Tissues of vertebrates

Premedical 22

Tissues

= a group or layer of similarly specialized cells that together perform certain special functions, cells of specific structure and of the same function

Four basic (primary) types of tissue:

1. Epithelia – ectoderm, mesoderm, endoderm

2. Connective tissue - mesoderm

3. Muscular tissue - mesoderm

4. Nervous tissue - ectoderm

1. Epithelia

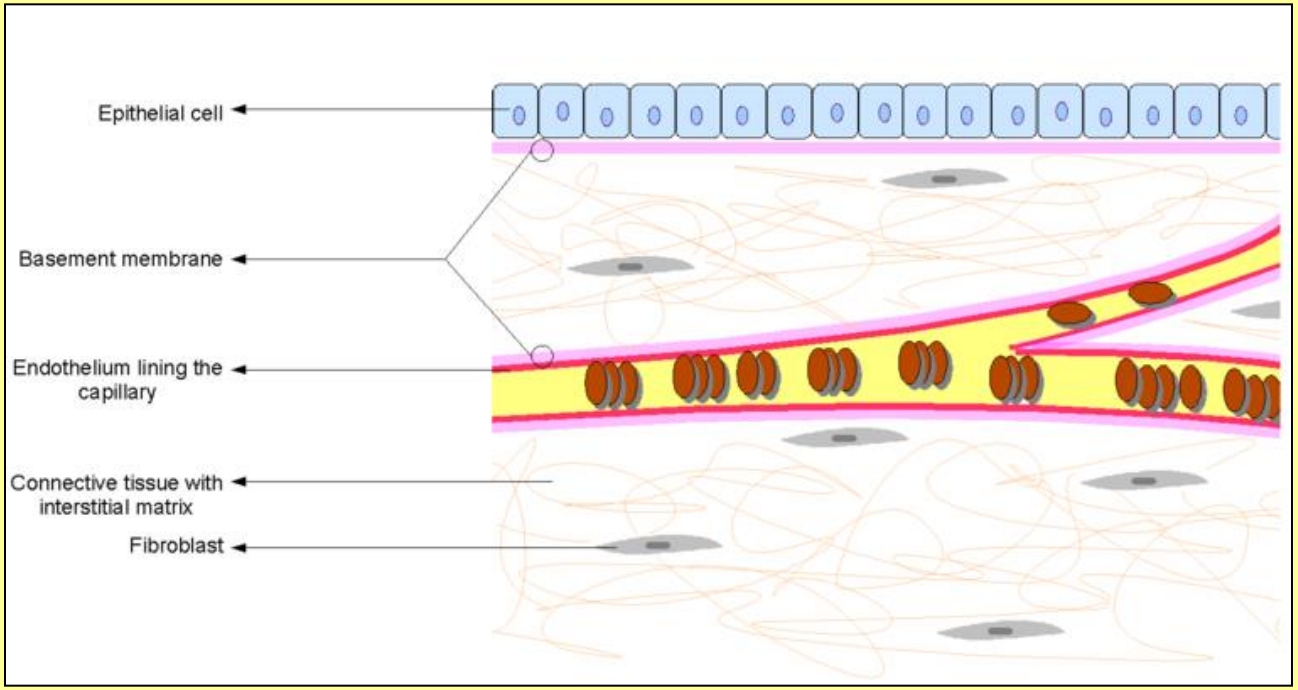
form sheets of cells that **cover the outer surface** of the body and **line the interior surface** of the body cavities and of hollow body organs.

- The cells fits very closely together. Their plasma membranes are fused by **tight junctions** = intracellular junction formed by the fusion of integral proteins of the lateral cell membranes of adjacent epithelial cells, limiting transepithelial permeability.

- The epithelia are among the most rapidly dividing cell types. Lining a small intestine replaces billion of cells every hour.

The epithelia cells are attached and supported by connective tissue **= basement membrane**

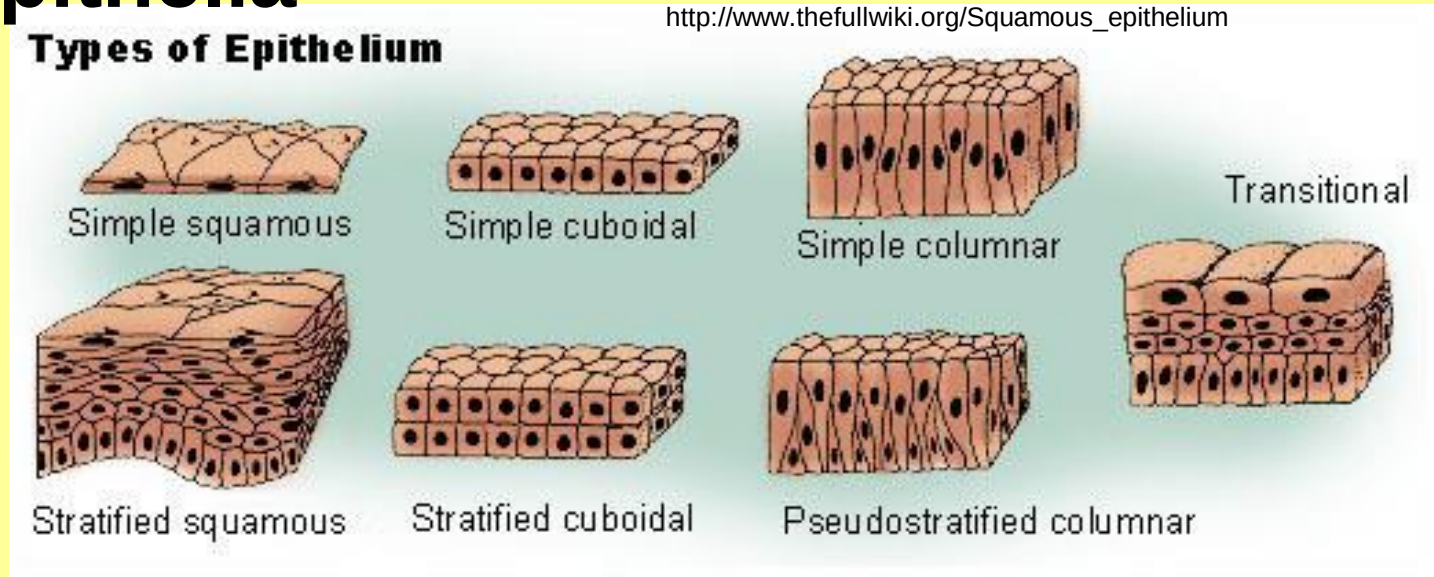
= thin sheet of fibers that underlies **the epithelium,** or **the endothelium**, which lines the interior surface of blood vessels.



http://www.thefullwiki.org/Basement_membrane

Types of epithelia

http://www.thefullwiki.org/Squamous_epithelium



Single layer of squamous flat cells

Single layer of cuboidal cells - sweat glands and outlets of digestive glands

Single layer of columnar cells

Single layer of columnar cells with microvili

Stratified e. of cuboidal cells

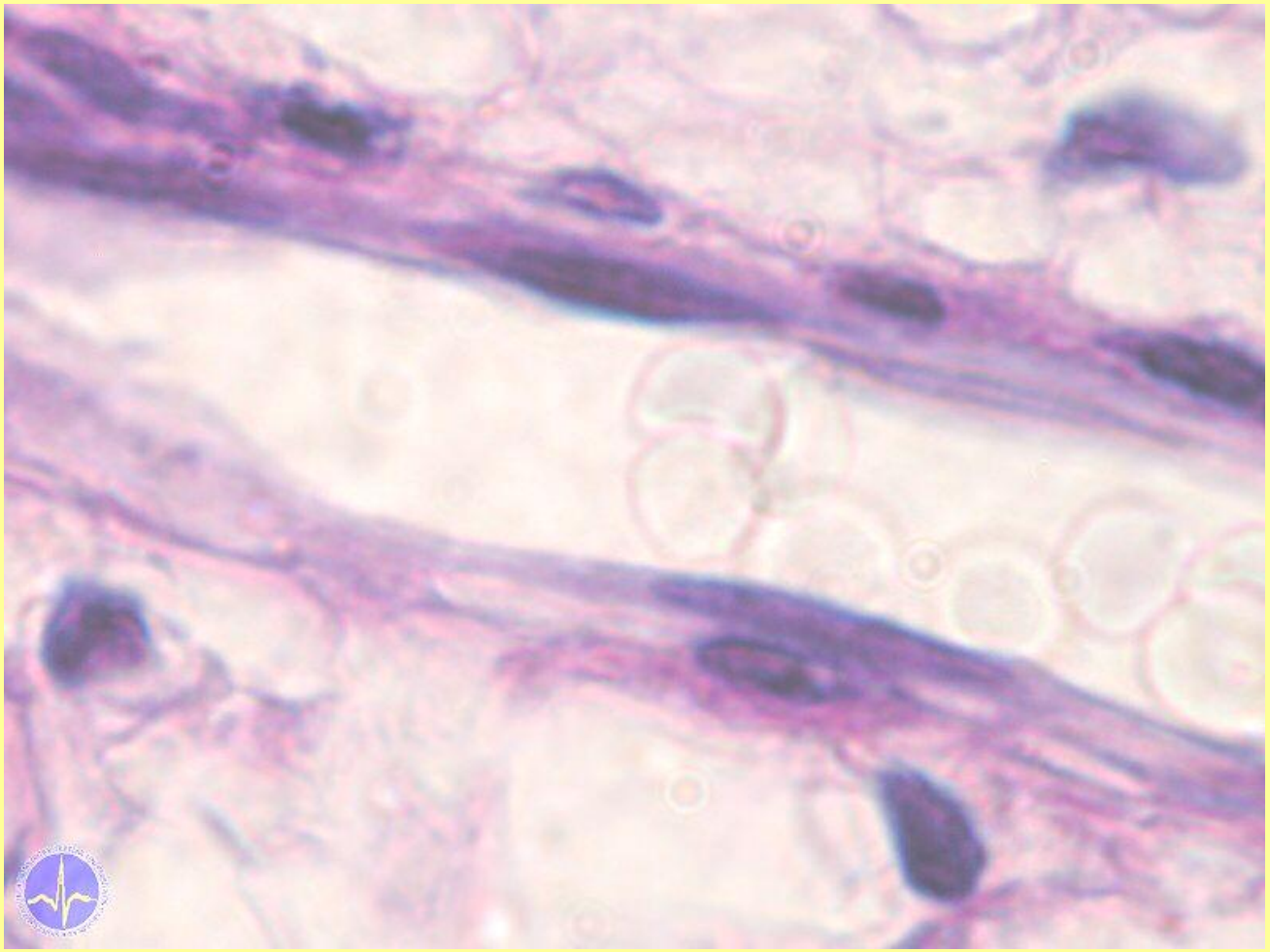
Stratified Squamous Epithelium (non-keratinized)

Stratified Squamous Epithelium (keratinized)

Transitional e. with cells in a stretched or relalxed state

Pseudostratified Ciliated Columnar Epithelial Tissue

Simple squamous epithel - capillary



Simple columnar epithel – gal gladder

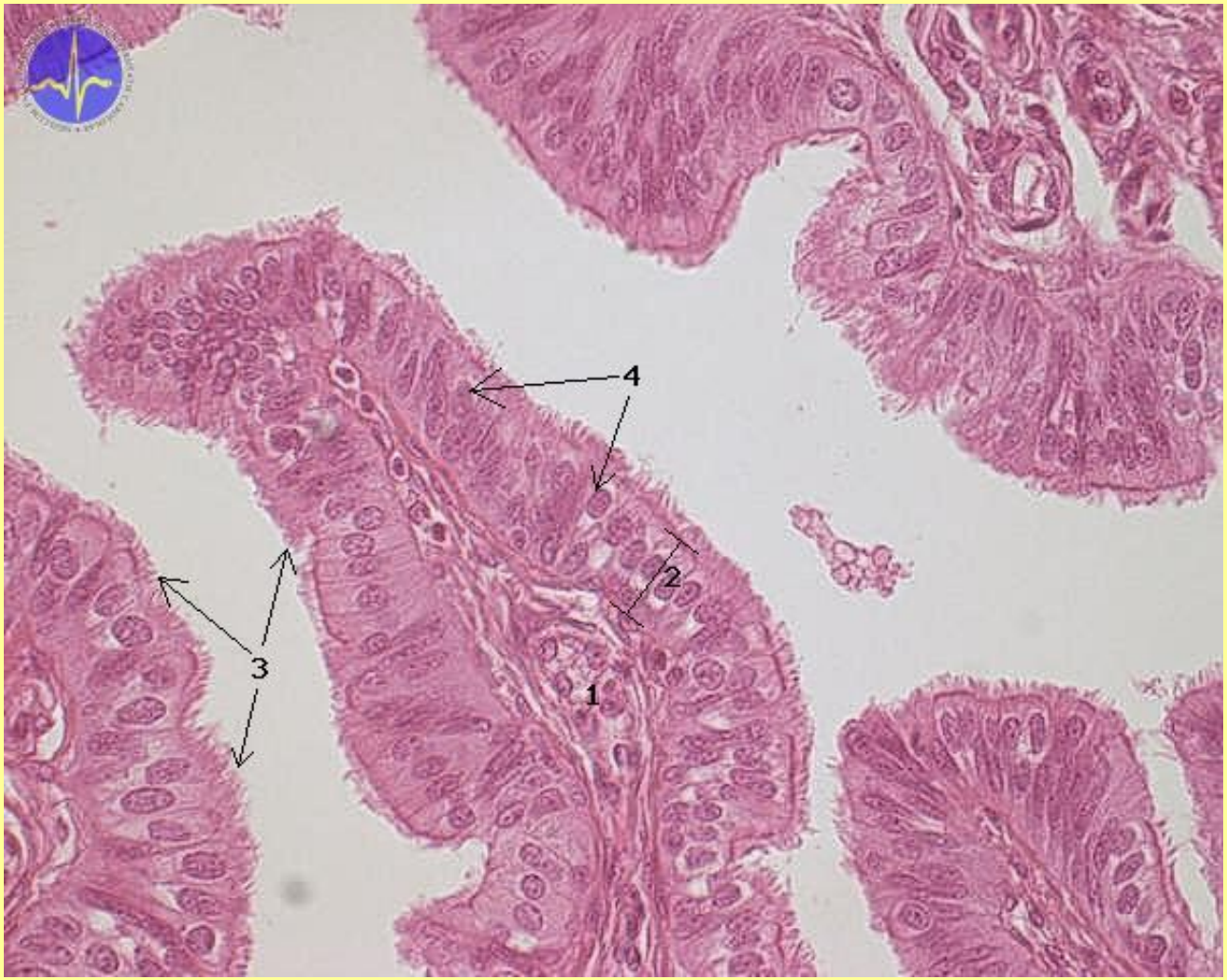
Vesica fellea

Hematoxylin-Eozin

It is the most widely used stain in medical diagnosis and is often the gold standard; A combination of hematoxylin and eosin, it produces blues, violets, and reds.

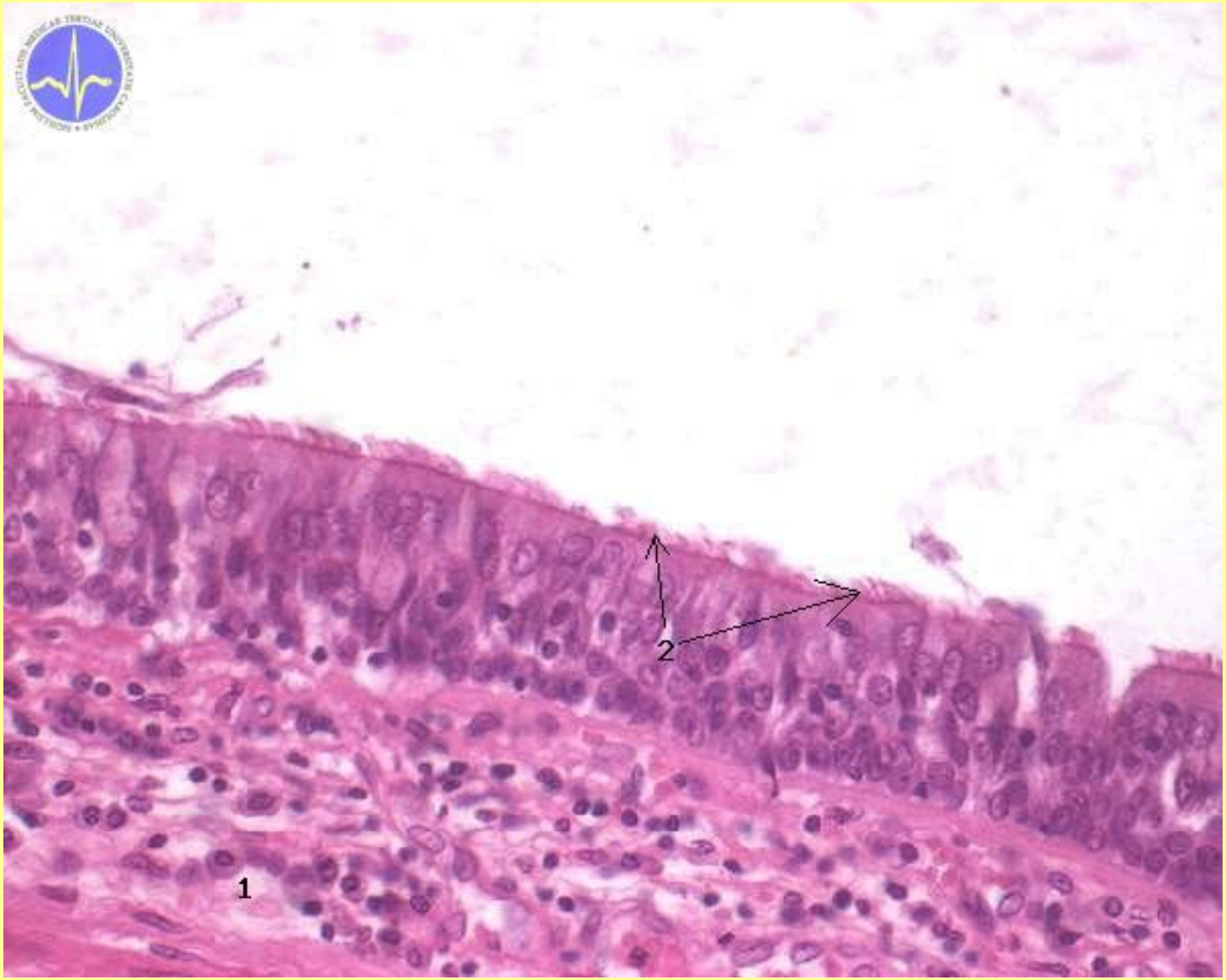
H&E stain the staining method involves application of an oxidation product of hematoxylin. Hemalum colors nuclei of cells (and a few other objects) blue. The nuclear staining is followed by counterstaining with an aqueous or alcoholic solution of eosin Y, which colors eosinophilic structures in various shades of red, pink and orange.

Single layer of columnar cells (2) with microvili (3) - oviduct



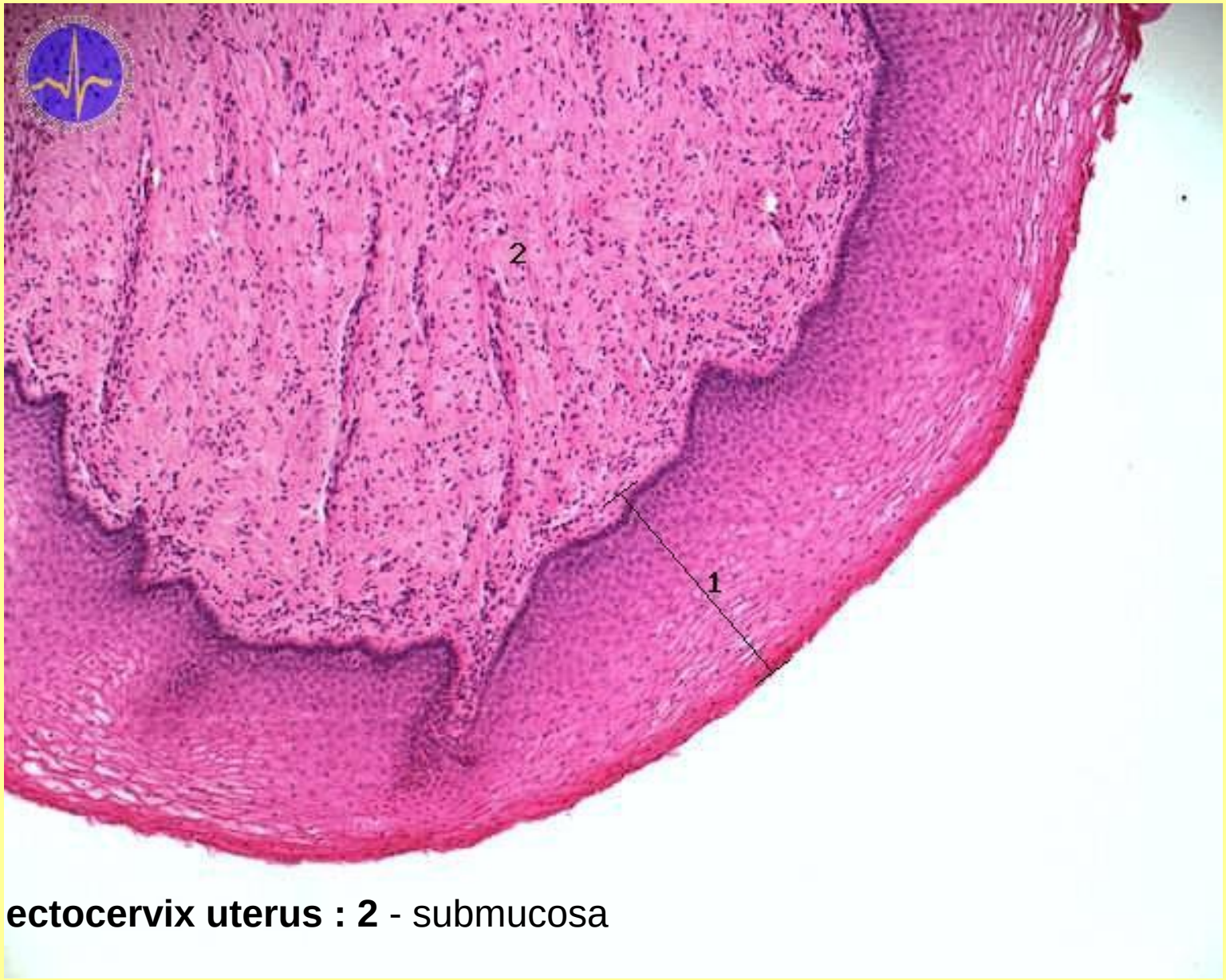
1 - lamina propria, **4** – gland cells

Stratified e. of cuboidal cells with microvilli (2) - trachea



1 - submucosa

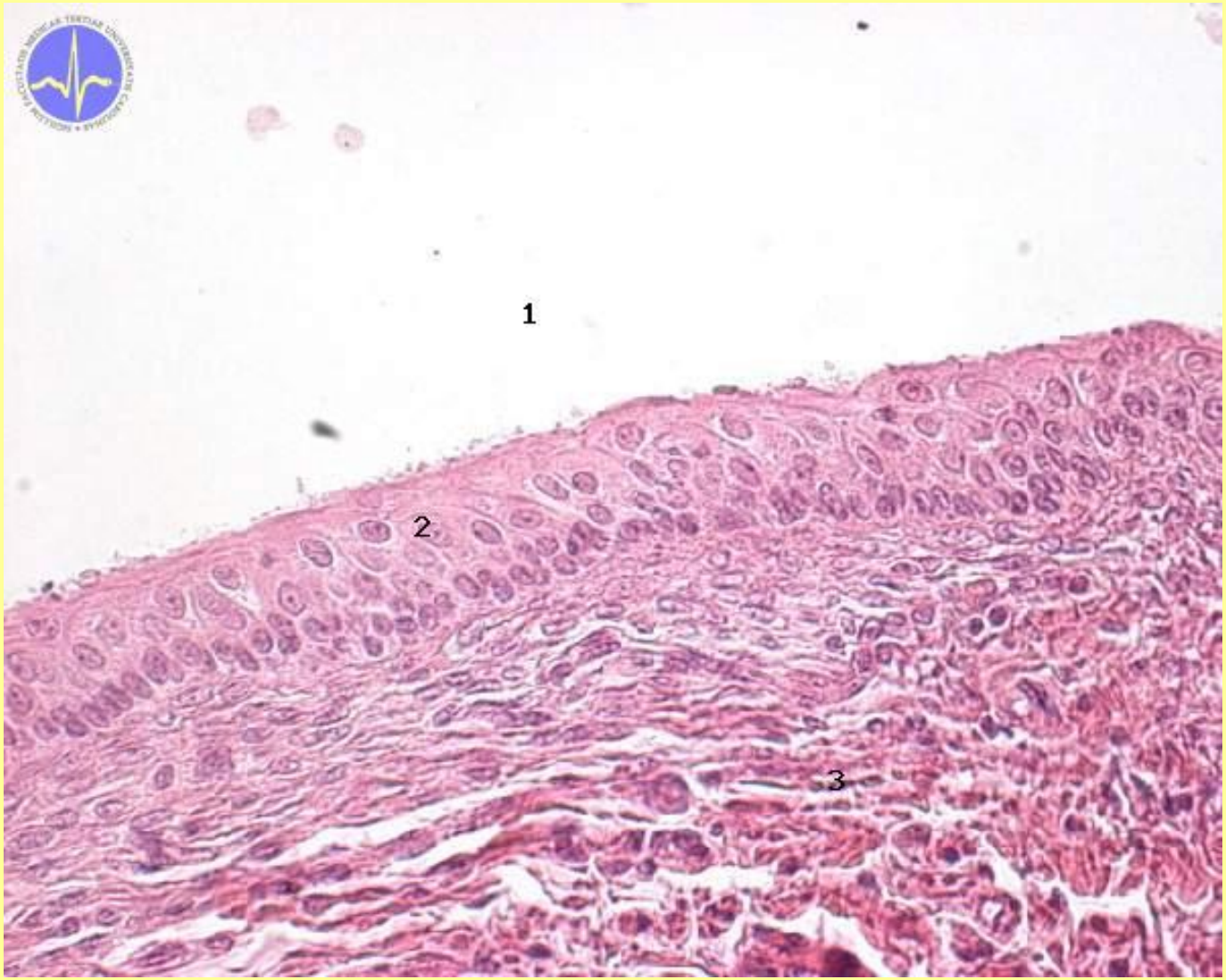
Stratified Squamous Epithelium (1) (non-keratinized)



Vagina, ectocervix uterus : 2 - submucosa

Stratified Squamous Epithelium (keratinized) – Cutis - Skin

Transitional Epithelium (2) (urinary bladder)



1 – lumen of vesica urinaria, **3** - Lamina propria mucosae

Function of epithelial tissue

- **protection and cover** - the skin - protect from mechanical injury, harmful chemicals, invading bacteria and from excessive loss of water

- **sensation** - specialized epithelial cells containing sensory nerve endings for the reception of stimuli are found in the skin, eyes, ears, nose and on the tongue

- **secretion** – glands - epithelial tissue is specialized to synthetize and secrete specific chemical substances such as enzymes, hormones and lubricating fluids

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- **resorption, absorption -** microvilli - certain epithelial cells line the small intestine absorb nutrients from the digestion of food

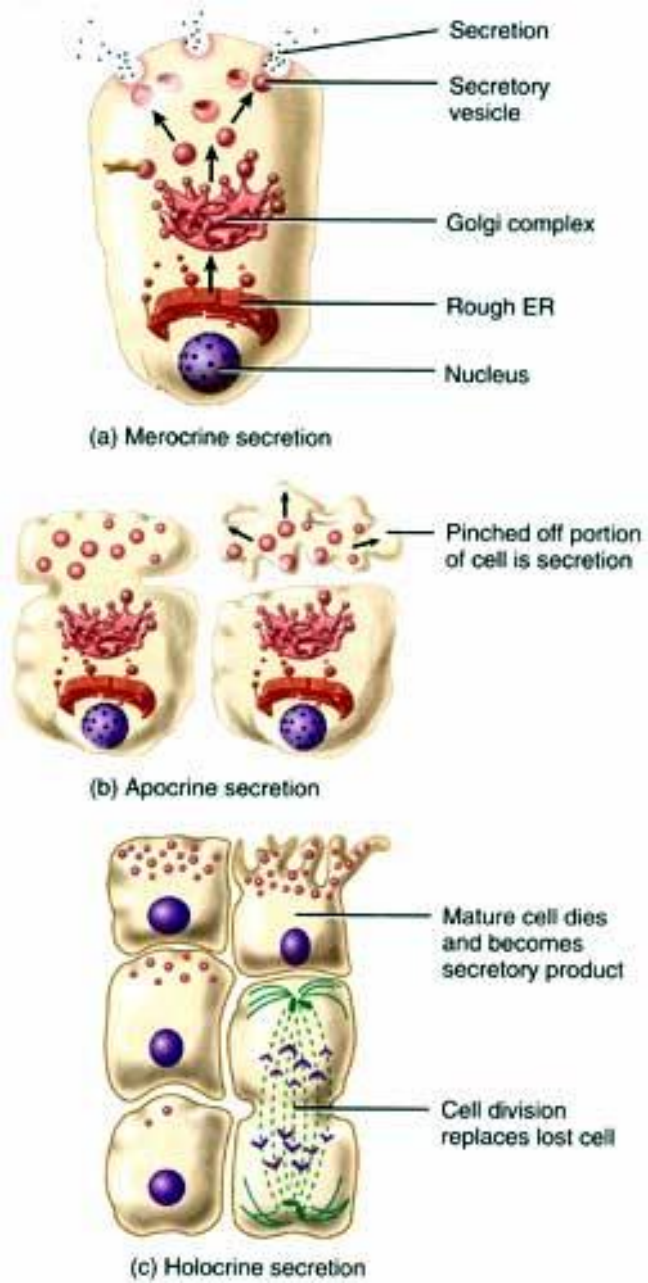
- **respiratory, diffusion** - simple epithelium mediates the diffusion of gases, liquids and nutrients. Because they form such a thin layer, they are ideal for the diffusion of gases (eg. walls of capillaries and lungs).

Specializations: **cilia, microvilli, goblet cells**

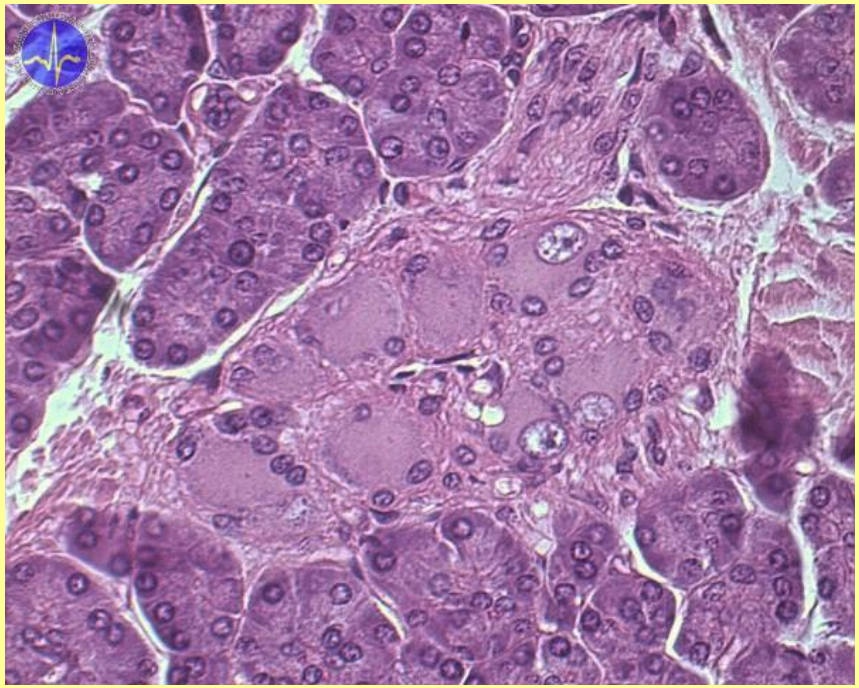
Glands

- **Exocrine** secrete enzymes through ducts, outlets to the surface mammary, oil and sweat gland

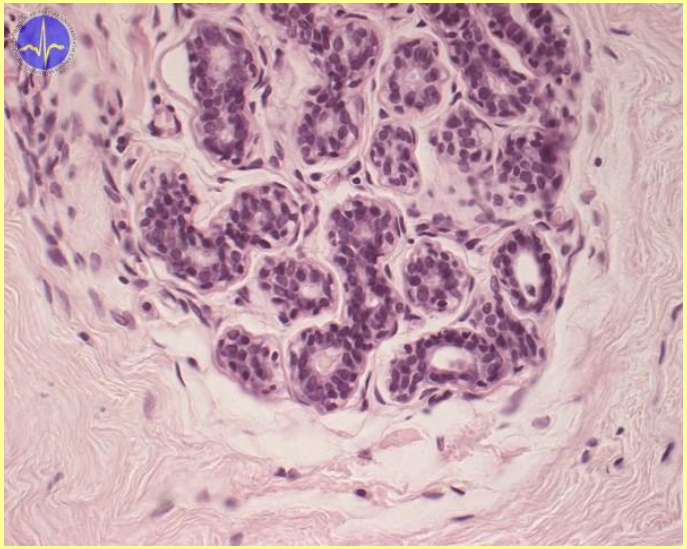
- **Endocrine** secrete hormones directly to body fluids, they are ductless

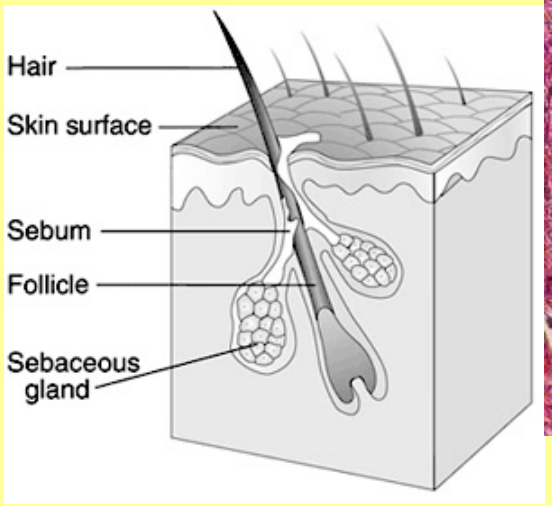


pancreas



lacteal gland





sebaceous gland

2. Connective tissue

- it supports and connects internal organs, forms bones and the walls of blood vessels, attaches muscles to bones, and replaces tissues of other types following injury.

- Consists of **a few types of cells** and extracellular matrix amorphous substance (proteoglycans, glycoproteins) a fibre:
  Collagenous **-** strong and flexible
  Elastic - resilient, and can be stretched
  Reticular – form extensive network, in the umbilical cord

Cells:

Fibroblasts – an immature **fibre-producing** cell of connective tissue capable of differentiating, fibrocyte is differentiated form

Cartilage cells (chondrocytes) - cells embedded in the lacunae of the cartilage matrix

Bone cells: osteoblasts - a bone-forming cell that is derived from fibroblast and forms an osseous matrix in which it becomes enclosed as

an osteocyte.

osteocytes: occupies lacuna and has cytoplasmic processes that extend into canaliculi and make contact by means of gap junctions with the processes of other osteocytes.

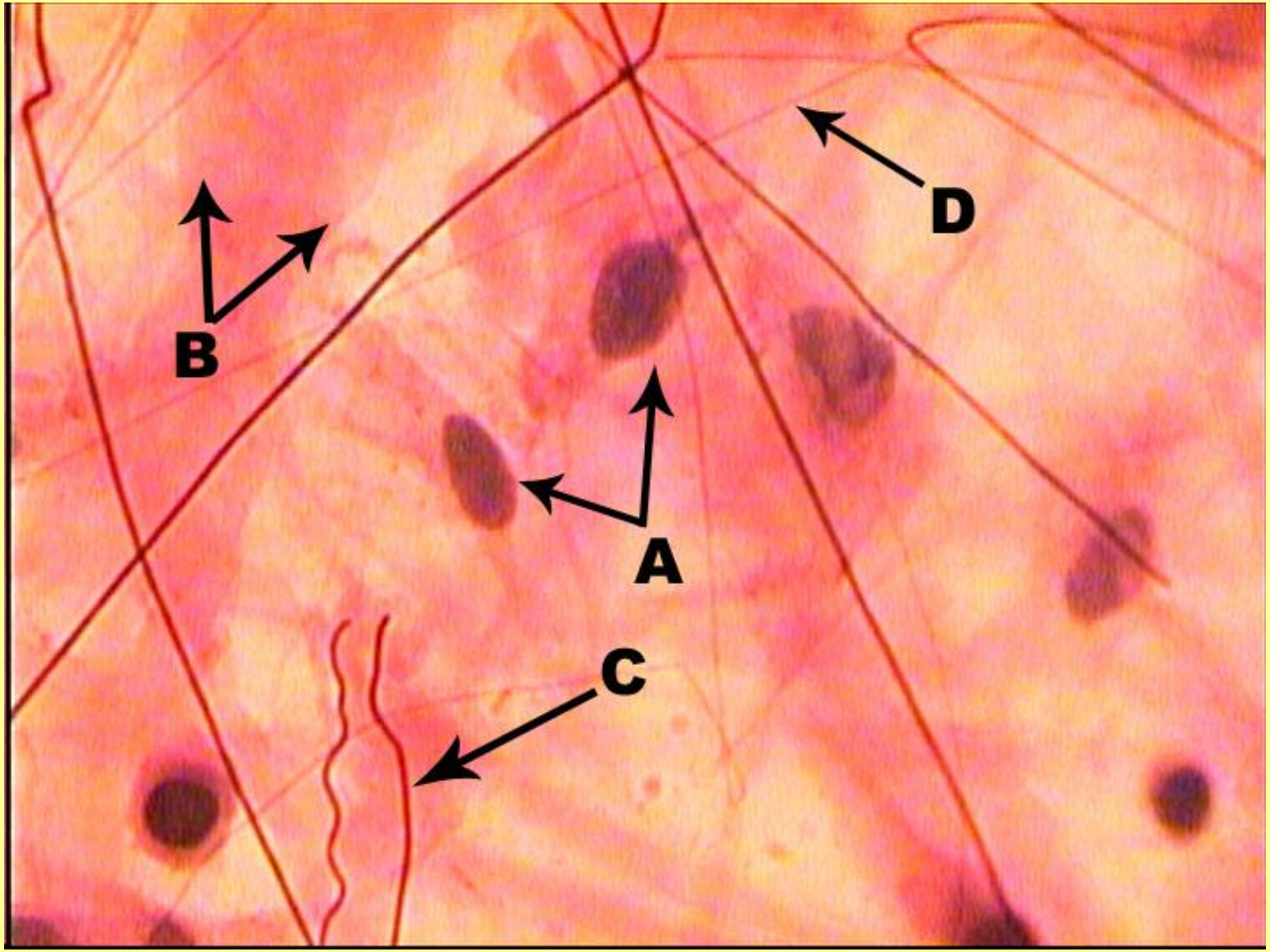
Fat cells (adipocytes) a generic term for any fat-storing cell

Mast cells contains numerous basophilic granules and releases substances such as heparin and histamine in response to injury or inflammation.

Macrophages white blood cells whose job is to destroy invading microorganism

Plasma cells plasma cells are derived from B lymphocytes and are active in the formation and secretion of antibodies.

Gap junction channels linking adjacent cells and through which can pass ions, most sugars, amino acids, nucleotides, vitamins, hormones, and cyclic AMP.



Fibroblasts with dark nuclei [A] are seen here along with thick collagen fibers [B], thin elastic fibers [C] and very fine reticular fibers [D].

Connective tissue

Loose connective tissue soft, pliable

Areolar fibrous connective tissue with loosely organized fibers arranged in a mesh or net, associated with muscles and epithelia. It supports organs and fills spaces between them.

Adipose t.: white In non-overweight humans, composes as much as 20% in men and 25% of the body weight in women. A store of energy, also acts as a thermal insulator.

brown – thermogenic tissue composed of cells containing numerous fat droplets and rich in heme-containing cytochromes and mitochondria; in newborns and in hibernating mammals

Dense connective tissue - dense fibrous tissue – the fibers are mainly composed of type I collagen. Crowded between the collagen fibers are rows of fibroblasts, fiber-forming cells, that generate the fibers.

Dense connective tissue -

cartilage

bone

dense regular fibrous tissue forms strong, rope-like structures such as tendons and ligaments.

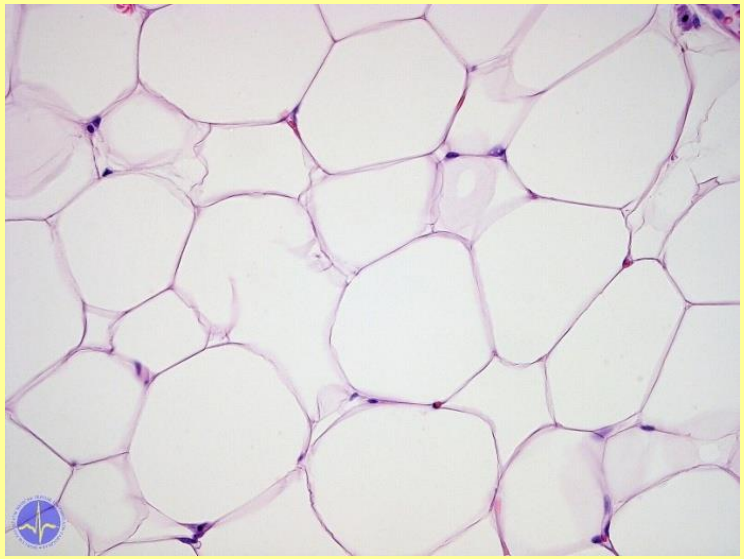
Tendons attach skeletal muscles to bones;

Ligaments connect bones to bones at joints. Ligaments are more stretchy and contain more elastic fibres than tendons. Aponeuroses are layers of flat broad tendons.

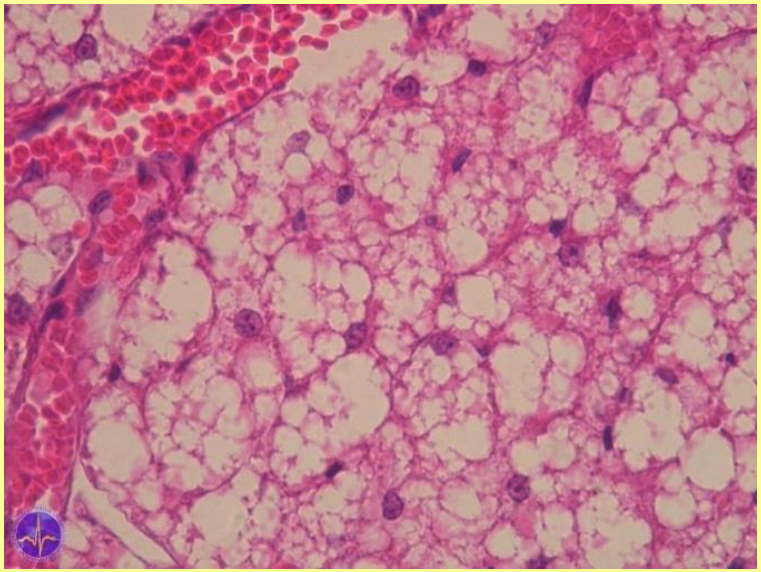
irregular fibrous tissue - Collagen fibres are no arranged in he parallel bundles

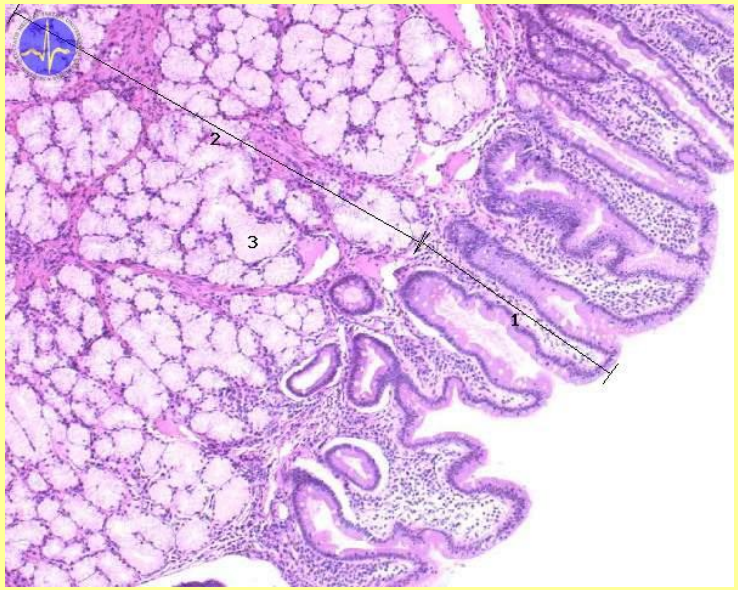
dense connective tissue make up the lower layers of the skin (dermis), where it is arranged in sheets, also makes up submucosa of the digestive tract, fibrous capsules of joints and lymph nodes, and some types of fascia.

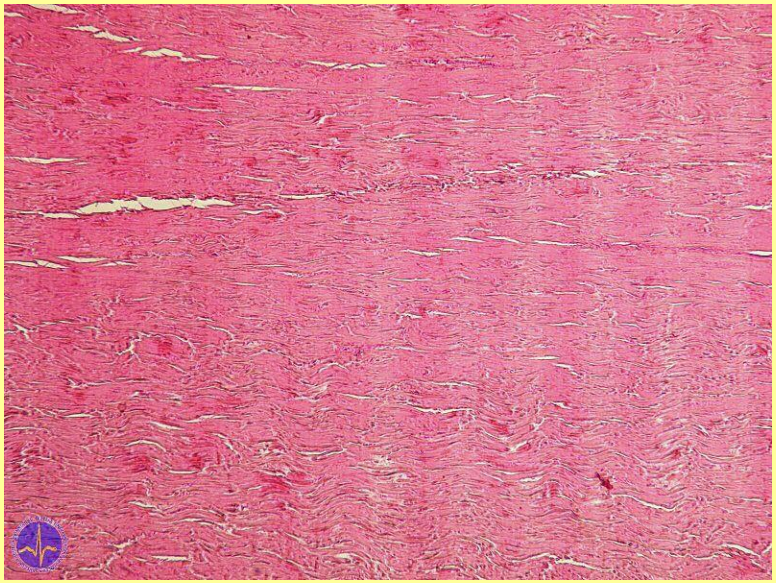
Blood and lymph an hemopoetic tissue



white, brown adipose tissue







tendon

Vertical section of duodenum: **1** - Tunica mucosa, **2** - Tunica submucosa, **3** – Brunner gland

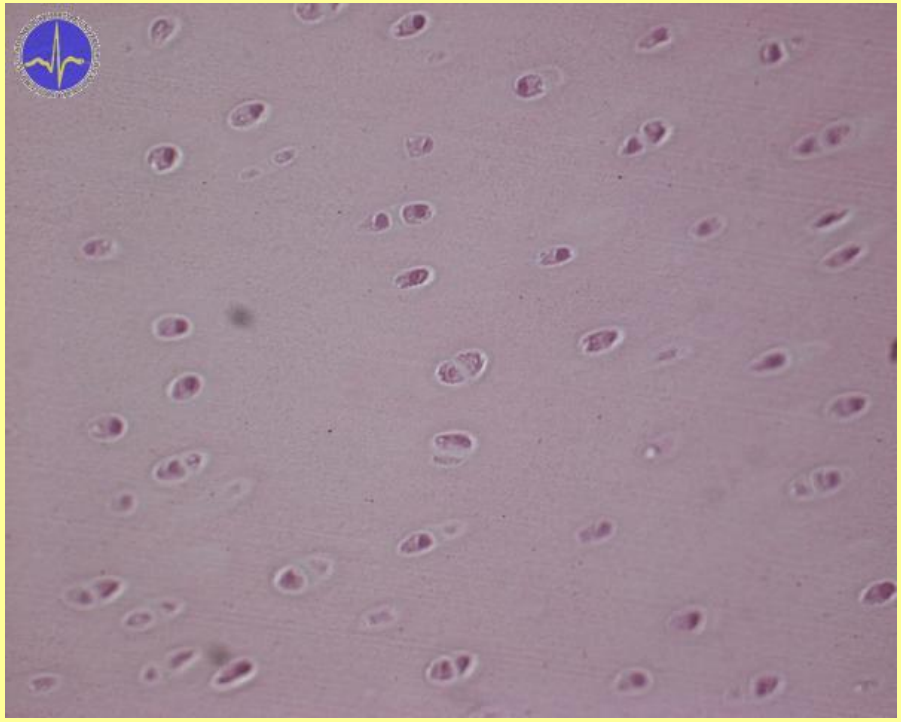
Cartilage

characterized by its nonvascularity and firm consistency; consists of cells **chondrocytes** in lacunas , an interstitial matrix of fibers **collagen**, and ground substance **proteoglycans,glykoproteins**. Is is strong, flexible and firm dense connective tissue, without blood vessels. Perichondrium

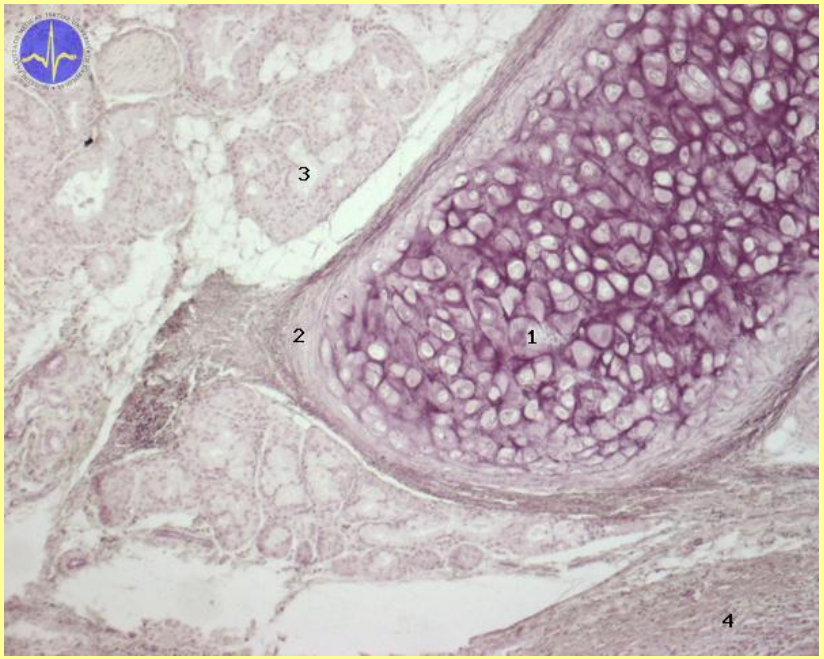
hyaline cartilage – the most abundant, surfaces of long bones and joints (knee, elbow), rib cartilages, respiratory sys.

fibrous cartilage - intervertebral discs, pelvic bones fuse

elastic cartilage – coll. fibres in network of elastic fibbers epiglottis, outer ear



hyaline cartilage



elastic cartilage - epiglottis

1 – elastic cartilage, **2** - perichondrium, **3** – seromucin glands, **4** - Tunica mucosa

Bone – extracellular matrix and collagen fibers, produces red and white blood cells – **red marrow**

Bone store minerals and most notably **calcium and phosphorus** (calcium phosphate 2/3, calcium hydroxiapatit 1/3), substances for hardness and rigidness, collagen of I. type

osteoblasts - a bone-forming cell that is derived from fibroblast and forms an osseous matrix in which it becomes enclosed as an osteocyte.

osteocytes: occupies lacuna and has cytoplasmic processes that extend into canaliculi and make contact by means of gap junctions with the processes of other osteocytes.

osteoclasts: a large, multinuclear cell associated with resorption of bone.

Ossification (or **osteogenesis**)

Intramembranous ossification is the direct formation and healing of bone from primitive connective tissue (mesenchyme)

endochondral ossification: cartilage is substituted by bone

Periosteum

Endosteum

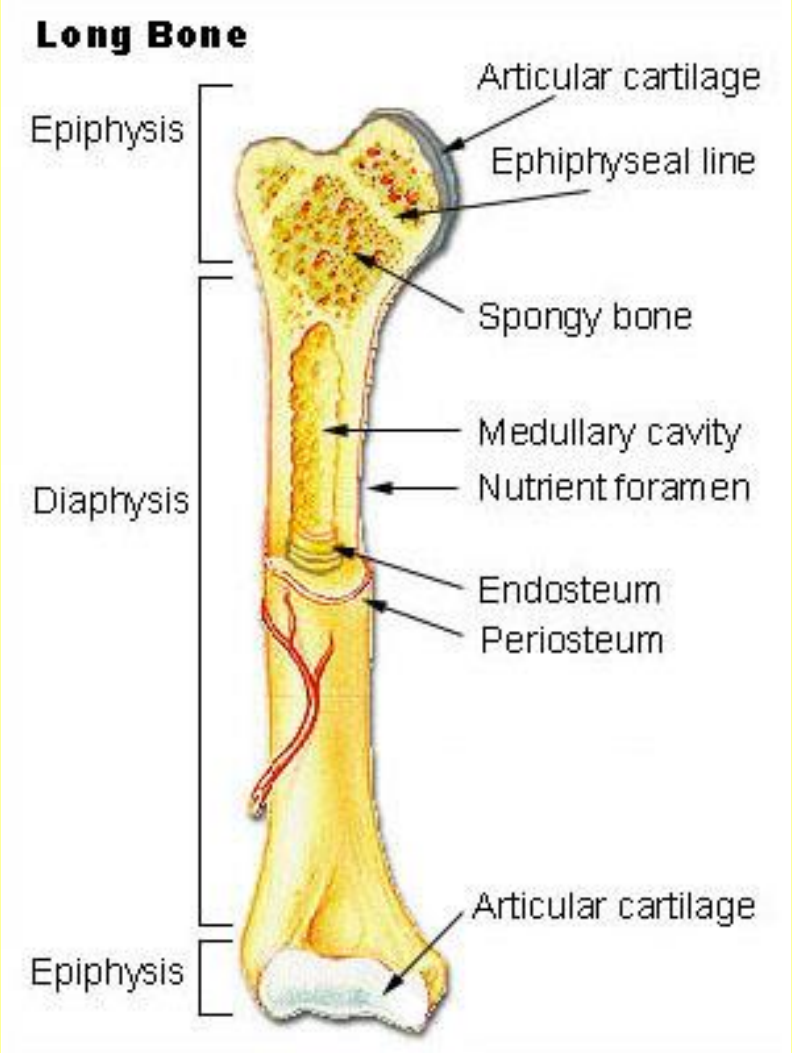
Compact bone

Cancellous, spongy bone

Bone marrow – red,

yellow, grey, medulla

- Diaphysis
- Epiphysis

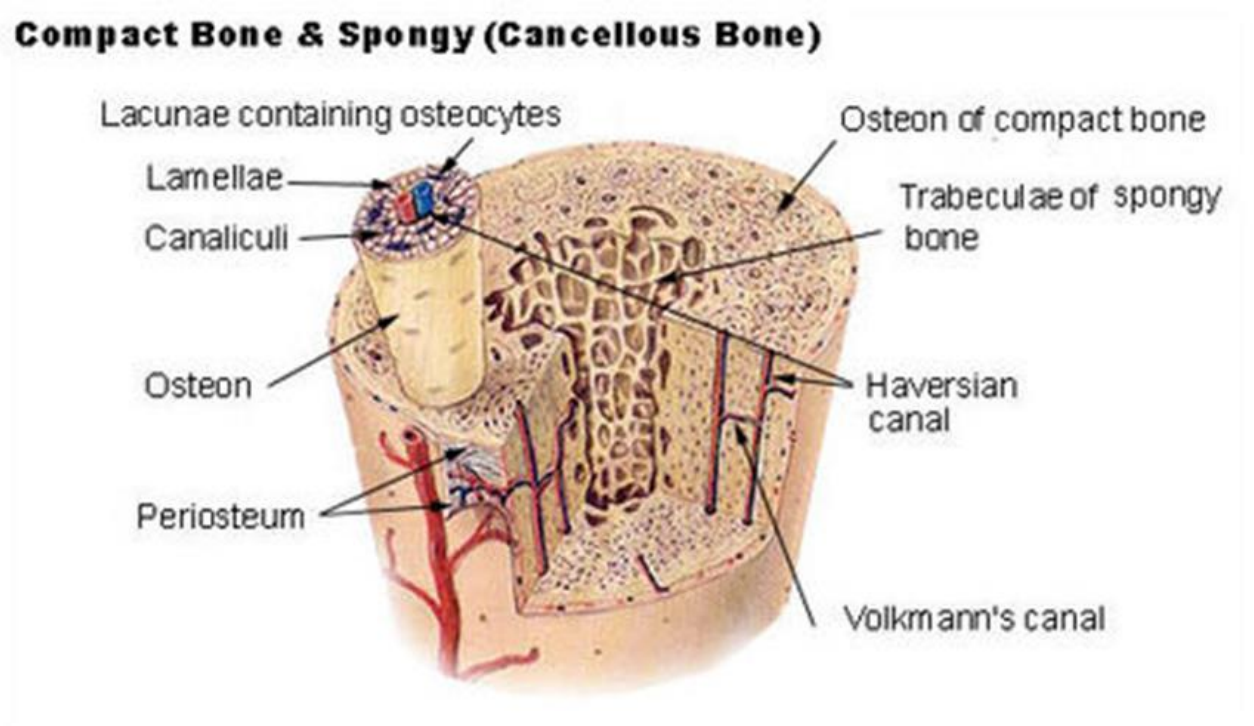


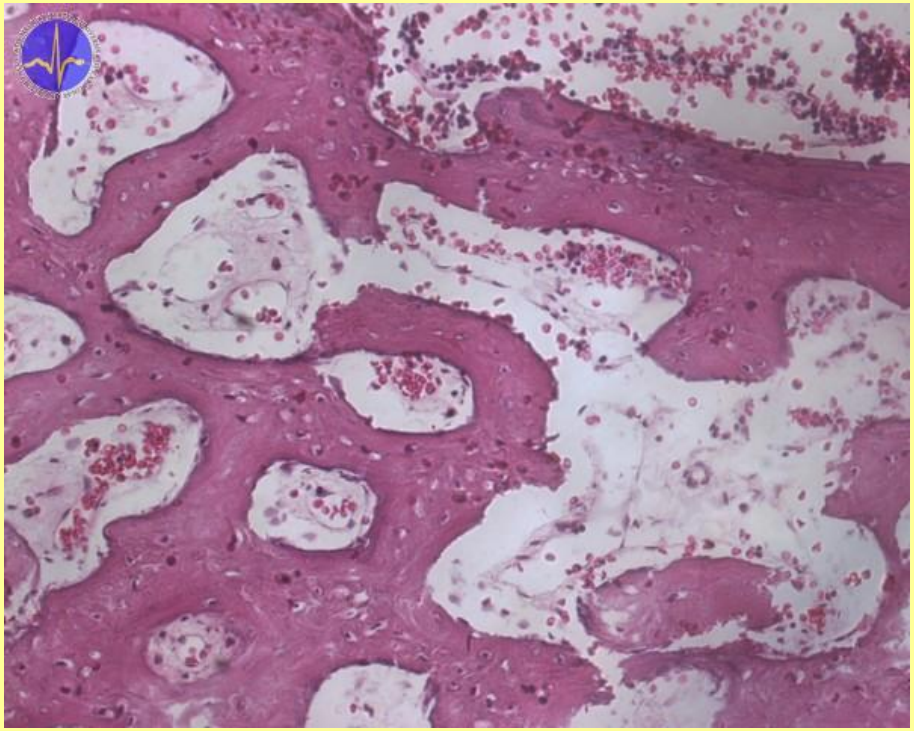
http://doctorsgate.blogspot.com/2010/11/compact-vs-spongy-bones.html

The periosteum, is a thin membrane of fibrous tissue. This membrane encloses all bones completely except at the joints where there is a layer of cartilage.

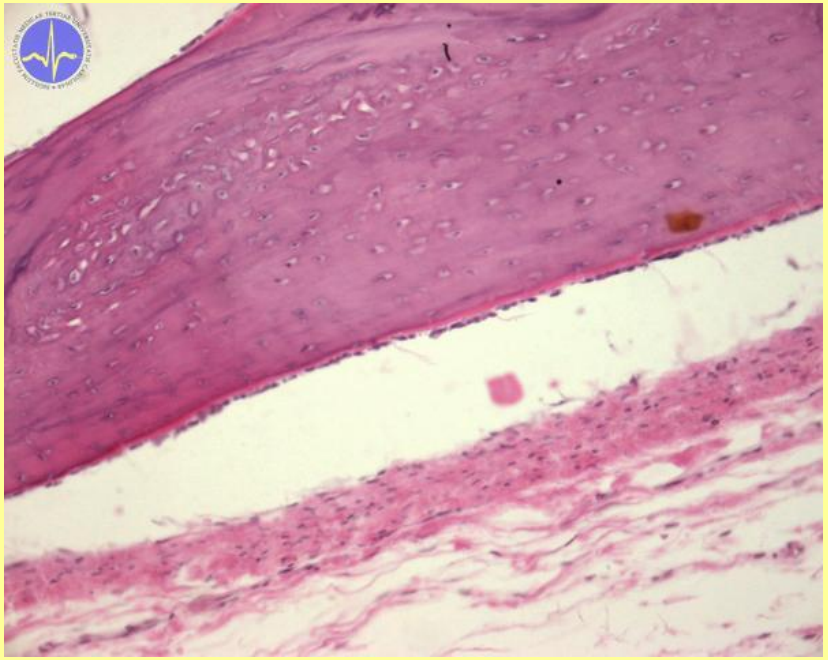
Compact bone are hard layers of dense bone tissue. It is lamellar in structure. It is permeated by an elaborate system of interconnecting vascular canals, the **haversian systems**, which contain the blood supply; the bone is arranged in concentric layers around those canals, forming structural units called **osteons**.

Spongy bone is porous bone enclosing numerous large spaces. The tissue makes up most of the volume of bone, because it contains little hollows like those of a sponge.

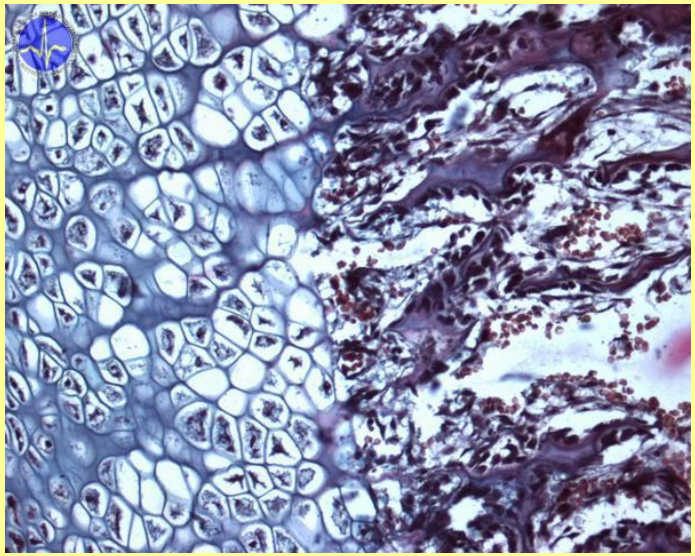




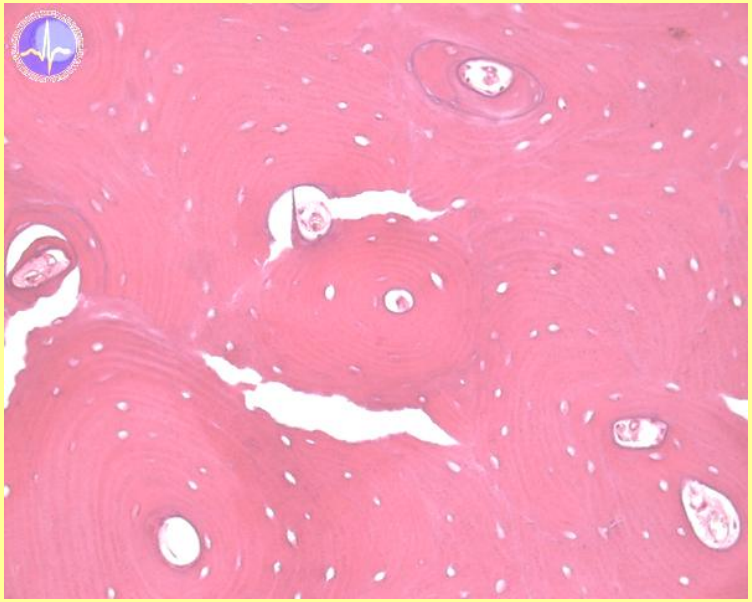
spongy bone



intramembranous ossification



endochondral ossification



compact bone with osteon

3. Muscle tissue

Tissue that causes movement or change in the shape of some body part

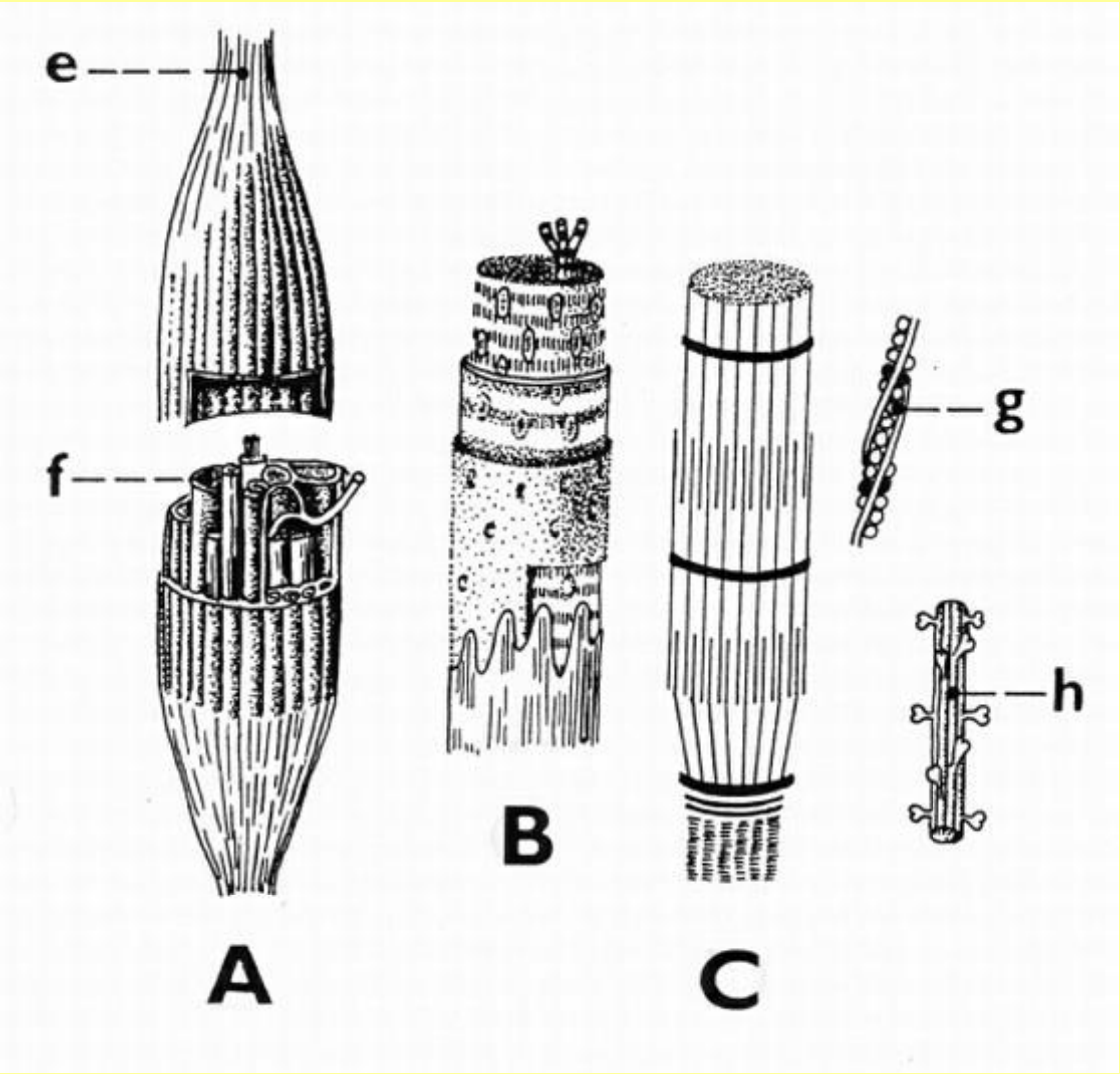
Skeletal muscle

voluntary muscle that is made up of elongated, multinucleate, transversely striated muscle fibers and **is typically attached to a bone or connective tissue.** Contractions are rapid.

- Control **by our will**, spinal and cerebral nerves.
- Skeletal muscle, lingual muscle, pharyngeal muscle

Multinucleated syncytium made up by fusion of myoblast cells. Their **nuclei** are located peripherally adjacent to the plasma membrane (**sarcolemma**).

Skeletal muscle - structure



A. Muscle with fascia

e. tendon

f. bundle of fibres

B. Fibre

C. Myofibril with **sarcolemma**

from **sarcomere**

g. actin (G actin into F actin)

tropomyosin

troponin

h. myosin

Mitochondria, myoglobin, sarcoplasmic reticulum

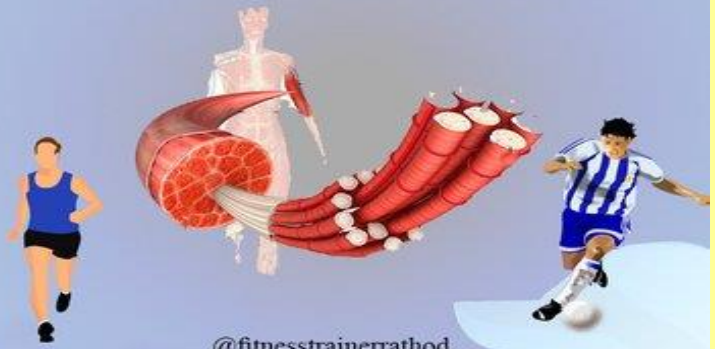
Skeletal muscle

Myofibrils are composed of **actin (thin)** and **myosin (thick)** filaments and associated proteins.

The regular repeating segments, **sacromeres** of myofibrils give **skeletal and cardiac muscle** cells transverse striations.

In smooth muscle cells, actin and myosin filaments form contractile fibers, which do **not** appear as **highly organized** as myofibrils

Type of Fibers



@fitnesstrainerrathod

TYPE 1

Slow twitch muscle fibers

Long distances - endurance

Less fatigue

TYPE 2A

Fast twitch - Oxidative

Moderate distance and intensities

Moderate fatigue

TYPE 2B

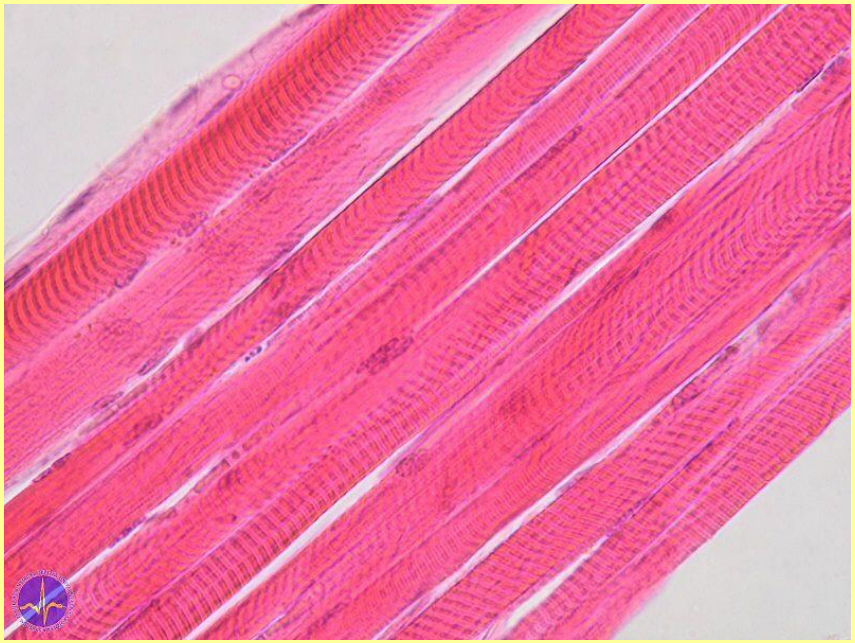
Fast twitch - glycolytic

Short distances

High Intensity

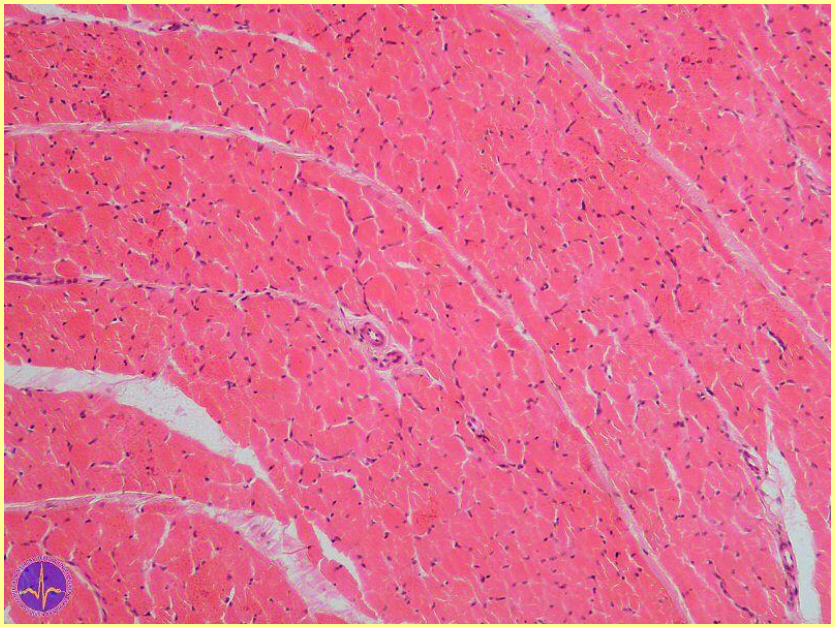
High fatigue

SLOW TWITCH	FAST TWITCH
Slow Contract	Fast Contract
Uses aerobic energy	Uses anaerobic energy
Slow Fatigue	Fast Fatigue
Produces less lactic acid	Produces more lactic acid
Suitable for endurance sports	Suitable for strength and power sports



Skeletal muscle

Skeletal and muscles of tongue and pharynx



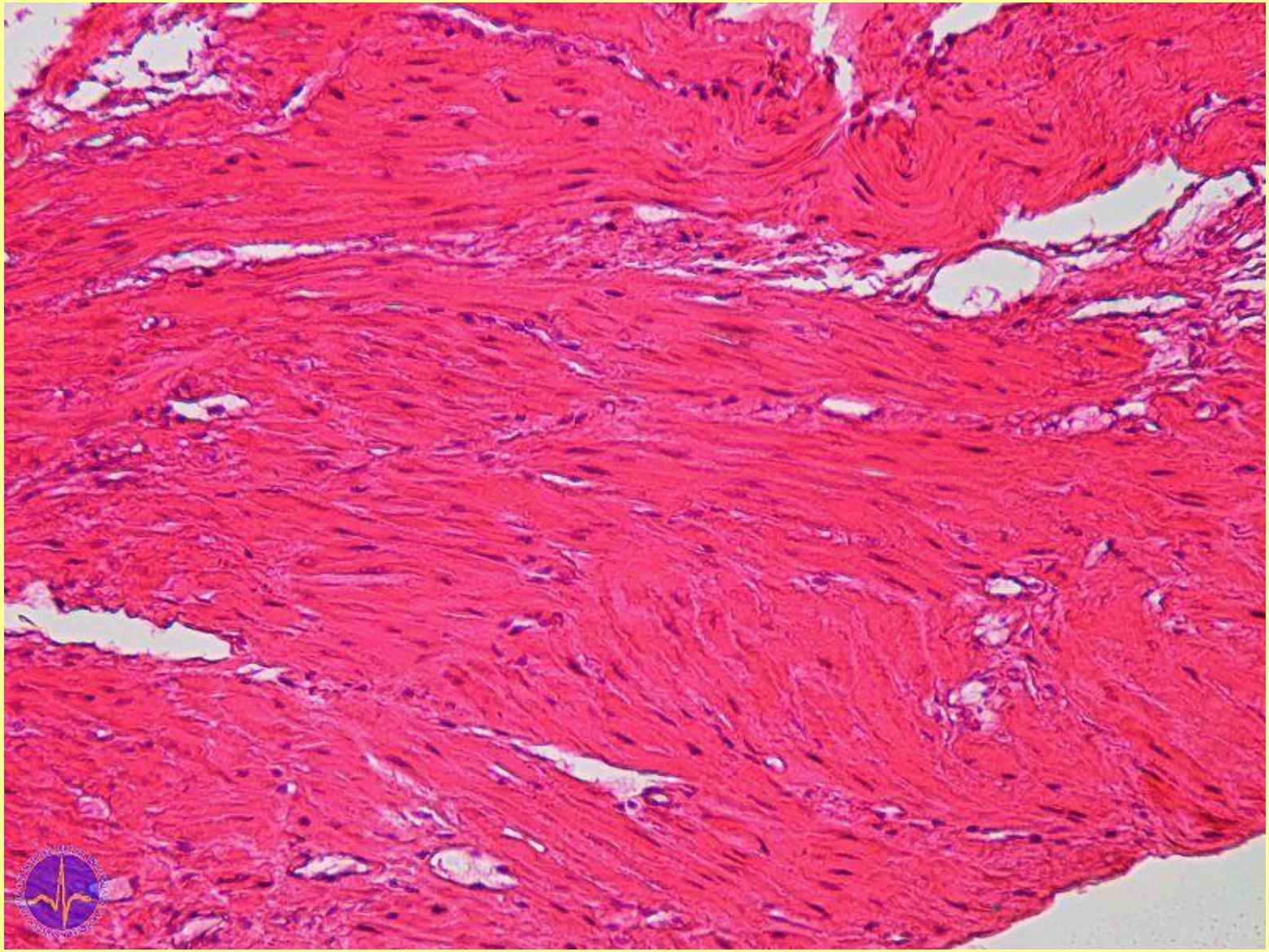
Smooth muscle

contracts without conscious control, having the form of thin layers or sheets made up of spindle-shaped, unstriated cells with single nuclei Cells are interconnected by **gap junctions**.

They are able to regenerate.

Is found **in the walls of the internal organs, such as the stomach, intestine, bladder, uterus, dermis and blood vessels, excluding the heart**. Contractions are slow and wavelike. Control by autonomic [**vegetative**] nerves

Smooth muscle - uterus



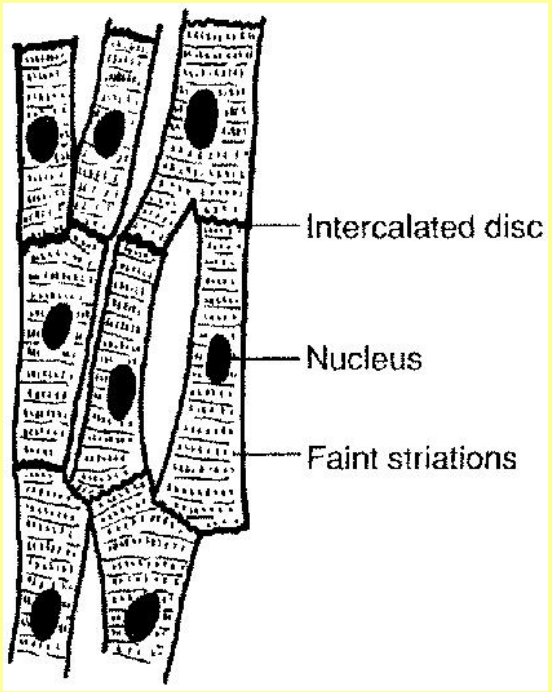
Cardiac muscle

Wall of the heart and pulmonary veins

Composed of branching and anastomosing chains of **cardiac muscle cells.** They are joined to their neighbors by **intercalated discs**, which contain **anchors and gap junctions**. The adherent junctions and desmosomes physically connect **the cytoskeletons** and contractile apparatuses of the neighboring cells.

Control by autonomic [**vegetative**] nerves

Cardiac muscle



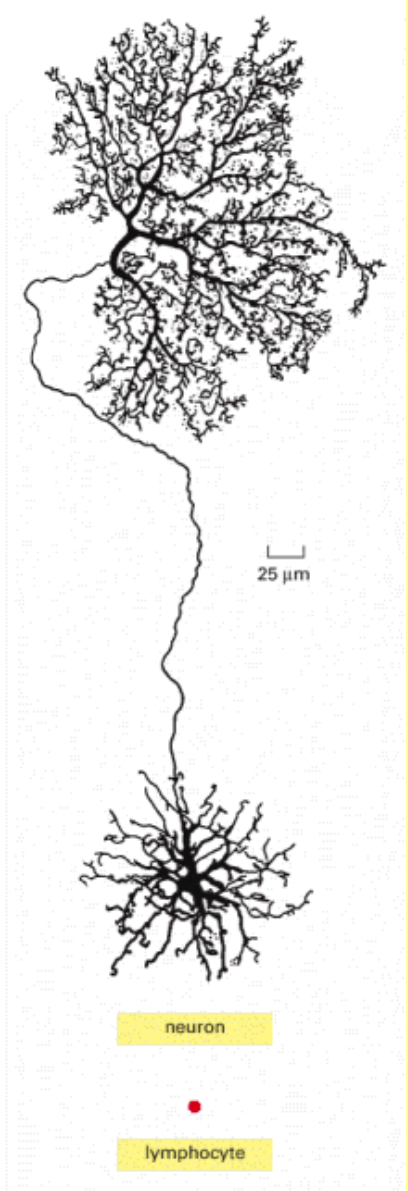
4. Nervous tissue

The extensive network that receives, integrates, coordinates, interprets, and reacts to changes.

The nerves make up the peripheral nervous system, as distinguished from the central nervous system (brain and spinal cord).

There are 12 pairs of cranial nerves, which carry messages to and from the brain.

Spinal nerves arise from the spinal cord and pass out between the vertebrae; there are 31 pairs, 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal.



Molecular Biology of the Cell. 4th edition.
Alberts B, Johnson A, Lewis J, et al.

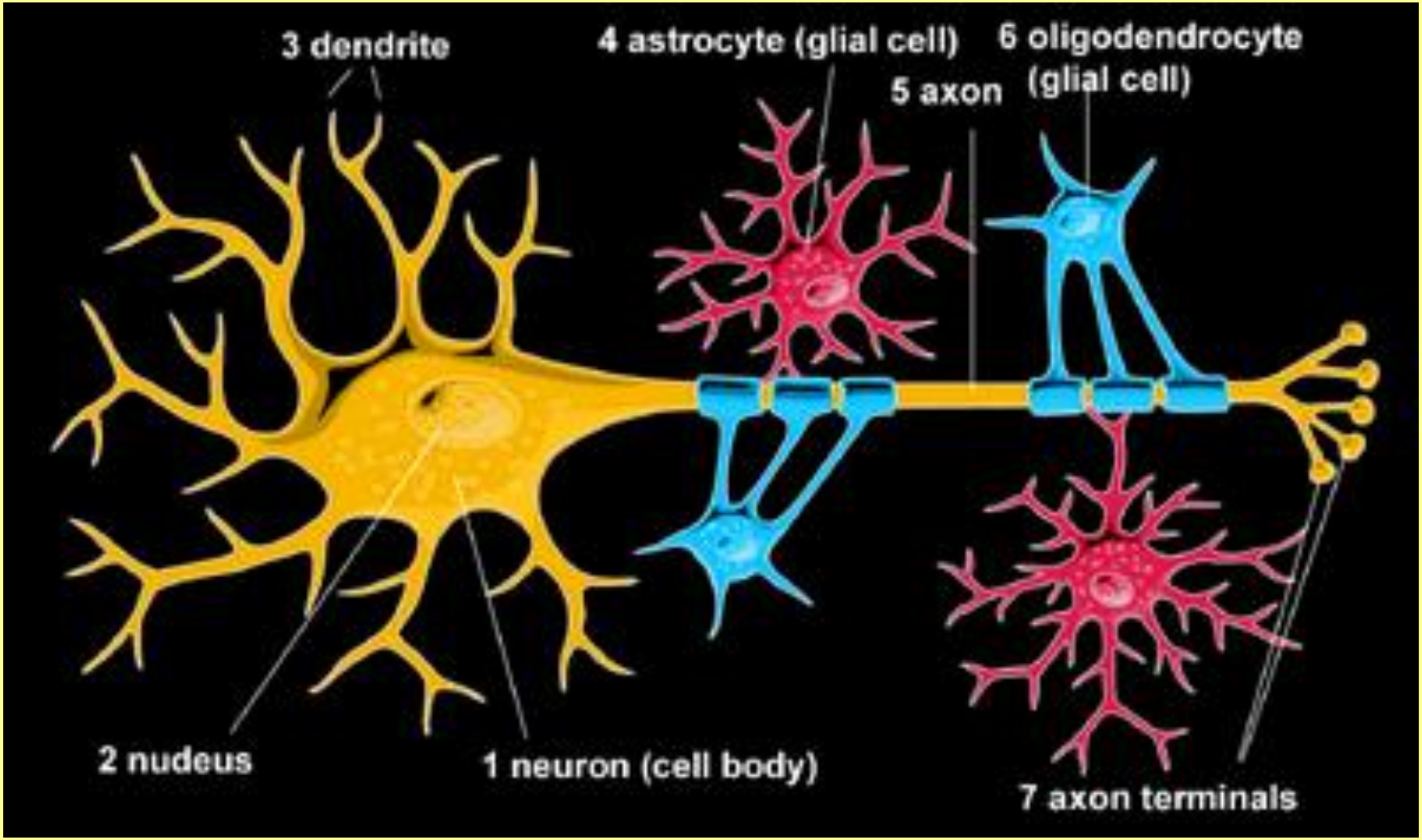
- **Neurons -** specialized, electrically excitable cells, which conduct impulses and numerous supporting cells
- **Glial cells**

  Astrocytes, Oligodendrocytes, Schwann cells
  - Lead away waste products, store of nutrients
  - origin of neurolemma, which cohere with sheath myelin

Neuron

- Centripetal fibers - dendrits
- centrifugal fibers – neurits – axons
- Cells have long projections, which may run in bundles of parallel fibers. Nerves are grey and white fibers with or without myelin sheet.

The various nerve fibers and cells that make up the autonomic nervous system innervate the glands, heart, blood vessels, and involuntary muscles of the internal organs.



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