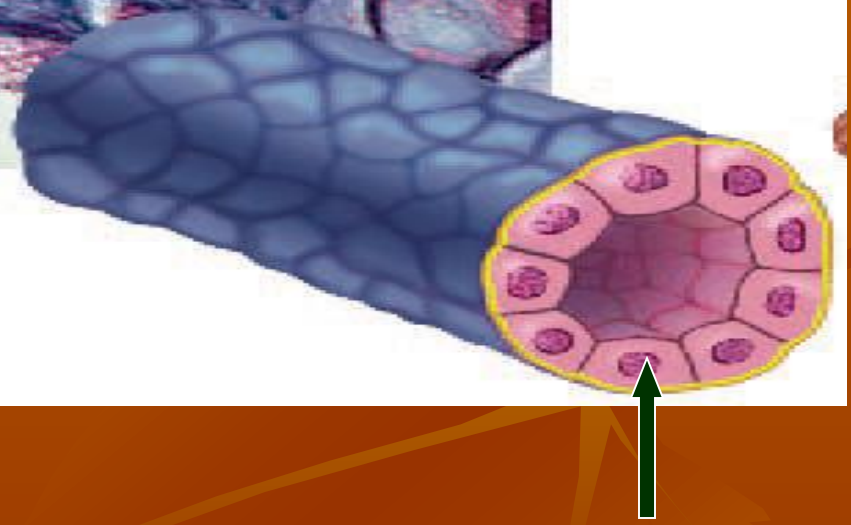
b- **Cuboidal epithelium :** contains cube-shaped cells and is found lining the kidney tubules, smallest blood vessels, called **capillaries,** are composed of a single layer of epithelial cells.

The permeability of capillaries allows exchange of substances between the blood and tissue cells.



Simple squamous epithelium

- has flattened cells.
- occurs in alveoli of lungs walls of capillaries, and lining of blood vessels.
- functions in protection, diffusion, filtration.



nucleus

Simple cuboidal epithelium

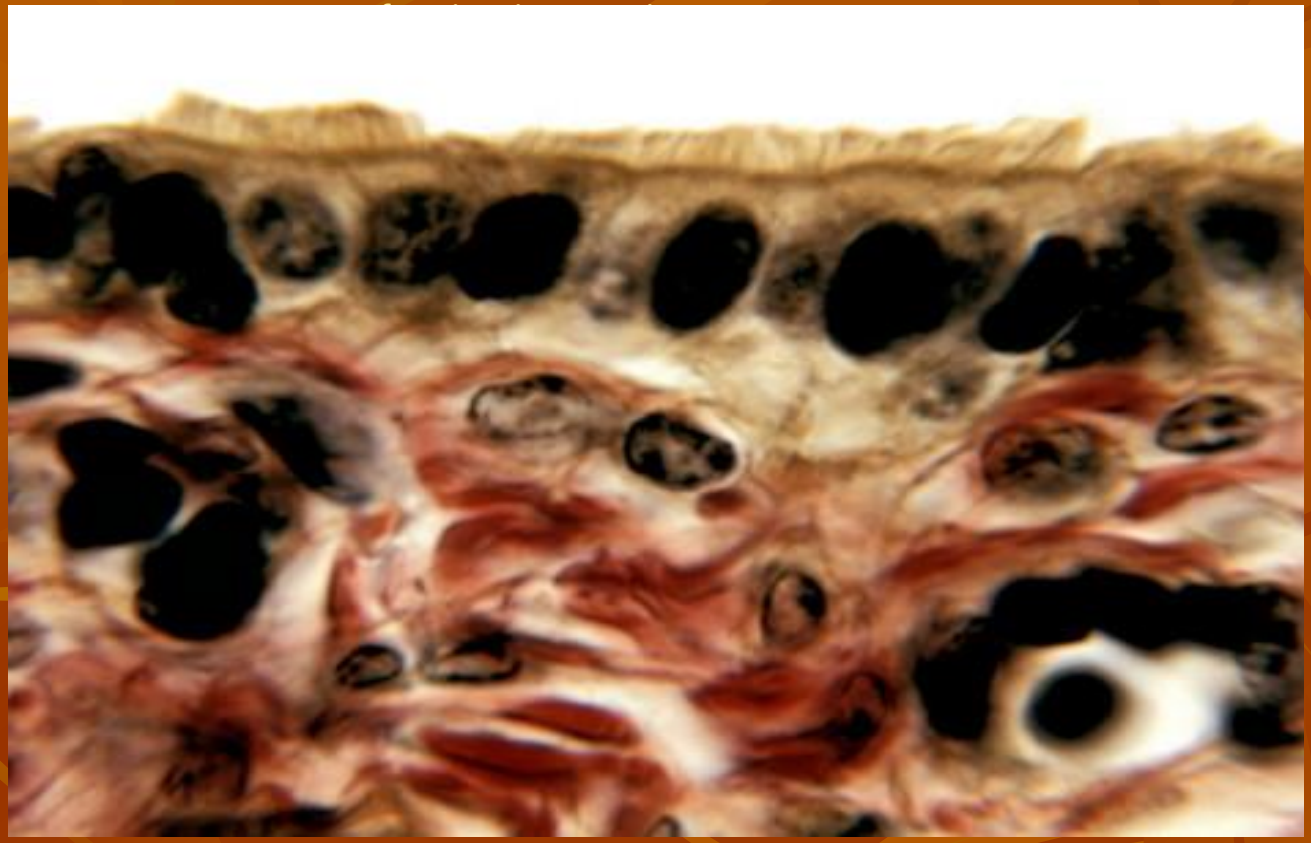
- has cube-shaped cells.
- occurs in lining of kidney tubules and on surfaces of ovaries.
- functions in protection secretion, absorption.

stratified squamous epithelium.

The nose, mouth, esophagus, anal canal, and vagina are all lined by stratified squamous epithelium.

As we shall see, the outer layer of skin is also stratified squamous epithelium, but the cells have been reinforced by keratin, a protein that provides strength.

• has flattened cells.
• occurs in air sacs of lungs, walls of capillaries, and lining of blood vessels



C - Columnar Epithelium

has cells resembling rectangular pillars or columns, and nuclei are usually located near the bottom of each cell.

This epithelium is found lining the digestive tract .

Ciliated columnar epithelium is found lining the oviducts, where it propels the egg toward the uterus.

Epithelial tissue is named according to the shape of the cell

An epithelium can be simple or stratified. Simple means the tissue has a single layer of cells, and stratified means the tissue has layers of cells piled one on top of the other.

Simple columnar epithelium

- has rectangle-shaped cells.
- occurs in lining of intestine and uterus
- functions in protection, secretion, absorption,

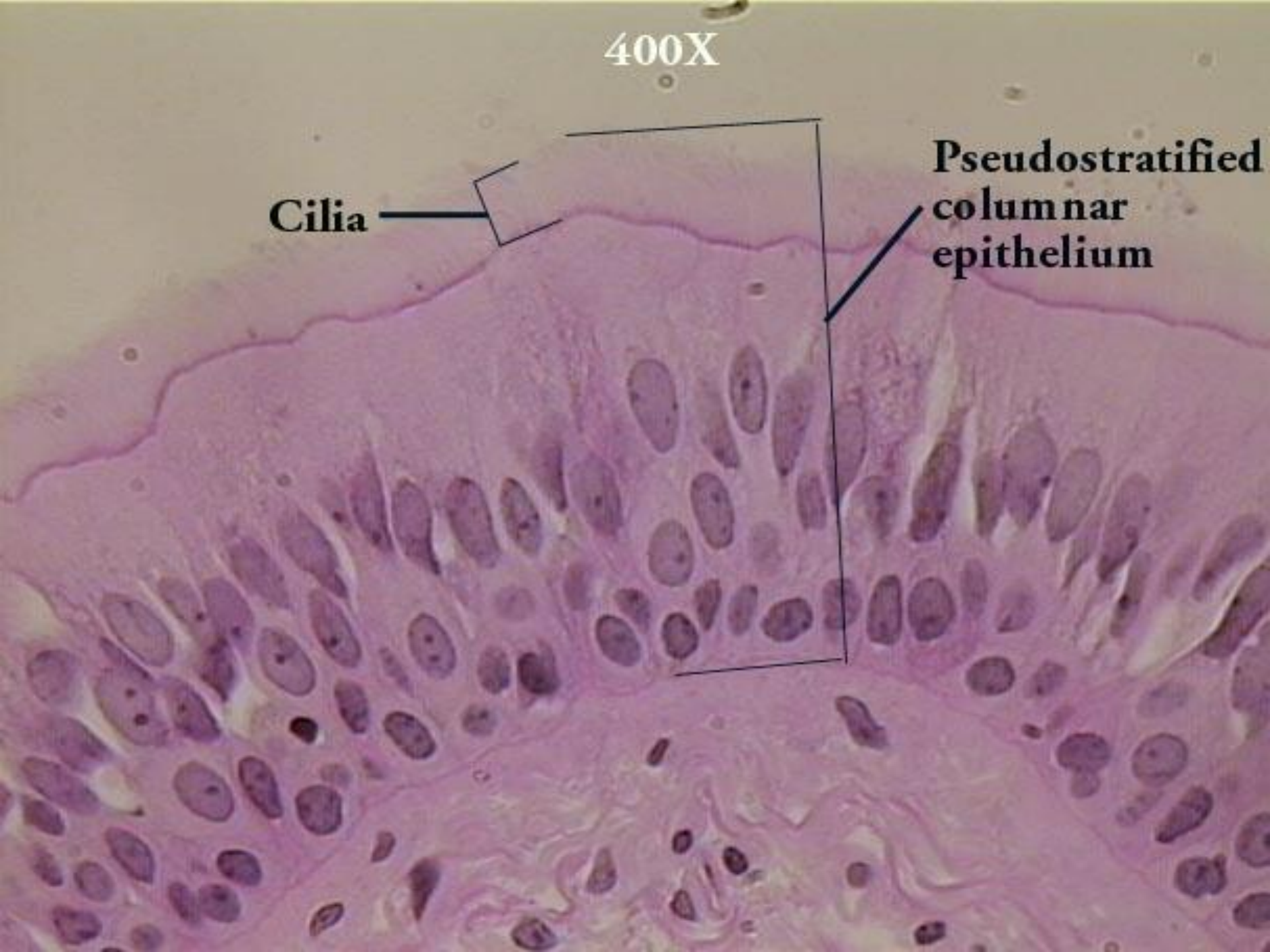
Pseudo stratified ciliated columnar epithelium

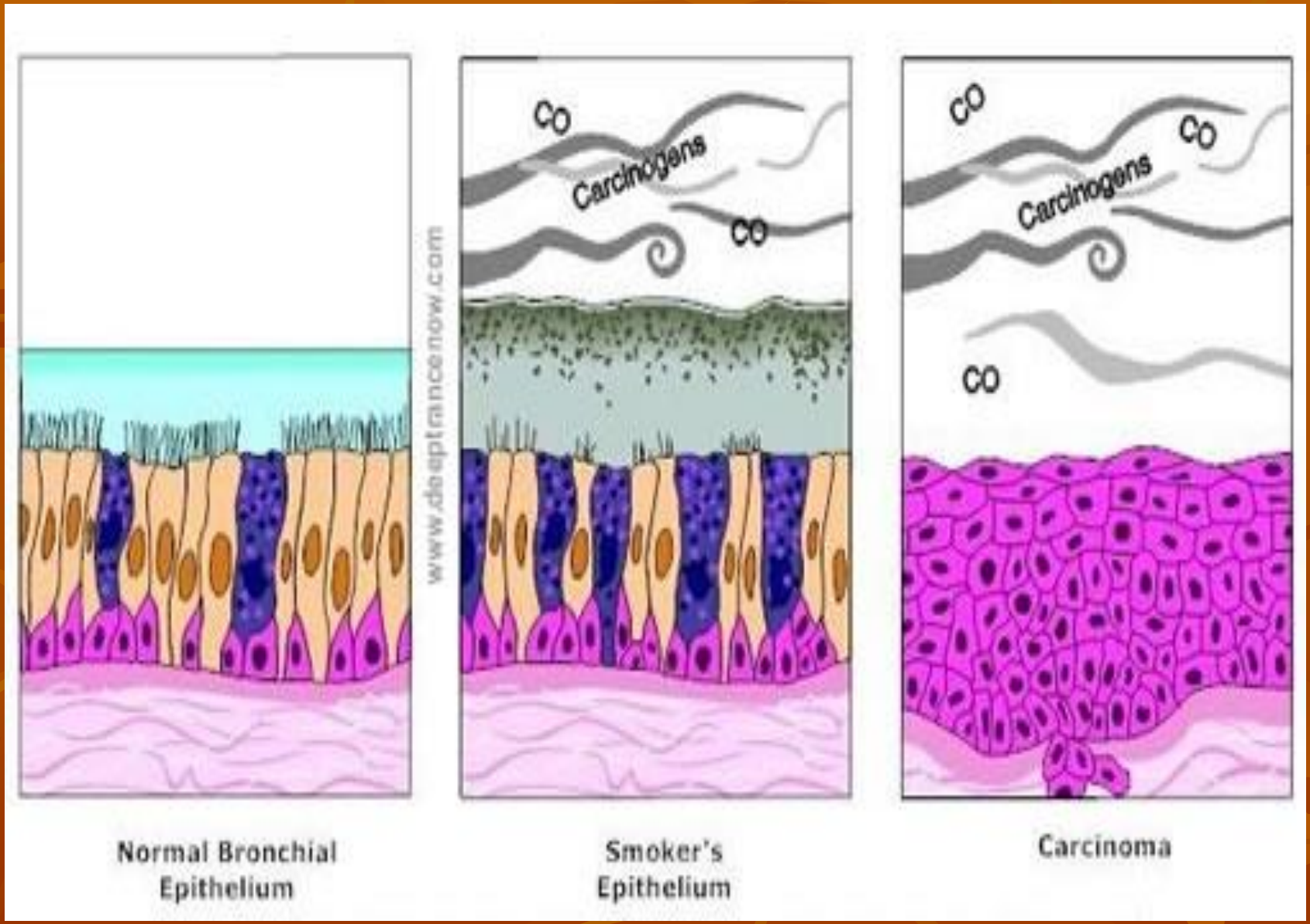
- appears to be layered.
- occurs in lining of respiratory tract.
- functions in protection, secretion, movement of mucus.

Pseudo stratified epithelium: appears to be layered; however, true layers do not exist because each cell touches the baseline .

The lining of the windpipe, or trachea, is called pseudo stratified ciliated columnar epithelium. A secreted covering of mucus traps foreign particles, and the upward motion of the cilia carries the mucus to the back of the throat, where it may either be swallowed or expectorated.

Smoking can cause a change in mucus secretion and inhibit ciliary action, and the result is a chronic inflammatory condition called bronchitis.


400X
Cilia
Pseudostratified columnar epithelium


CO
Carcinogens
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www.deeptrancenow.com
Normal Bronchial Epithelium
Smoker's Epithelium
Carcinoma

basement membrane often joins an epithelium to underlying connective tissue. We now know that the basement membrane is glycoprotein, reinforced by fibers that are supplied by connective tissue.
An epithelium sometimes secretes a product, in which case it is described as glandular.

A **gland** can be a single epithelial cell, as in the case of mucus-secreting goblet cells found within the columnar epithelium lining the digestive tract, or a gland can contain many cells. Glands that secrete their product into ducts are called exocrine glands, and those that secrete their product directly into the bloodstream are called endocrine glands .

- The pancreas is both an exocrine gland, because it secretes digestive juices into the small intestine via ducts, and an endocrine gland, because it secretes insulin into the bloodstream.

Junctions Between Cells

The cells of a tissue can function in a coordinated manner when the plasma membranes of adjoining cells interact. The junctions that occur between cells help cells function as a tissue

. A **tight junction** forms an impermeable barrier because adjacent plasma membrane proteins actually join, producing a zipper like fastening. In the intestine, the gastric juices stay out of the body, and in the kidneys, the urine stays within kidney tubules because epithelial cells are joined by tight junctions.

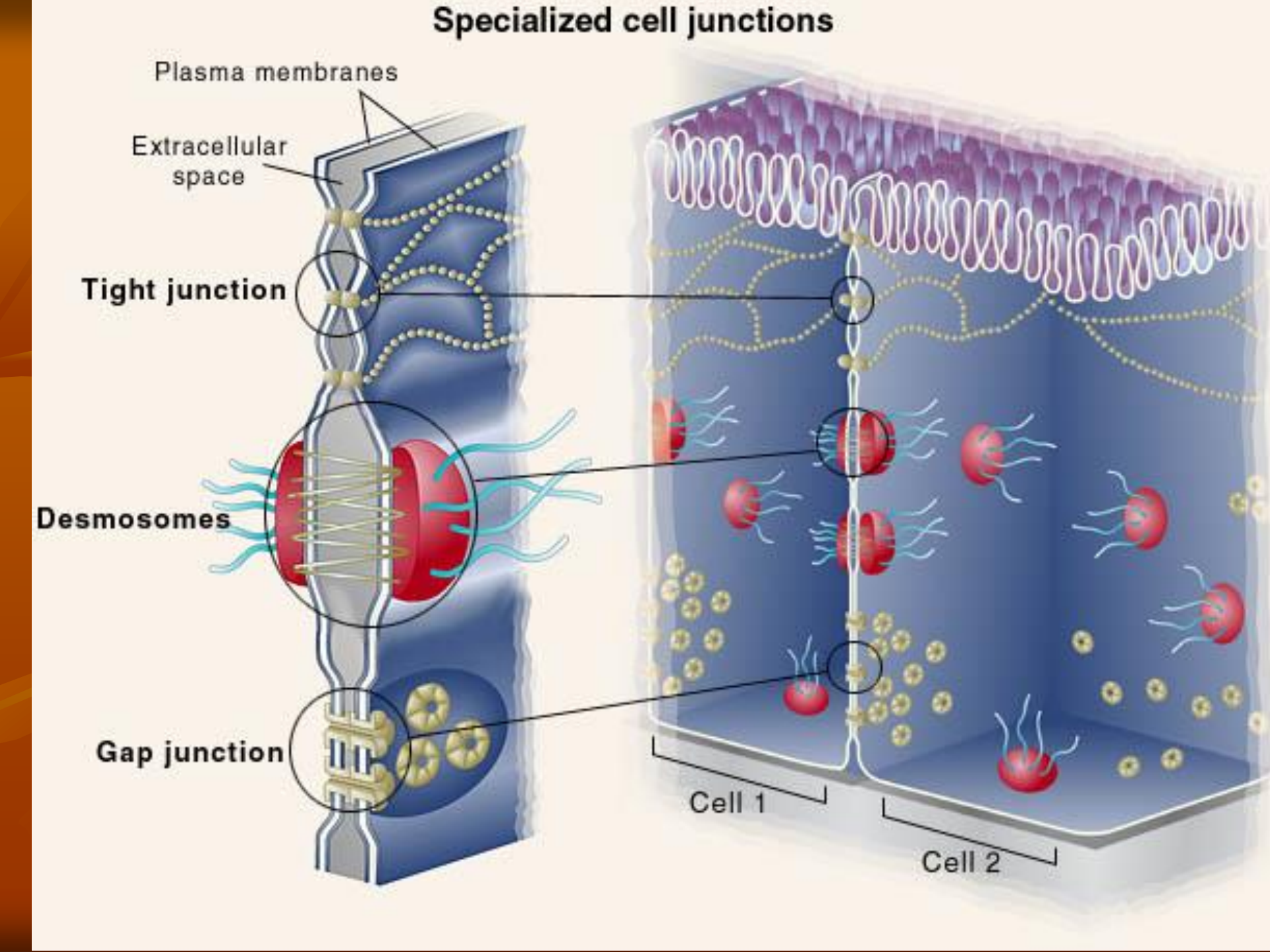
A **gap junction** forms when two adjacent plasma membrane channels join. This lends strength, but it also allows ions, sugars, and small molecules to pass between the two cells. Gap junctions in heart and smooth muscle ensure synchronized contraction.

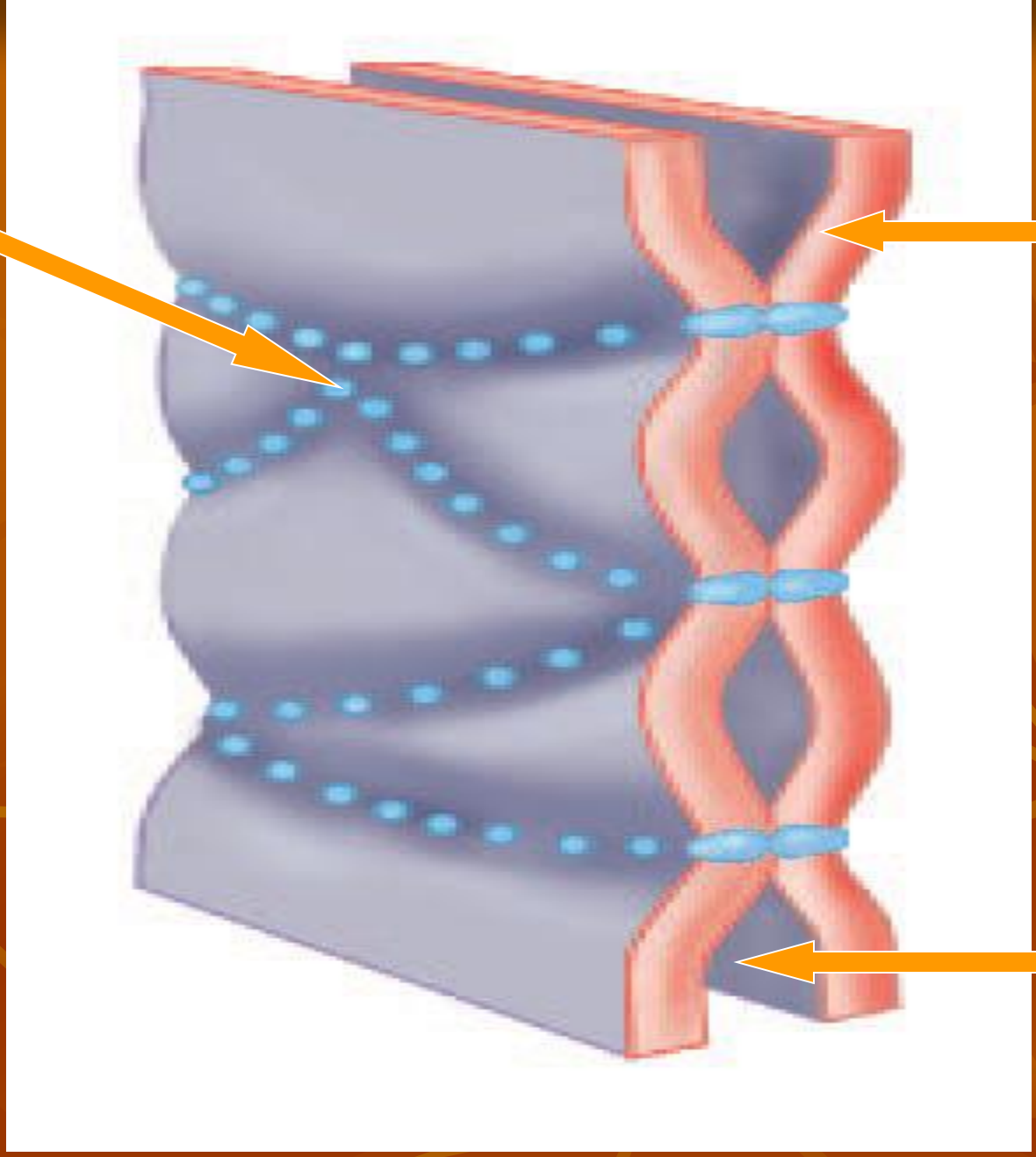
Adhesion junction (desmosome)

the adjacent plasma membranes do not touch but are held together by intercellular filaments firmly attached to button like thickenings.

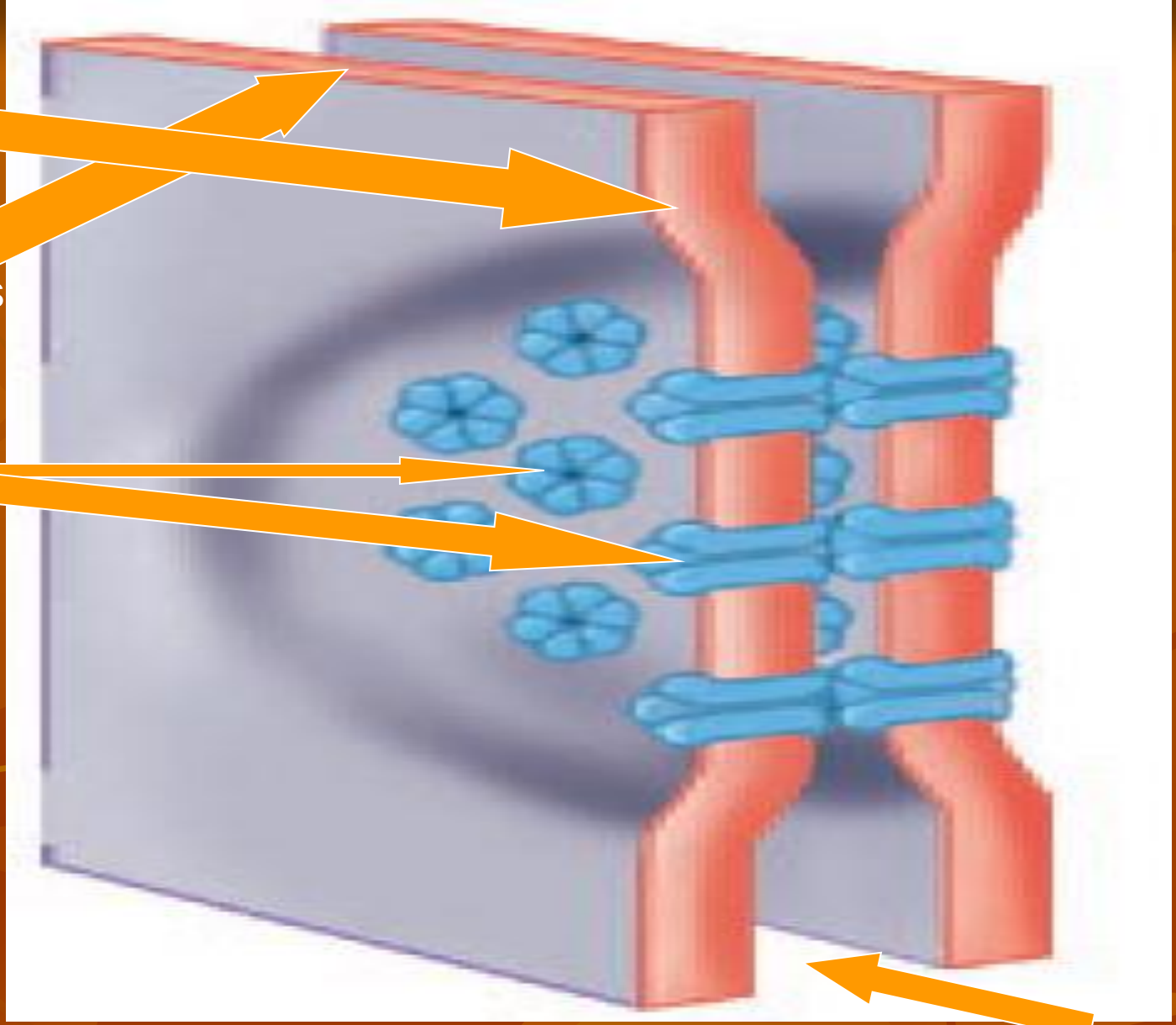
In some organs—like the heart, stomach, and bladder, where tissues get stretched—adhesion junctions hold the cells together.

Specialized cell junctions

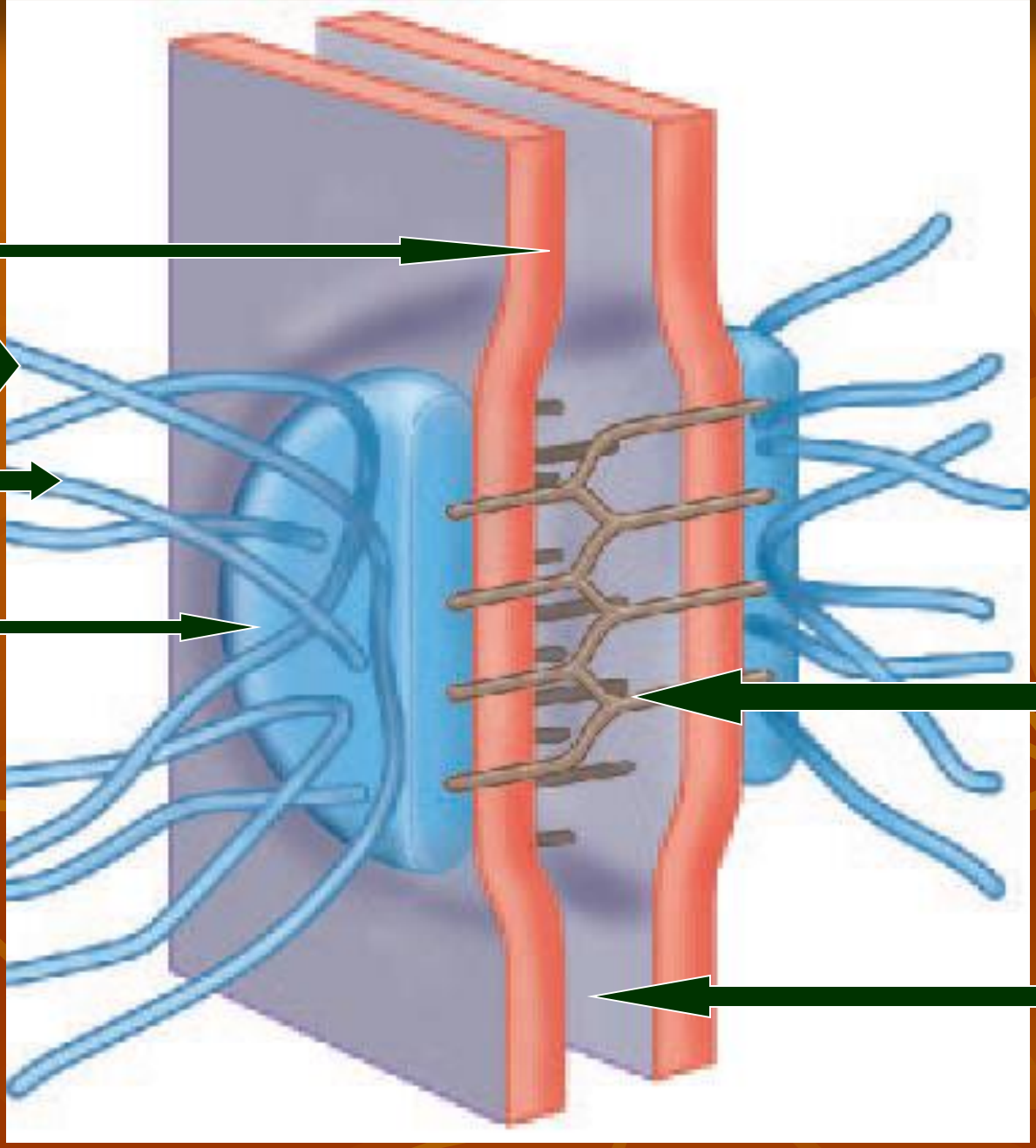




Tight junction



Gap junction



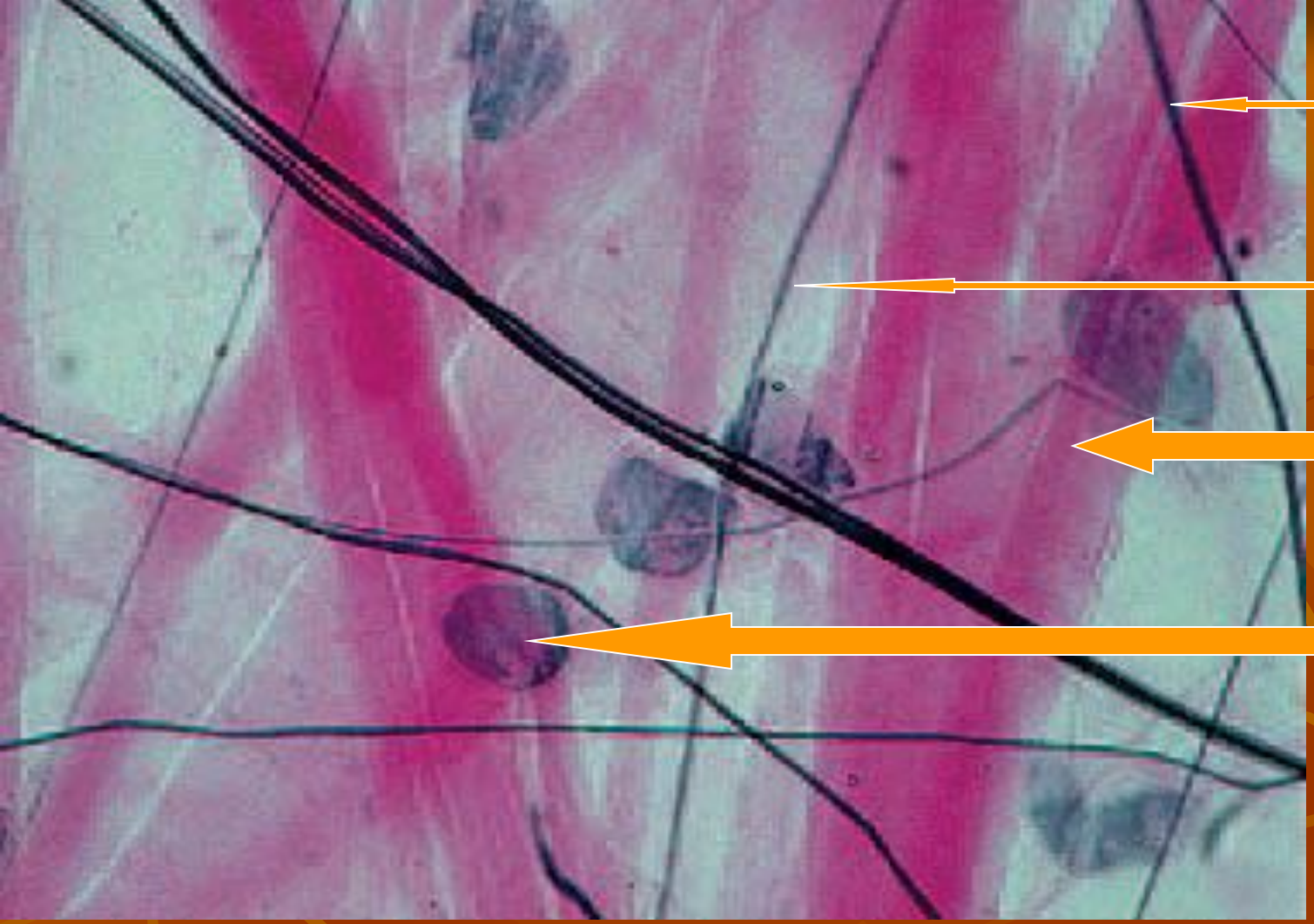
Adhesion junction

- **2-Connective Tissue**
- **Connective tissue** binds organs together, provides support and protection, fills spaces, produces blood cells, and stores fat. As a rule, connective tissue cells are widely separated by a **matrix,** consisting of a non cellular material that varies in consistency from solid to semi fluid to fluid. The matrix may have fibers of three possible types:
- A- white **collagen fibers** contain collagen, a protein that gives them flexibility and strength.
- B- **Reticular fibers** are very thin collagen fibers that are highly branched and form delicate supporting networks.
- C-Yellow **elastic fibers** contain elastin, a protein that is not as strong as collagen but is more elastic.

- ***Loose Fibrous and Dense Fibrous Tissues***

Both loose fibrous and dense fibrous connective tissues have cells called **fibroblasts** that are located some distance from one another and are separated by a jellylike matrix containing white collagen fibers and yellow elastic fibers.

- **Loose fibrous connective tissue**
- supports epithelium and also many internal organs. Its presence in lungs, arteries, and the urinary bladder allows these organs to expand. It forms a protective covering enclosing many internal
- organs, such as muscles, blood vessels, and nerves.



Loose fibrous connective tissue

- has space between components.
- occurs beneath skin and most epithelial layers.
- functions in support and binds organs.

Dense fibrous connective tissue

- contains many collagen fibers that are packed together. This type of tissue has more specific functions than does loose connective tissue. For example, dense fibrous connective tissue is found in **tendons**, which connect muscles to bones, and in **ligaments**, which connect bones to other bones at joints.

Adipose Tissue and Reticular Connective Tissue

- In **adipose tissue** the fibroblasts enlarge and store fat. The body uses this stored fat for energy, insulation, and organ protection. Adipose tissue is found beneath the skin, around the kidneys, and on the surface of the heart.
- Reticular connective tissue forms the supporting meshwork of lymphoid tissue present in lymph nodes, the spleen, the thymus, and the bone marrow. ((All types of blood cells are produced in red bone marrow, but a certain type of lymphocyte (T lymphocyte) completes its development in the thymus. The lymph nodes store lymphocytes)).

Adipose tissue

- has cells filled with fat.
- occurs beneath skin, around organs including the heart.
- functions in insulation, stores fat.

Cartilage

- In **cartilage,** the cells lie in small chambers called lacunae (single: **lacuna**), separated by a matrix that is solid yet flexible. Unfortunately, because this tissue lacks a direct blood supply, it heals very slowly. There are three types of cartilage, distinguished by the type of fiber in the matrix.

1-Hyaline cartilage

- the most common type of cartilage, contains only very fine collagen fibers. The matrix has a white, translucent appearance. Hyaline cartilage is found in the nose and at the ends of the long bones and the ribs, and it forms rings in the walls of respiratory passages. The fetal skeleton also is made of this type of cartilage. Later, the cartilaginous fetal skeleton is replaced by bone.

Hyaline cartilage

- has cells in scattered lacunae.
- occurs in nose and walls of respiratory passages; at ends of bones including ribs.
- functions in support and protection.

2-Elastic cartilage

- has more elastic fibers than hyaline cartilage. For this reason, it is more flexible and is found, for example, in the framework of the outer ear.

3-Fibrocartilage

- has a matrix containing strong collagen fibers. Fibro cartilage is found in structures that withstand tension and pressure, such as the pads between the vertebrae in the backbone and the wedges in the knee joint.

Bone

- **Bone** is the most rigid connective tissue. It consists of an extremely hard matrix of inorganic salts, notably calcium salts, deposited around protein fibers, especially collagen fibers. The inorganic salts give bone rigidity, and the protein fibers provide elasticity and strength, much as steel rods do in reinforced concrete.

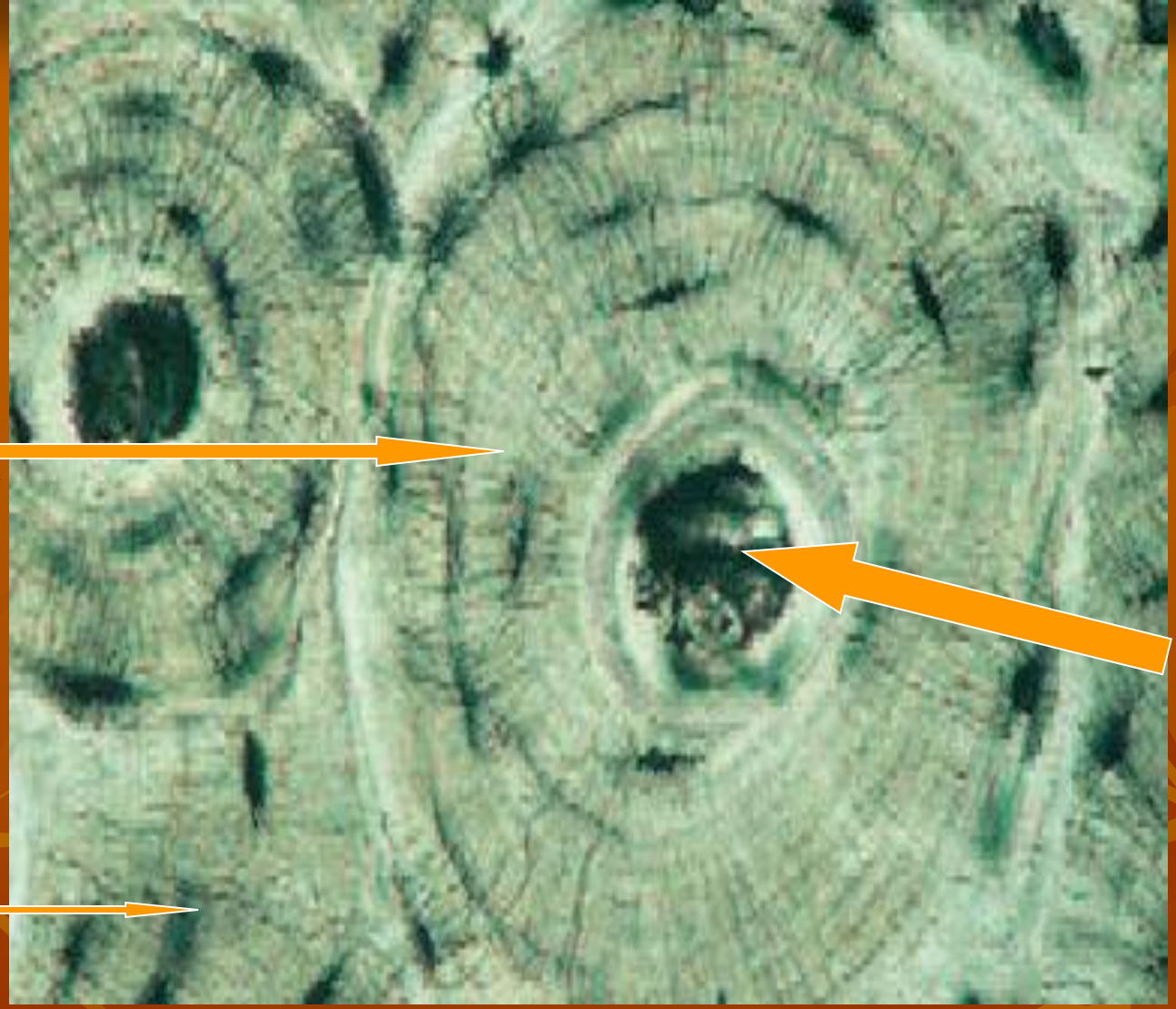
Compact bone

- makes up the shaft of a long bone . It consists of cylindrical structural units called osteons) Haversian systems). Canals called Volkmann's canals link the Haversian canals of different osteons with one another and with the marrow cavity.

The central canal of each osteon is surrounded by rings of hard matrix. Bone cells (osteocytes) are located in spaces called lacunae between the rings of matrix.

Blood vessels in the central canal carry nutrients that allow bone to renew itself. Nutrients can reach all of the bone cells because they are connected by thin processes within canaliculi (minute canals) that also reach to the central canal.

The ends of a long bone contain spongy bone, which has an

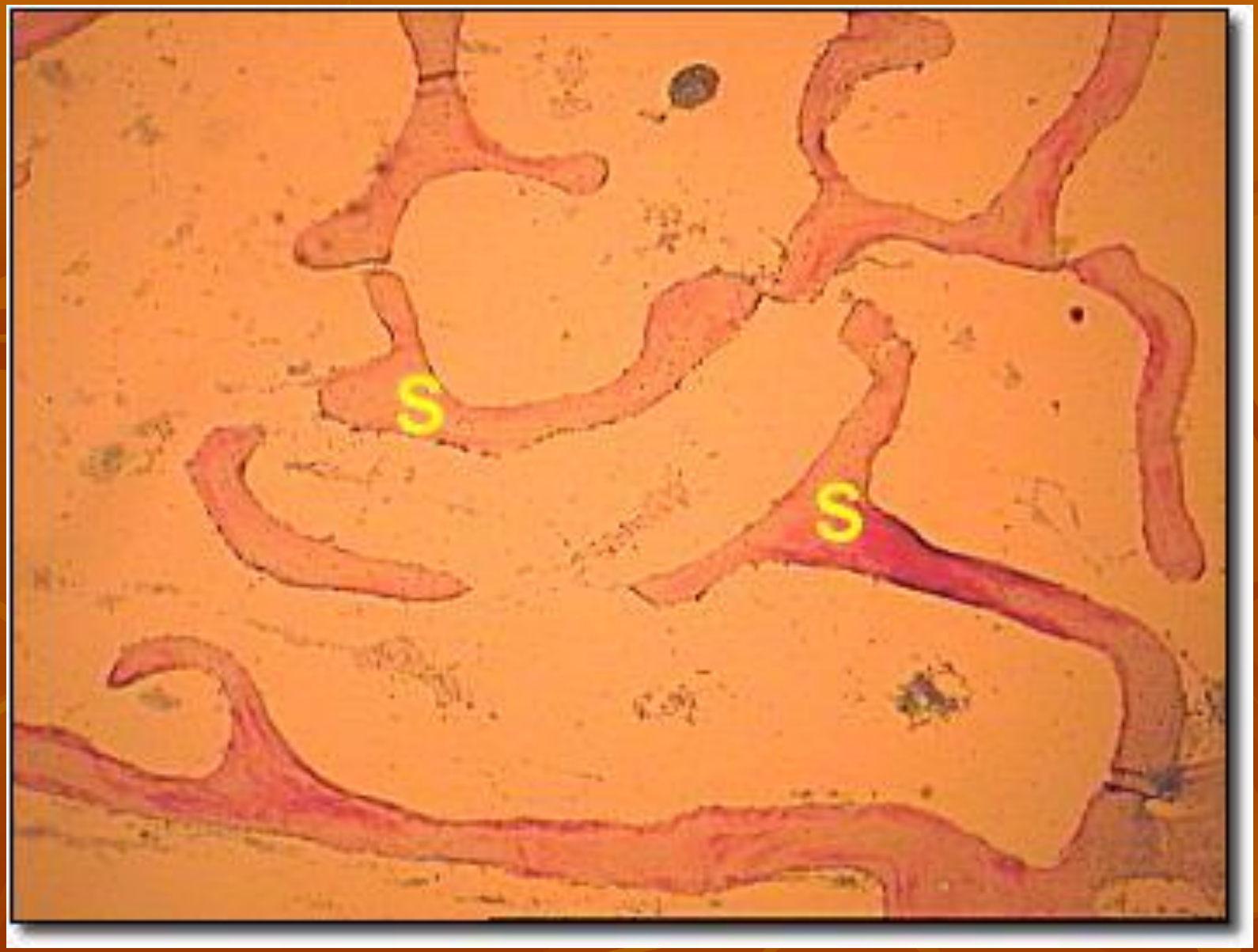


Compact bone

- has cells in concentric rings of lacunae.
- occurs in bones of skeleton.
- functions in support and protection.

Spongy bone

- Contains numerous bony bars and plates, separated by irregular spaces. Although lighter than compact bone, spongy bone still is designed for strength. Just as braces are used for support in buildings, the solid portions of spongy bone follow lines of stress. Connective tissues, which bind and support body parts, differ according to the type of matrix and the abundance of fibers in the matrix.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- ***Blood _***
  - **Blood** is unlike other types of connective tissue in that the matrix (i.e., plasma) is not made by the cells.
    - Some people do not classify blood as connective tissue; instead, they suggest a separate tissue category called vascular tissue

- The upper liquid layer, called **plasma,** represents about 55% of the volume of whole blood and contains a variety of inorganic and organic substances dissolved or suspended in water . The lower layer consists of red blood cells (erythrocytes), white blood cells (leukocytes), and blood platelets (thrombocytes). Collectively, these are called the formed elements and represent about 45% of the volume of whole blood. Formed elements are manufactured in the red bone marrow of the skull, ribs, vertebrae, and ends of long bones.
- Blood serum is blood plasma without fibrinogen or the other clotting factors

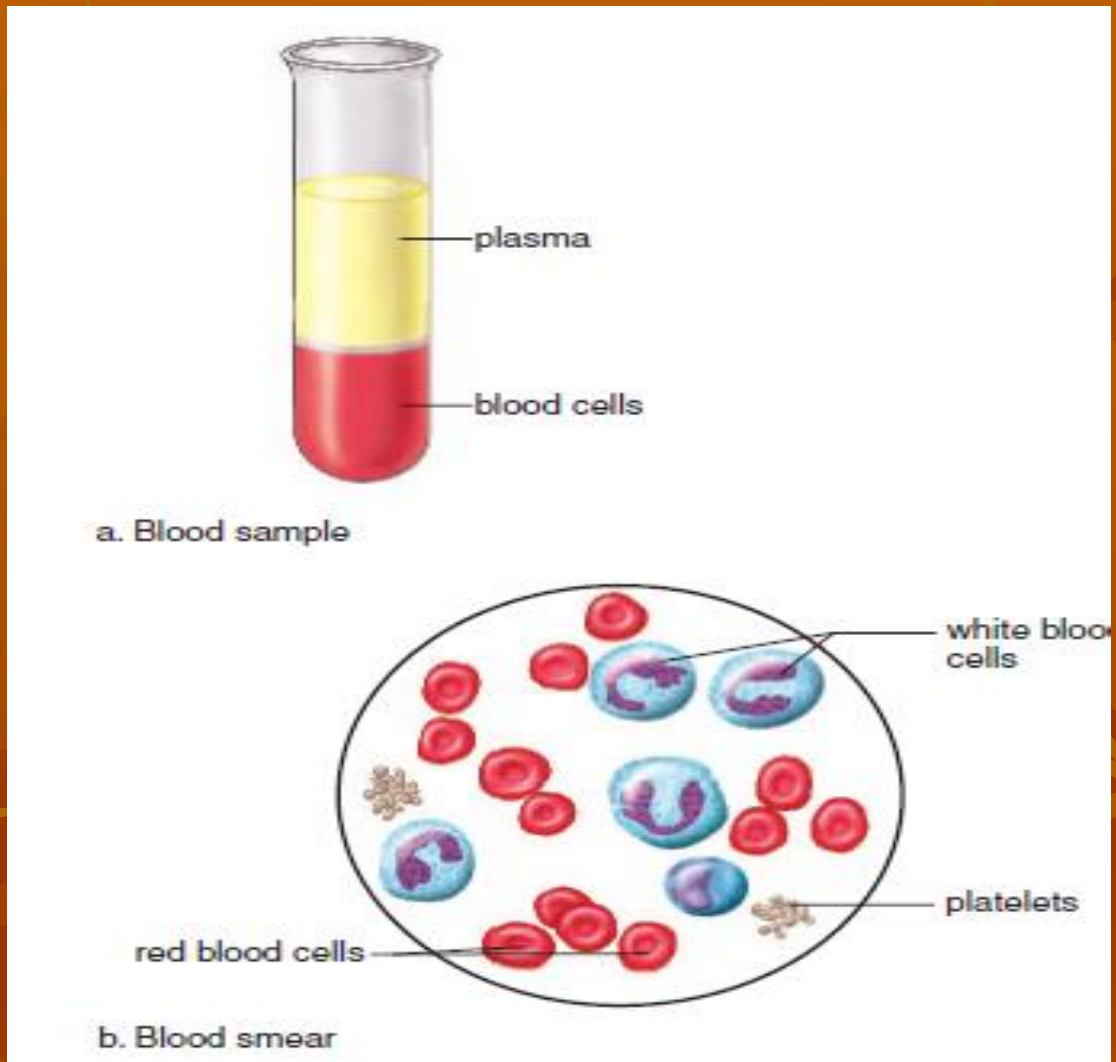
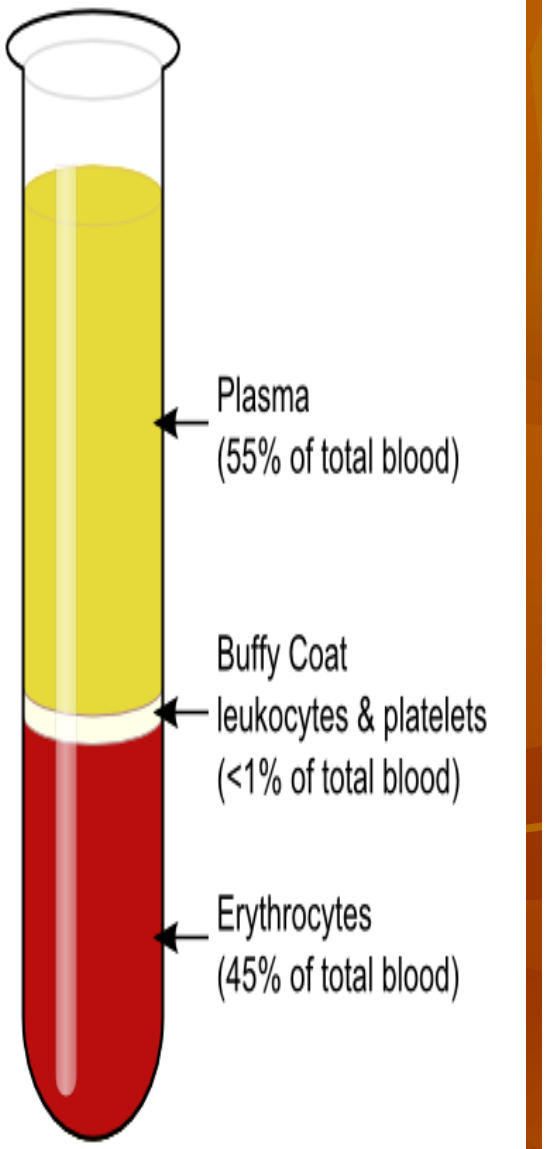
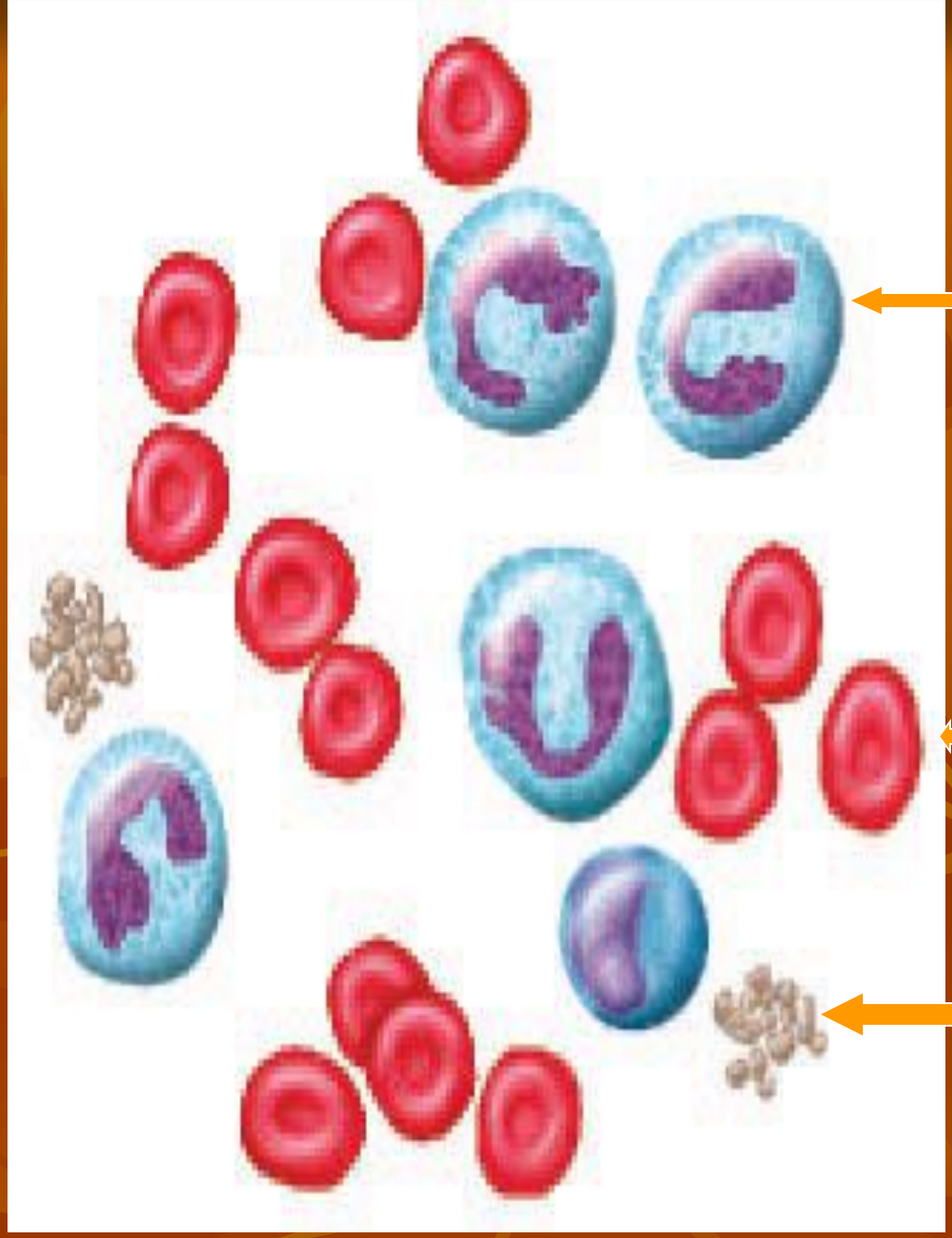
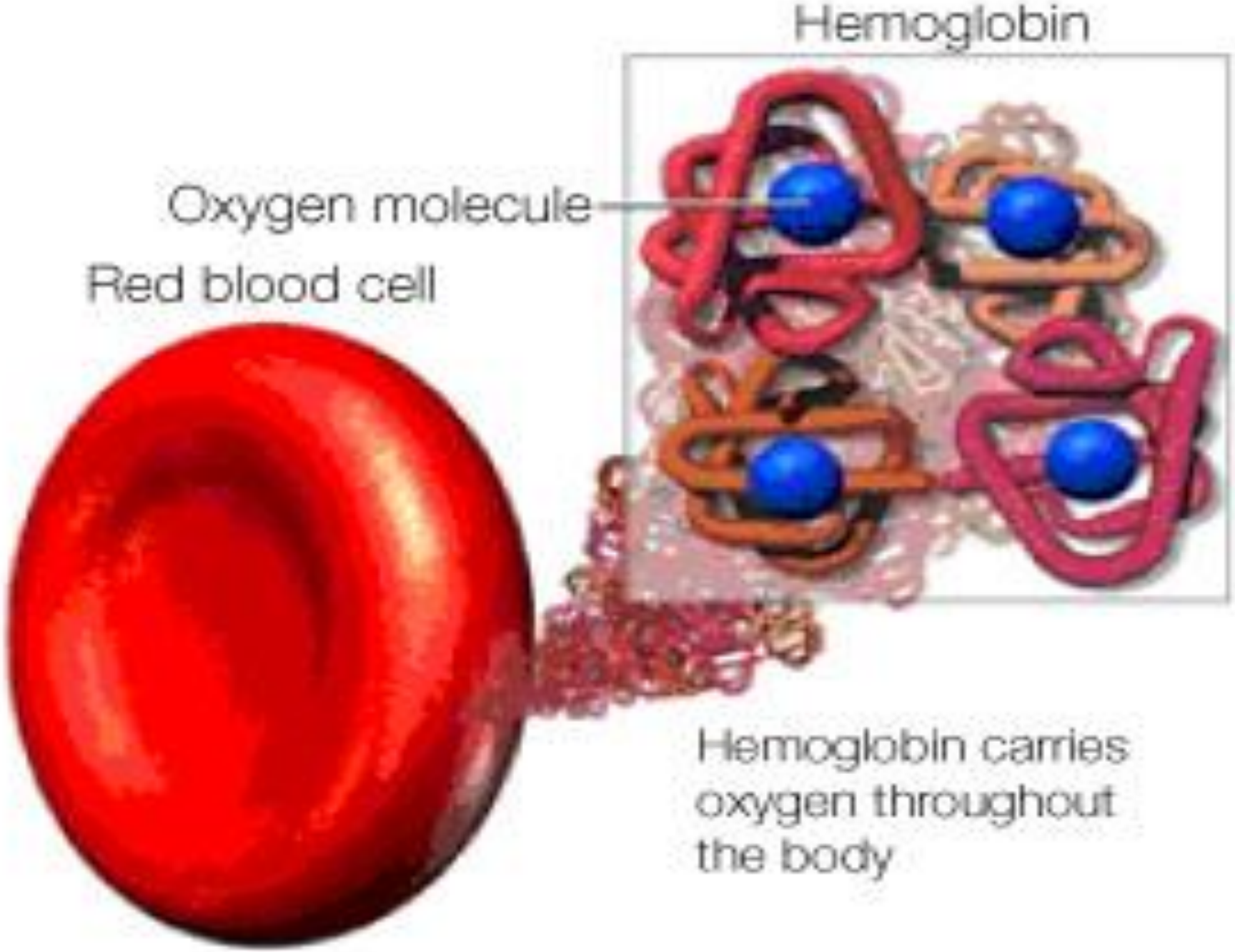


Figure 4.5 **Blood, a fluid tissue.**
a. In a test tube, a blood sample separates into its two compone blood cells and plasma. **b.** Microscopic examination of a blood smear shows that there are red blood cells, white blood cells, an platelets. Platelets are fragments of a cell. Red blood cells transp oxygen, white blood cells fight infections, and platelets are involv


Plasma
(55% of total blood)
Buffy Coat
leukocytes & platelets
(<1% of total blood)
Erythrocytes
(45% of total blood)


white blood cells
red blood cells
platelets

- 1- **Red blood cells** are small, biconcave, disk-shaped cells without nuclei. The presence of the red pigment hemoglobin makes the cells red, and in turn, makes the blood red. Hemoglobin is composed of four units; each is composed of the protein globin and a complex iron-containing structure called heme. The iron forms a loose association with oxygen, and in this way red blood cells transport oxygen. 2**White blood cells** may be distinguished from red blood cells by the fact that they are usually larger, have a nucleus, and without staining would appear to be translucent.
- White blood cells characteristically look bluish because they have been stained that color. White blood cells, which fight infection,


Hemoglobin
Oxygen molecule
Red blood cell
Hemoglobin carries oxygen throughout the body

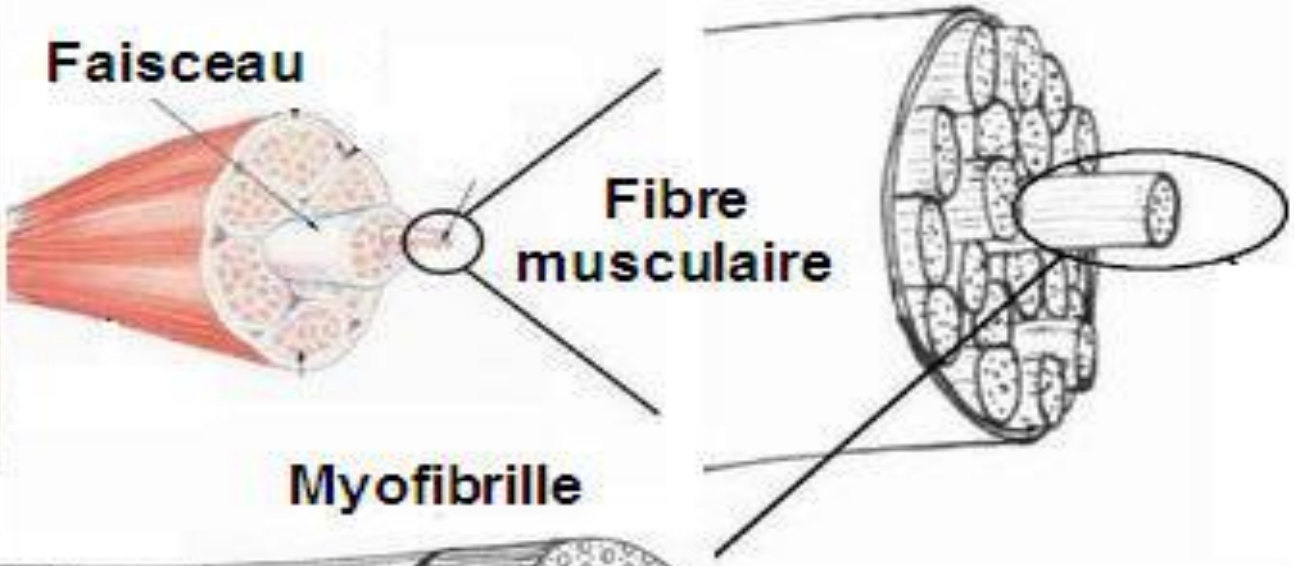
- function primarily in two ways. Some white blood cells are phagocytic and engulf infectious pathogens, while other white blood cells produce antibodies, molecules that combine with foreign substances to inactivate them.
- **Platelets** are not complete cells; rather, they are fragments of giant cells present only in bone marrow. When a blood vessel is damaged, platelets form a plug that seals the vessel and injured tissues release molecules that help the clotting process. Blood is a connective tissue in which the matrix is plasma.

THANK YOU

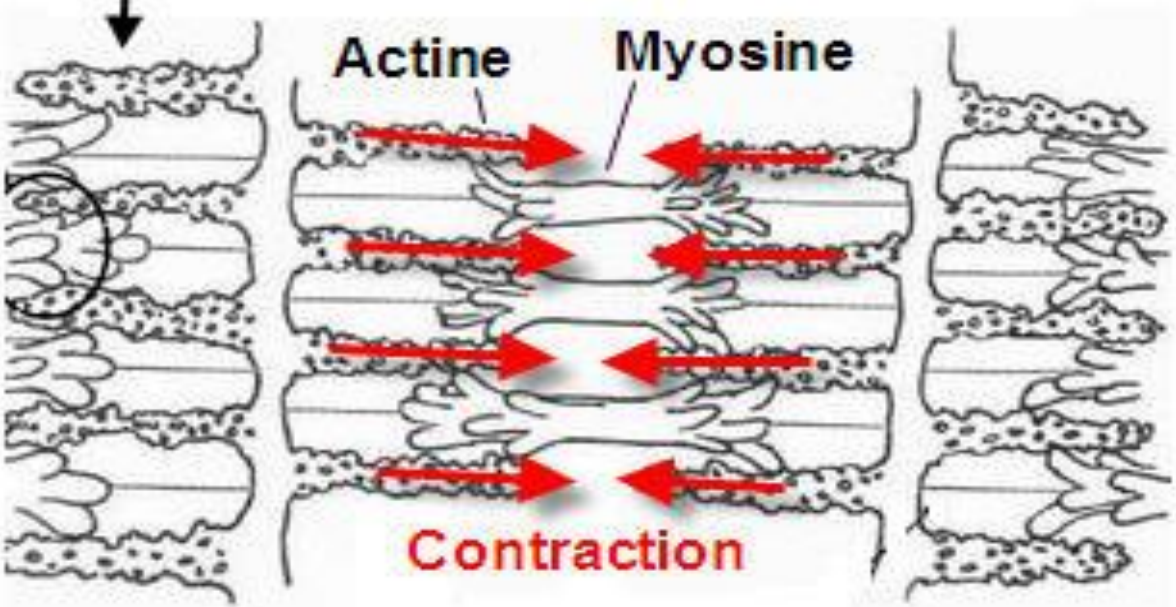
Will MEET IN NEW LECTURE

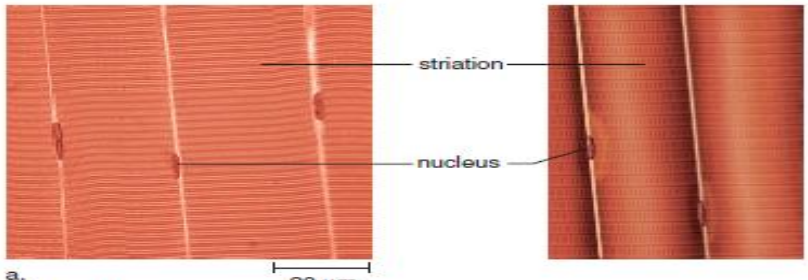
Muscular Tissue

- **3-Muscular (contractile) tissue** is composed of cells that are called muscle fibers. Muscle fibers contain actin filaments and myosin filaments, whose interaction accounts for movement.
  - There are three types of vertebrate muscles:
    - skeletal, smooth, and cardiac.
  - **1-Skeletal muscle,** also called voluntary muscle is attached by tendons to the bones of the skeleton, and when it contracts, body parts move. Contraction of skeletal muscle is under voluntary control and occurs faster than in the other muscle types. Skeletal muscle fibers are cylindrical and quite long—sometimes they run the length of the muscle.
- They arise during development when several cells fuse, resulting in one fiber with multiple nuclei. The nuclei are located at the periphery of the cell, just inside the plasma membrane.
- The fibers have alternating light and dark bands that give them a **striated** appearance. These bands are due to the placement of actin filaments and myosin filaments in the cell.


Faisceau
Fibre musculaire

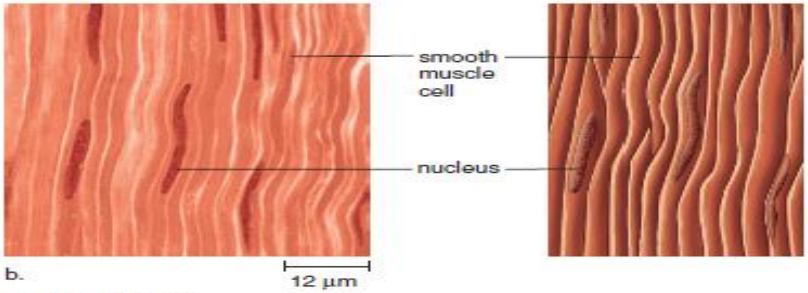

Myofibrille


Actine
Myosine
Contraction



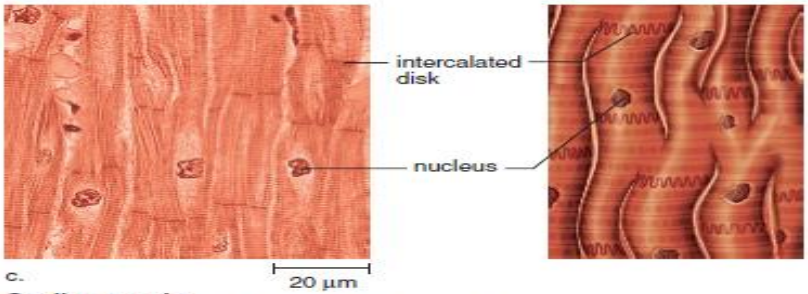
a.

Skeletal muscle
- has striated cells with multiple nuclei.
- occurs in muscles attached to skeleton.
- functions in voluntary movement of body.
- voluntary



b.

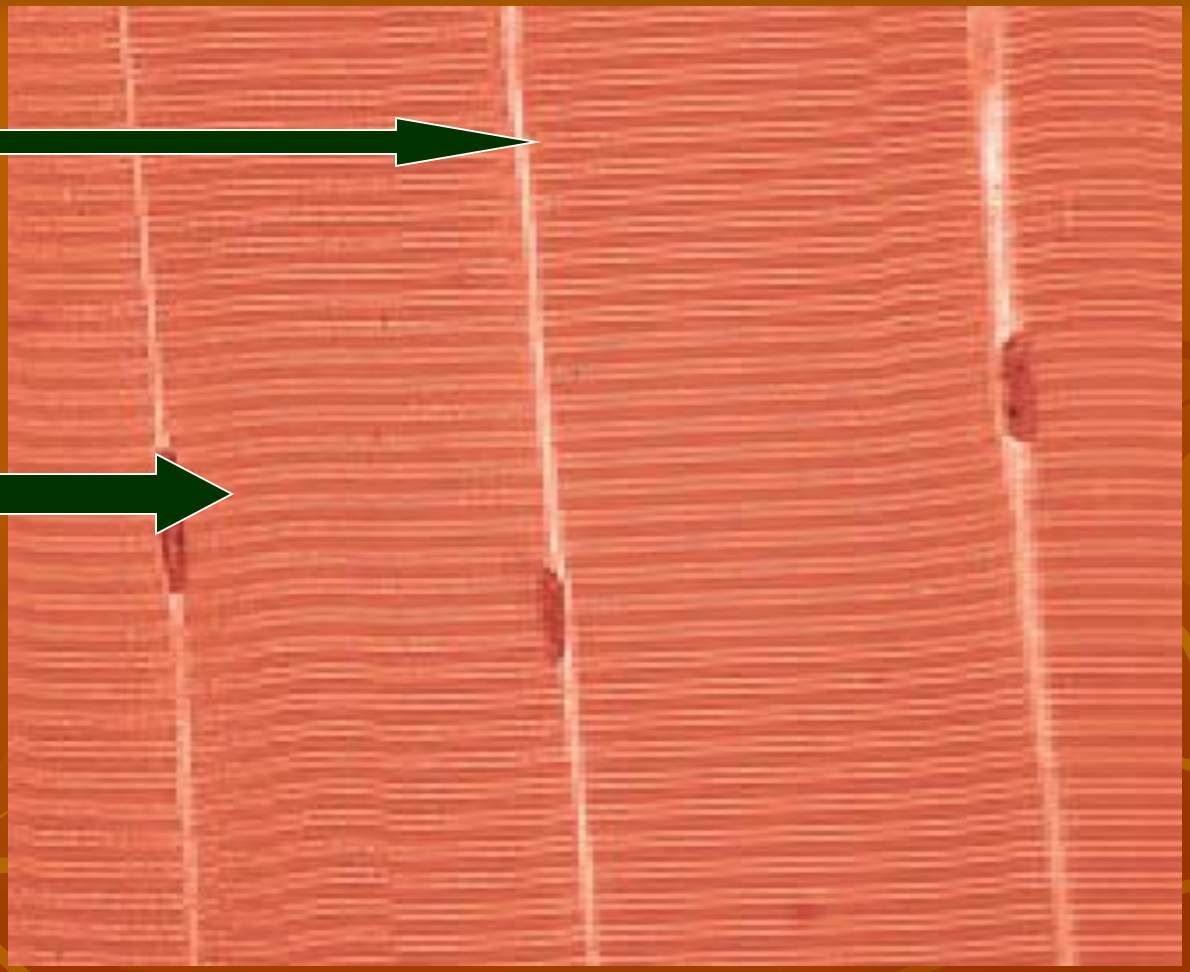
Smooth muscle
- has spindle-shaped cells, each with a single nucleus.
- cells have no striations.
- functions in movement of substances in lumens of body.
- involuntary.



c.

Cardiac muscle
- has branching striated cells, each with a single nucleus.
- occurs in the wall of the heart.
- functions in the pumping of blood.
- involuntary.

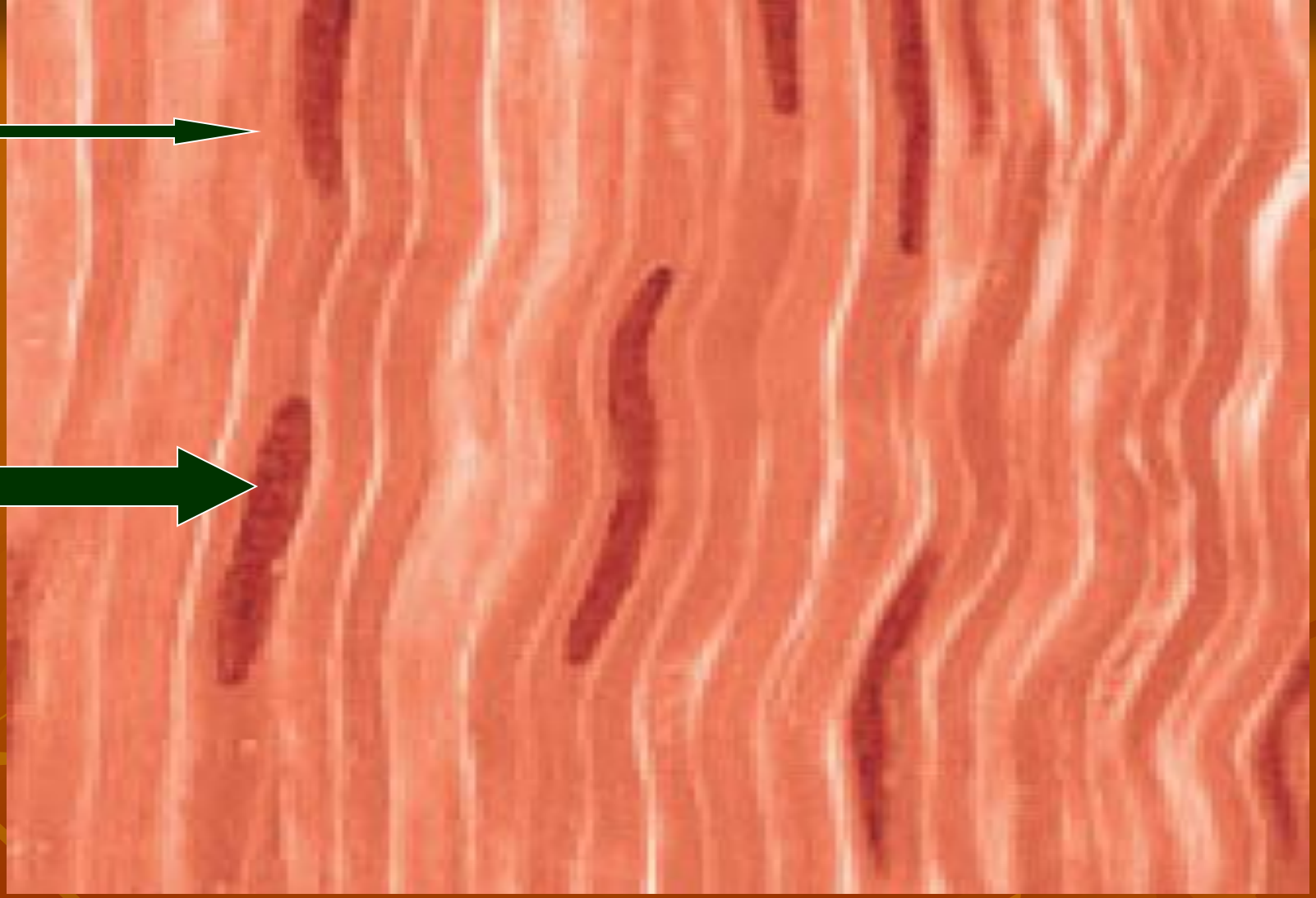
Figure 4.6 **Muscular tissue.**



Skeletal muscle

- has striated cells with multiple nuclei.
- occurs in muscles attached to skeleton.
- functions in voluntary movement of body.
- voluntary

- **2-Smooth (visceral) muscle** is so named because the cells lack striations. The spindle-shaped cells form layers in which the thick middle portion of one cell is opposite the thin ends of adjacent cells. Consequently, the nuclei form an irregular pattern in the tissue .Smooth muscle is not under voluntary control and therefore is said to be involuntary. Smooth muscle, found in the walls of viscera (intestine, stomach, and other internal organs) and blood vessels, contracts more slowly than skeletal muscle but can remain contracted for a longer time. **When the smooth muscle of** the intestine contracts, food moves along its lumen (central cavity). When the smooth muscle of the blood vessels contracts, blood vessels constrict, helping to raise blood pressure.

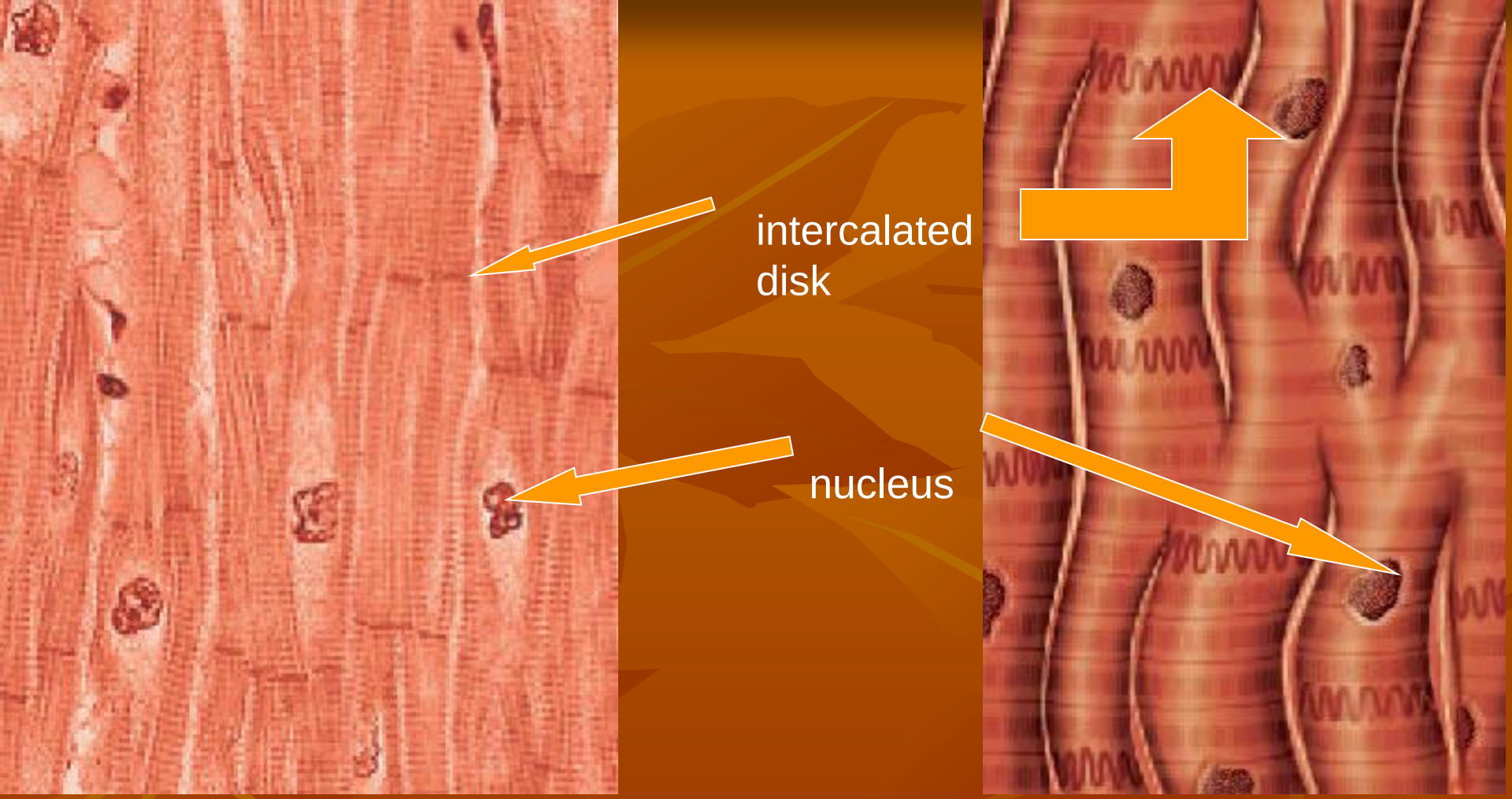


Smooth muscle

- has spindle-shaped cells, each with a single nucleus.
- cells have no striations.
- functions in movement of substances in lumens of body.
- involuntary

3- Cardiac muscle

- is found only in the walls of the heart. Its contraction pumps blood and accounts for the heartbeat. Cardiac muscle combines features of both smooth muscle and skeletal muscle. It has striations like skeletal muscle, but the contraction of the heart is involuntary for the most part. Cardiac muscle cells also differ from skeletal muscle cells in that they have a single, centrally placed nucleus. The cells are branched and seemingly fused one with the other, and the heart appears to be composed of one large interconnecting mass of muscle cells. Actually, cardiac muscle cells are separate and individual, but they are bound end to end



Cardiac muscle

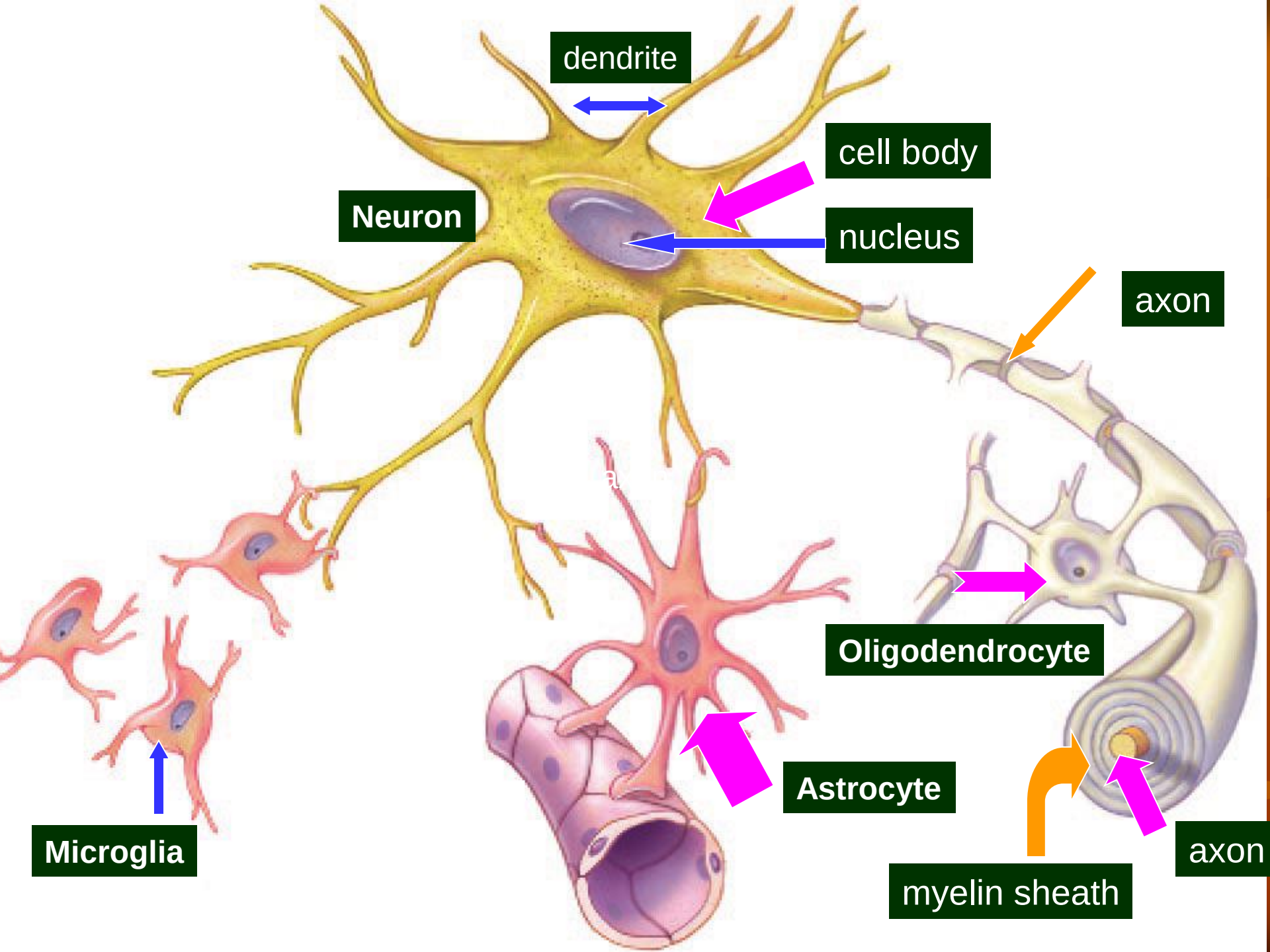
- has branching striated cells, each with a single nucleus.
- occurs in the wall of the heart.
- functions in the pumping of blood.
- involuntary.

intercalated disks

- **intercalated disks,** areas where folded plasma membranes between two cells contain adhesion junctions and gap junctions. All muscular tissue contains actin filaments and myosin filaments; these form a striated pattern in skeletal and cardiac muscle, but not in smooth muscle.

4-Nervous Tissue

- **Nervous tissue,** which contains nerve cells called neurons, is present in the brain and spinal cord.
- A **neuron** is a specialized cell that has three parts: dendrites, a cell body, and an axon. A dendrite is a process that conducts signals toward the cell body. The cell body contains the major concentration of the cytoplasm and the nucleus of the neuron. An axon is a process that typically conducts nerve impulses away from the cell body. Long axons are covered by myelin, a white fatty substance. Outside the brain and spinal cord, fibers bound by connective tissue form **nerves.**


dendrite
cell body
Neuron
nucleus
axon
Oligodendrocyte
Astrocyte
Microglia
axon
myelin sheath

Neuroglia

- There are several different types of neuroglia in the brain and much research is currently being conducted to determine how much "glia" contribute to the functioning of the brain. **Neuroglia** outnumber neurons nine to one and take up more than half the volume of the brain, but until recently,
- they were thought to merely support and nourish neurons.
- Three types of neuroglia are oligodendrocytes, microglia, and astrocytes. Oligodendrocytes form myelin, and microglial cells, in addition to supporting neurons, engulf bacterial and cellular debris. Astrocytes provide nutrients to neurons and produce a hormone known as **glia-derived growth factor**, which someday might be used as a cure for Parkinson disease and other diseases caused by neuron degeneration

- The nervous system has just three functions: sensory input, integration of data, and motor output. Nerves conduct impulses from sensory receptors to the spinal cord and the brain where integration occurs. The phenomenon called sensation occurs only in the brain, however. Nerves also conduct nerve impulses away from the spinal cord and brain to the muscles and glands, causing
- them to contract and secrete, respectively. In this way, a coordinated response to the stimulus is achieved. In addition to neurons, nervous tissue contains neuroglial cells.

- Neuroglia don’t have a long process, but even so, researchers are now beginning to gather evidence that they do communicate among themselves and with neurons! Nerve cells, called neurons, have fibers (processes) called axons and dendrites. In general, neuroglia support and service neurons.

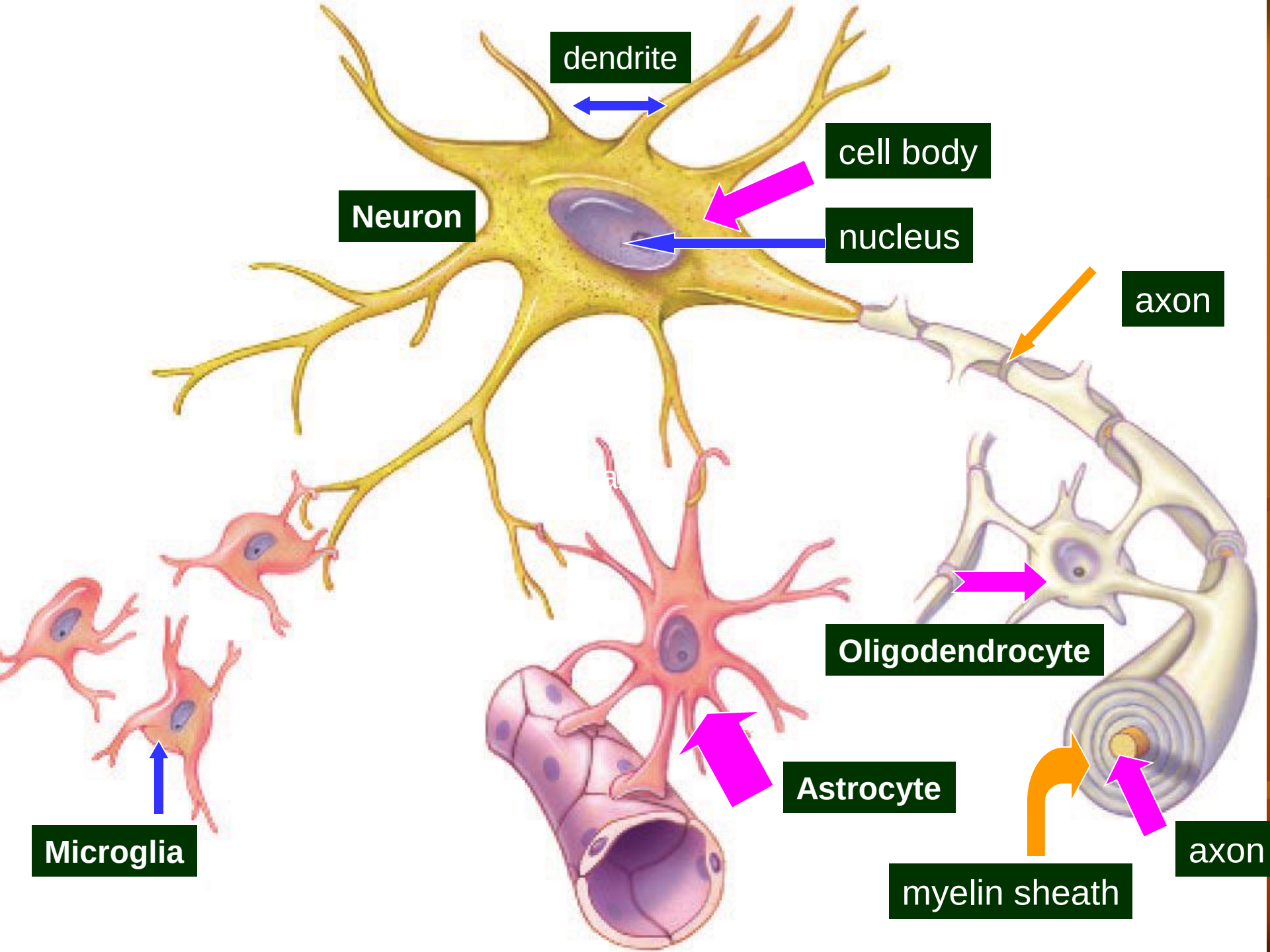
- Glial Cells (neuroglia) are the non-excitable supporting cells of the nervous system. All glial cells are much smaller but far more numerous than the nerve cells. They form a major component of the nervous tissue and include the the following.

Neuroglial cells found in the parenchyma of brain and spinal cord. (oligodendrocytes, microglia, and astrocytes) (CNS)

Ependymal cells lining the internal cavities or ventricles;

Capsular or satellite cells, surrounding neurons of the sensory and autonomic ganglia. (PNS)

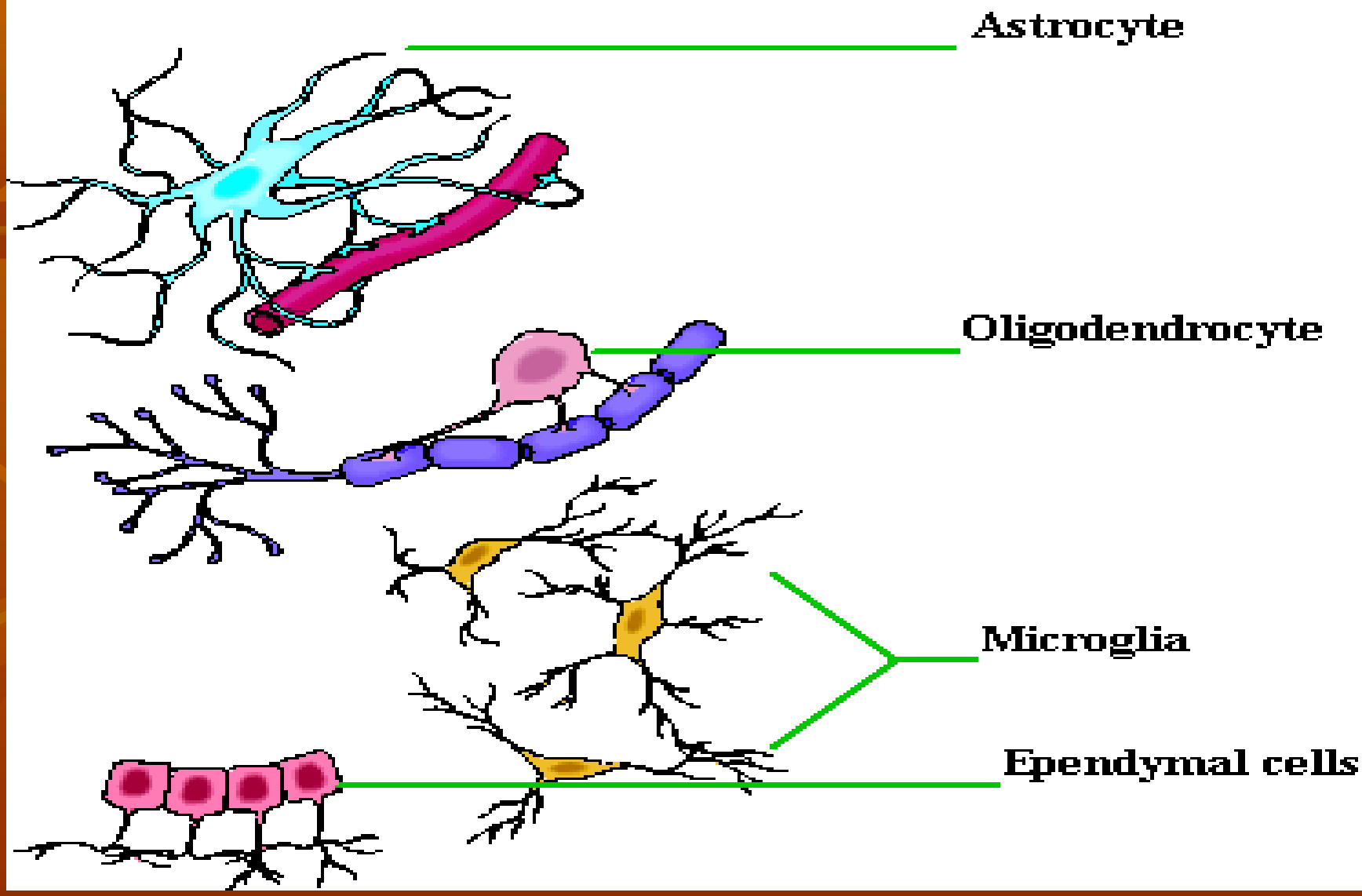
Schwann cells, forming sheaths for axons of peripheral nerves. (PNS)


dendrite
cell body
Neuron
nucleus
axon
Oligodendrocyte
Astrocyte
Microglia
axon
myelin sheath

4.2 Body Cavities and Body Membranes

The internal organs are located within specific body cavities (Fig. 4.8). During human development, there is a large ventral cavity called a **coelom,** which becomes divided into the thoracic (chest) and abdominal cavities. Membranes divide the thoracic cavity into the pleural cavities, containing the right and left lungs, and the pericardial cavity, containing the heart. The thoracic cavity is separated from the abdominal cavity by a horizontal muscle called the diaphragm. The stomach, liver, spleen, gallbladder, and most of the small and large intestines are in the upper portion of the abdominal cavity. The lower portion contains the rectum, the urinary bladder, the internal reproductive organs, and the rest of the large intestine. Males have an external extension of the abdominal wall, called the scrotum, containing the testes. The dorsal cavity also has two parts: the cranial cavity within the skull contains the brain; and the vertebral canal,

Neuroglial Cells of the CNS



integumentary system.

- The skin and its accessory organs comprise the integumentary system.
- The accessory organs include nails, hair, and glands.
- Skin protects underlying tissues from physical trauma, pathogen invasion, and water loss.
- Skin helps regulate body temperature,
- and because it contains sensory receptors,
- skin also helps us to be aware of our surroundings.
- Skin has two regions. The epidermis contains basal cells that produce new epithelial cells that become keratinized as they move toward the surface.

The dermis, a largely fibrous connective tissue,

contains epidermally derived glands and hair follicles,
nerve endings,

and blood vessels. Sensory receptors for touch, pressure,
temperature,

and pain are also present in the dermis. A subcutaneous

layer, which is made up of loose connective tissue
containing adipose cells, lies beneath the skin

Body Membranes

we are using the term *membrane* to refer to a

thin lining or covering composed of an epithelium overlying

a loose connective tissue layer.

Body membranes line cavities and internal spaces of organs and tubes that open to the outside

Mucous membranes line the tubes of the digestive,

respiratory, urinary, and reproductive systems. The epithelium

of this membrane contains goblet cells that secrete

mucus. This mucus ordinarily protects the body from invasion

by bacteria and viruses;. In addition, mucus usually protects the walls

of the stomach and small intestine from digestive juices,

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Nervous Tissue4

Summary Types of Tissues

Human tissues are categorized into four groups. Epithelial tissue covers the body and lines its cavities. The different types of epithelial tissue (squamous, cuboidal, and columnar) can be stratified and have cilia or microvilli. Also, columnar cells can be pseudostratified. Epithelial cells sometimes form glands that secrete either into ducts or into the blood.

Connective tissues, in which cells are separated by a matrix, often bind body parts together. Connective tissues have both white and yellow fibers and may also have fat (adipose) cells. Loose fibrous connective tissue supports epthelium and encloses organs. Dense fibrous connective tissue, such as that of tendons and ligaments, contains closely packed collagen fibers. Adipose tissue stores fat. Both cartilage and bone have cells within lacunae, but the matrix for cartilage is more flexible than that for bone, which contains calcium salts. In bone, the lacunae lie in concentric circles within an osteon (or Haversian system) about a central canal. Blood is a connective tissue in which the matrix is a liquid called plasma.

Muscular tissue is of three types. Both skeletal and cardiac muscle are striated; both cardiac and smooth muscle are involuntary. Skeletal muscle is found in muscles attached to bones, and smooth muscle is found in internal organs. Cardiac muscle makes up the heart.

Nervous tissue has one main type of conducting cell, the neuron, and several types of neuroglial cells. Each neuron has dendrites, a cell body, and an axon. The brain and spinal cord contain complete neurons, while the nerves contain only neuron fibers. Axons are specialized to conduct nerve impulses.

4.2 Body Cavities and Body Membranes

The internal organs occur within cavities. The thoracic cavity contains the heart and lungs; the abdominal cavity contains organs of the digestive, urinary, and reproductive systems, among others.

Membranes line body cavities and internal spaces of organs. As an example, mucous membrane lines the tubes of the digestive system, while serous membrane lines the thoracic and abdominal cavities

and covers the organs they contain.

4.3Organ Systems

The digestive, cardiovascular, lymphatic, respiratory, and urinary systems perform processing and transporting functions that maintain the normal conditions of the body. The skeletal system and muscular system support the body and permit movement. The nervous system receives sensory input from sensory receptors and directs the muscles and glands to respond to outside stimuli. The endocrine system produces hormones, some of which influence the functioning of the reproductive system, which allows humans to make more of their own kind.

The skin and its accessory organs comprise the integumentary system.

The accessory organs include nails, hair, and glands. Skin protects underlying tissues from physical trauma, pathogen invasion, and water loss. Skin helps regulate body temperature, and because it contains sensory receptors, skin also helps us to be aware of our surroundings.

Skin has two regions. The epidermis contains basal cells that produce new epithelial cells that become keratinized as they move

toward the surface. The dermis, a largely fibrous connective tissue, contains epidermally derived glands and hair follicles, nerve endings, and blood vessels. Sensory receptors for touch, pressure, temperature, and pain are also present in the dermis. A subcutaneous layer, which is made up of loose connective tissue containing adipose cells, lies beneath the skin.

4.4 Homeostasis

Homeostasis is the relative constancy of the internal environment. Negative feedback mechanisms keep the environment relatively stable. When a sensor detects a change above and/or below a set point, a regulatory center activates an effector that reverses the change and brings conditions back to normal again. In contrast, a positive feedback mechanism brings about rapid change in the same direction as the stimulus. Still, positive feedback mechanisms are useful under certain conditions such as when a child is born.

The internal environment consists of blood and tissue fluid. All organ systems contribute to the constancy of tissue fluid and blood. Special contributions are made by the liver, which keeps blood glucose constant, and the kidneys, which regulate the pH.

The nervous and endocrine systems regulate the other systems

- **Maintenance of the Body _**
- The internal environment of the body consists of the blood
- within the blood vessels and the tissue fluid that surrounds
- the cells.
- Five systems (digestive, cardiovascular, lymphatic,
- respiratory, and urinary) add substances to and/or remove
- substances from the blood.
- The **digestive system** consists of the mouth, esophagus,
- stomach, small intestine, and large intestine (colon) along
- with the associated organs: teeth, tongue, salivary glands,
- liver, gallbladder, and pancreas. This system receives food
- and digests it into nutrient molecules, which can enter the
- cells of the body.

- The **cardiovascular system** consists of the heart and
- the blood vessels that carry blood through the body. Blood
- transports nutrients and oxygen to the cells, and removes
- their waste molecules that are to be excreted from the
- body. Blood also contains cells produced by the lymphatic
- system.
- The **lymphatic system** consists of lymphatic vessels,
- lymph fluid, lymph nodes, and other lymphoid organs. This
- system protects the body from disease by purifying lymph
- and supporting lymphocytes, the white blood cells that produce
- antibodies. Lymphatic vessels absorb fat from the digestive
- system and collect excess tissue fluid, which is
- returned to the blood circulatory system.

- The **respiratory system** consists of the lungs and the
- tubes that take air to and from them. The respiratory system
- brings oxygen into the body and takes carbon dioxide out of
- the body through the lungs.
- The **urinary system** contains the kidneys and the urinary
- bladder. This system rids the body of nitrogenous
- wastes and helps regulate the fluid level and chemical content

1. Name the four major types of tissues. 62
2. Name the different kinds of epithelial tissue, and give a location and function for each. 62
3. What are the functions of connective tissue? Name the different kinds, and give one location for each. 64–66
4. What are the functions of muscular tissue? Name the different kinds, and give a location for each. 67
5. Nervous tissue contains what types of cells? Which organs In the body are made up of nervous tissue? 68
6. In what cavities are the major organs located? 69
7. Distinguish between the terms plasma membrane and body membrane. 69
8. Which organ systems maintain the body, support and move the body, coordinate and regulate body systems? 70

9. Why is skin sometimes called the integumentary system? State at least two functions of skin and describe its structure. 71–72

10. Why is homeostasis sometimes defined as the dynamic equilibrium of the internal environment? 74

11. Give a mechanical and a biological example of a negative feedback mechanism. Give an example of a positive feedback mechanism. 74–76

12. After consulting the working together illustration on page 77, explain how the various systems of the body contribute to homeostasis. 76–77

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