جامعة بغداد

كلية العلوم

قسم التقنيات الاحيائية

الانسجة والتحضيرات المجهرية/ العملي

المرحلة الثانية 2021- 2022

الفصل الدراسي الاول

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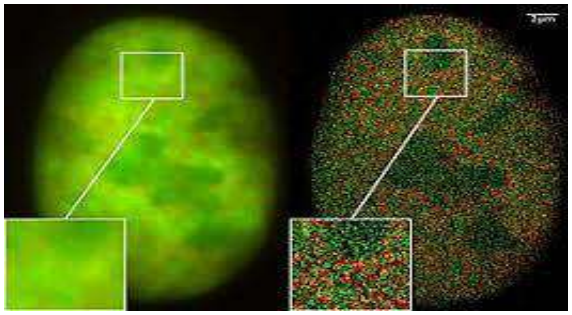
Microscope

An instrument that produces enlarged images (magnified with high resolution).

Magnifying power of a microscope: the number of times the object to be enlarged. It is expressed in the form Nx (for example 10x for an image magnified 10-fold).

Resolution: is the ability to distinguish two objects as separate entities.

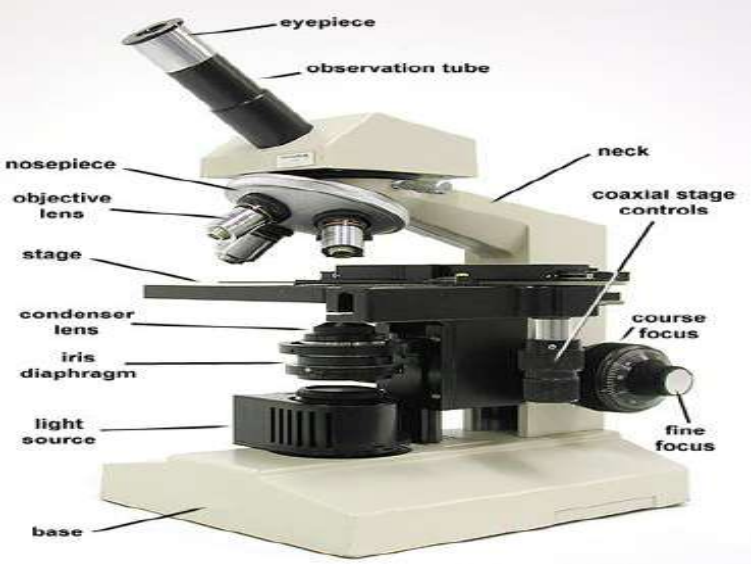


Low resolution High resolution

Light Microscope :

Also called an optical microscope, is an instrument to observe small objects using visible light and lenses.

It can be used to view living or dead samples and can maximize samples up to one thousand times (1,000x) their actual size.



Light Microscope

The light microscope usually comes with three ocular lenses of different magnification levels set on a rotating nosepiece (turret). There may also be a fourth lens used for oil immersion viewing of specimens.

Inverted microscope

Is a microscope with light source and condenser on the top, above the stage pointing down, while the objectives and turret are below the stage pointing up. It is useful for observing living cells or organisms at the bottom of a large container.

Fluorescence Microscope

Modern biological microscopy depends heavily on the development of fluorescent probes for specific structures within a cell.

In fluorescence microscope; the sample is illuminated through the objective lens with a long, narrow set of wavelengths of light.

This light interacts with fluorophores (such as organic dyes or biological /chemical fluorophores) in the sample which then emit light of a longer wavelength. This emitted light makes up the image.

Chemical fluorescent stains, such as DAPI which binds to DNA, have been used to label specific structures within the cell.

More recent developments include; using labelled antibodies (with fluorescent dyes) to recognize specific proteins within a sample. This technique is called immunofluorescence.

Electron microscopy

Is a technique for obtaining high resolution images of biological and non-biological specimens.

It is using electrons (which have very short wavelengths) as the source of illuminating radiation.

There are two main types of electron microscope – the transmission EM (TEM) and the scanning EM (SEM).

Scanning Electron Microscopy

المختبر الثاني : تحضير العينات

Types of slides: There are two types of slides:

Temporary slides: prepared via four methods:

1. Wet mount
2. Dry mount
3. Squash
4. Smear (blood smear)

Permanent slides (Paraffin method)

If necessary, staining is used with each of the above methods

Dry Mount:

The dry mount is the most basic technique: simply position a thinly sliced section on the center of the slide and place a cover slip over the sample.

Dry mounts are ideal for observing hair, feathers, airborne particles such as pollens and dust as well as dead matter such as insect and aphid legs or antennae. Opaque specimens require very fine slices for adequate illumination.

Wet Mount:

Used for aquatic samples, living organisms and natural observations, wet mounts suspend specimens in fluids such as water, brine, glycerin and immersion oil.

A wet mount requires a liquid, tweezers, pipette and paper towels

To prepare the slide:

1. Place a drop of fluid in the center of the slide.
2. Position sample on liquid, using tweezers.
3. At an angle, place one side of the cover slip against the slide making contact with outer edge of the liquid drop.
4. Lower the cover slowly, avoiding air bubbles.

Remove excess water with the paper towel.

Limitations of wet mount methods:

1. This method provides a transitory window as the liquid will dehydrate and living specimens will die.

2. Organisms such as protozoa may only live 30 minutes under a wet mount slide. (applying petroleum jelly to the outer edges of the cover slip creates a seal that may extend the life of the slide up to a few days).

3. Larger protozoan such as paramecium may be too large and/or move too quickly under the wet mount.

(In these circumstances, adding ground pieces of cover glass to the water before the slip layer will create more space. Chemicals or strands of cotton can be added to slow the movement of paramecium, amoeba and ciliates).

Squash Slides

Designed for soft samples, it begins by preparing a wet mount.

1. Place tissue over the cover glass and gently press down (careful not to destroy the sample or break the cover glass).

2. Squash the sample.

3. Remove excess water.

Suitable specimens include soft fruits and fungi

The advantage of squashing is, that it is a fast and easy method to obtain very thin specimen samples.

Staining

A variety of methods exist for staining microscope slides, including non-vital or in vitro stains of non-living cells and vital or in vivo stains of living tissue.

Staining is useful in the fields of histology, virology and pathology, allowing researchers to study/diagnose diseases, identify gram positive and well as examine detailed attributes of a variety of negative bacteria as cells.

Staining solutions such as iodine, methylene blue and crystal violet can be added to wet or dry mounts.

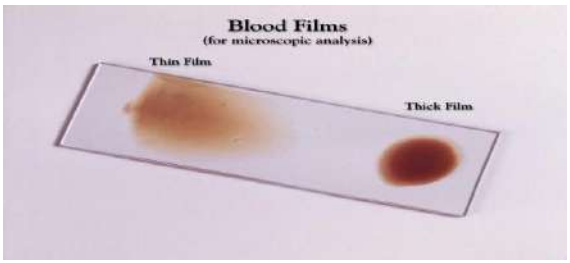
A simple staining method:

1. Add a drop of staining solution on the edge of one side of the cover slip..
2. Position the edge of a paper towel on the opposite end.
3. Allow dye to be pulled across the specimen.

Blood smear

It is a microscope slide made by placing a drop of blood on the slide to examine the blood cells.

commonly used to look for hematological problems, and, occasionally, to determine if parasites are present in the blood.



Blood smear

Protocol of blood smear preparation:

1. Placing a small drop of venous blood on a glass microscope slide, using a glass capillary pipette.

2. A spreader slide has been positioned at an angle and slowly drawn toward the drop of blood.

3. The spreader slide has been brought in contact with the drop of blood and is being drawn away leaving a thin layer of blood behind. (The cells must be spaced far enough apart to count and differentiate; if they too concentrated very little information can be gleaned).

4. The blood smear is dried for about 10 minutes.

5. Fix the slide with methanol.

6. Stain to distinguish the cells from each other

Types of blood smear stains:

1- Gimza stain

2- Leishman's Stain

3- Wrigth stain

Leishman’s stain

- Put the stain on the slide for 10 min.
- Then put the buffer over the slide for 5 min.
- Wash the slide by tap water.
- Leave the slide to be dried and examine it under the microscope.

Some cases distinguished via blood smear:

Anemia, Sickle cell anemia, Spherocytosis.

Malaria have distinguished morphological features under the microscope.

To detect the presence of parasites:

Thick smears concentrate red cell layers approximately 40-fold to screen a relatively large amount of blood. Because red cells are lysed in this process, parasites are visualized outside red cells.

Parasites can be estimated from thick smears by counting the number of parasites until 200.

المختبر الثالث : تحضير السلايدات بطريقة البارافين (السلايدات الدائمية)

Paraffin method:

Tissues are hardened by replacing water with paraffin.

Includes:

1. Fixation
2. Tissue processing (Dehydration, Clearing, infiltration)
3. Embedding (casting or blocking) in molten paraffin
4. Sectioning
5. Staining
6. Mounting

Fixation

Cells and tissue are fixed in a physical and chemical state using fixatives so that they will withstand subsequent treatment with various reagents.

The aims of fixation are:

1- Denature the proteins and harden them.

2- Prevents further decomposition of the tissue by arresting cell metabolism.

3- Keep the tissue component as possible as it is in the living body.

4- Make them easier to handle and section.

Type of fixative solutions

1- 10% buffered formalin.

2- Ethyl alcohol.

3- Bouin's solution.

4- Zenker's solution.

(for 1.5 hour each)

No fixative will penetrate a piece of tissue thicker than 1 cm.

Tissue processing:

Hardening tissues with paraffin wax. (Paraffin wax is a hydrophobic, insoluble in water but dissolves in xylene and has a melt point at 46–68 °C).

1. Dehydration: Removed water completely using increasing strength of alcohol, usually ethanol (70%, 90% and 100% for one hour each). Now , water in tissue has been replaced by alcohol. next step alcohol should be replaced by paraffin wax.

Washing tissue with distilled water (DW) for 2-3 min.

60% ethanol alcohol for 1 hour.

70% ethanol alcohol for 1 hour. (so far, most water-soluble proteins are removed)

80% ethanol alcohol for 1 hour.

90% ethanol alcohol for 1 hour.

100% ethanol alcohol for 1 hour. (certain lipids may be dissolved; water-free alcohol is reached).

Q/ why a series of increasing concentrations is used?

To avoid excessive distortion of the tissue

2. Clearing

** So far, we have to add paraffin wax to the tissue, but: ethanol alcohol and wax don't mix (immiscible) .

To pass this problem, clearing have to be done. And the 'clearing agent' needs to be miscible with both ethanol and paraffin wax.

Xylene is used for this step.

Xylene for 1 hour.

Xylene for 1 hour.

Some other clearing agents: Xylene, Toluene, Chloroform.

3. Infiltration:

The final xylene is replaced with molten wax, which infiltrates the tissue.

1. Paraffin wax (I) for 1.5 hours
2. Paraffin wax (II) for 1.5 hours
3. Paraffin wax (III) for 1.5 hours

Q/Why three three wax immersions?

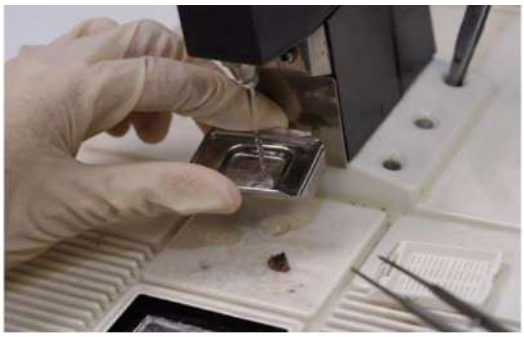
To ensure that none of the clearing agent remains in the tissue.

Embedding (casting or blocking):

Solidifying infiltrated tissues with paraffin wax to provide support during sectioning.

here, the tissue is placed in molten paraffin (melted in oven at 52 56°C for 15 min).

leave it in 2 L-shape metal pieces (moulds) at room temperature and then overnight in the refrigerator.



Fill the mould with paraffin wax

Sectioning:

1. The tissue are cut producing 5µm sections with a microtome.
2. The cut sections are floated on a water bath to remove wrinkles,
3. The sections are transferred by hand to glass slides. Adhesives used for fixing the sections on the slides: Albumin

Solution “Mayor’s egg albumin”

(egg albumin +glycerin+ thymol).

4. Take the slides to oven (60°C) for 20-30 min.

Staining

Remove the paraffin from

tissue slides by Xylene:

Xylene 1 for 10 min.

Xylene 2 for 10 min.

Xylene 3 for 10 min.

Rehydration: using a series of alcohol washings rehydrates the tissue by:

100% ethnol alcohol for 3-5 min.

90% ethnol alcohol for 3-5 min.

80% ethanol alcohol for 3-5 min.

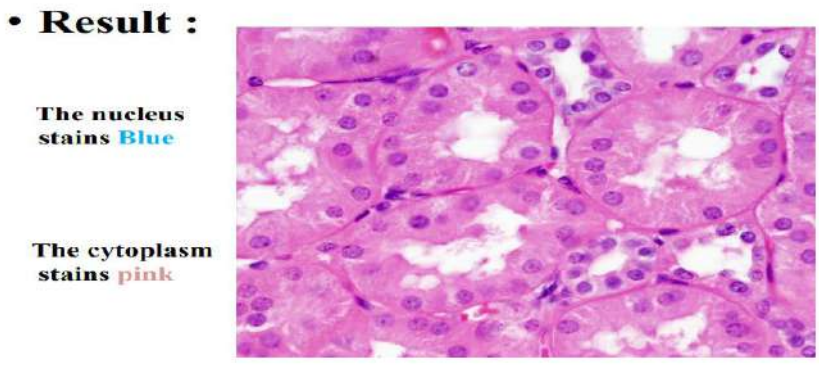
70% ethanol alcohol for 3-5 min.

Wash with tap water.

Classification of used stains:

• Basic stains (ex. Hematoxylin for 3-5 min) gives the acidic structures in the tissue (like nuclei) the blue color

• Acid stains (ex. Eosin few seconds) gives the basic structures in the tissue (like endoplasmic reticulum) the red color.



المختبر الرابع : النسيج الطلائي

Epithelial tissues:

Classification of epithelial tissue

The epithelial tissue can be divided into two groups:

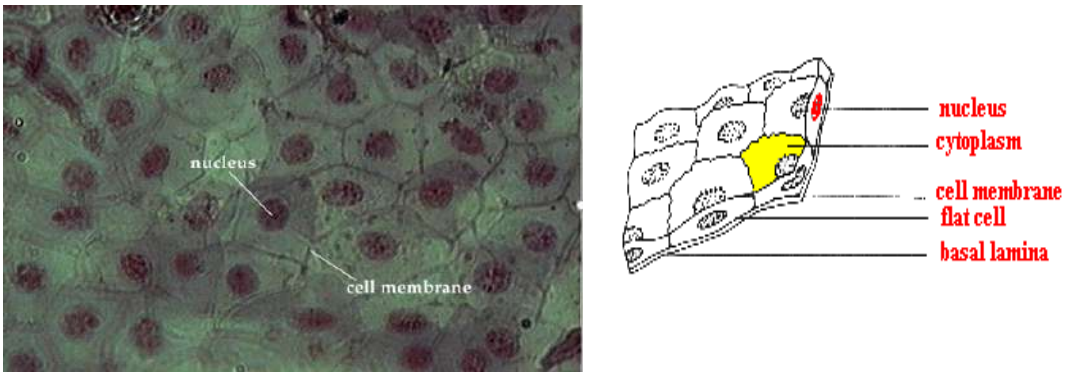
1- Covering and lining epithelial tissue: which covers the outer surface of the organ or lining its inner surface.

2- Glandular epithelial tissue: These are clusters of epithelial cells that are highly specialized for the function of secretion, which may be in the form of hormones, enzymes, fatty or mucous substances, or others.

Another classification on the basis of the number of cell layers and the shape of the cells in the surface layer. If there is only one layer of cells in the epithelium, it is designated simple. If there are two or more layers of cells, it is termed stratified.

Simple squamous epithelial tissue:

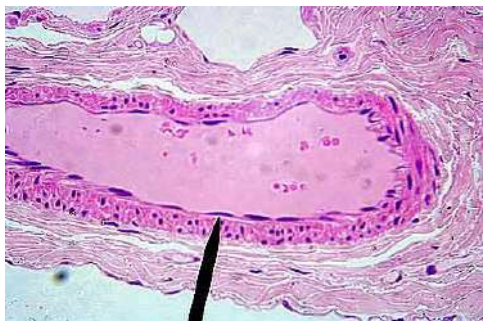
This type is composed of a single layer of flattened, scale- or plate-like cells. It is quite common in the body. The large body cavities and heart, blood vessels and lymph vessels are typically lined by a simple squamous epithelium. The nuclei of the epithelial cells are often flattened or ovoid, i.e. egg-shaped, and they are located close to the centre of the cells.



Simple squamous epithelial tissue

Epithelium also lines the large internal body cavities, where it is termed mesothelium.

the internal surfaces of blood and lymph vessels are lined by epithelium, here called endothelium.

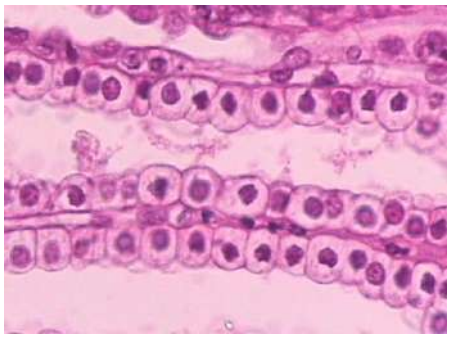


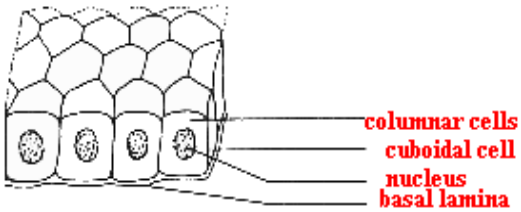
Simple Squamous Epithelium (Endothelium)

Simple cuboidal epithelial tissue:

Cells appear cuboidal in sections perpendicular to the surface of the epithelium, round central nuclei.

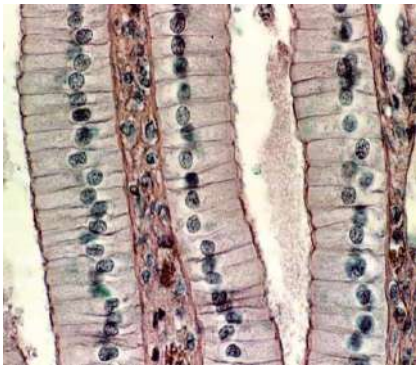
Simple cuboidal epithelium found in small excretory ducts of many glands, the follicles of the thyroid gland, the tubules of the kidney and on the surface of the ovaries.

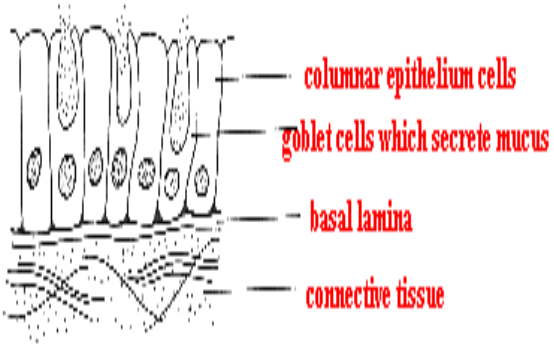




Simple columnar epithelial tissue:

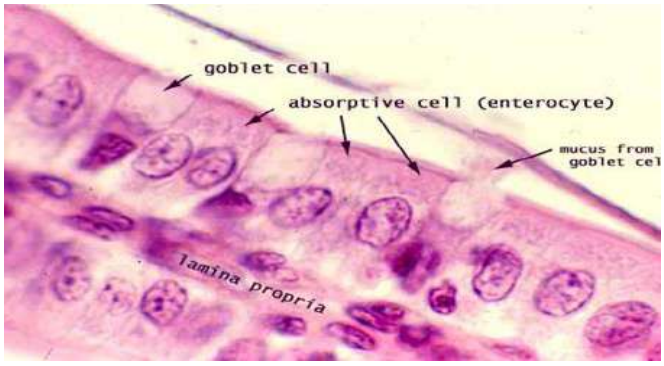
The cells are taller than they are wide. The nuclei of cells within the epithelium are usually located at the same height within the cells - often close to the base of the cells. An example is the cells lines the internal surface of the gastrointestinal tract (GIT) from the cardia of the stomach to the rectum.





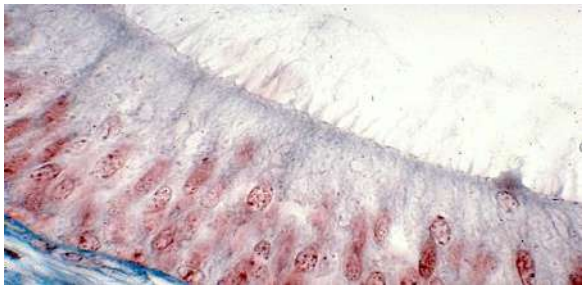
Simple columnar epithelial tissue

Goblet cells are scattered among the absorptive cells in the epithelium of the small intestine and colon. These epithelial cells are specialized for secretion of mucus, which facilitates passage of material through the bowel. The name "goblet" refers to the cell's shape, narrow at the base and bulging apically. (Similar cells may also be found in the respiratory and reproductive tracts)



brush border cover the apical border with microvilli of intestinal epithelium. Note the size of the microvilli relative to the cells that they cover.

Stereocilia: are found in the male reproductive tract and are thought to facilitate absorption in the epididymis and ductus deferens. Note their large size compared to microvilli.



Simple Columnar Ciliated Epithelium:

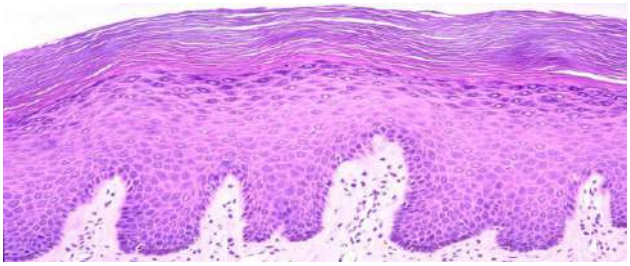
When simple columnar epithelial tissue covered with cilia which are much longer than microvilli . Each cilium consists of a projection of the plasma membrane and is actively motile, beating in a synchronous rhythm to move fluid in a constant direction. Cilia are commonly found in the respiratory tract and female reproductive tract.

Stratified Squamous Epithelium Non-keratinised

Consists of squamous (flattened) epithelial cells arranged in layers upon a basement membrane. Only one layer is in contact with the basement membrane; the other layers adhere to one another to maintain structural integrity. In the deeper layers, the cells may be columnar or cuboidal. It forms the inner lining of the mouth, esophagus, and vagina.

Stratified Squamous Keratinized

Have two or more layers of cells, with a superficial squamous layer and basal layers that are usually cuboidal or columnar. The nuclei of these cells become condensed and eventually disappear as they reach the outermost layers. They are found in skin.

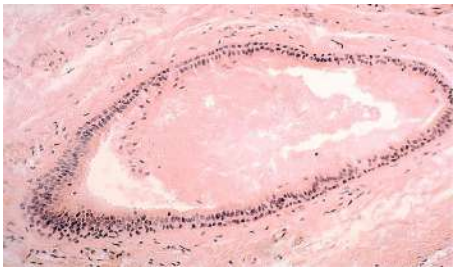


Stratified Columnar and Cuboidal Epithelia

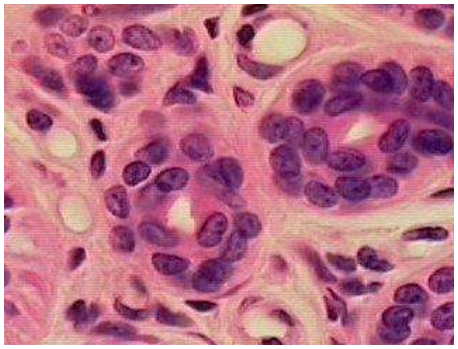
Basal cells are typically cuboidal with surface cells either columnar or cuboidal in appearance.

These types can be found in the larger ducts of various glands, including the pancreas, salivary, and sweat glands.

Stratified squamous types and transitional are the only epithelial consisting of multiple cell layers.



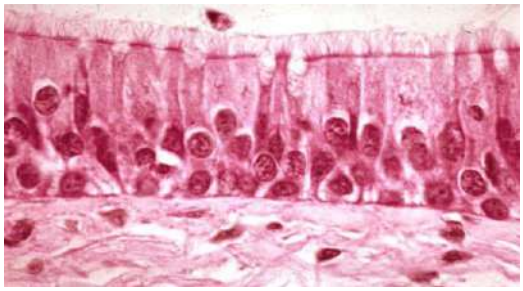
Stratified Cuboidal Epithelium:



Pseudostratified Epithelial cells:

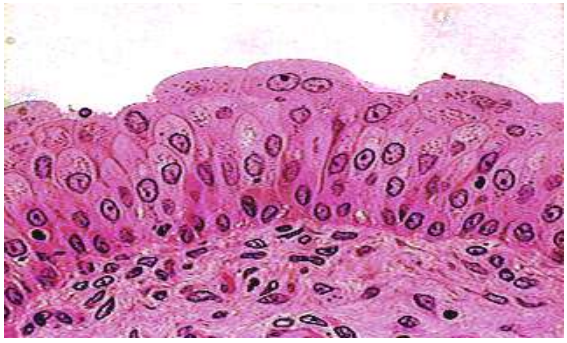
cells become so crowded that some of the nuclei become displaced and several rows of nuclei appear in sections of the cell sheet, even though each cell is still attached to the basement membrane.

commonly found along the respiratory airways; the cilia of these epithelia propel mucous and particles toward the pharynx and out of the airways.



Transitional Epithelium:

Transitional epithelium in the human ureter and renal pelvis. Two diagnostic characteristics of transitional epithelium are: luminal cells (1) are sometimes binucleate and (2) "balloon" out into the lumen giving an uneven appearance to the luminal surface.



Transitional epithelial tissue

Connective tissue

A kind of animal tissues that supports, connects, or separates different types of tissues and organs of the body. It is one of the four general classes of animal tissues (epithelial, muscle, and nervous tissues).

Connective tissue is the most abundant type and found everywhere in the body.

Functions:

1-Storage of energy.

2-Protection of organs.

3-Provision of structural framework for the body.

4-Connection of body tissues.

5-Nutritional support to epithelium.

6- Site of defense reactions.

Structure of Connective Tissue:

1. Ground substance - A clear, colorless, and viscous fluid containing glycosaminoglycans and proteoglycans (to fix the body water and the collagen fibers in the intercellular spaces).

In bone the ground substance includes minerals.

In blood, the ground substance is fluid (plasma).

2. Fibers**:** Not all types of CT are fibrous. Examples of non-fibrous CT include adipose tissue and blood.

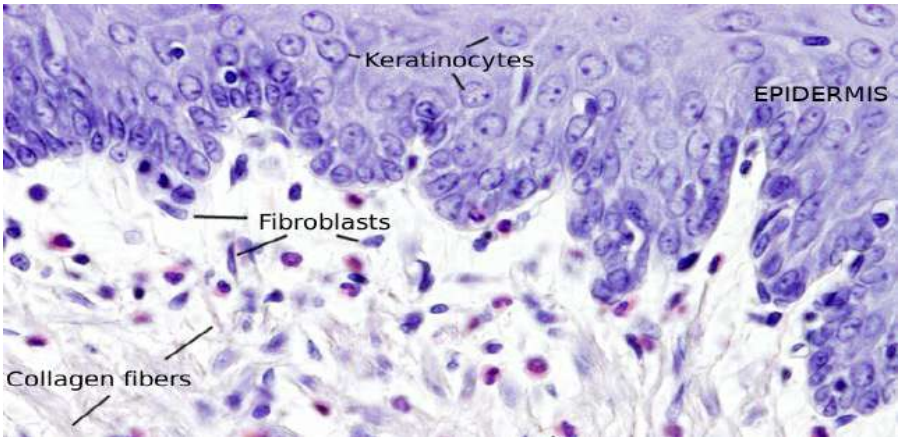
** Together the ground substance and fibers make up the extracellular matrix

3. Cells are spread through an extracellular fluid.

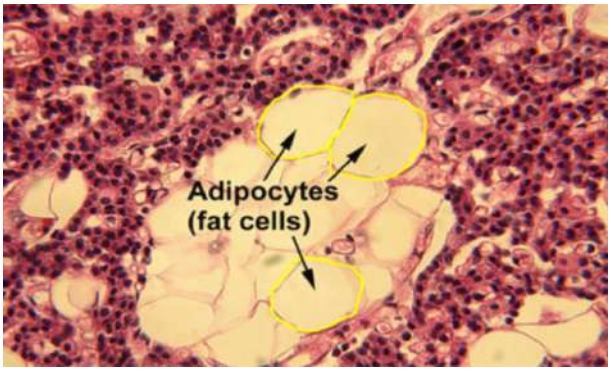
Mesenchyme cells: unspecialized cells capable of developing into connective tissue: bone, cartilage, lymphatics and vascular structures.

Fixed or resident cells:

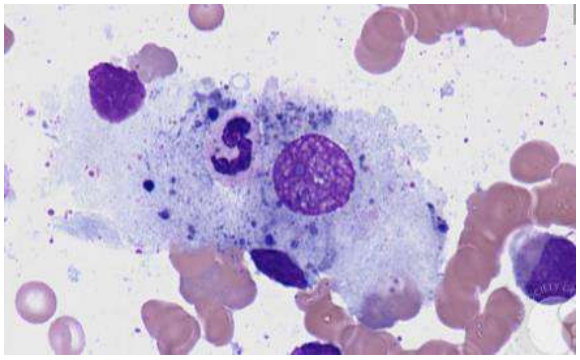
1- Fibroblasts: these are stem cells with multiple processes , basophilic cytoplasm, and large rounded nuclei . In resting phase; these cells appear spindle shaped with long tapering ends and are called fibrocytes. The main function is to synthesize and maintain the extracellular matrix of tissues.



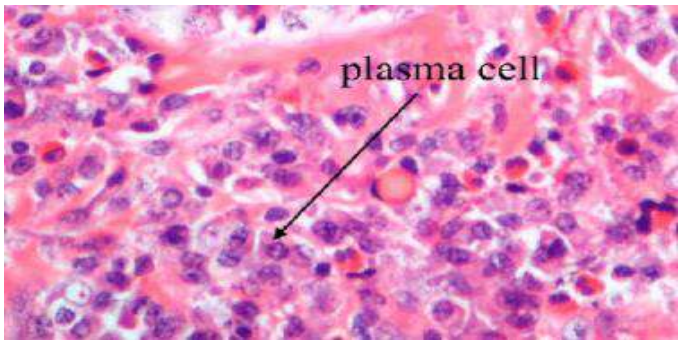
2-Adipose or fat cells: these cells are spherical/oval in shape, each of the cells accumulate lipid to such an extent that nucleus flattened to one side and cytoplasm becomes so thinned.



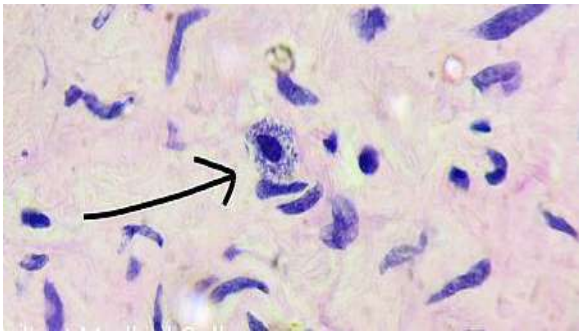
Macrophage: originate from blood **monocytes**. Once a monocyte leaves the blood, it matures into a wandering macrophage or a fixed macrophage. Wandering macrophages travel throughout both blood and lymph streams to perform their job. This cell can modulate their shape, the nucleus tends to be smaller darkly stained, lies at one end of the cell. The cytoplasm contains granules and vacuoles.



Plasma cells (plasma B cells): ovoid cells with a slightly eccentric, oval or round nucleus and basophilic cytoplasm, the chromatin in the nucleus is arranged in a radial pattern, giving it a car wheel (clock face) appearance. These cells secret antibodies.

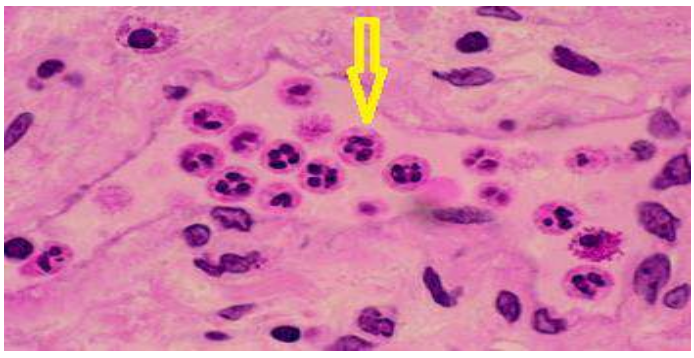


Mast cells: these cells are round or ovoid in shape. The nucleus is round and small, the cytoplasm is packed by stained granules. These cells contain heparin and histamine. Special stains are required to identify mast cells in connective tissue.



Lymphocytes: small cells with round nuclei and minimal cytoplasm.

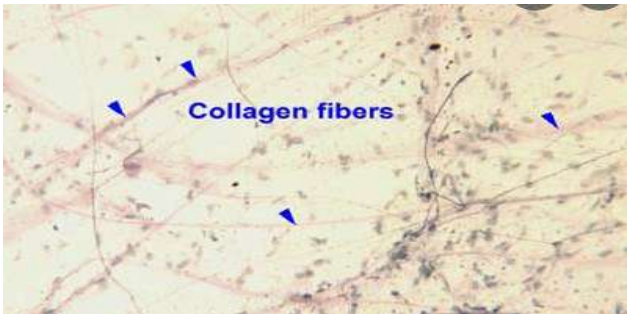
Neutrophil: they show no special affinity for either acidic or basic stains but are stained mildly by both. The nuclei of mature neutrophils are elongated and pinched into several distinct lobes.



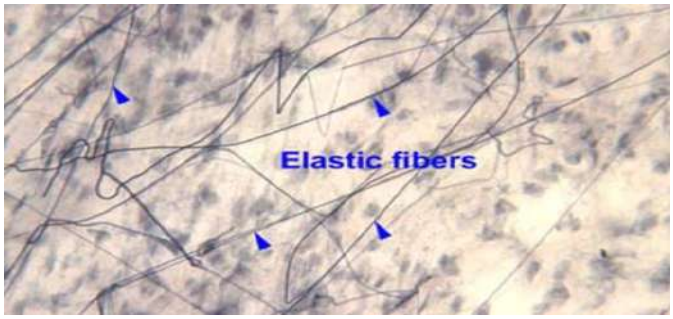
Connective tissue

Fibers :

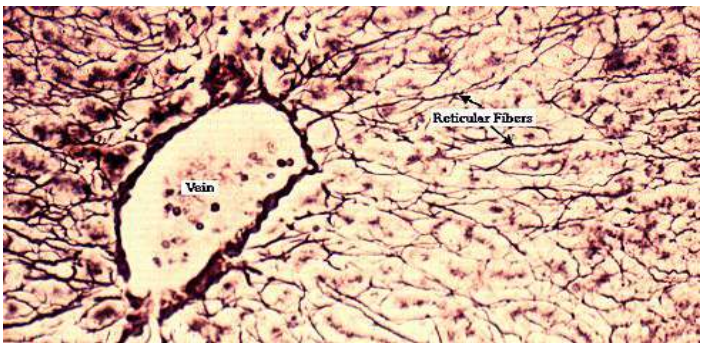
1- Collagen Fibers: elongated fibers made up of collagen glycoproteins ,



2-Elastic fibers: contain elastin and fibrillin, provides a high elasticity to the tissue, as well as a yellowish color.



3-Reticular fibers: They are composed of branched and anastomosed fibers (type III collagen), it occurs as thin sheets.

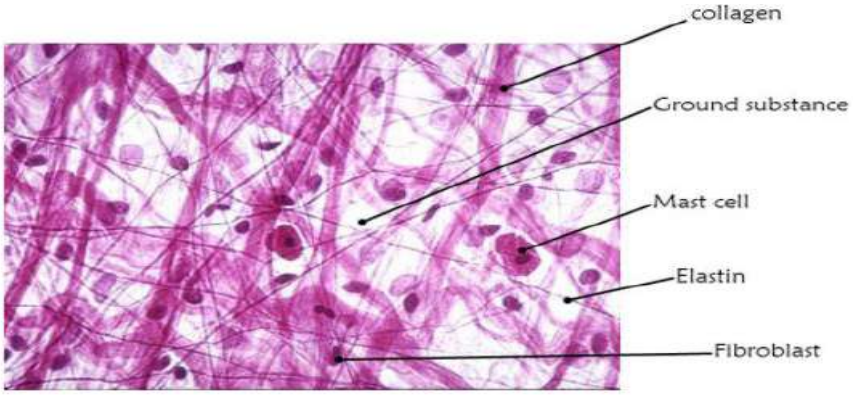


Types of connective tissues:

Areolar Connective Tissue

The extracellular matrix contains scattered collagen and elastic fibers, and much less abundant reticular fibers. This tissue plays a fundamental role in nourishing other tissues and organs since nutrients easily diffuse through the ground component of the extracellular matrix.

This tissue fills spaces between the skin and muscles. Also found in kidney, livers, testis, and many others.



Adipose Connective Tissue:

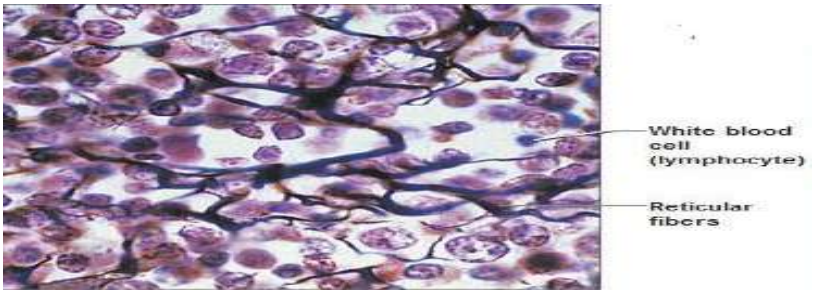
Composed of adipocytes (around 80% fat). Its main role is to store energy in the form of lipids.
Found: subcutaneous layer; around organs; in yellow marrow.

Reticular Connective Tissue

resembles areolar connective tissue, but the only fibers in its matrix are the reticular fibers, which form a delicate network.

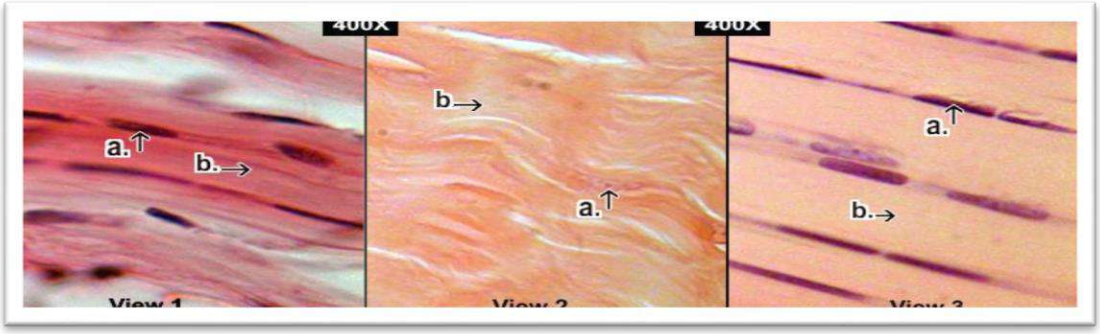
Found as framework (scaffold) that can support lymph nodes, spleen, and bone marrow.

There are many cells like lymphocytes, adipocytes, macrophages and many others. Thus, cell density is higher than in other connective tissues.



Dense regular C.T:

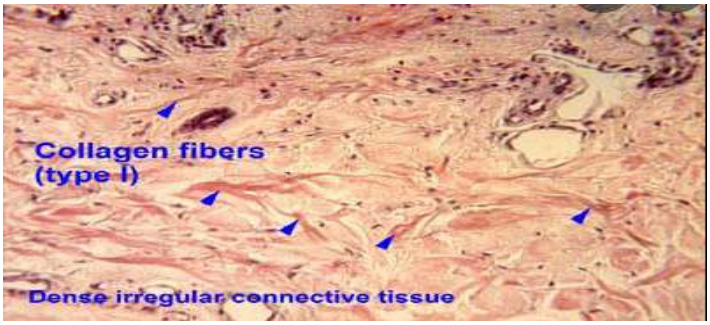
Collagen fibers in the extracellular matrix arranged in parallel bundles or sheets. Found in tendons, ligaments, and sheaths surrounding skeletal muscles.



a long narrow nucleus of a fibroblast
b collagen fibers

Dense Irregular Connective:

Has large amounts of collagen fibers grouped in thick bundles forming a tridimensional network (the direction of fibers is random). Found in the dermis of the skin.



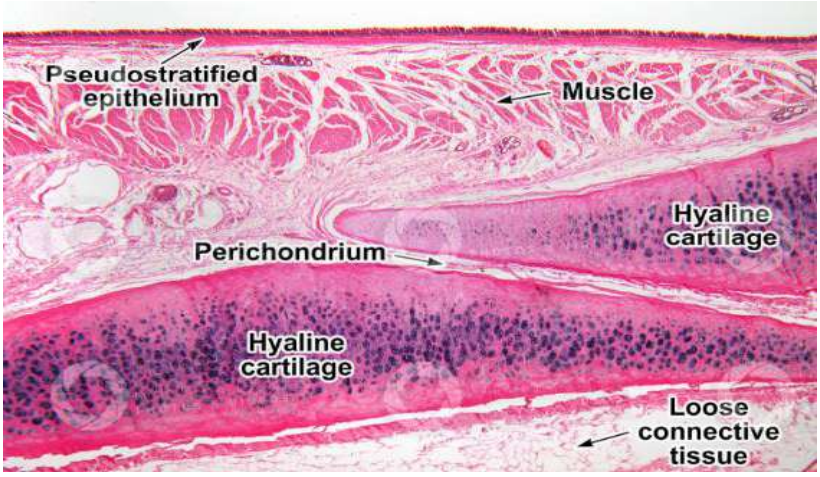
Cartilage:

A type of connective tissue in the body It is made of cells embedded in a matrix, strengthened with fibers of collagen and sometimes elastin, depending on the type of cartilage.

Cartilage is avascular, meaning that it is not supplied by blood vessels; instead, nutrients diffuse through the matrix.

In early development, the greater part of the skeleton is cartilaginous, but, during later stages of development, the cartilage is remodeled and replaced by bone.

Serves to provide structure and support to the body's other tissues without being as hard or rigid as bone. It can also provide a cushioning effect in joints. Cartilage found in the ears, nose, ribcage, and intervertebral discs.



Cartilage contains:

1- Chondroblasts cells that produce cartilage, and, in mature cartilage where the cells are housed in lacunae, they are termed chondrocytes.

2. Chondrocytes: may be single or arranged in groups 2,4, or 8 cells (isogenous grouping) within single smooth-walled spaces or lacunae, with centrally placed large spherical nuclei.

3. Fibrous connective tissue (dense connective tissue) embedded in an abundant and firm matrix. In addition to Elastic fibers that oriented in all directions within the matrix, elastic fibers give flexibility to the cartilage

4. Matrix: The matrix is composed of ground substance (protein polysaccharide) and connective tissue fibers. It fills the space between chondrocytes. The matrix contains collagenous and elastic fibers

5. Perichondrium: is a layer of dense irregular connective tissue_that surrounds the cartilage of developing bone , Fibrous perichondrium tissue also allows oxygen and nutrients to flow without obstruction.

7. Capsule: The walls of the lacunae are referred to as a capsule. The capsule is a condensation of the matrix surrounding the lacunae.

Types of cartilage:

1-Hyaline cartilage: makes up the majority of the body's cartilages. It persists in human adults at the ends of bones (in joints), helping them to articulate (connected) smoothly. Hyaline cartilage contains mostly type II collagen fibers but relatively little elastin with large amounts of water, allowing high diffusion rate.

Found in :

1- On the surfaces of bone joints where it is called articular cartilage.

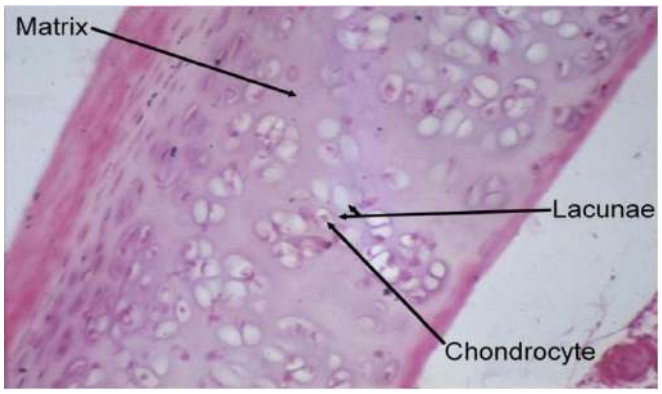
2- Ends of ribs

3- Nose

4- Larynx .

5-Trachea

Undergoes calcification in bone formation and also as part of aging process.



2-Elastic cartilage:

Is more flexible than the other types of cartilage because of high concentration of elastin fibers.

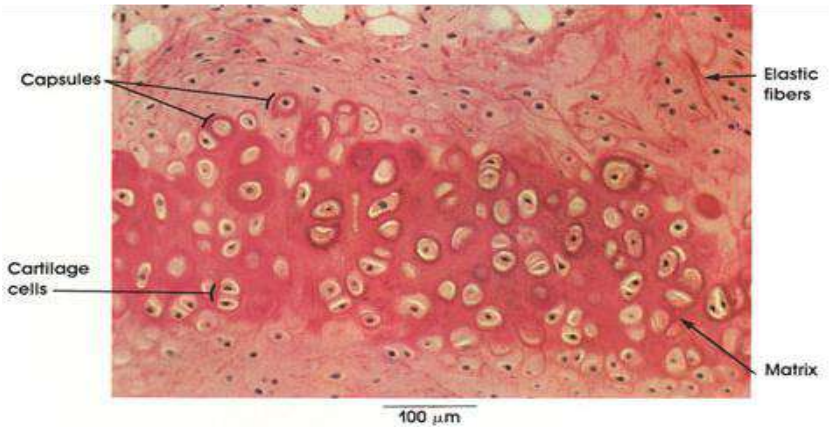
This type of cartilage is found in:

1- The outer ear, the larynx,

2- The Eustachian tubes.

It provides the perfect balance of structure and flexibility and helps keep tubular structures open.

This cartilage does not calcify



3- Fibrocartilage:

The strongest and most rigid type of cartilage. **It has** large numbers of collagen (type I) fibers.

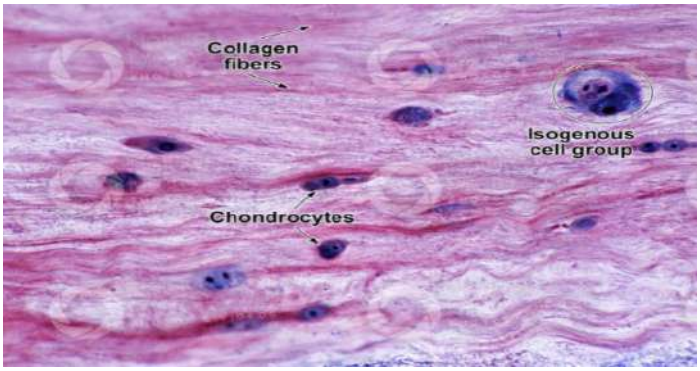
A. Contains very large bundles of collagen fibers with lees cells that arranged in scattered clusters

B. Has no identifiable perichondrium.

C. Appears to be a gradual transition between dense connective tissue and hyaline cartilage.

D. Found at connection of tendons to bone and intervertebral discs.

*Damaged hyaline cartilage is often replaced with fibrocartilage, which unfortunately does not bear weight as well due to its rigidity.



Muscular tissues:

Muscle function:

1. Skeletal Stability and Organ Protection

2. Internal Organ Function

3. Produce energy in heat form.

4- Blood Circulation

5- Different types of Movement

Morphological classification (based on structure)

There are two types of muscle based on the morphological classification system

1. Striated
2. Non striated or smooth.

Functional classification:

There are two types of muscle based on a functional classification system

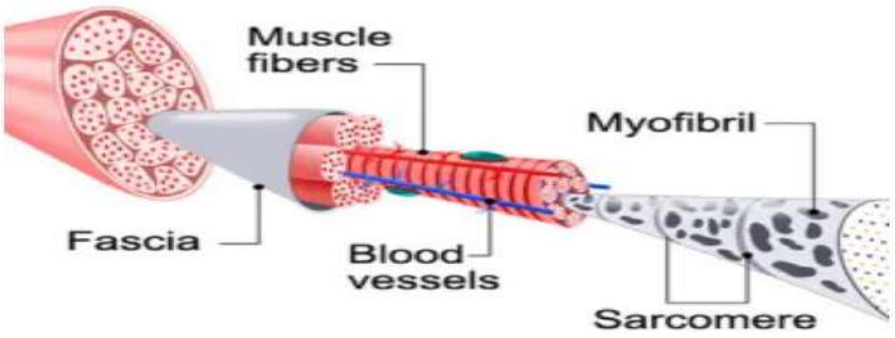
1. Voluntary
2. Involuntary.

Muscle terminology

Muscle fiber or Myocyte or Myofiber: is a muscle cell which are composed of many myofibrils

Myofibril: is a basic rod-like unit of a muscle cell which are composed of sarcomeres.

Sarcomere is the basic contractile unit (functional unit) of muscle fiber. Each **sarcomere** is composed of two main protein filaments—**actin** (thin filament).and **myosin** (thick filaments) —which are the active structures responsible for muscular contraction.



Sarcolemma (myolemma) : is the cell membrane of a **striated** muscle fibers.

Sarcoplasm: the cytoplasm of the muscle cell (myofiber).

Components vital for contraction:

- Sarcolemma

- Sarcoplasmic Reticulum: the endoplasmic reticulum of a muscle cell. It is the main intracellular calcium store

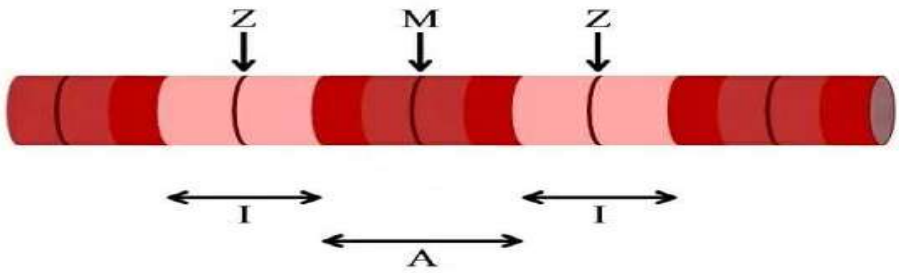
- Sarcosome: the mitochondria of a muscle cell.

- Calcium

sarcomere zones

A band: higher content of myosin filament, maintained a constant length during contraction

I bands contain thin filaments, **Z lines** or discs that give sarcomeres a striped appearance under a light microscope , **M line**, or middle division.



There are three types of muscle in the human body.

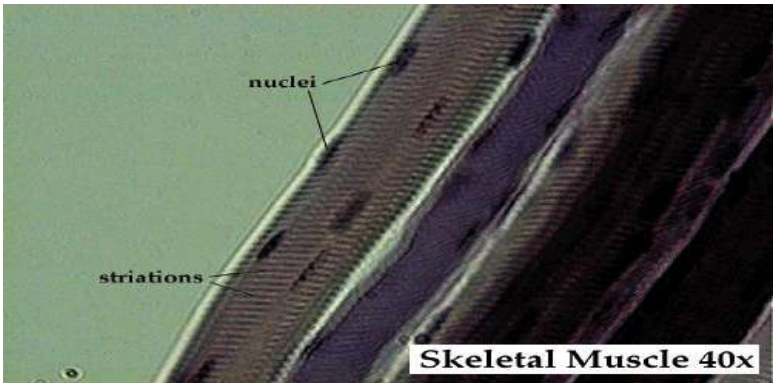
Skeletal muscle: which is striated and voluntary

Cardiac muscle: which is striated and involuntary

Smooth muscle: which is non striated and involuntary

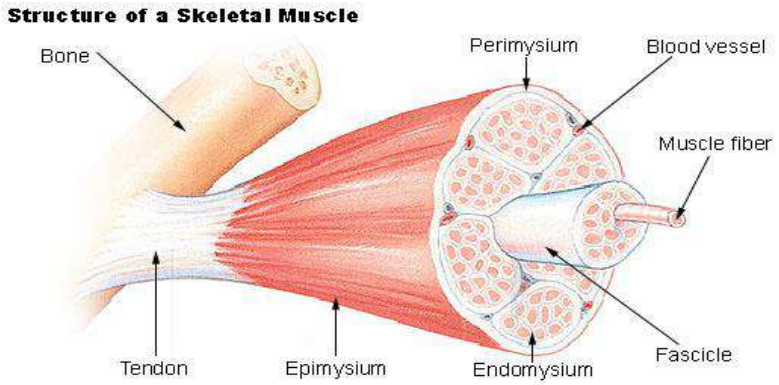
Characteristics of skeletal muscle:

Skeletal muscle cells are elongated or tubular. They have multiple nuclei and these nuclei are located on the periphery of the cell. Skeletal muscle is striated. That is, it has an alternating pattern of light band (I-band) and dark bands (A-band) bands. Skeletal muscle makes up the voluntary muscle so it is present in muscles of the limbs and trunk.



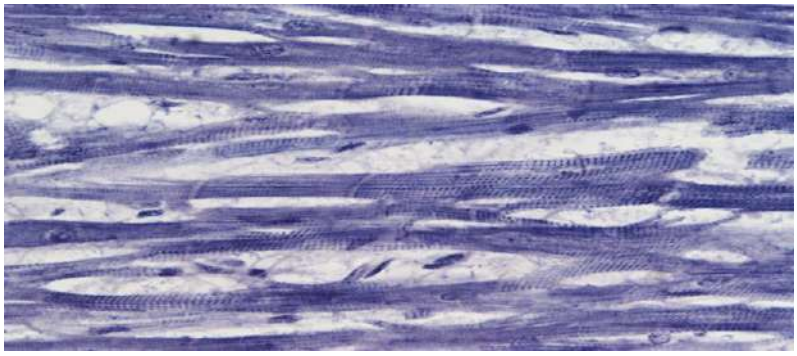
The entire muscle is surrounded by a connective tissue called the epimysium.

The muscle is made up of smaller bundles known as fascicles. The fascicles are actually bundles of individual muscle cells (known as myocytes or muscle fibers). Each muscle cell is surrounded by a connective tissue sheath known as the endomysium. These bundles are surrounded by a connective tissue sheath called the perimysium.



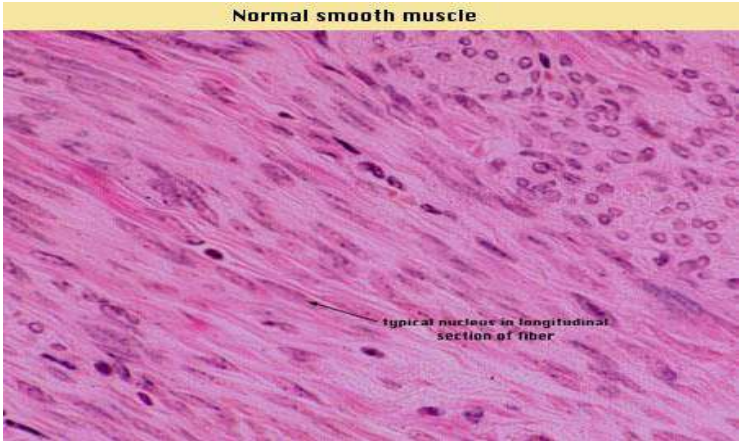
Characteristics of Cardiac muscle:

Cardiac muscle cells are not as long as skeletal muscles cells and often are branched cells. Cardiac muscle cells may be mononucleated or binucleated. In either case the nuclei are located centrally in the cell. Cardiac muscle is also striated. In addition cardiac muscle contains intercalated discs. Example of cardiac muscle is the muscle of the heart.



Characteristics of Smooth muscle:

Smooth muscle cell is described as spindle shaped. They are wide in the middle and narrow to almost a point at both ends. Smooth muscle cells have a single centrally located nucleus. Smooth muscle cells do not have visible striations although they do contain the same contractile proteins as skeletal and cardiac muscle. Smooth muscle is present in muscle of stomach, intestine, urinary and genital tracts, and in walls of blood vessels.



Bone

Specialized dense connective tissue, where the matrix is impregnated with calcium salts making it hard and rigid.

Basic functions of bone:

1- The basic unit of the human skeletal system.

2- Provides the framework.

3- Bears the weight of the body.

4- Protects the vital organs.

5- Supports mechanical movement.

6- Blood formation (haematopoiesis).

Terminology of bone

Epiphysis; is the rounded end of a long bone, at its joint with adjacent bone(s).it is filled with red bone marrow which produce erythrocytes (red blood cells).

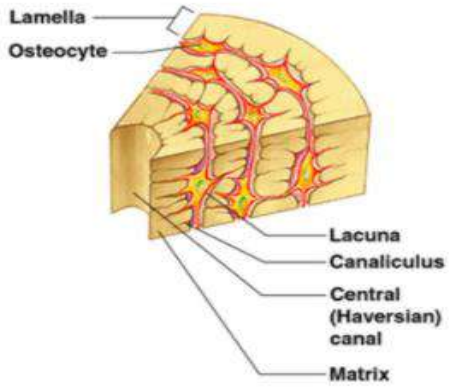
Diaphysis ; is the long midsection of the long bone.

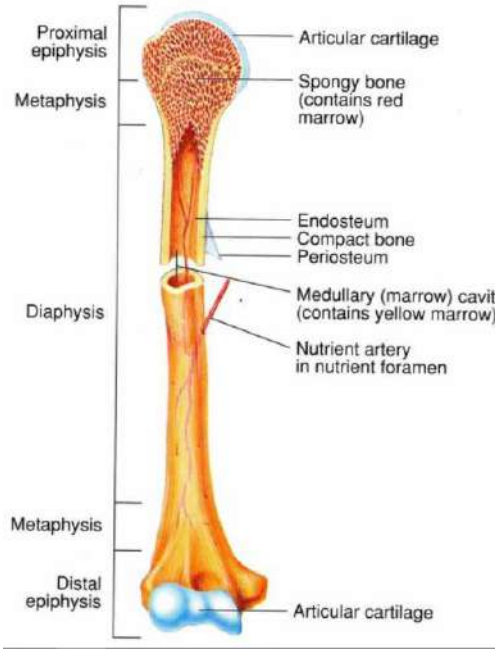
Metaphysis; is the section Between
the epiphysis and diaphysis which include epiphyseal plate (growth plate).

Endosteum; is a thin, soft, connective tissue, lining the cavity of long bones like Humerus and Femur.

Periosteum; is a membrane that covers the outer surface of most bones.

Osteocyte: is the bone cell; an oblate shaped with dendritic processes. Osteocytes are present in lacunae; their cytoplasmic processes contact each other through the canaliculi.

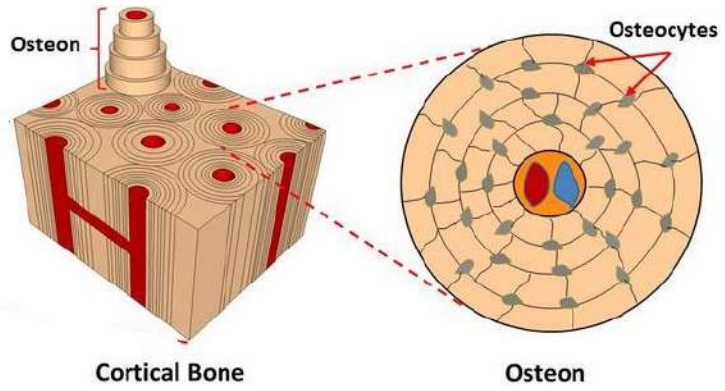


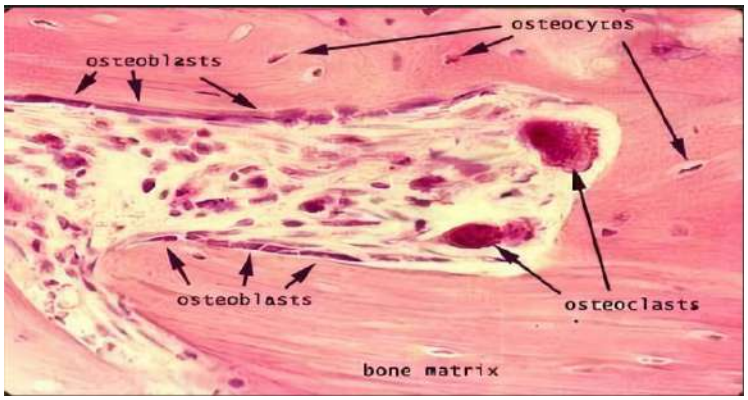


Osteoblast: A cell that makes bone. It does so by producing a matrix that then becomes mineralized. Bone mass is maintained by a balance between the activity of osteoblasts that form bone and other cells called osteoclasts that break it down.

Osteoclast: A cell that nibbles at and breaks down bone and is responsible for bone resorption. Osteoclasts are large multinucleate cells that differentiate from another type of cell called a macrophage.

Osteon: the chief structural unit of compact bone consisting of Concentric bone layers called lamellae, the Haversian canal and osteocytes.



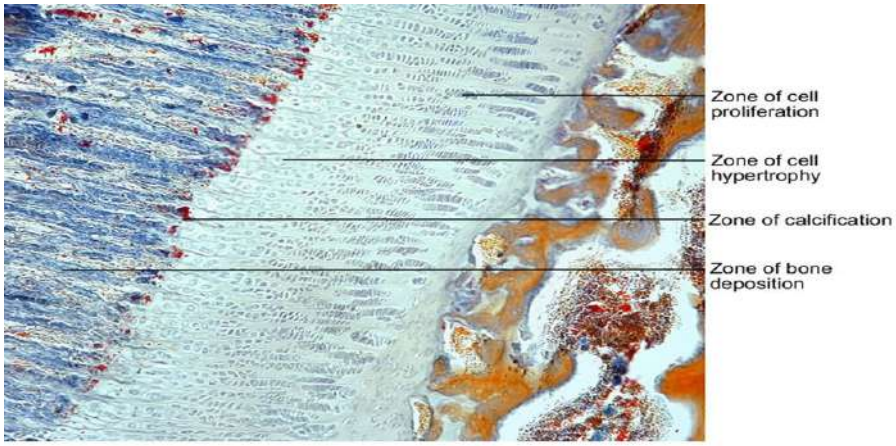


Remodeling of bone: is a continuous process, in which damaged bone is repaired, ion homeostasis is maintained, and bone is reinforced for increased stress; entire remodeling cycle requires ~ 6 months.

Cement line (reversal line):

Is evidence of previous remodeling activity; it is formed by filling of new bone in a previously resorbed cavity. It is normally found in the harversian and interstitial systems of adult bone.

Endochondral ossification is a process where bone replaces cartilage. It occurs during fetal development and throughout childhood as the bones of the body grow. This process usually occurs in growth plate.



Endochondral Ossification (100x)

Classification of bone

Bone tissue can be classified according to:

1- Texture

2- Matrix arrangement.

3- Developmental origin

4- Size

Based on **texture,** bone tissue can be classified as:

Compact bone (dense bone, cortical bone)

Spongy bone (trabecular bone, cancellous bone)

Based on **developmental origin**, bones can be classified as:

Intramembranous bone (mesenchymal bone)

Intracartilaginous bone (cartilage bone)

Based on **matrix arrangement**, bone tissue can be classified as:

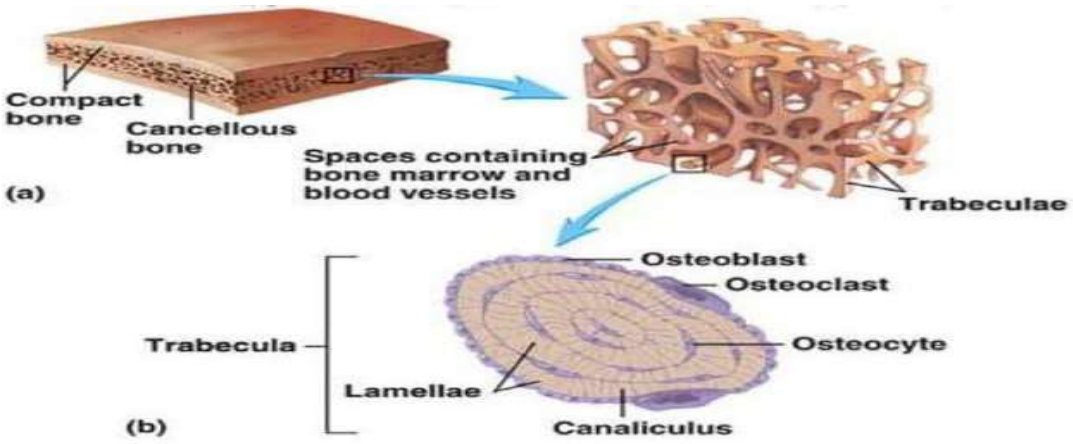
Woven bone (primary bone tissue)

Lamellar bone (secondary bone tissue)

Based on **size**, bones can be classified as; Long bone and Short bone

Compact bone (dense bone, cortical bone): is ivory like and dense in texture without cavities. consists mainly of Haversian systems (osteons).

Spongy bone (trabecular bone, cancellous bone): Spongy bone is so named because it is sponge like with numerous cavities. Found in the medullary cavity . osteons are usually absent in spongy bone.



Intramembranous bone (mesenchymal bone):

develops from direct transformation of condensed mesenchyme. Ex: Flat bones.

Intracartilaginous bone (cartilage bone):

endochondral bone forms by replacing reformed cartilage model. Ex: Long bones.

Woven bone (primary bone tissue):

Is immature bone, in which collagen fibers are arranged in irregular random arrays.

Lamellar bone (secondary bone tissue):

Is mature bone with collagen fibers that are arranged in lamellae

المختبر العاشر: جهاز الدوران

Circulatory system

Two sub systems:

Cardiovascular system & lymphatic system

The blood and lymph are classified as specialized connective tissues. The main functions of the blood are to transport oxygen, nutrients and hormones to the tissues and to collect the waste products (carbon dioxide and waste metabolites) for removal from the body via the excretory system.

Cardiovascular System consists of the:

Heart (muscular pump)

Vessels (Blood and Lymph vessels)

Blood and Lymph.

Cardiovascular system can be divided into:

Pulmonary circulation (system of blood vessels to and from the lungs)

Systemic circulation (system of blood vessels bringing blood to and from all the other organs of the body).

Blood vessel, a vessel in the human or animal body in which blood circulates.

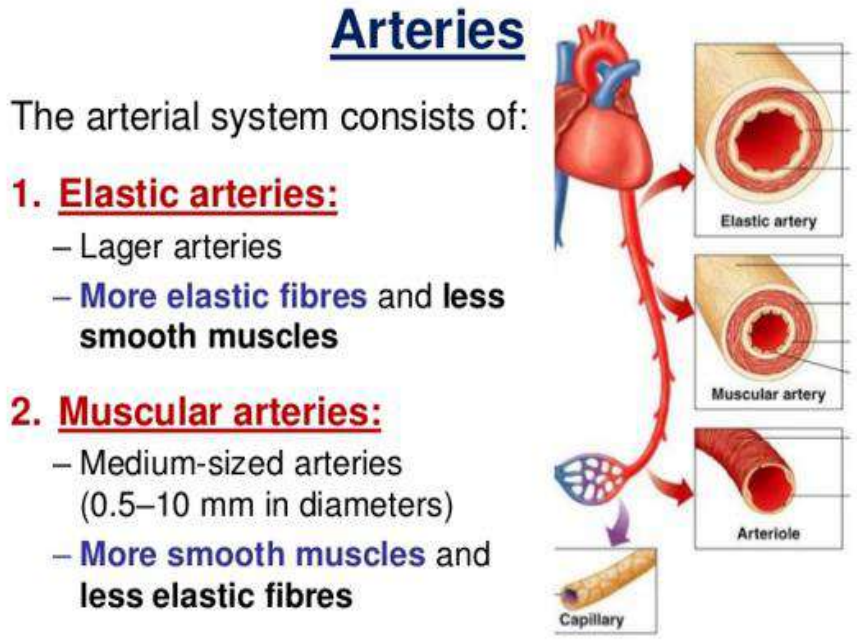
. Arteries: thick walled vessels carry blood away from the heart.

. Arterioles: very small branches of arteries.

. Veins: thin walled vessels, provided with **valves**, carry blood to the heart.

. Venules: very small branches of veins that collect the blood from the various organs.

Capillaries are minute thin-walled vessels that connect the arterioles and venules.



Arteriole

- Small arteries with diameter - less than 100 µm
  - Larger Arterioles: 50-100 µm
  - Terminal Arterioles: < 50 µm
- Arise from the muscular arteries & deliver blood to capillaries
- Wall is relatively thicker than the lumen
- Specialized for controlling blood flow -
- Major determinant of systemic blood pressure

Types of veins:

1. Large sized veins.
2. Medium sized veins.
3. Venules

Capillaries

Are tiny blood vessels that transport blood, nutrients and oxygen to cells in your organs and body systems. Average diameter 8 µm. Site of exchange of gases, nutrients and metabolic wastes.

Continuous capillaries

They are called continuous because these cells sit close together, one after the other.

- **Continuous non-fenestrated capillaries:**

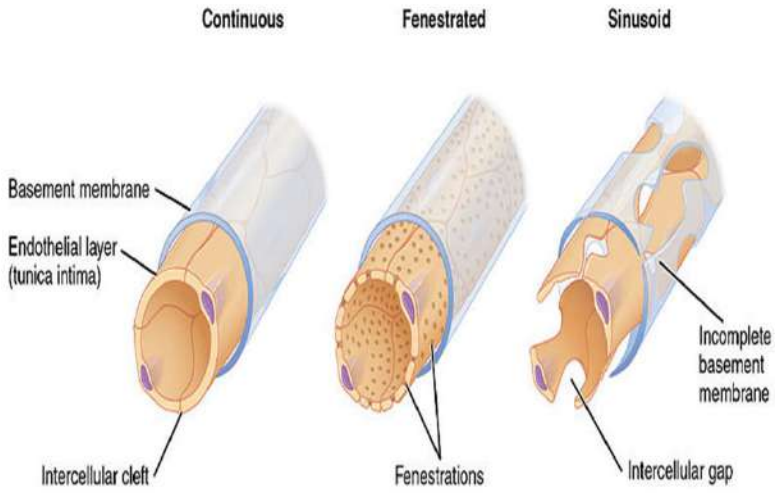
have a lining that contains pores that let only small molecules pass through. These molecules include water, glucose, hormones and gases.

- **Continuous fenestrated capillaries:**

have larger openings (fenestrations) between the cells that allow the quick exchange of substances.

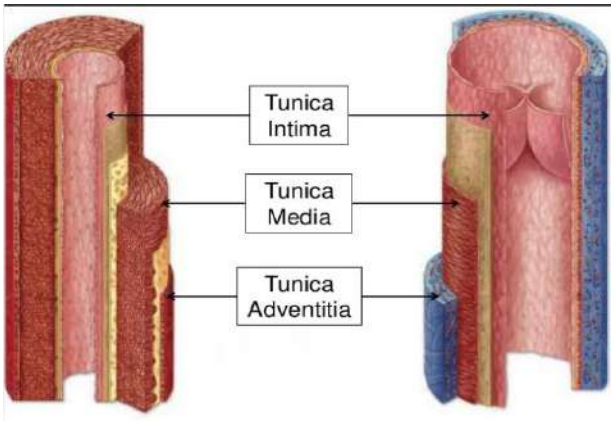
Sinusoids

is discontinuous. These capillaries have even larger gaps and pores.

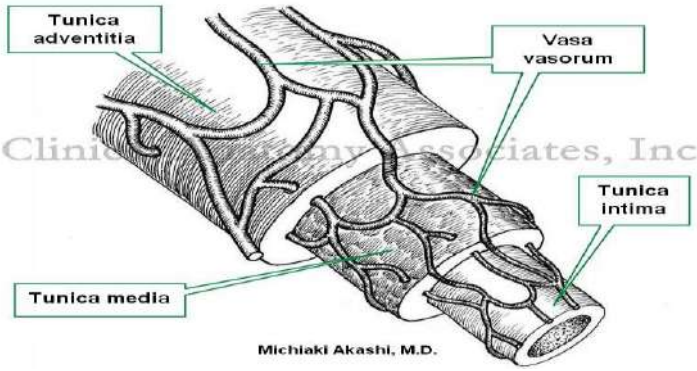


All blood vessels except capillaries have **3** concentrically arranged basic

Tunics or Coats



The **vasa vasorum** is a network of small blood vessels that supply the walls of large blood vessels, such as elastic arteries (e.g., the aorta) and large veins (e.g., the venae cavae).



vasa vasorum

Elastic fibres allow expansion during contraction (systole) and recoil during relaxation (diastole).