

The background of the slide is a microscopic image of connective tissue, showing a dense network of pink-stained fibers and scattered purple-stained nuclei. A semi-transparent blue horizontal band is overlaid across the middle of the image, containing the title text.

Connective tissue: Definition and Types

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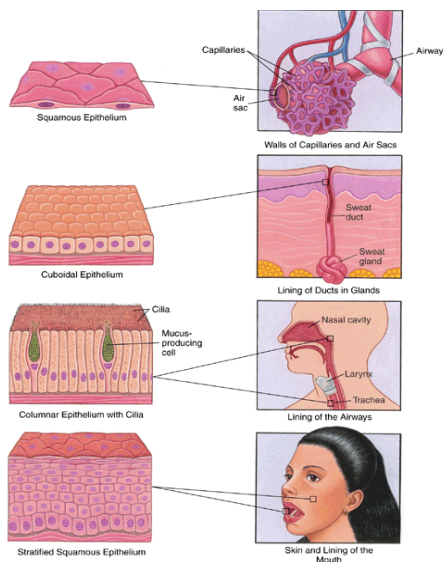
Types of Tissues

There are 4 major tissue types

- **Connective and supportive tissues**
 - **Connective Tissue**
 - Cartilage Tissue
 - Bone Tissue
 - Blood Tissue
- **Epithelial tissue**
 - Basement membrane
- **Muscle tissue**
 - Fasia
 - Supeficial, deep, visceral (parietal)
 - Ligaments
 - Aponeuroses
 - Tendons
- **Nerve tissue**
 - Central nervous system - Meninges, (cover the brain and spinal cord)
 - Dura mater
 - Arachnoid mater
 - Pia mater
 - Peripheral nervous system
 - Endoneurium
 - Perineurium
 - Epineurium

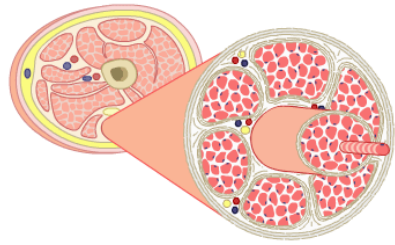
Major tissues

1. Epithelial tissue

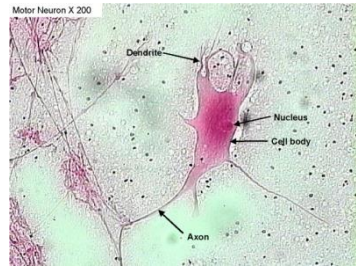


2. Connective and supportive tissues

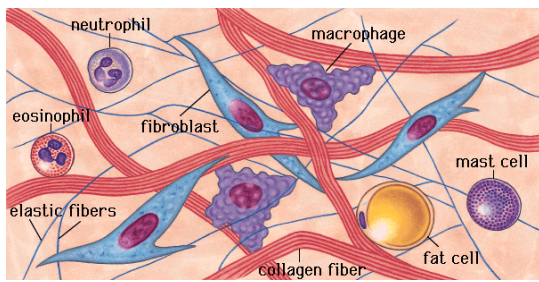
3. Muscle tissue



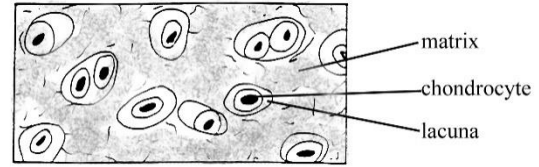
4. Nervous tissue



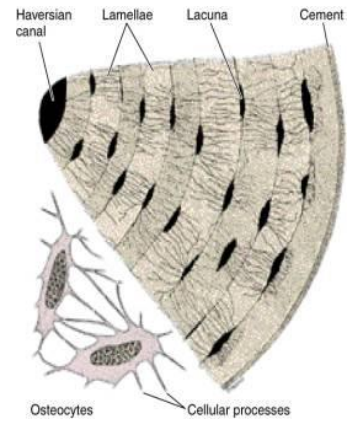
Connective tissue



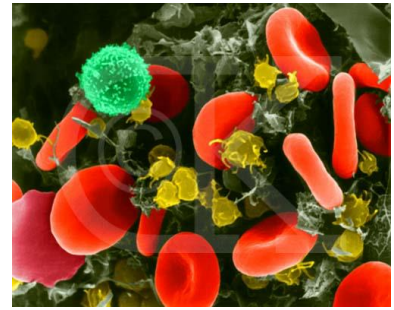
Cartilage tissue



Bone tissue



Blood tissue



Connective Tissue - Definition

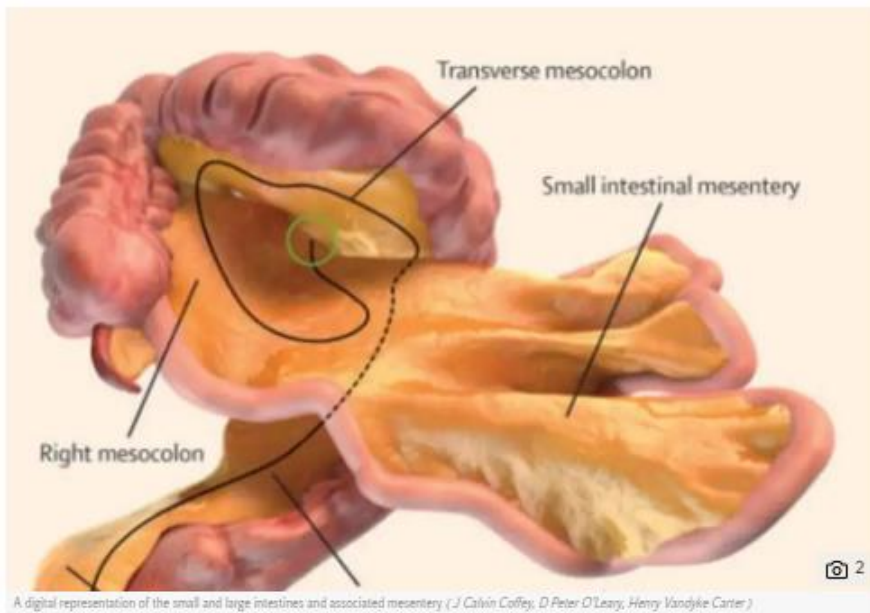
- Tissue composition that forms vast and continuous compartment throughout the body.
- **Connects** all the cells, tissues and organs
- **Supports** their morphologic, physiologic and metabolic structure (=stroma).
- Connective tissue has two components
 - **Cells** (storage of metabolites, immune response, tissue repair)
 - **Extracellular matrix (ECM)** [50-70% of a tissue (5% in epithelium)]
 - **Fibers** and fibrils = Fibrous = Collagens, Reticular fibers, Elastic fibers
 - **Ground substance** (*temel madde, ara madde*) =proteoglycans, glycoproteins, glycosaminoglycans

Mesentery: New organ discovered inside human body by scientists (and now there are 79 of them)

The finding opens up 'a whole new area of science'

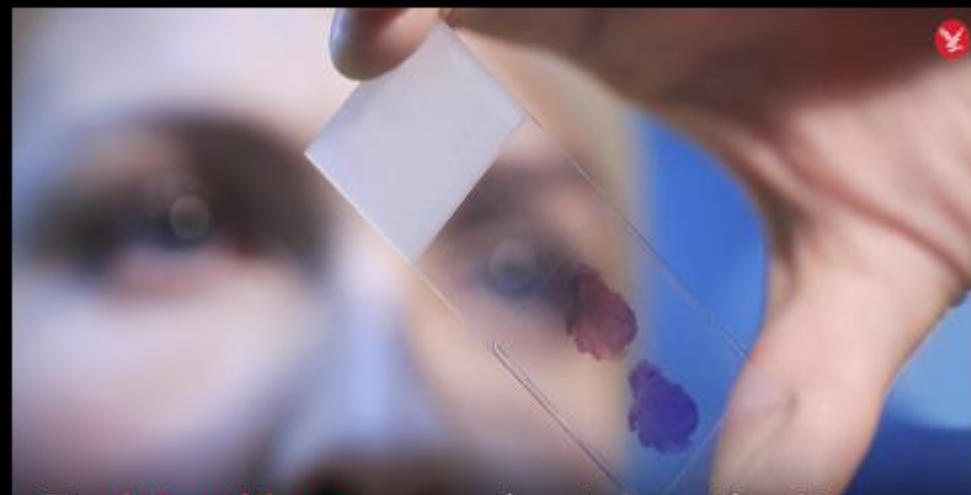
Tom Embury-Dennis | @tomemburyd | Tuesday 3 January 2017 17:27 |

56 comments



05.01.2017

Mesentery (*mezenter*): A contiguous set of tissues that attaches the intestines to the posterior abdominal wall in humans and is formed by the double fold of peritoneum. It helps in storing fat and allowing blood vessels, lymphatics, and nerves to supply the intestines, among other functions



The **interstitium** was previously unnoticed by scientists despite being **one of the largest organs**

Traditional medical microscopic slides have previously missed an entire organ in the human body due to the way in which they are prepared

Interstitium: New organ discovered in human body after it was previously missed by scientists

'Interstitium' acts as a shock absorber for vital tissues and could improve understanding of cancer spread

Josh Gabbatiss | Science Correspondent | @josh_gabbatiss |

Wednesday 28 March 2018 16:31 | 85 comments



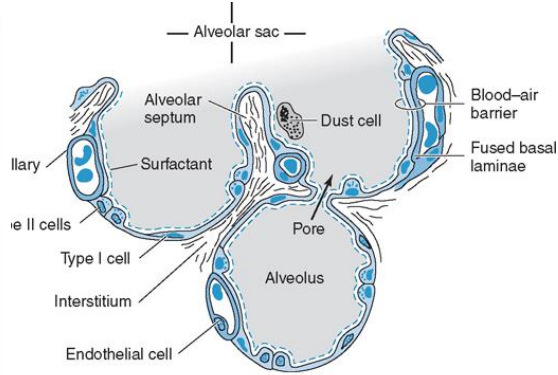
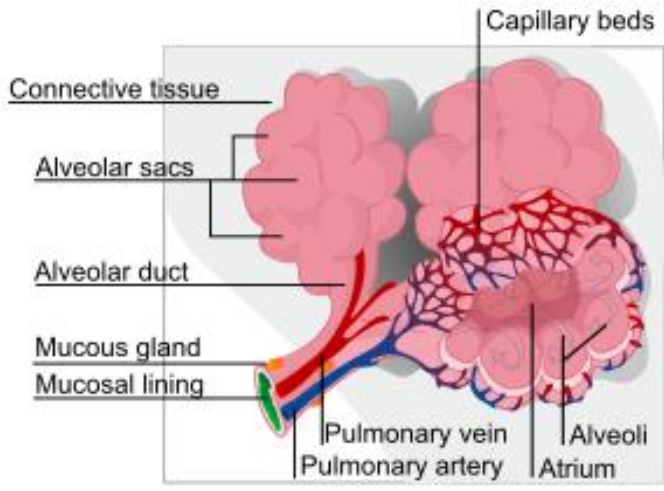
28.03.2018

Interstitium (*Interstisyum*): A contiguous fluid-filled space existing between a structural barrier, such as a cell wall or the skin, and internal structures, such as organs, functional units, including muscles and the circulatory system

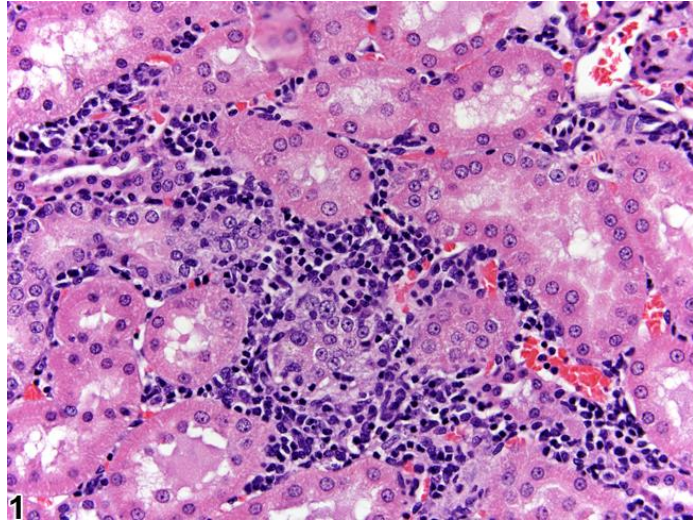
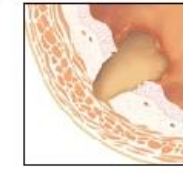
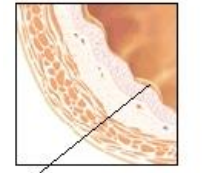
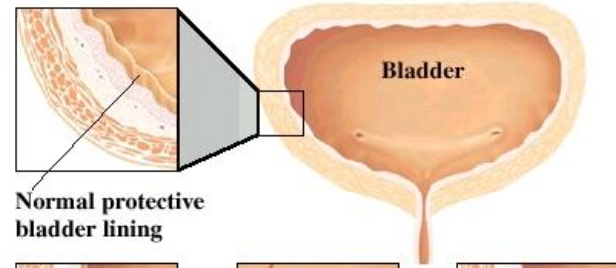
Interstitial

Interstitial lung disease Interstitial pneumonia

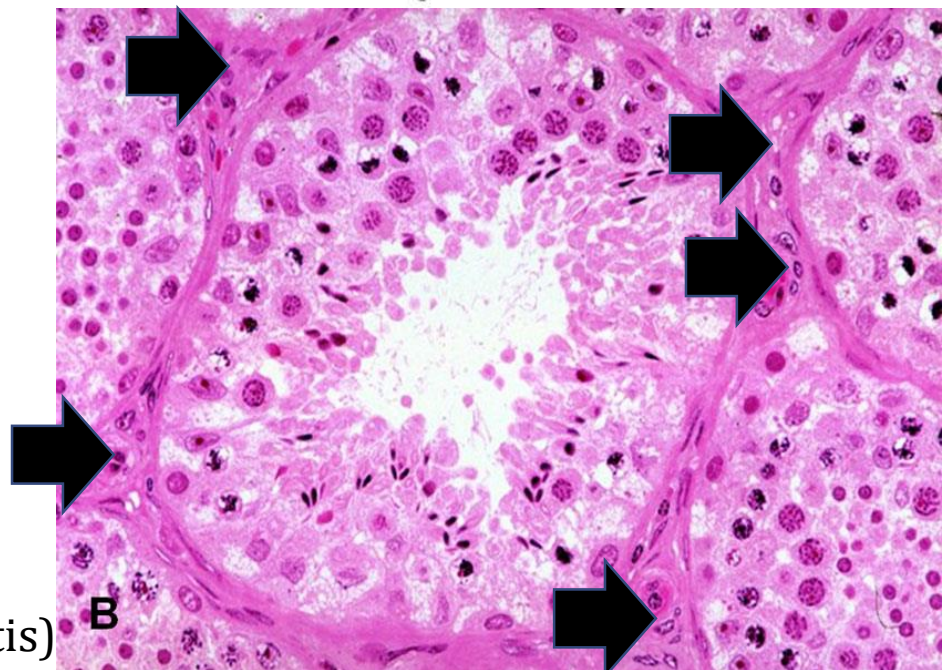
Interstitial cystitis



1: Paulsen DF; Histology & Cell Biology: Examination & Board Review, 5th Edition: accessmedicine.com
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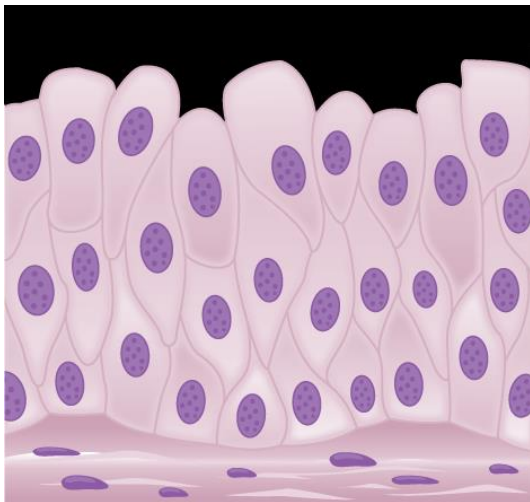
Acute interstitial nephritis



Interstitial cells (testis)

Epithelial cells

- No ground substance between cells
- Do not have a direct blood and lymphatic circulation



Connective tissue cells

- Extracellular matrix present between cells
- Do have blood and lymphatic circulation, plus innervation

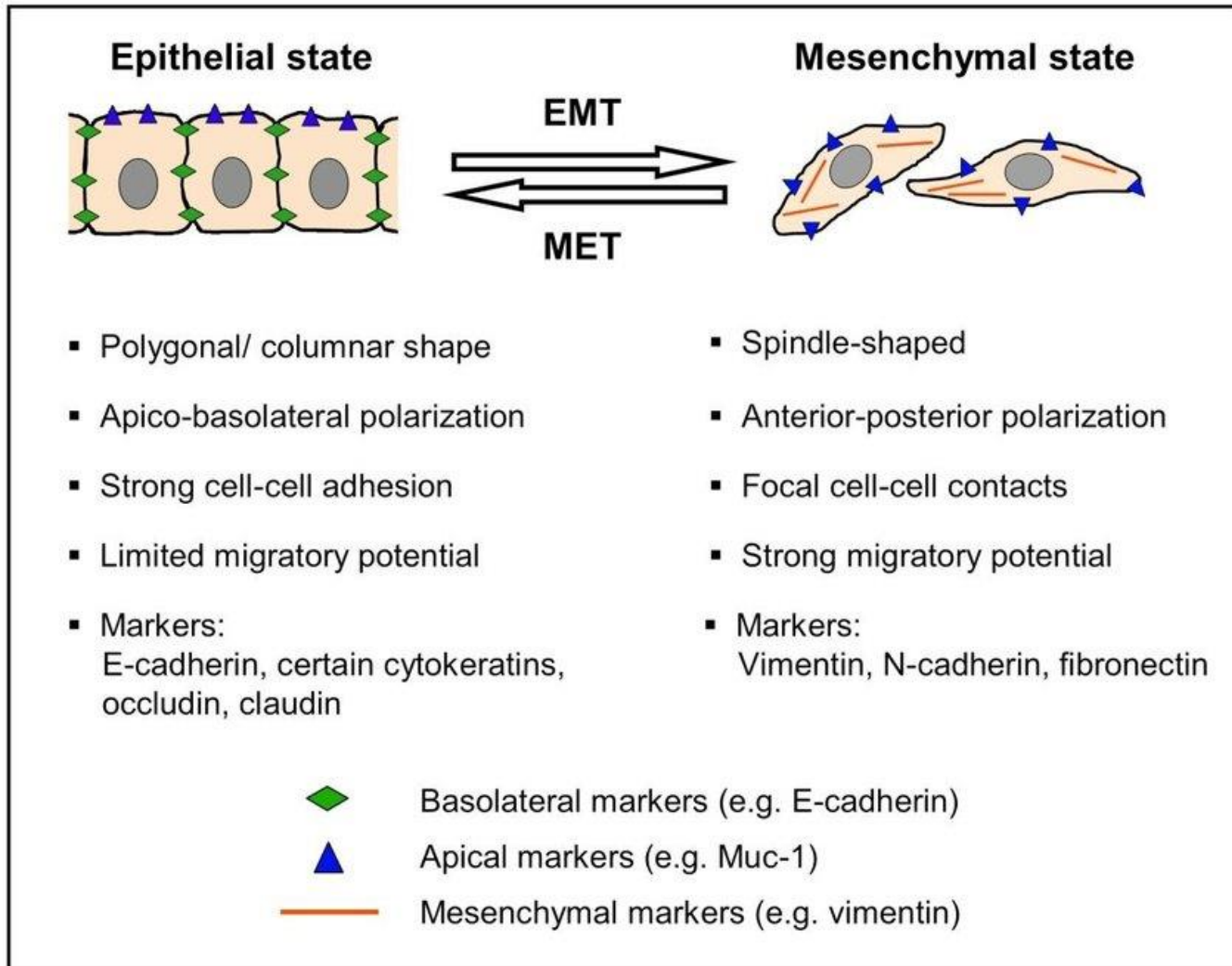
Epithelio-mesenchymal transformation

Further reading:

Kalluri R, Weinberg RA.

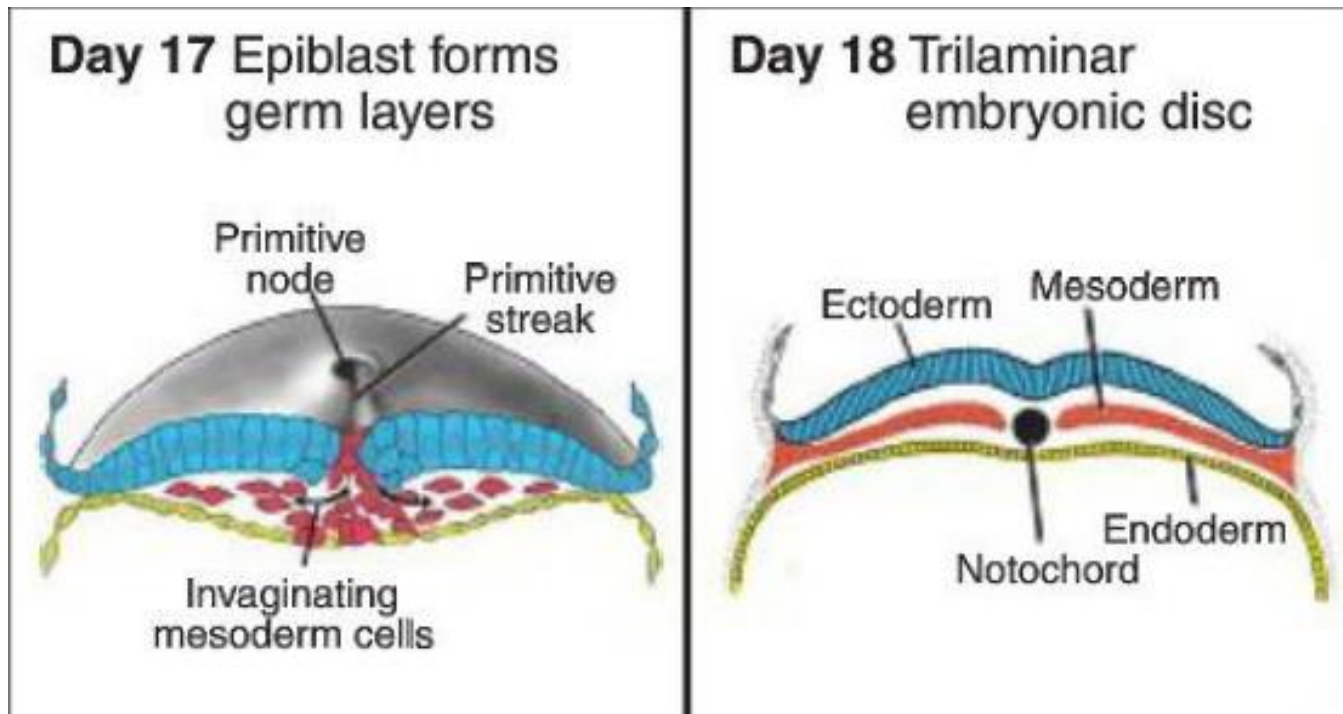
The basics of epithelial-mesenchymal transition. J Clin Invest. 2009 Jun 1; 119(6): 1420-1428. doi: 10.1172/JCI39104

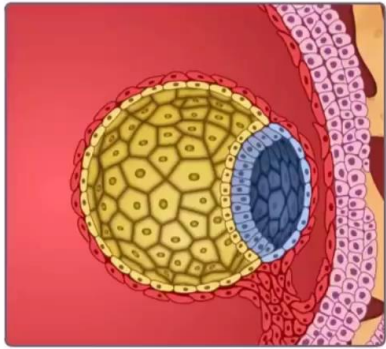
PMID: 19487818



Originated from mesoderm

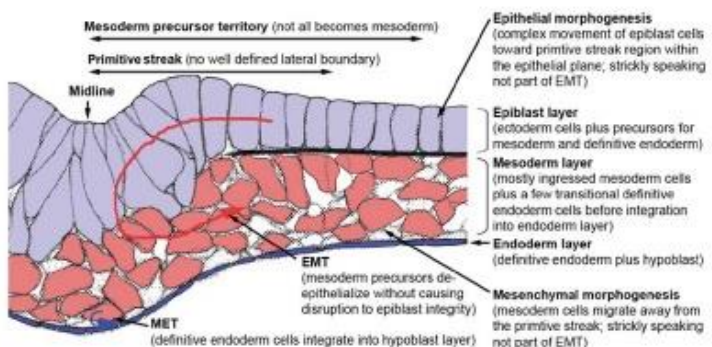
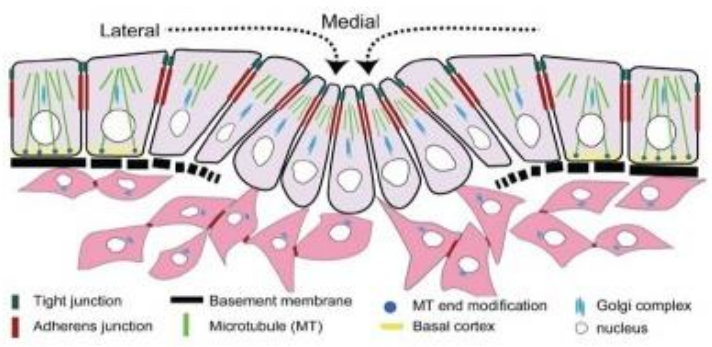
- Mesoderm occurs in the third week of embryonic development by a process called **gastrulation**.

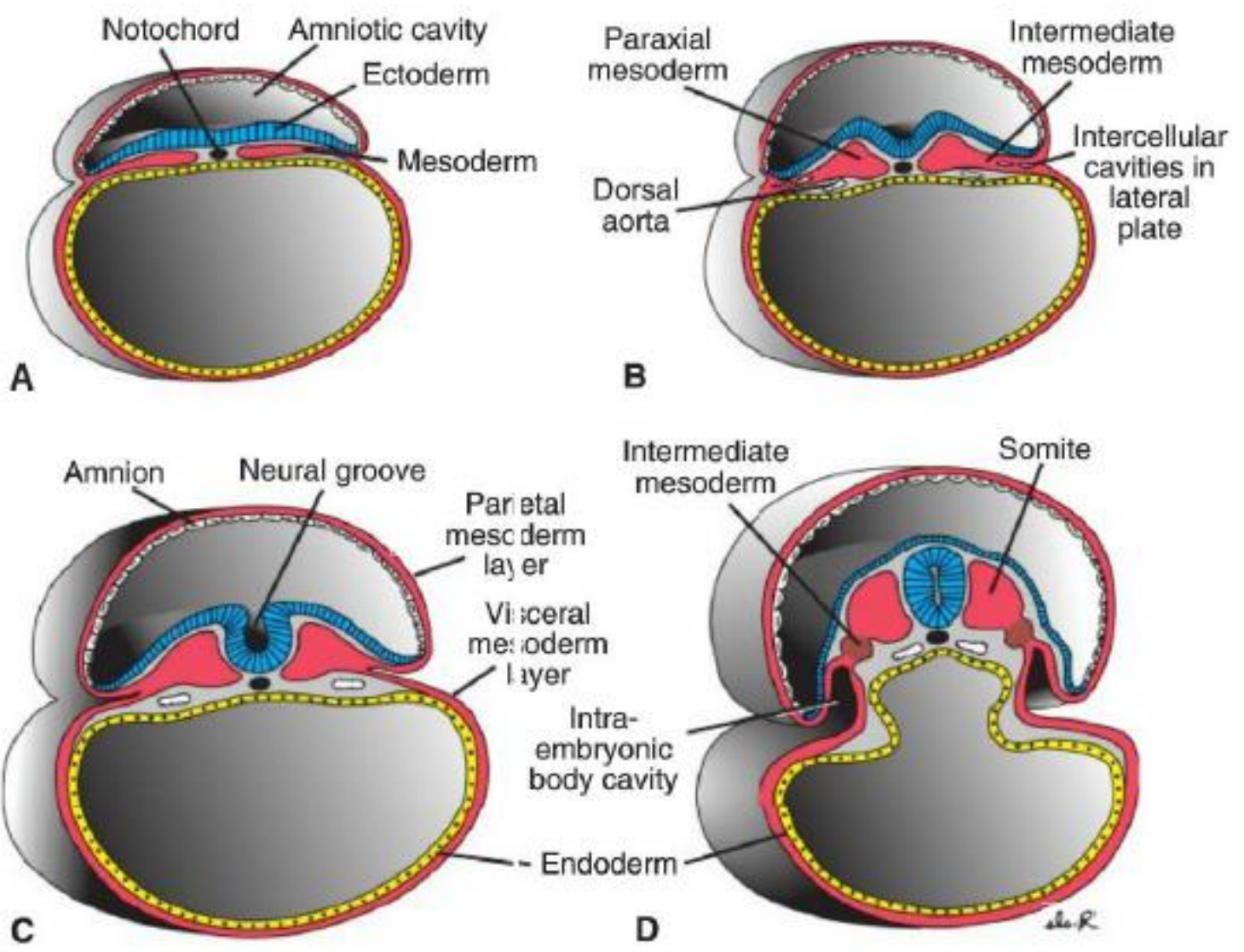


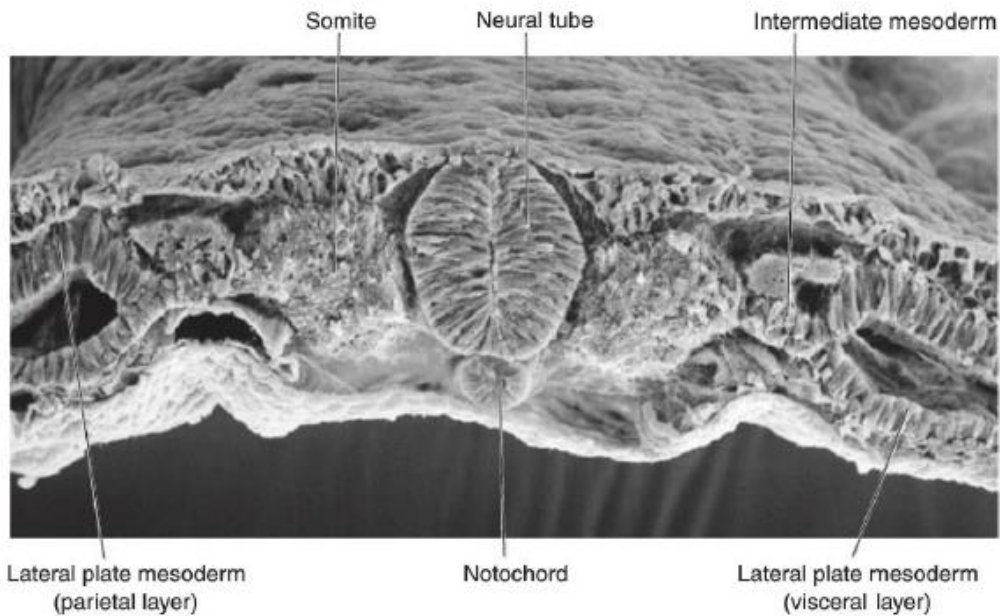


- At the beginning of the third week, embryonic body appear in the form of a bilaminar disc.
 - Epiblast
 - Hypoblast
- Primitive streak determines cranial and caudal ends, as well as left and right sides of the embryo.

- A portion of the epiblast cells located in the vicinity of the primitive streak is separated from the layer by showing an «epithelial to mesenchymal transition» and invaginates towards the inside of the embryo.
- Inner hypoblast cells are completely occupied and regenerated. This layer forms endoderm.
- The remaining epiblast cells form ectoderm.
- Invaginated epiblast cells remain between the two layers and form **mesoderm**, after which no further epiblast cell migration occurs.
- This event proceeds from the cranial end to the caudal end along the entire embryonic disc and controlled by fibroblast growth factor 8 (FGF8), synthesized by streak cells.

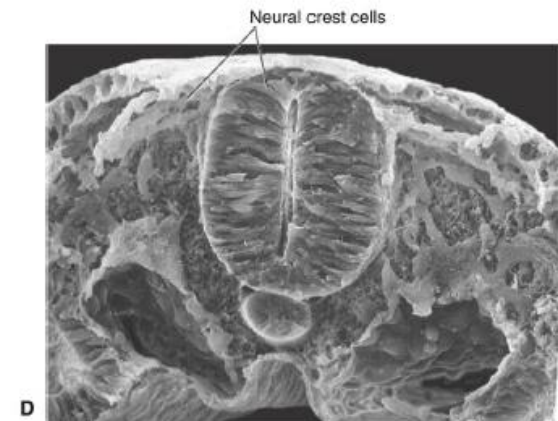
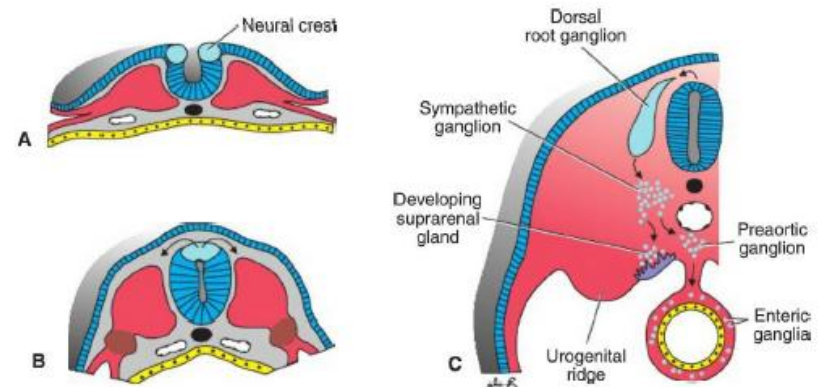






Neural crest derivatives

- Mesectoderm: odontoblasts, dental papillae, the chondrocranium, tracheal and laryngeal cartilage, the dermatocranium (membranous bones), pericytes and smooth muscle of branchial arteries and veins, tendons of ocular and masticatory muscles, connective tissue of head and neck glands (pituitary, salivary, lachrymal, thymus, thyroid) dermis and adipose tissue of calvaria, ventral neck and face
- Endocrine cells: chromaffin cells of the adrenal medulla, glomus cells type I/II.
- Peripheral nervous system: Sensory neurons and glia of the dorsal root ganglia, cephalic ganglia (VII and in part, V, IX, and X), Satellite glial cells of all autonomic and sensory ganglia, Schwann cells of all peripheral nerves.
- Enteric cells: Enterochromaffin cells
- Melanocytes and iris muscle and pigment cells

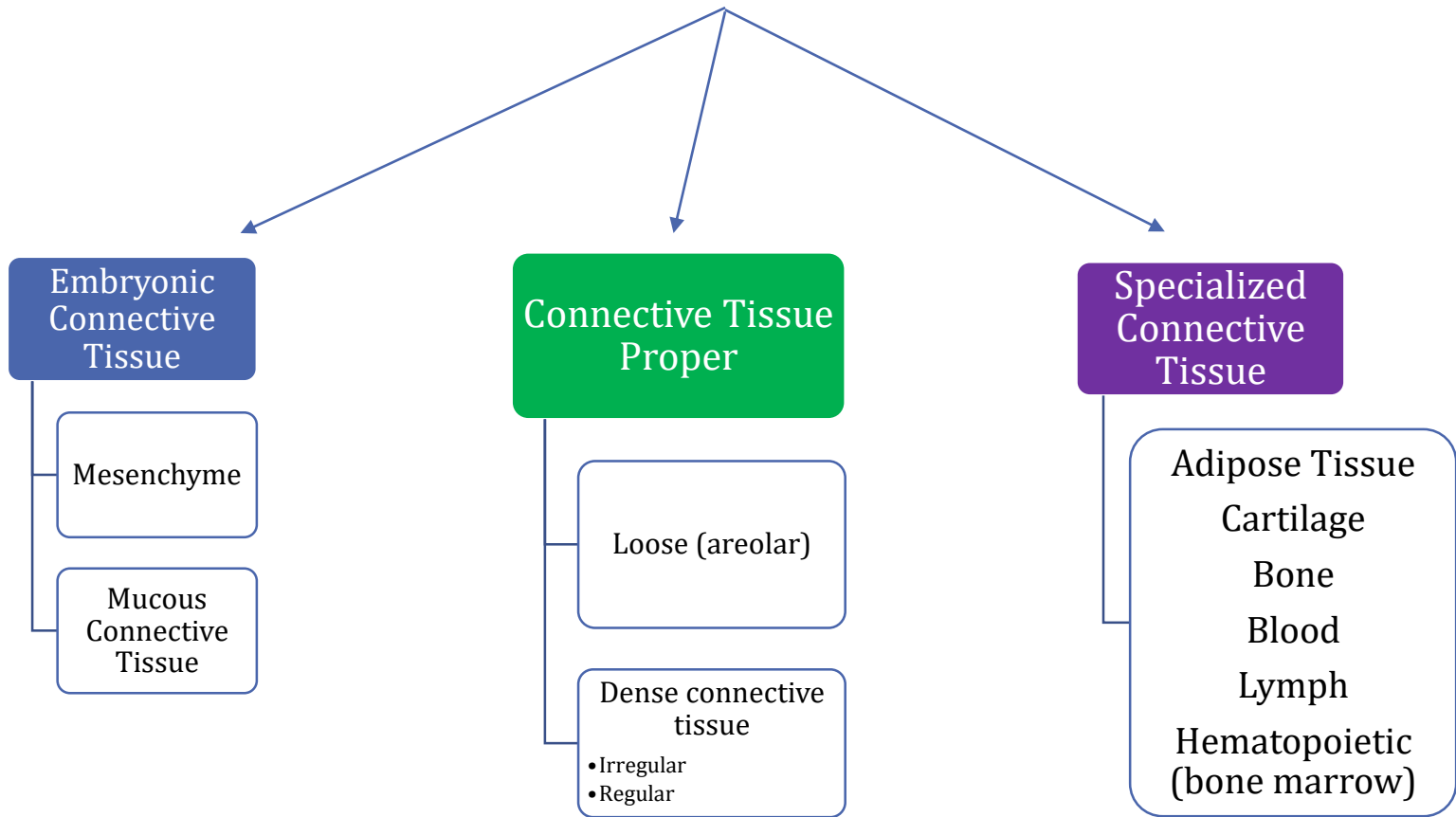


Connective tissue types

- Embryonic Connective Tissue
 - Mesenchyme
 - Mucous
- Connective Tissue Proper
 - Loose (areolar) connective tissue
 - Dense connective tissue
 - Dense irregular connective tissue
 - Dense regular connective tissue
- Specialized Connective Tissue
 - Adipose Tissue
 - Cartilage
 - Bone
 - Blood
 - Lymph
 - Hematopoietic (bone marrow)

- Cells
- Extracellular matrix

Connective Tissue

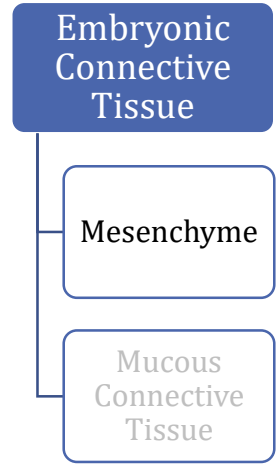


Embryonic Connective Tissue

- **Mesoderm**, the middle embryonic germ layer, gives rise to almost all of the connective tissues of the body.
- An exception is the head region, where specific progenitor cells are derived from ectoderm by way of the **neural crest cells**
- Primitive connective tissue structures in the embryo are called **mesenchyme** (**ectomesenchyme** in the head region).
- With the development of this tissue adult connective tissue structures develop, in addition to **blood cells, muscular, vascular structures and urogenital system.**

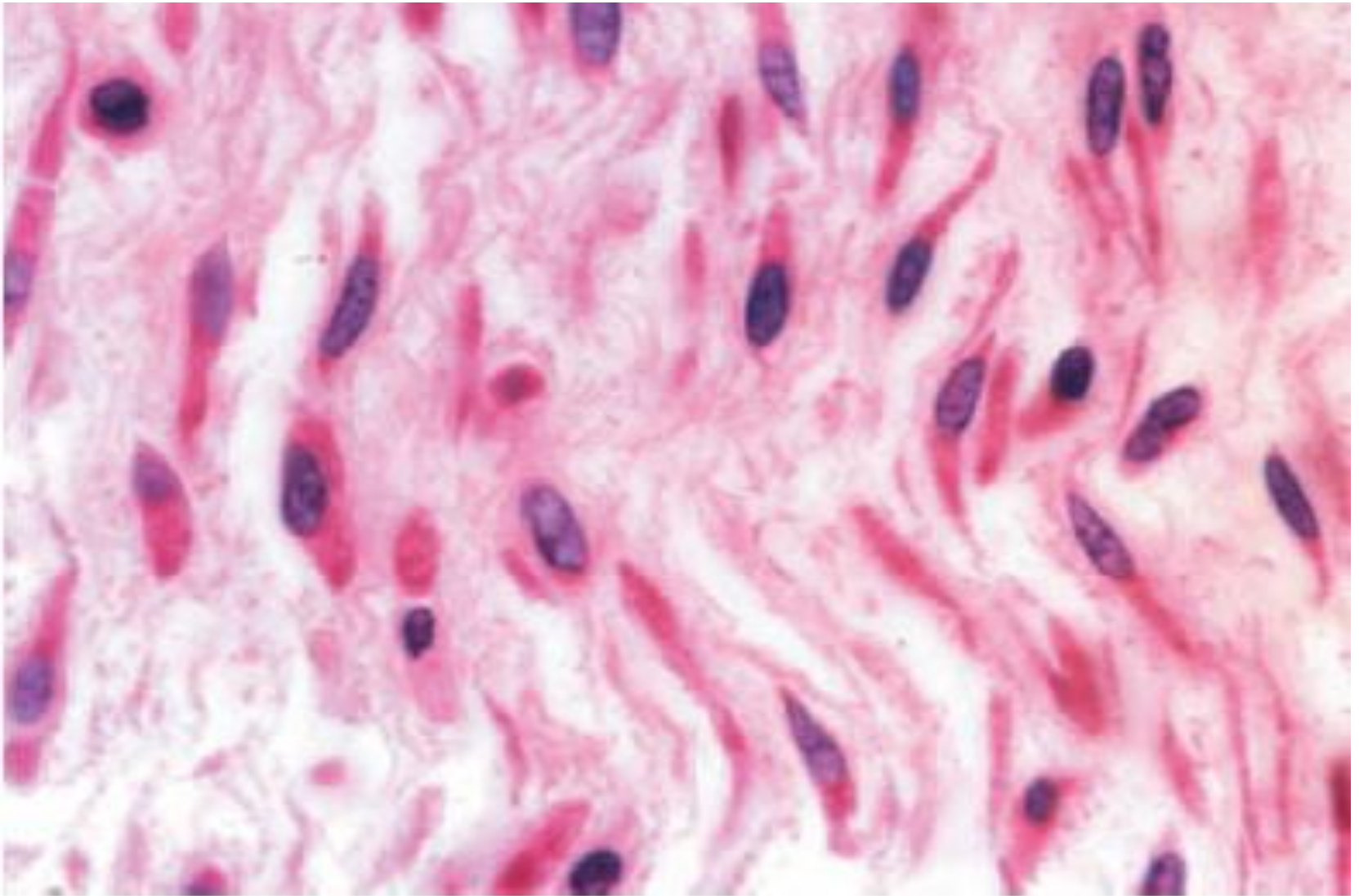
Mesenchyme

- **Mesenchyme is primarily found in the embryo.**
- It contains small, spindle-shaped cells of relatively uniform appearance = mesenchymal cells
- Processes extend from these cells and contact similar processes of neighboring cells, forming a three-dimensional cellular network using **gap junctions**.
- They have fine, pale stained chromatin structure and prominent nucleolus = **euchromatic**
- they are mitotically active and give rise to cells that will differentiate into various cell types
- The extracellular space is occupied by a viscous ground substance. Collagen (**reticular**) fibers are present; they are very fine and relatively sparse.
= reduced physical stress on the growing fetus



Mesenchymal stem cells (MSC)

- Mesenchyme is embryonic connective tissue that is derived from the mesoderm and that differentiates into hematopoietic and connective tissue, whereas **MSCs do not differentiate into hematopoietic cells**
- Locations:
 - **Bone marrow**
 - Bone marrow was the original source of MSCs, and still is the most frequently utilized. These bone marrow stem cells do not contribute to the formation of blood cells and so do not express the hematopoietic stem cell marker CD34. They are sometimes referred to as bone marrow stromal stem cells.
 - **Umbilical cord cells**
 - Wharton's jelly and the umbilical cord blood.
 - **Adipose tissue**
 - Adipose tissue is a rich source of MSCs (or adipose-derived mesenchymal stem cells, AdMSCs)
 - **Molar cells**
 - The developing tooth bud of the mandibular third molar is a rich source of MSCs.
 - **Amniotic fluid**

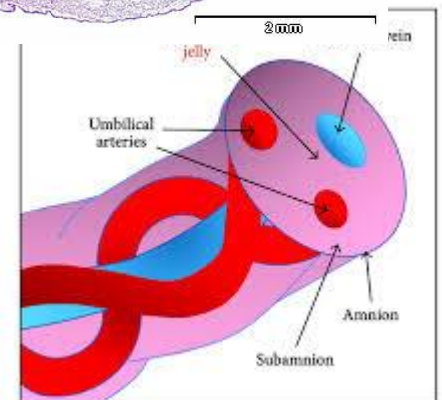
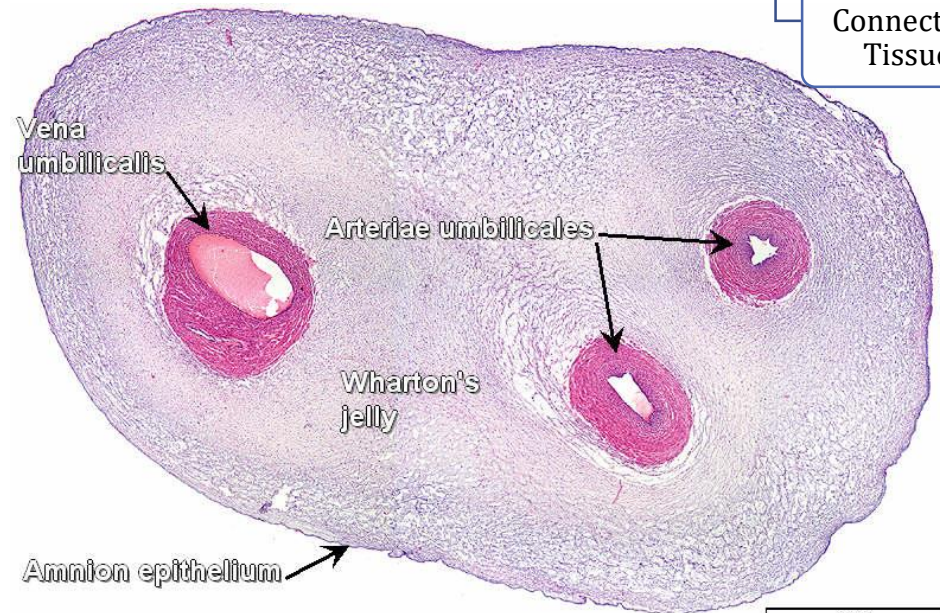


Mesenchymal cells
Euchromatic
Small, spindle-shaped
Gap junctions

Extracellular matrix
Viscous ground substance
Reticular fibers

Mucous Connective Tissue

- Mucous connective tissue is present in the umbilical cord.
- It consists of a specialized, almost gelatin like ECM
- Its ground substance is frequently referred to as **Wharton's jelly**.
- The spindle-shaped cells are widely separated and appear much like fibroblasts in the near-term umbilical cord
- Wharton's jelly occupies large intercellular spaces located between thin, wispy collagen fibers.



Connective Tissue Proper

- **Loose connective tissue**
 - Fine and relatively **sparse collagen fibers**
 - **Ground substance is abundant**, occupies more volume than the fibers.
 - It has a viscous to gel-like consistency
 - Oxygen and nutrients from the small vessels **diffuse** through cells
 - Carbon dioxide and metabolic wastes are transferred back to the vessels
 - **Found mostly under epithelium, glandular tissues and around vascular structures**
 - First immune defence region when pathogens exceed covering surfaces

Rich in ground substance and cells, relatively poor in fibrils

Connective Tissue Proper

Loose (areolar)

Dense connective tissue

- Irregular
- Regular

Loose connective tissue

- Under the epithelium,
- Around blood vessels,
- Around glandular structures,
- **In between muscle and nerve fibers.**
- **Surrounds spaces between tissues in organs**
- Supports mesothelium around pleura and peritoneum
- ****The most common type of connective tissue.**
- ****It contains all cells of connective tissue except for reticular cells and all three types of connective tissue fibers.**

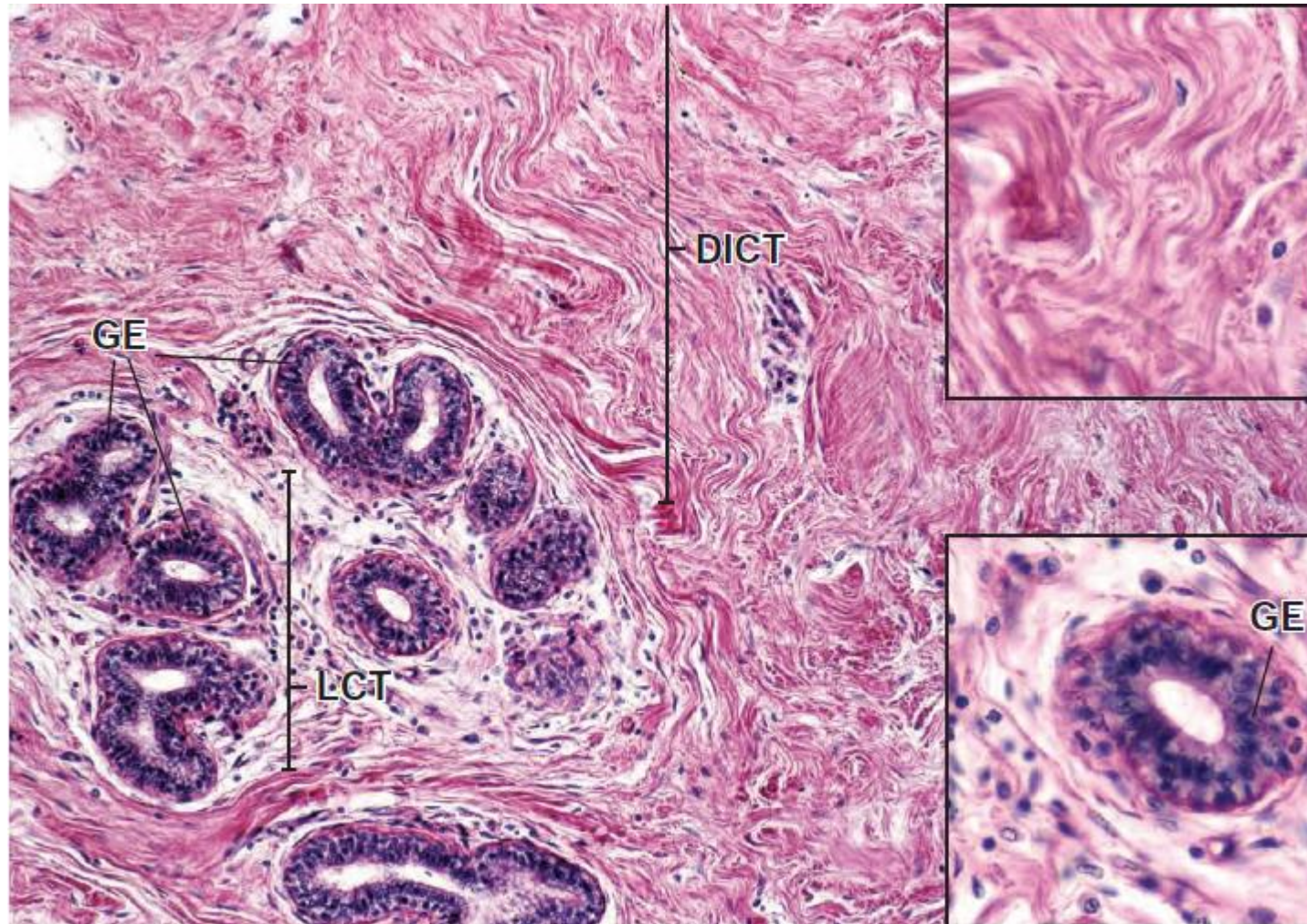
Connective Tissue Proper

Loose (areolar)

Dense connective tissue

- Irregular
- Regular

Around glandular structures- Loose connective tissue



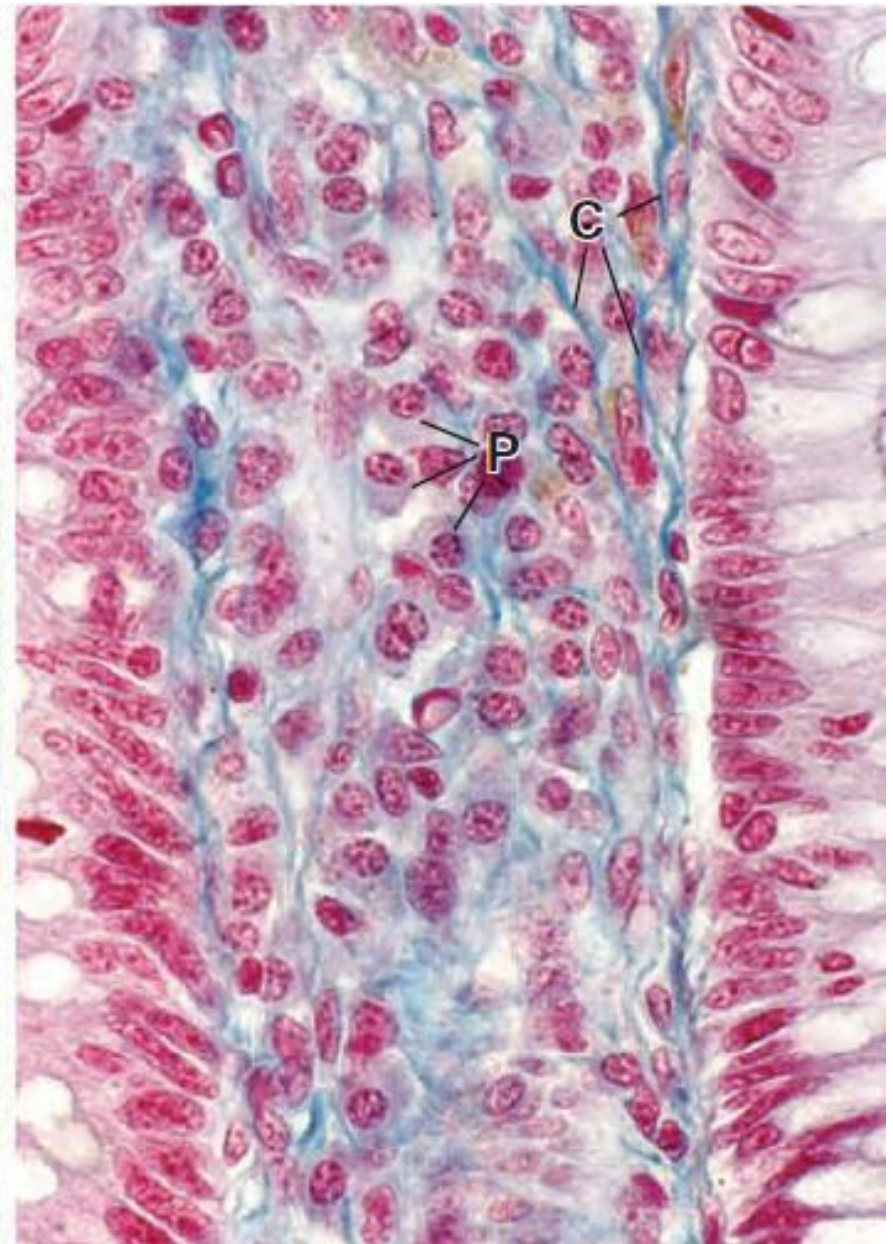
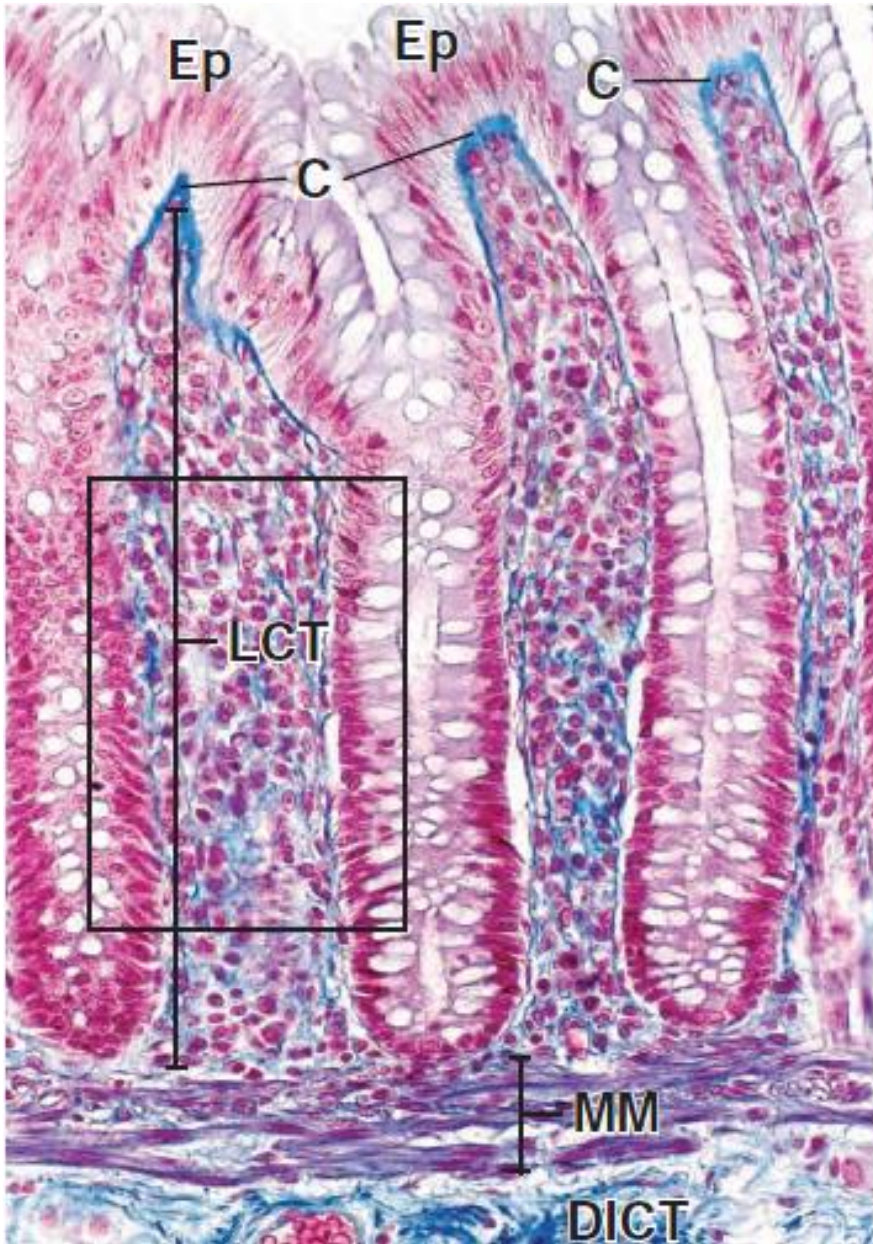
- **Loose connective tissue**

- The cell population is composed of cells that migrate from blood vessels according to different stimuli which change more rapidly.

(immune response, inflammation, wound healing)

- Inflammatory, allergic and immune response region
- The first-response-zone to **foreign bodies**
- **Calor** (heat increase), **dolor** (pain), **rubor** (redness), and **tumor** (swelling)
- Lamina propia
- **Rich in ground substance and cellular elements**
- **Relatively sparsely arranged thin fibrils embedded in abundant extracellular matrix**

LCT under epithelium



Mallory stain: nucleus, collagen

Colon

- **Dense irregular connective tissue**

- It is mostly composed of collagen fibers
- Collagens are in bundles but extends in different directions (**irregular...**)
- Cells are scattered and generally uniform = **fibroblast**
- Contains a small amount of ground substance

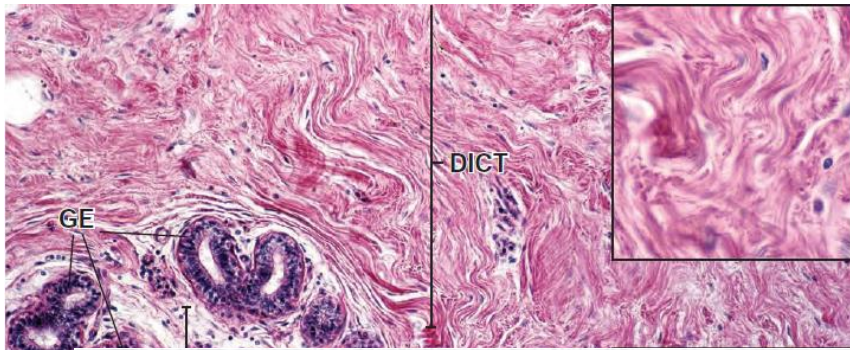
- It is responsible for providing power (durability) to the tissue
- It acts as a layer of **submucosa** on the wall of hollow organs and provides resistance to stress and distension of the organ.
- The reticular layer of the dermis is also included in this classification.
- Fibers extending in different directions prevent tearing against forces applied from different directions

Connective Tissue Proper

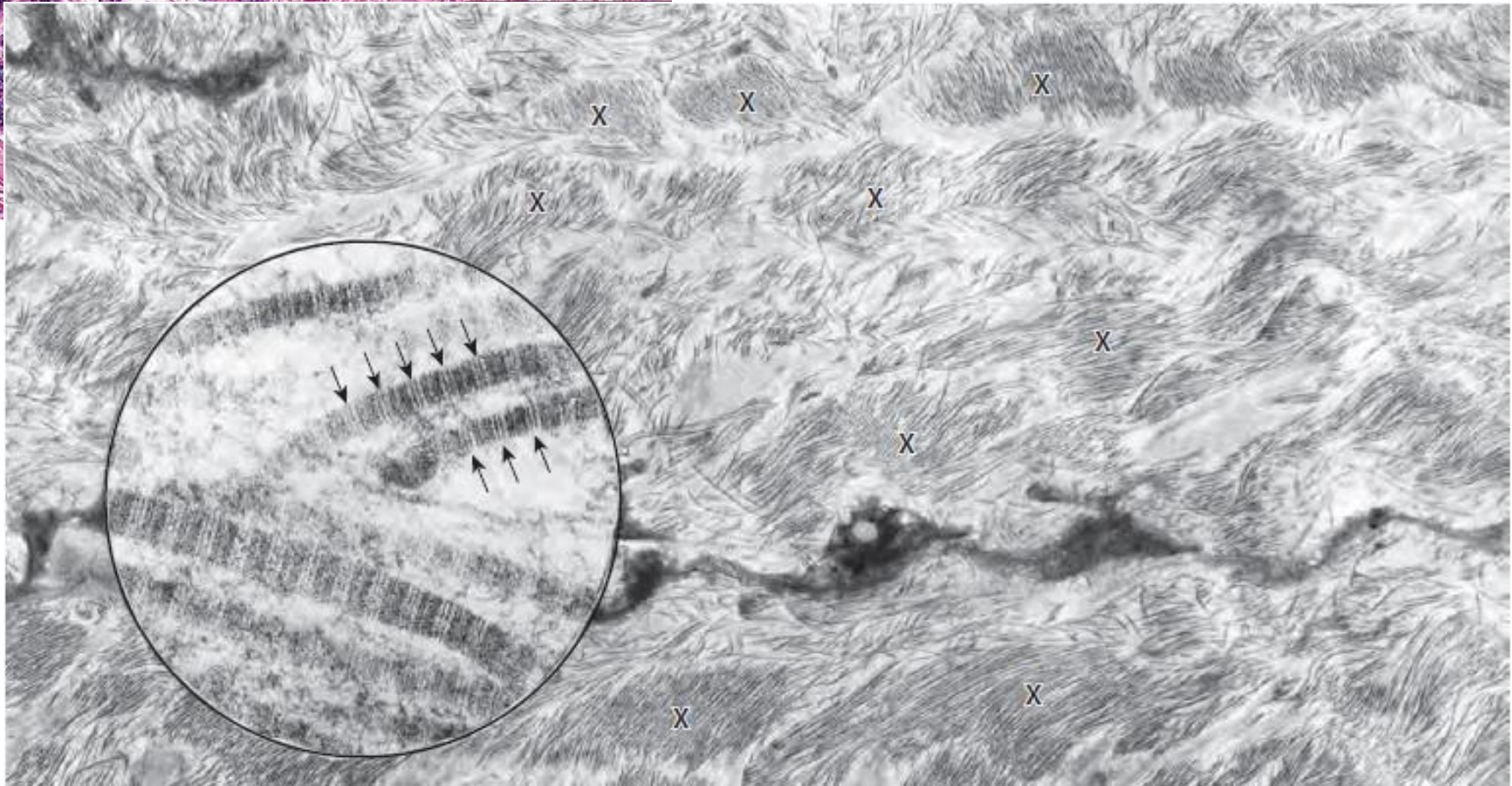
Loose (areolar)

Dense connective tissue

- Irregular
- Regular



Dense irregular connective tissue



• Dense Regular Connective Tissue

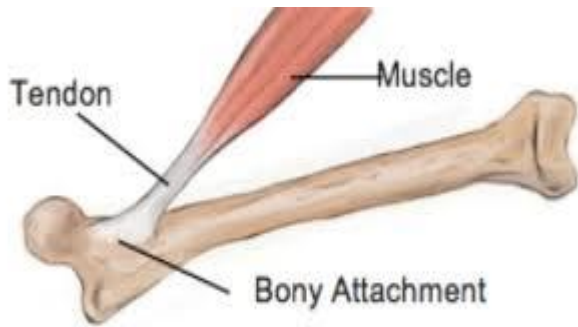
- It is composed of cells and bundles organized in a single direction.
- Between tightly packed and aligned bundles, the cells extend in aligned form too.
 - Contains very little extracellular matrix
- It is the main component of tendons, ligaments and aponeuroses.
- Provides maximum power to the tissue in single direction

Connective Tissue Proper

Loose (areolar)

Dense connective tissue

- Irregular
- Regular

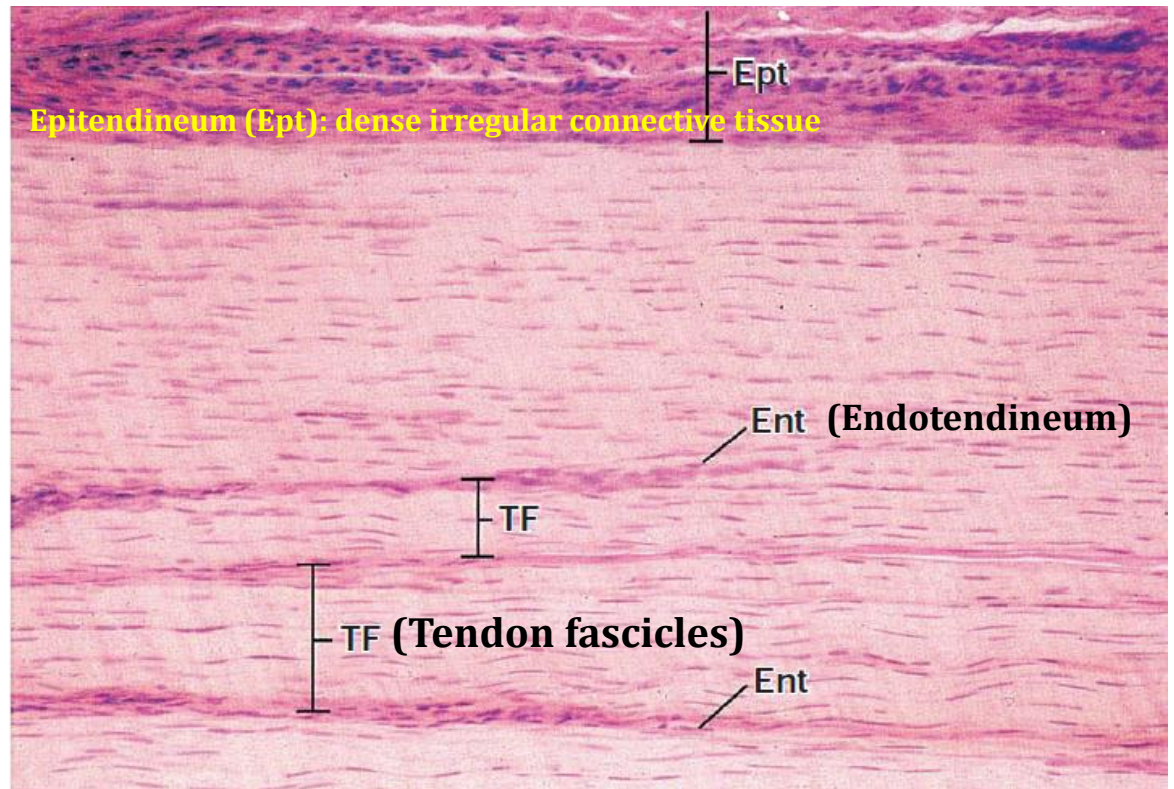


Tendons are cord-like tissues that connect muscles to the bones. **Consist of parallel aligned collagen fibers.** Fibroblast arrays are located between the fibers and the cells are called **tendinocytes**. Around the cells there is a small amount of extracellular matrix that separates them from the fiber bundles. (indistinguishable in H&E staining)

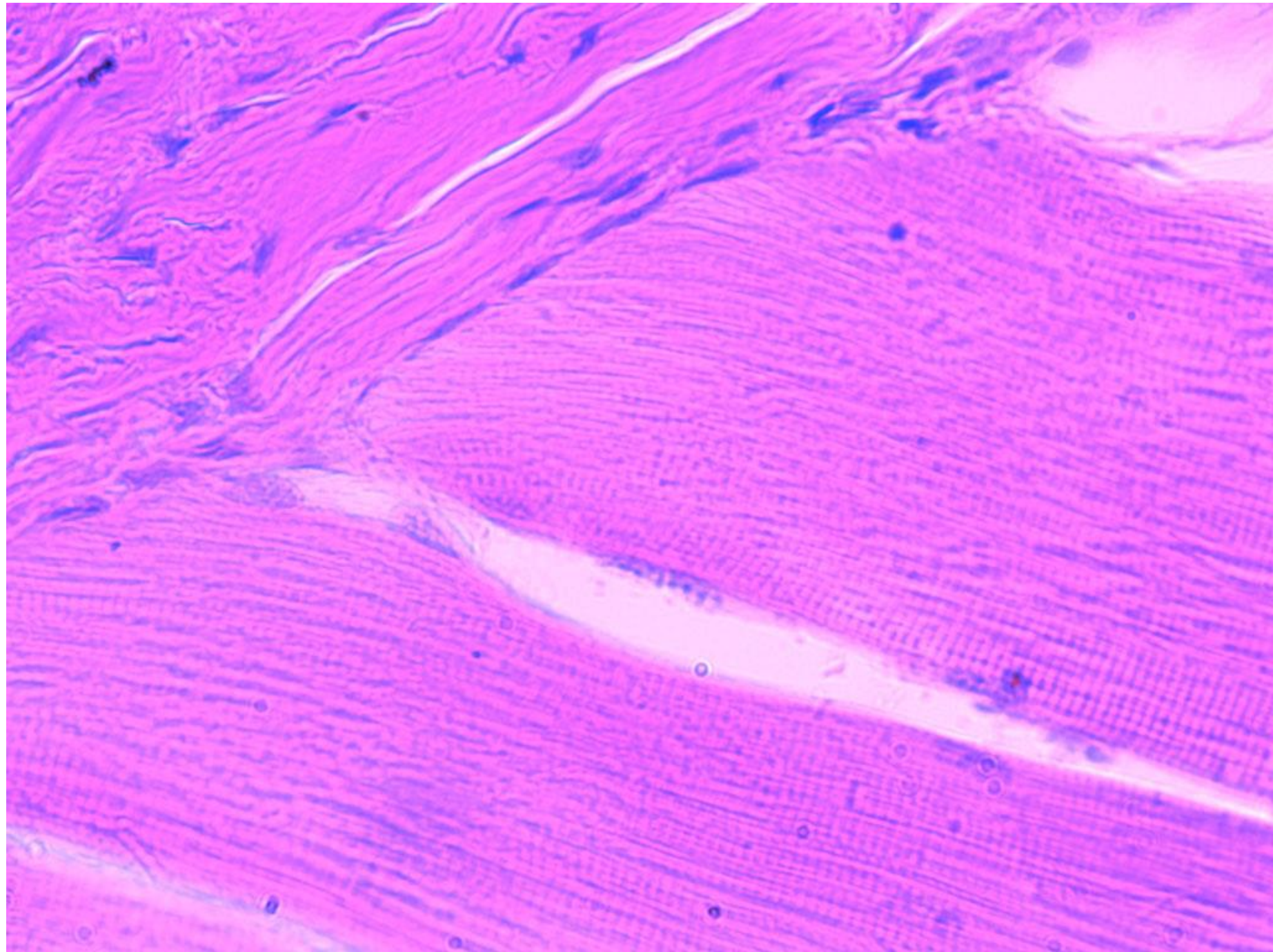
The tendon is surrounded by a thin connective tissue capsule. This structure is in dense irregular connective tissue formation and is called **epitendineum**.

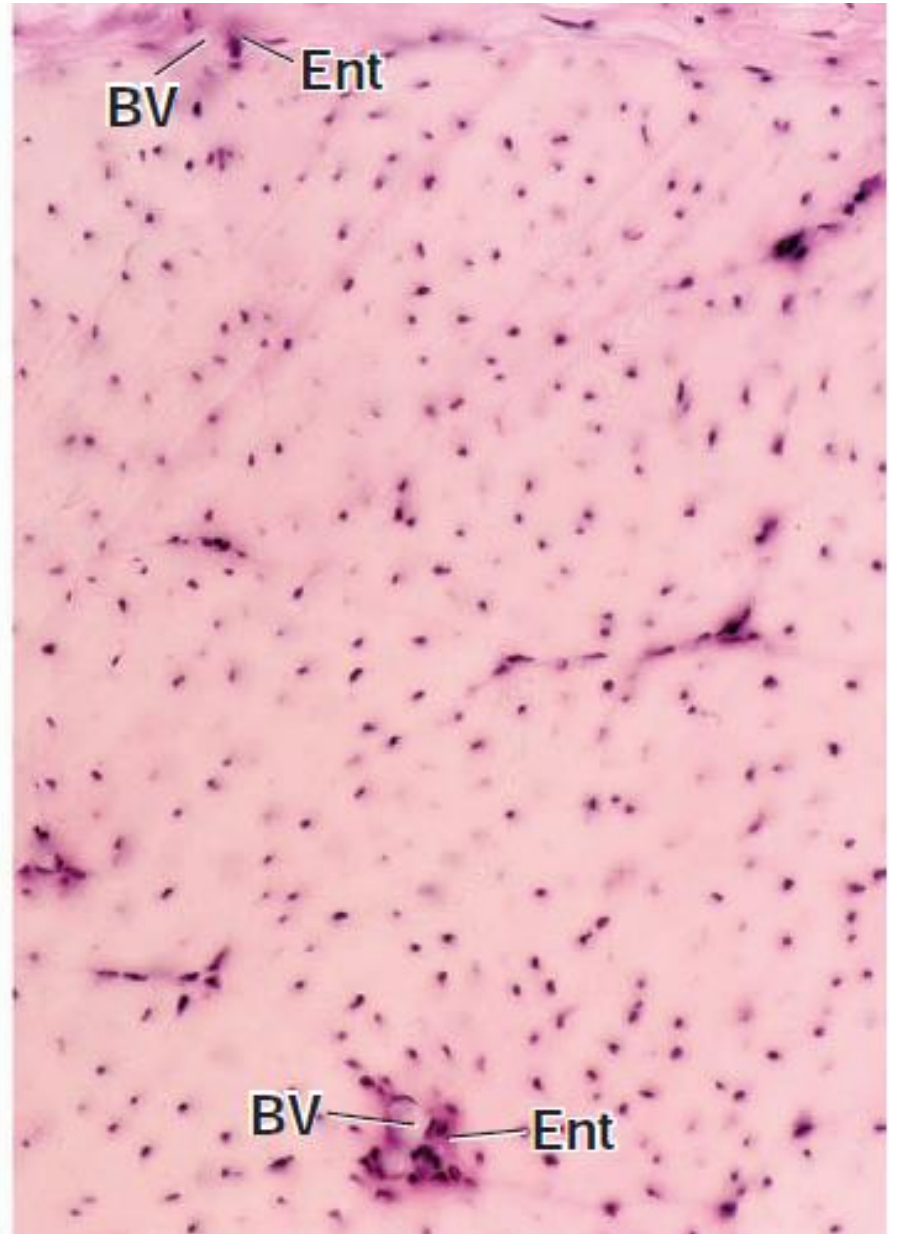
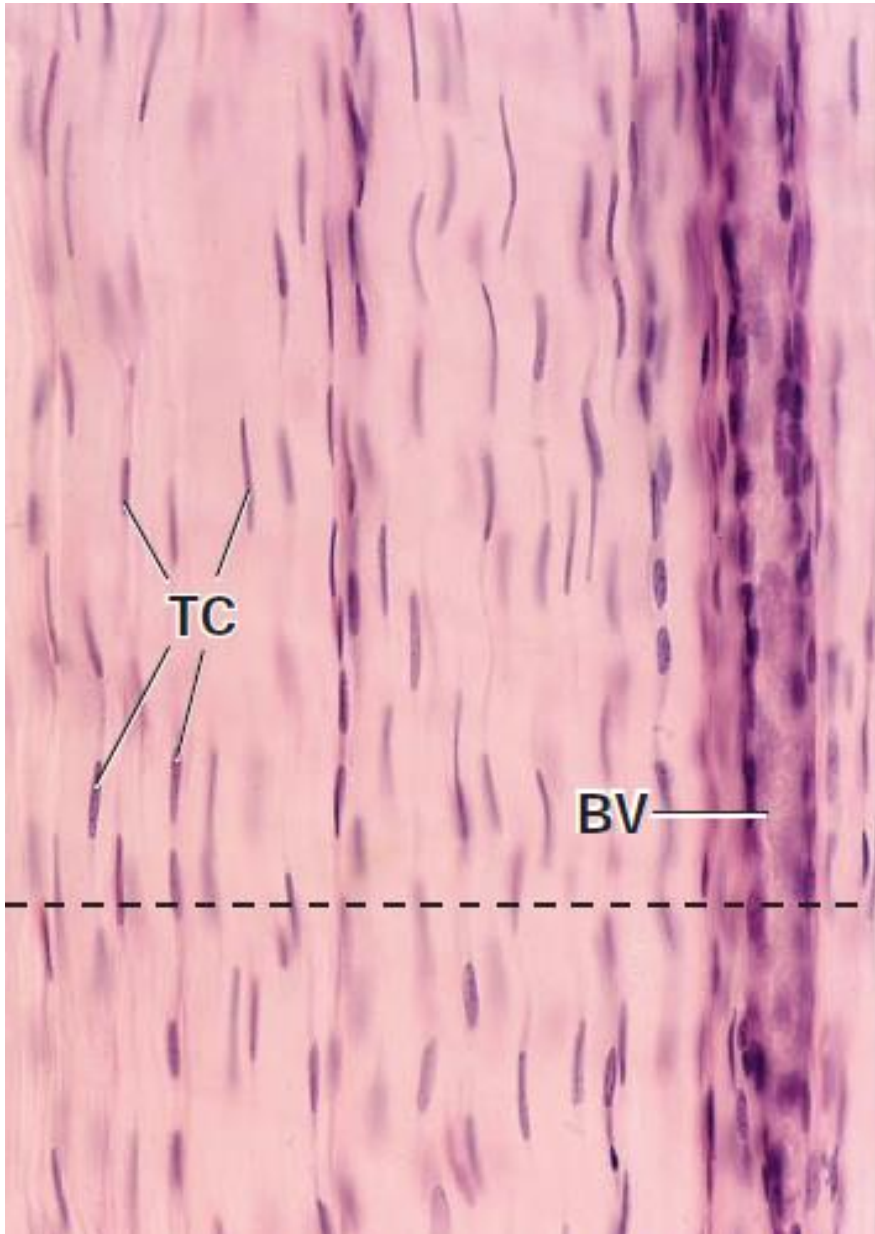
Inside the tendon, there are connective tissue sheaths extending from the epitendineum, which separates it into fascicles and is called the **endotendineum**.

It contains blood vessels and nerve fibers



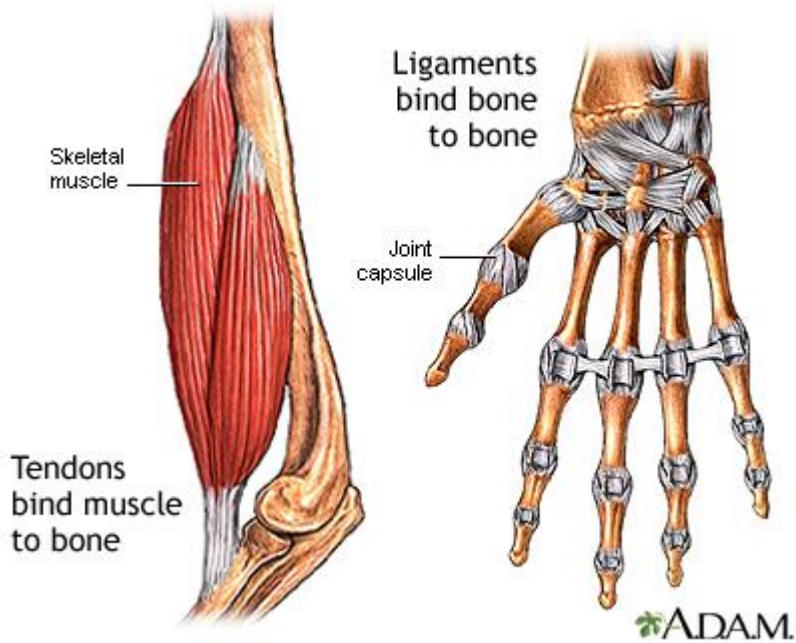
Tendon longitudinal section H&E





Nuclei of tendinocytes (TC)
(cytoplasm are indistinguishable from collagen)

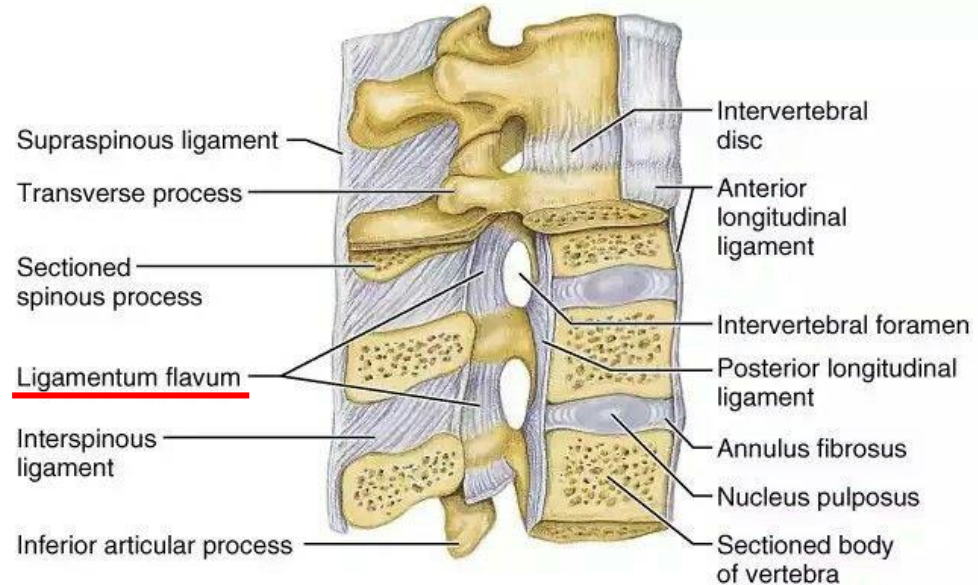
Tendon cross section

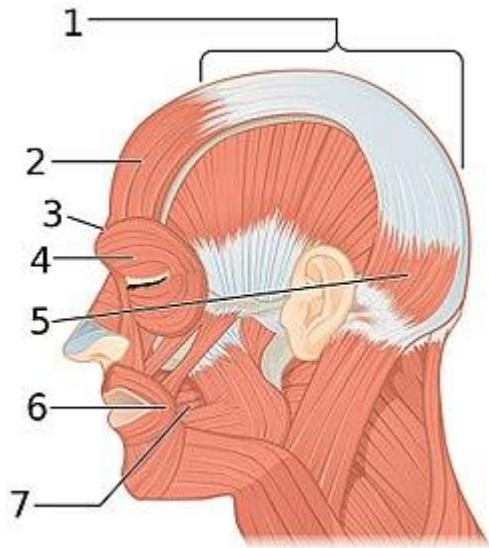


Ligaments; connects bones to each other. **Parallel aligned fibers and fibroblasts** form the main structure, like in tendons.

Like the tendons, the ligaments consist of dense collagen fibers. However, in some areas requiring flexibility (spinal ligaments), **elastic fibers** may also be incorporated into the structure.

Ligamentum flavum structure consists of highly elastic, lesser collagen fiber. Such ligaments are called **elastic ligaments**.





Aponeurosis; define wide, flat tendon structures

Rather than being in single direction, the fiber structures are organized in a multi-layer manner and each layer is staged at an angle of 90° with its neighbour.

These structures are large areas that give the structural strength rather than movement.

