

Histology

lecture from Human Morphology

22. 10. 2020

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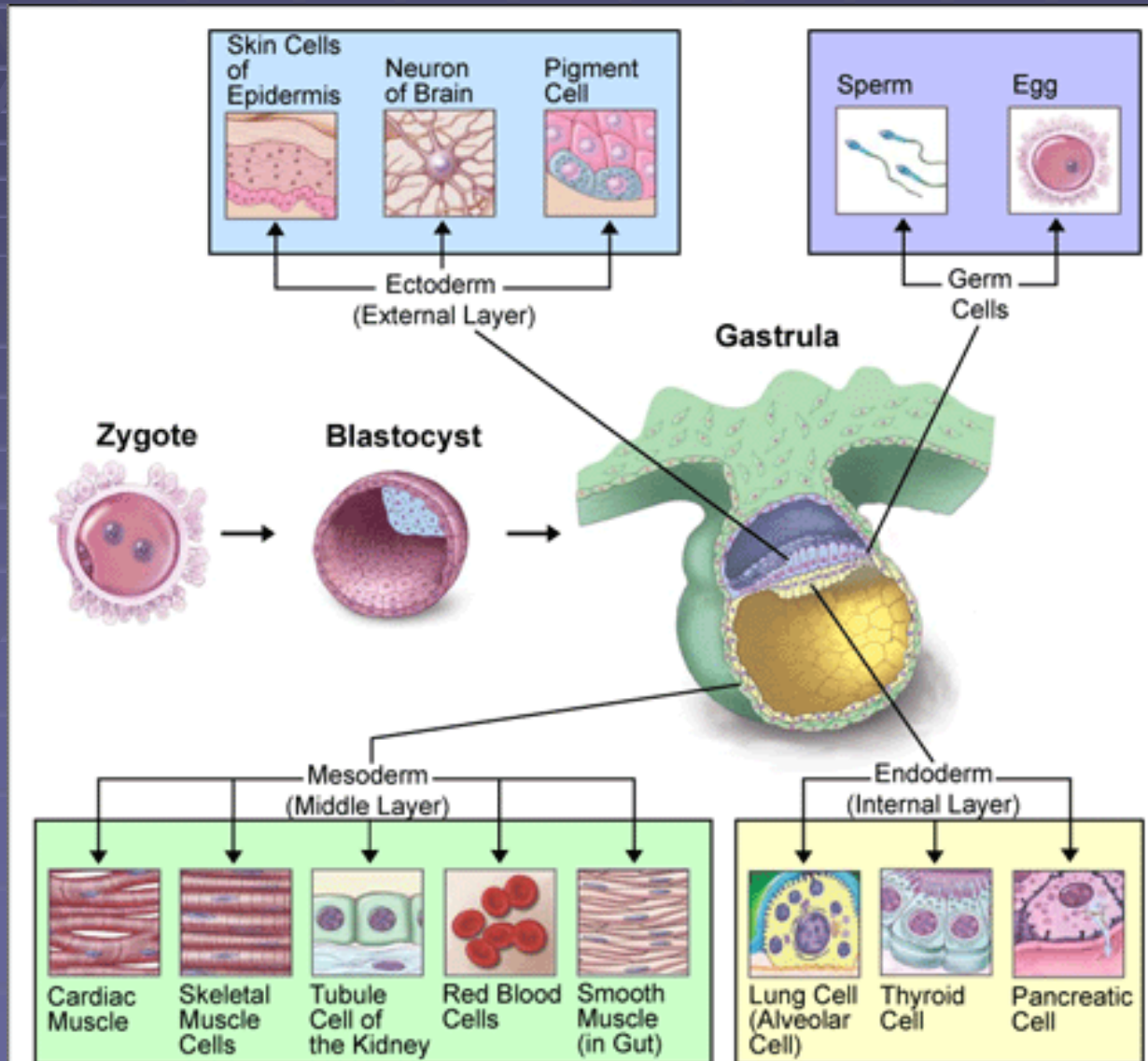
HISTOLOGY

- the study of the microscopic structure of cells, tissues and organs
- it is performed by examining a thin sections of tissue under a light or electron microscope

TISSUE ORIGIN

- during embryonic period tissues are differentiated from the **germ layers**
- ECTODERM
- MESODERM
- ENDODERM

TISSUE ORIGIN



HISTOLOGICAL TECHNIQUE

■ Tissue sampling

- necropsy – samples taken from dead bodies
- biopsy
 - probatory excision – during the surgery
 - probatory puncture – sucking of cells or pieces of tissue through the syringe with thick needle
 - curettage – in gynaecology and obstetrics



HISTOLOGICAL TECHNIQUE

■ FIXATION

- autolysis – each living tissue gradually loses the structural features and undergoes decay and disintegration by means of degrading enzymes
- fixing – stopping the autolysis; denaturation of cell and tissue proteins and their precipitation
- physical means of fixing – dry hot, boiling, lyophilisation (desiccation during lower temperature)
- chemical means of fixing – ethanol, methanol, acetone, acetic acid, triacetic acid, picric acid, mercuric chlorid, copper dichromate, formaldehyde, glutaraldehyde
- common fixing time 12 – 24 hours
- washing after fixation – by means of water or alcohol

HISTOLOGICAL TECHNIQUE

■ EMBEDDING

- water-soluble media – hot gelatine, cellodal, polyethylenglycols
- water-insoluble media – paraffin, celloidin, celloidin-paraffin

■ SECTIONS

- microtoms
- slice thickness – for studying purposes 10 μm thin slices
- slice processing – put albumen fixative on the slide, adding a few drops of distilled water, arranging the sections on the slides, warming the slide to spread the sections and drying in air

HISTOLOGICAL TECHNIQUE

■ STAINING

- rendering of outlines and structures more distinct by giving them a color contrast with their surroundings (color image), the differentiation of particular structures or substances which by their selective staining facilitate the histological analysis
- removal of embedding media
- staining
 - hematoxylin a eosin: nuclei and cartilage (hematoxyline), fibrous tissue, cytoplasm, muscle tissue (eosin)
 - Azan: nuclei, erythrocytes, collagen tissue, muscle tissue
 - Weigert – van Gieson: muscle tissue, collagen, nuclei

■ MOUNTING

- it means arrange it upon some suitable support (glass slide) in suitable mounting medium that it may be satisfactorily studied with the microscope
- canadian balsam, gum arabic sirup, glycerine



TISSUE

- ensemble of cells, not necessarily identical, but from the same embryonic origin, that together perform the same function

- epithelial tissue
- connective tissue
- muscle tissue
- nervous tissue

- body fluids



Connective tissue



Epithelial tissue

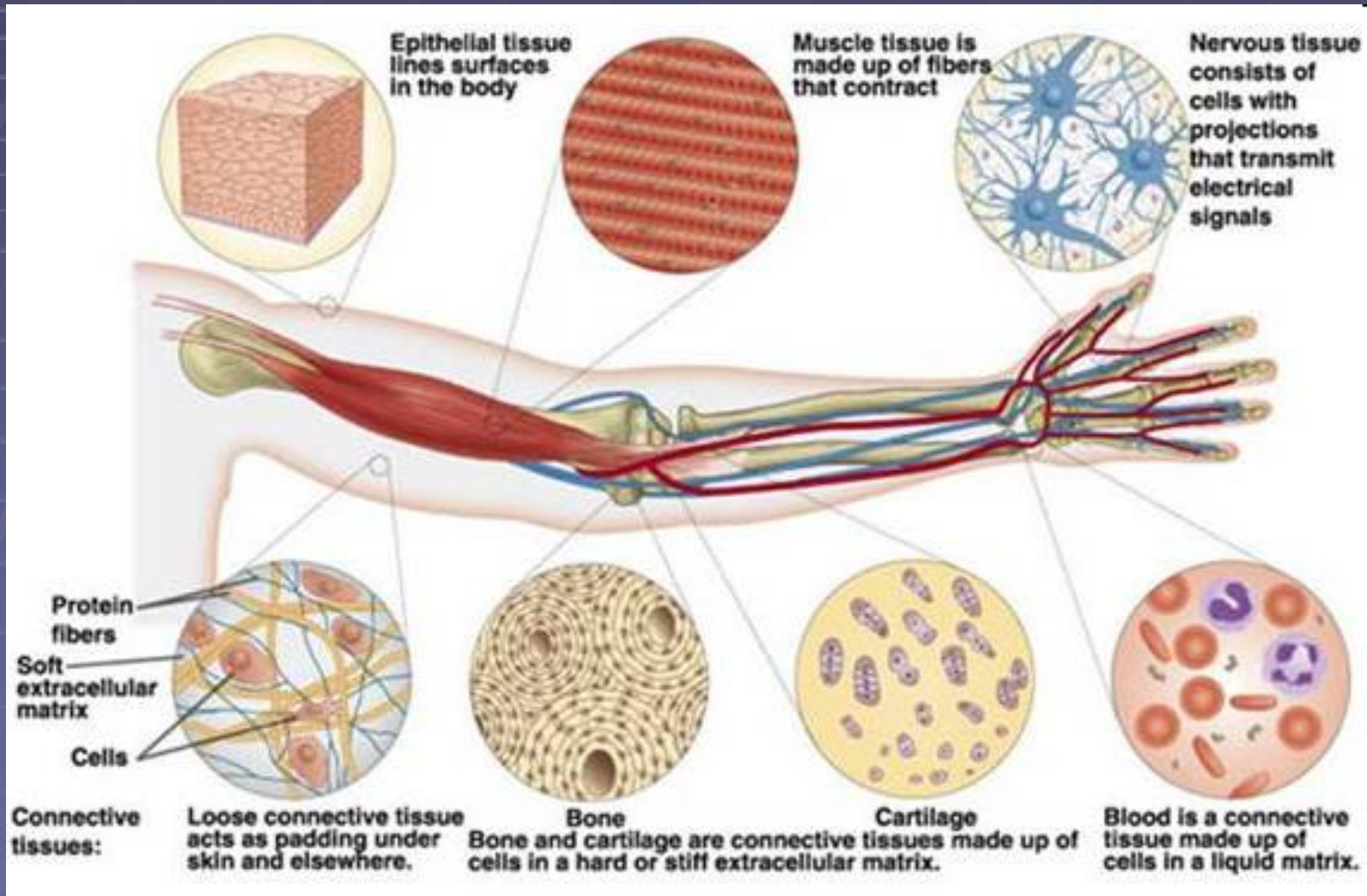


Muscle tissue



Nervous tissue

TISSUES



EPITHELIA

■ SIMPLE EPITHELIA

- simple squamous
- simple cuboidal
- simple columnar


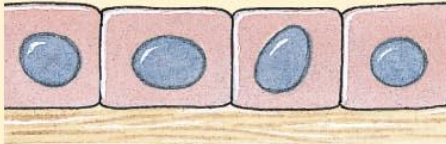
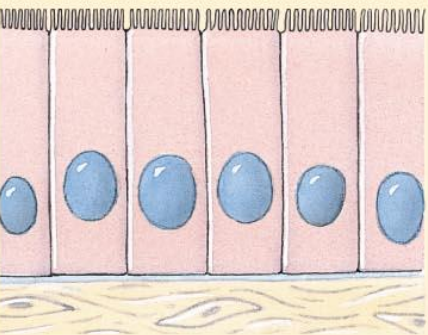
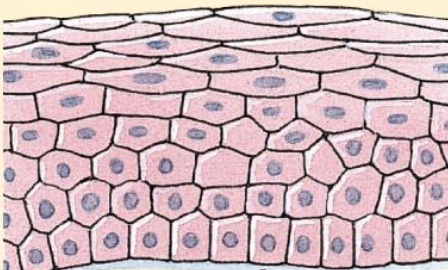
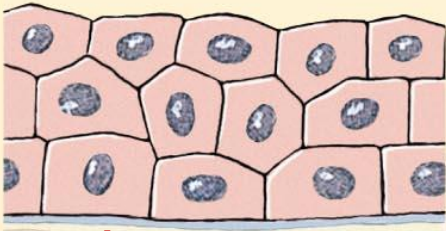
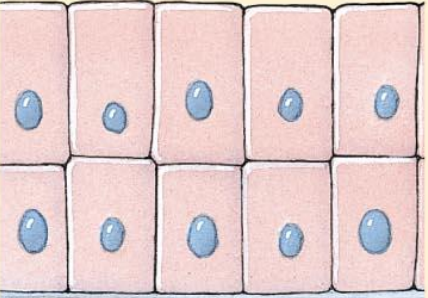
■ STRATIFIED EPITHELIA

- stratified squamous
- stratified cuboidal
- stratified columnar

- transitional

Types of Epithelium

TABLE 4 - 1 *Classifying Epithelia*

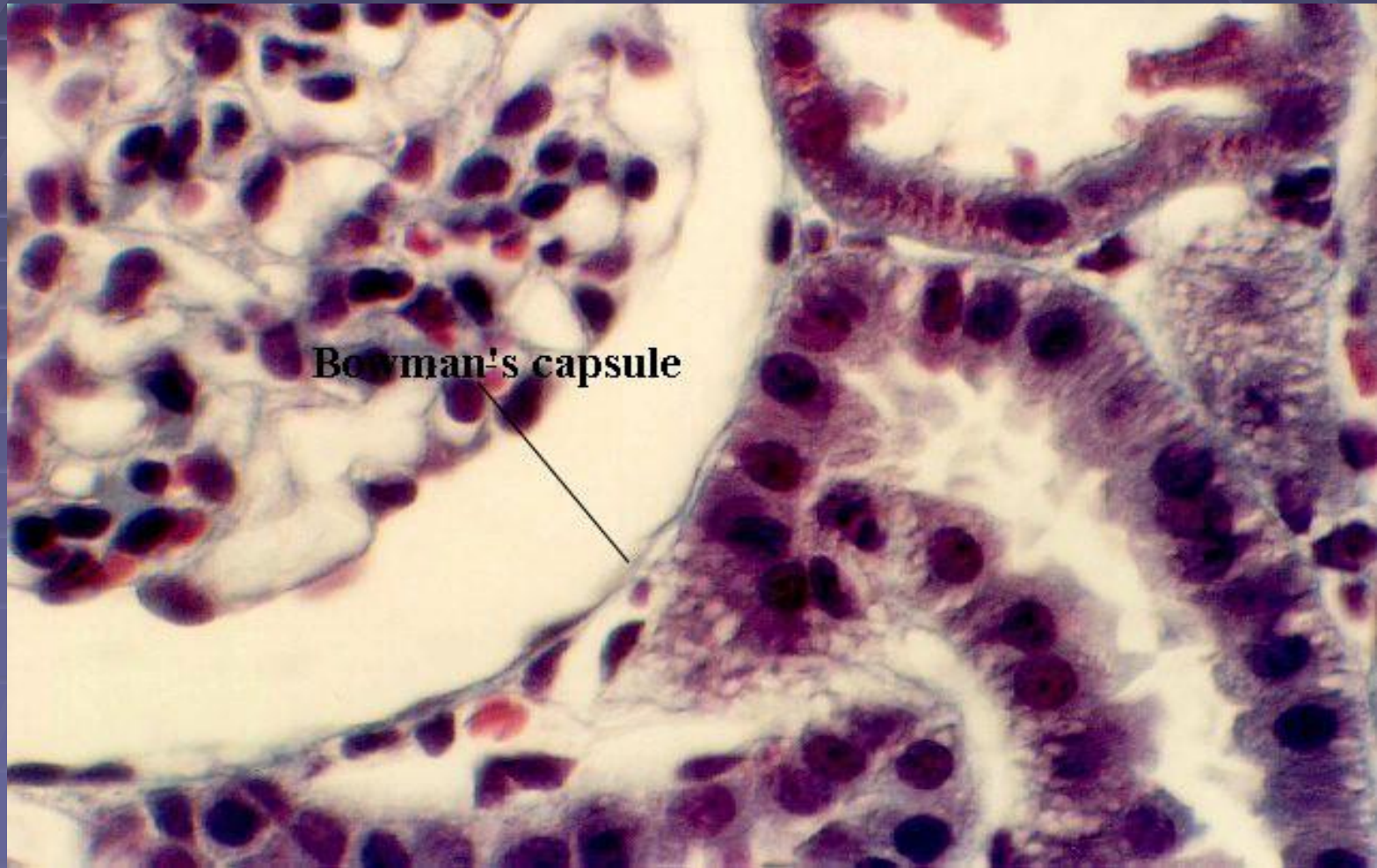
| | Squamous | Cuboidal | Columnar |
|------------|--|---|--|
| Simple |  <p>Simple squamous epithelium</p> |  <p>Simple cuboidal epithelium</p> |  <p>Simple columnar epithelium</p> |
| Stratified |  <p>Stratified squamous epithelium</p> |  <p>Stratified cuboidal epithelium</p> |  <p>Stratified columnar epithelium</p> |

basement membrane

EPITHELIAL FUNCTIONS

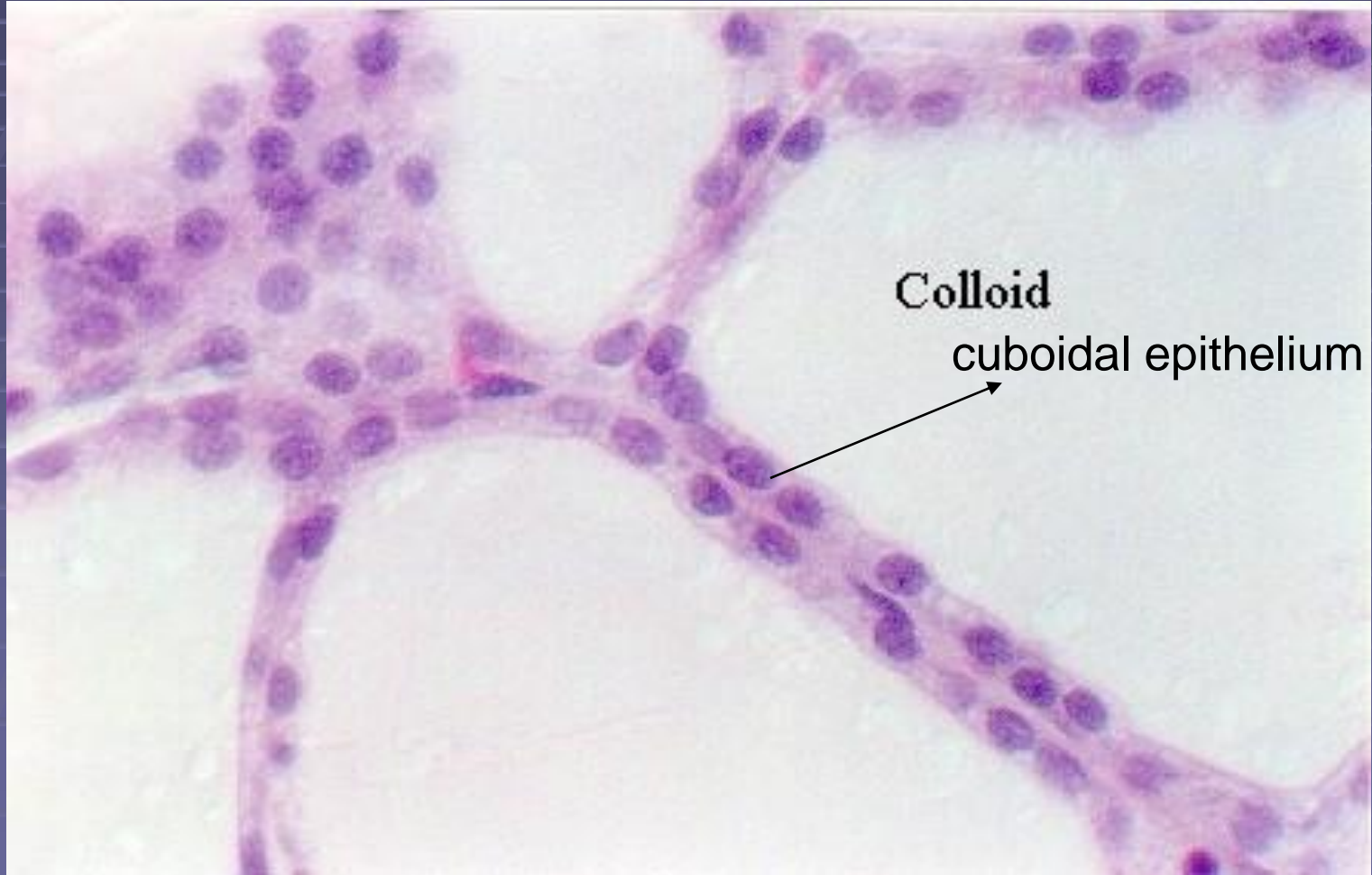
- protection
- secretion (glands)
- excretion
- absorption
- diffusion (capillaries, lungs)
- sensation

SIMPLE SQUAMOUS EPITHELIUM kidney



SIMPLE CUBOIDAL EPITHELIUM

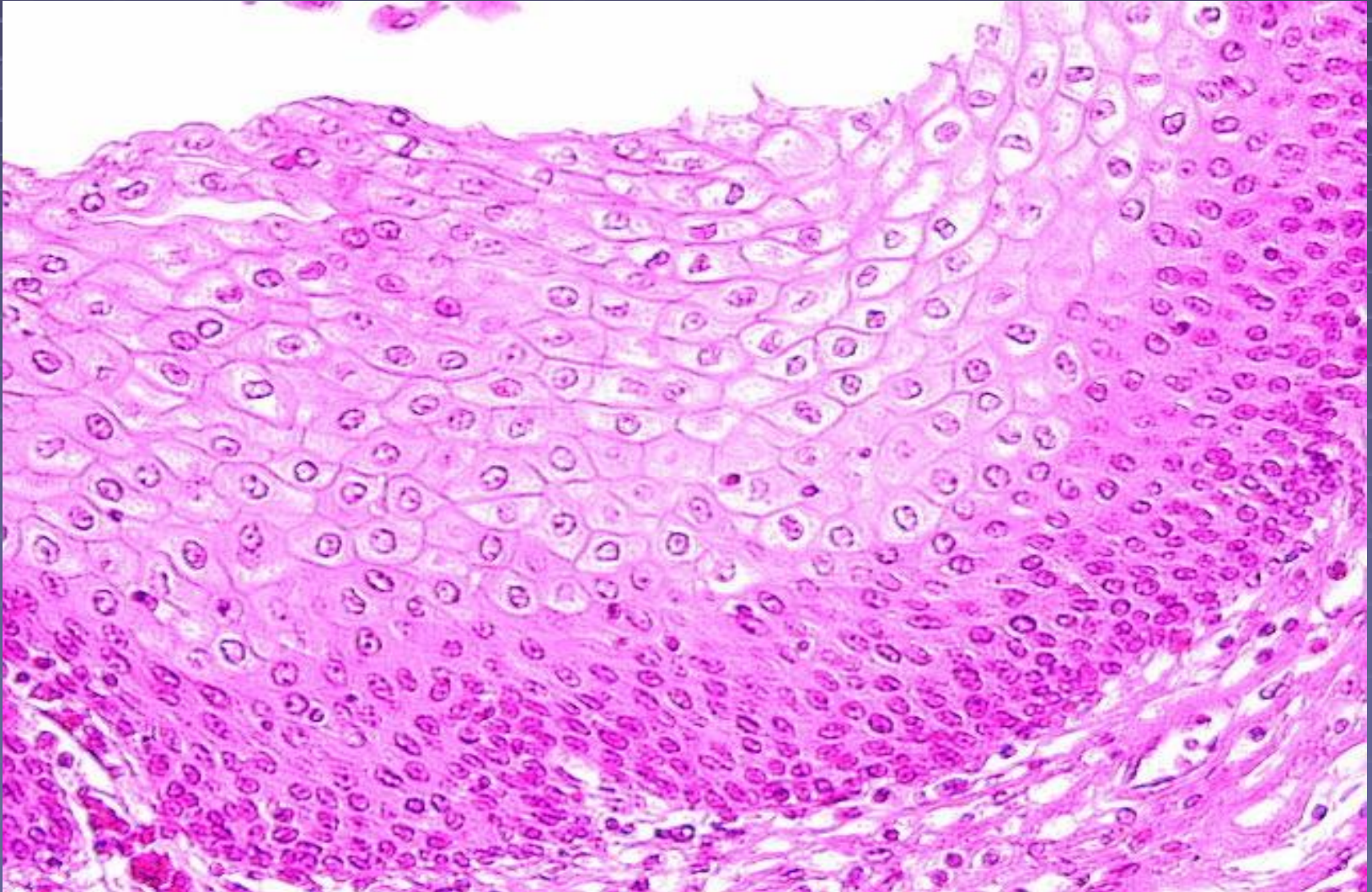
thyroid gland



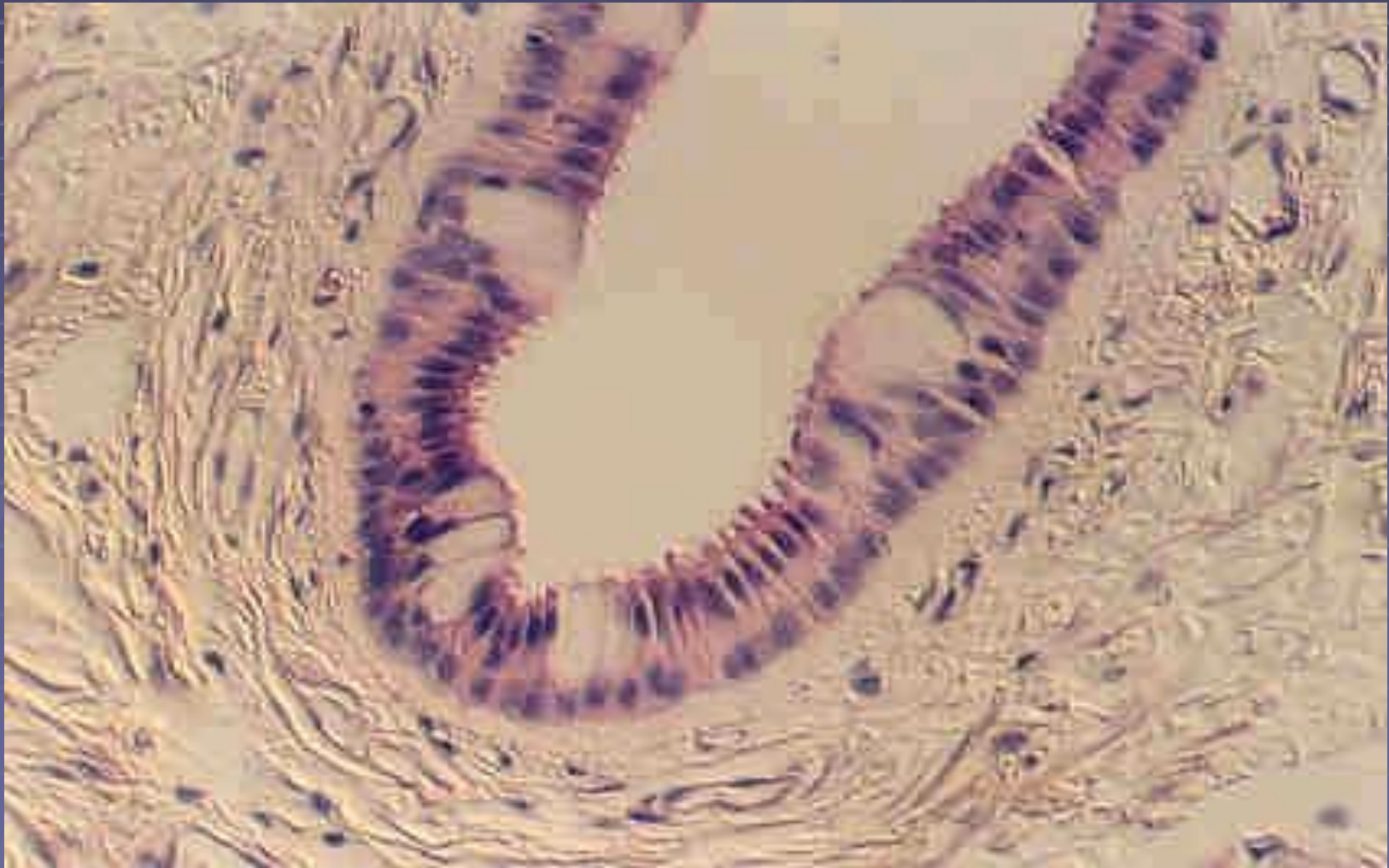
SIMPLE COLUMNAR EPITHELIUM jejunum



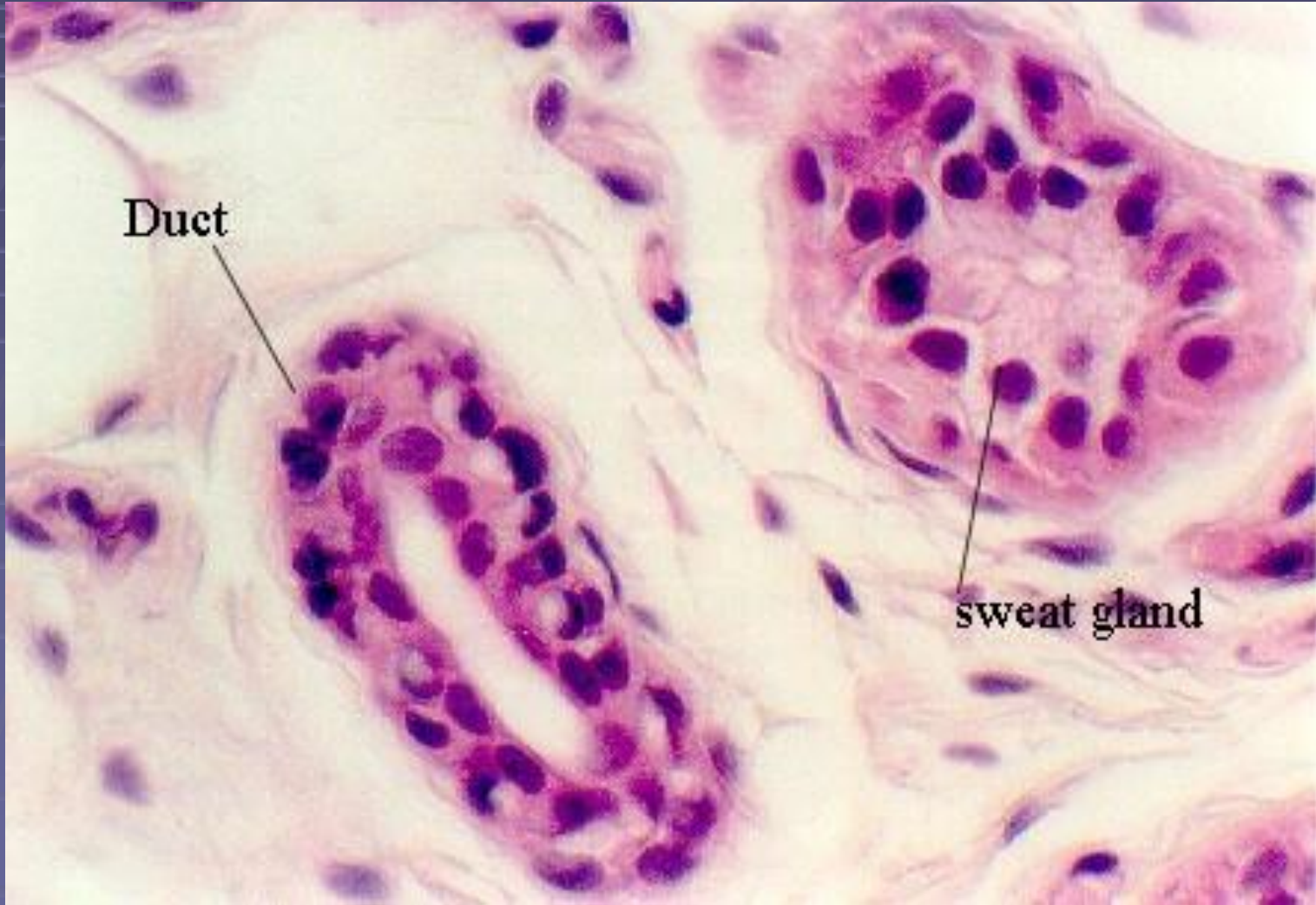
STRATIFIED SQUAMOUS EPITHELIUM gullet / esophagus



STRATIFIED COLUMNAR EPITHELIUM salivary gland



STRATIFIED CUBOIDAL EPITHELIUM sweat gland



TRANSITIONAL EPITHELIUM

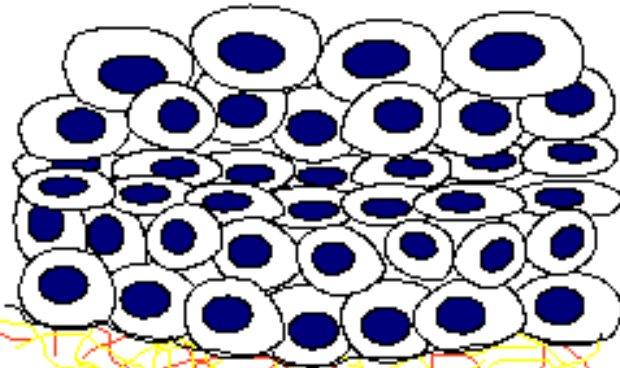
urinary bladder

large, ovoid surface cells

normal

transitional

stretched



GLANDULAR EPITHELIUM

■ UNICELLULAR GLANDS

- goblet cells
- gastro-enteropancreatic system

■ MULTICELLULAR GLANDS

- endocrine
- exocrine

- types of secretion: **serous** – thin watery, protein-rich secretion
- mucinous** – viscous secretion, which has a lubricating or protective function
- seromucinous** – mixed type



GLANDS



Simple tubular



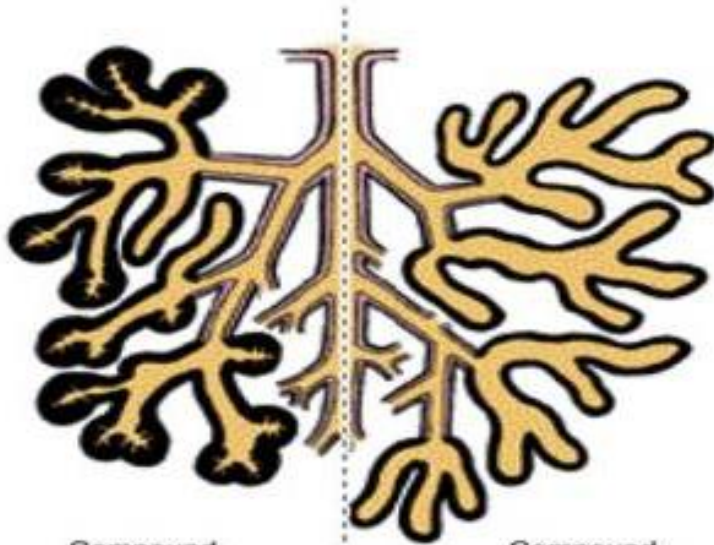
Simple coiled tubular



Simple branched tubular



Simple branched acinar



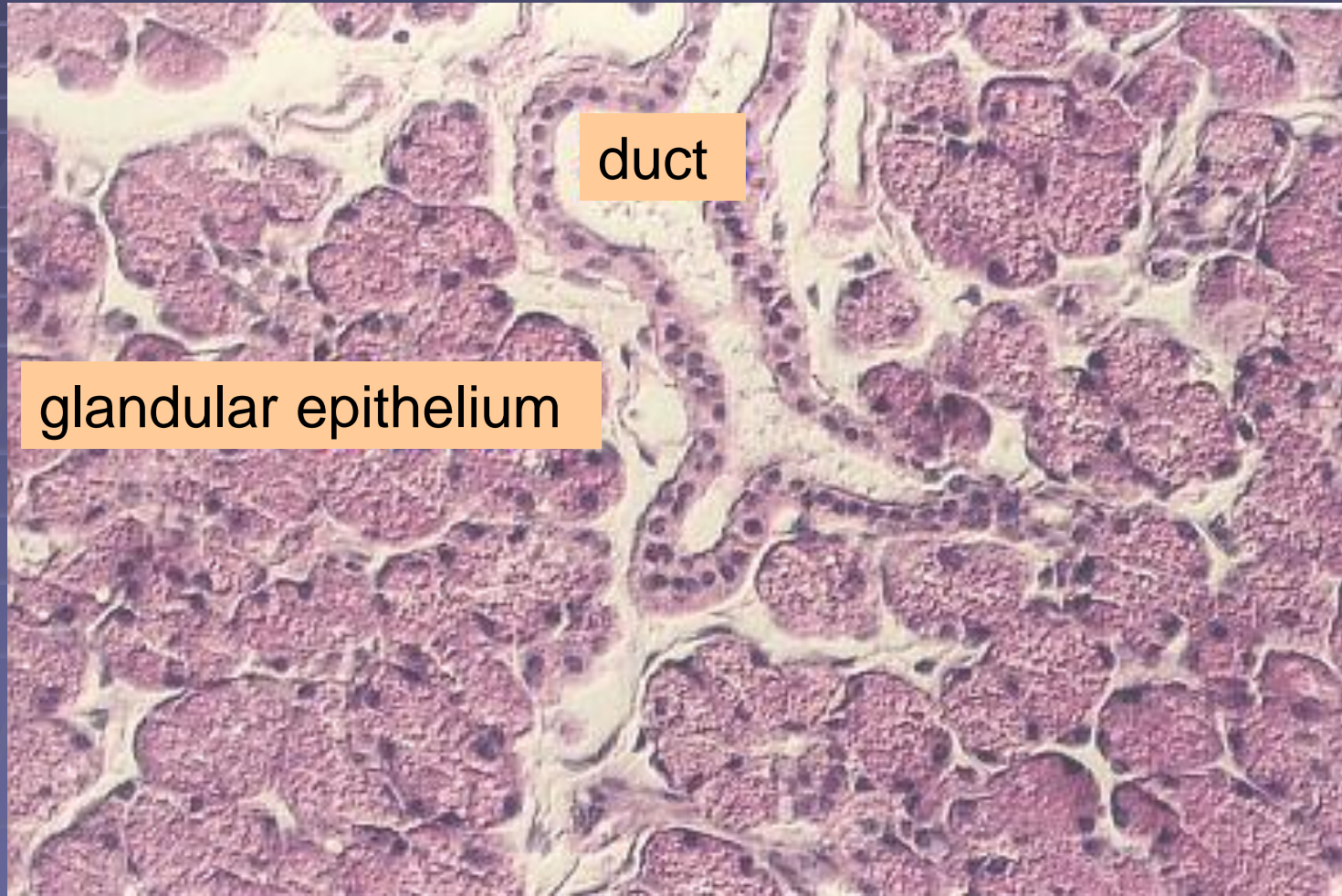
Compound tubuloacinar

Compound tubular

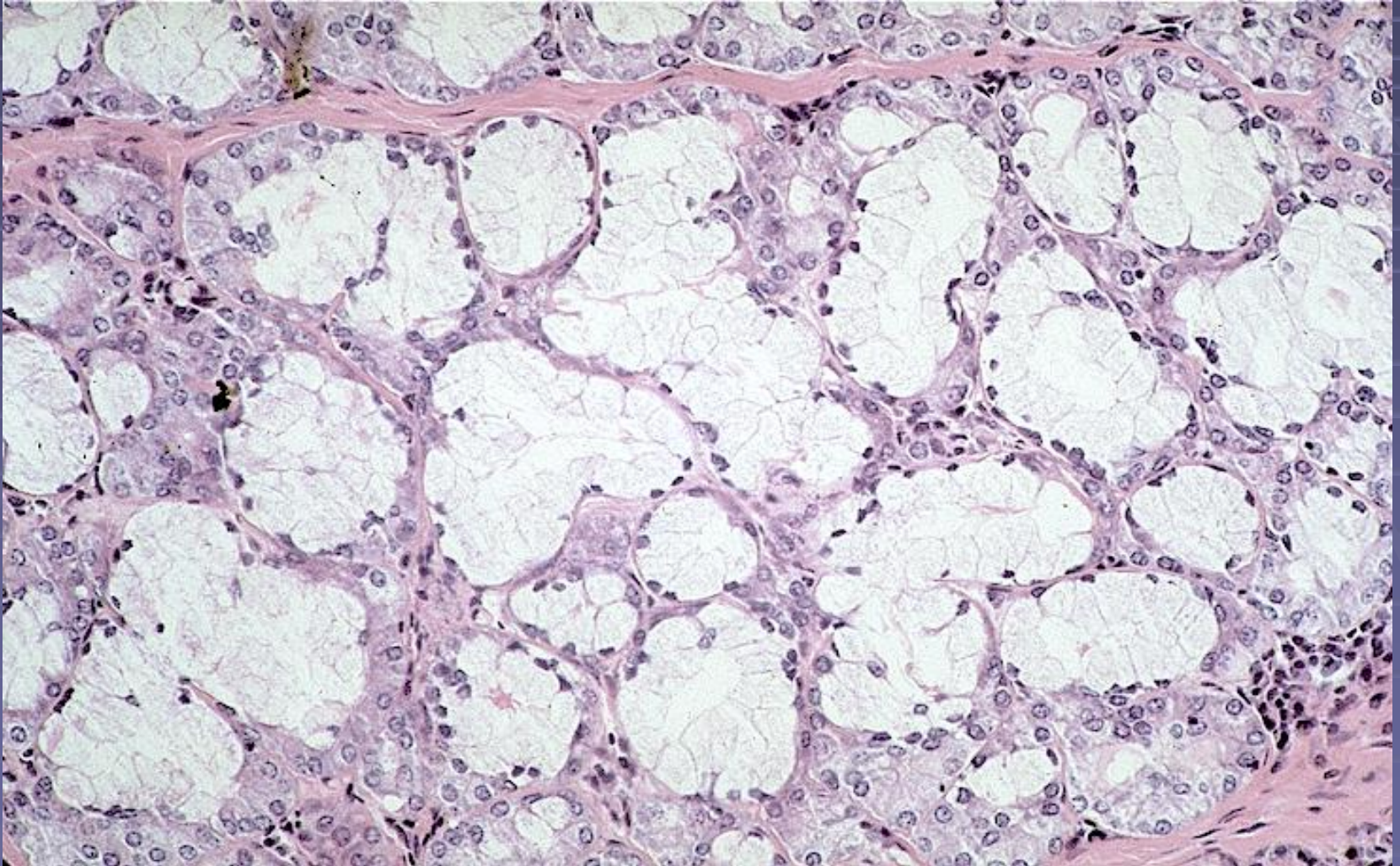


Compound acinar

PAROTID GLAND serous acini

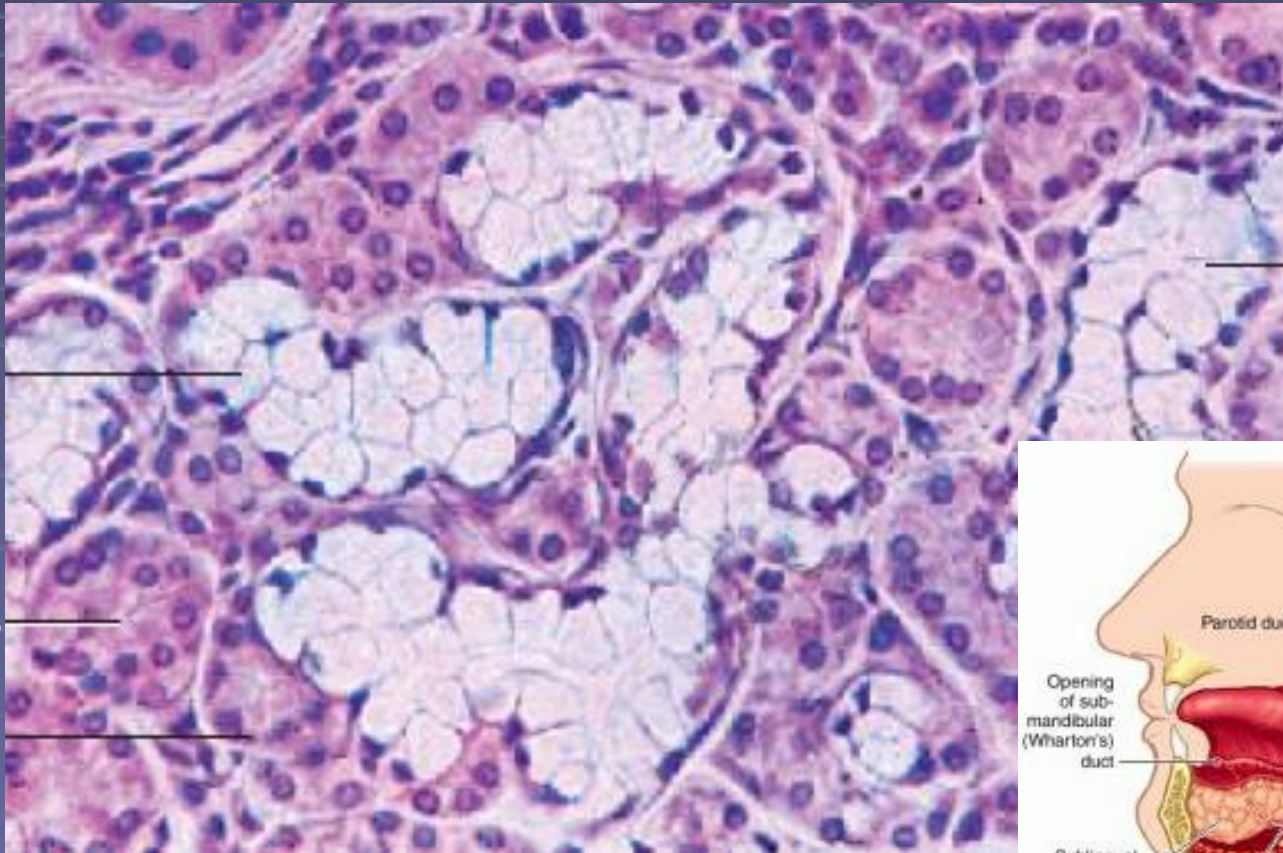


SUBLINGUAL GLAND mucinous tubules



SUBMANDIBULAR GLAND

mixed type

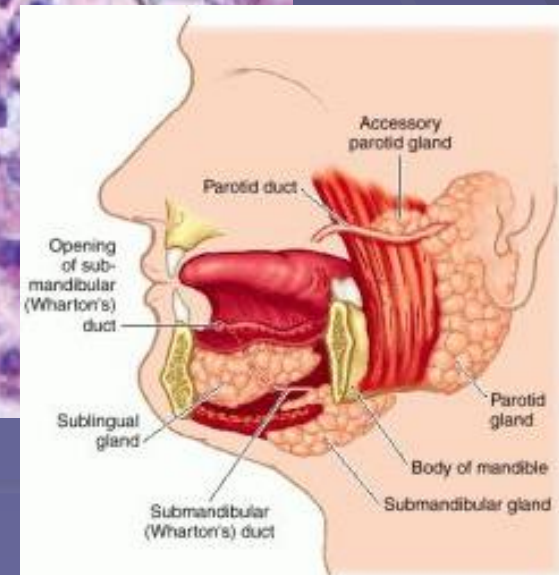


mucinous tubules

serous acines

Giannuzzi lunules

mucinous tubules



SENSORY EPITHELIUM

- specialised epithelial cells that detect sensory stimuli, found in the skin, eyes, ear, nose or on the tongue
 - rods and cons in retina
 - olphactory region in nose
 - taste bud cells
 - hair cells in auditory and balance organ

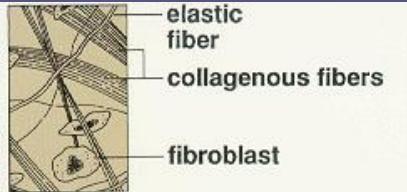
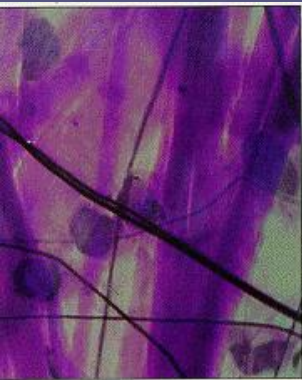
CONNECTIVE TISSUE

- FIBROUS CONNECTIVE TISSUE
- CARTILAGE
- BONE

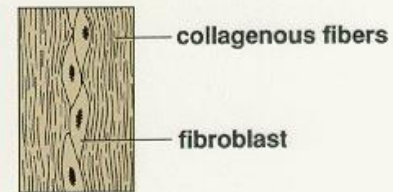
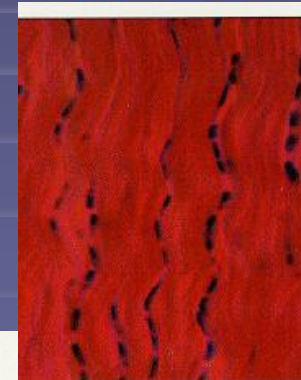
CONNECTIVE TISSUE

■ FIBROUS CONNECTIVE TISSUE

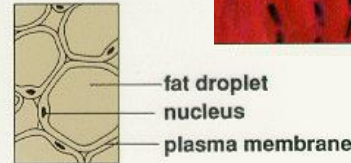
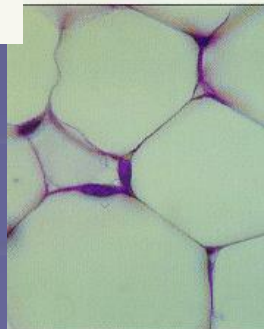
- dense → regular – tendons and ligaments
→ irregular – dermis, lining of various organs
- loose → collagen – interstitial, submucous tissues
→ elastic – skin, lungs, veins
→ reticular – bone marrow, spleen, lymph nodes
→ adipose – white and brown



TYPE: Loose
COMMON LOCATIONS:
Under skin, most epithelia
FUNCTION: Support, elasticity



TYPE: Dense, regular
COMMON LOCATIONS:
Tendons, skin, kidney capsule
FUNCTION: Support, elasticity

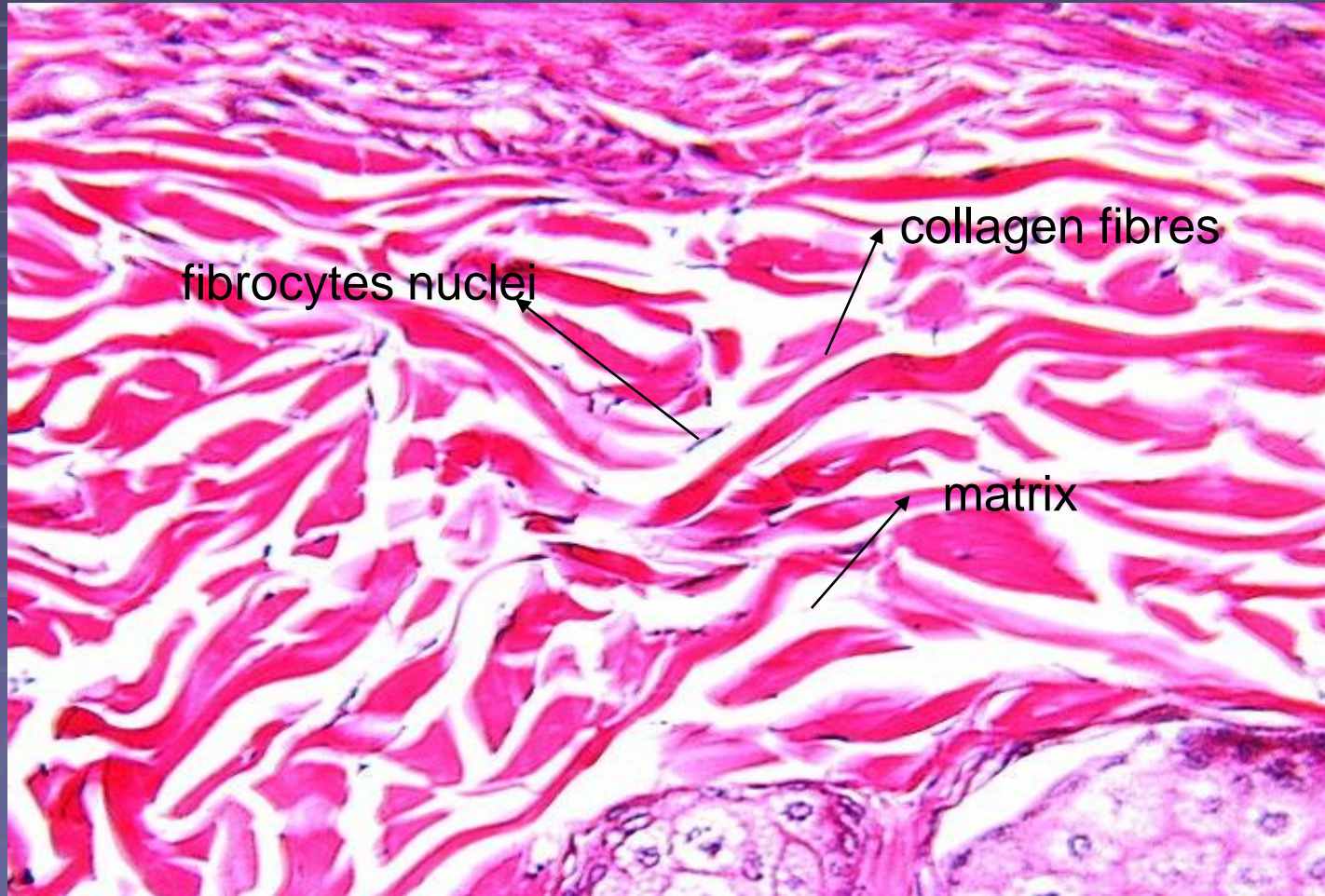


TYPE: Adipose
COMMON LOCATIONS: Under skin,
around kidneys, heart
FUNCTION: Energy reserve, insulation,
padding

DENSE REGULAR CONNECTIVE TISSUE tendons

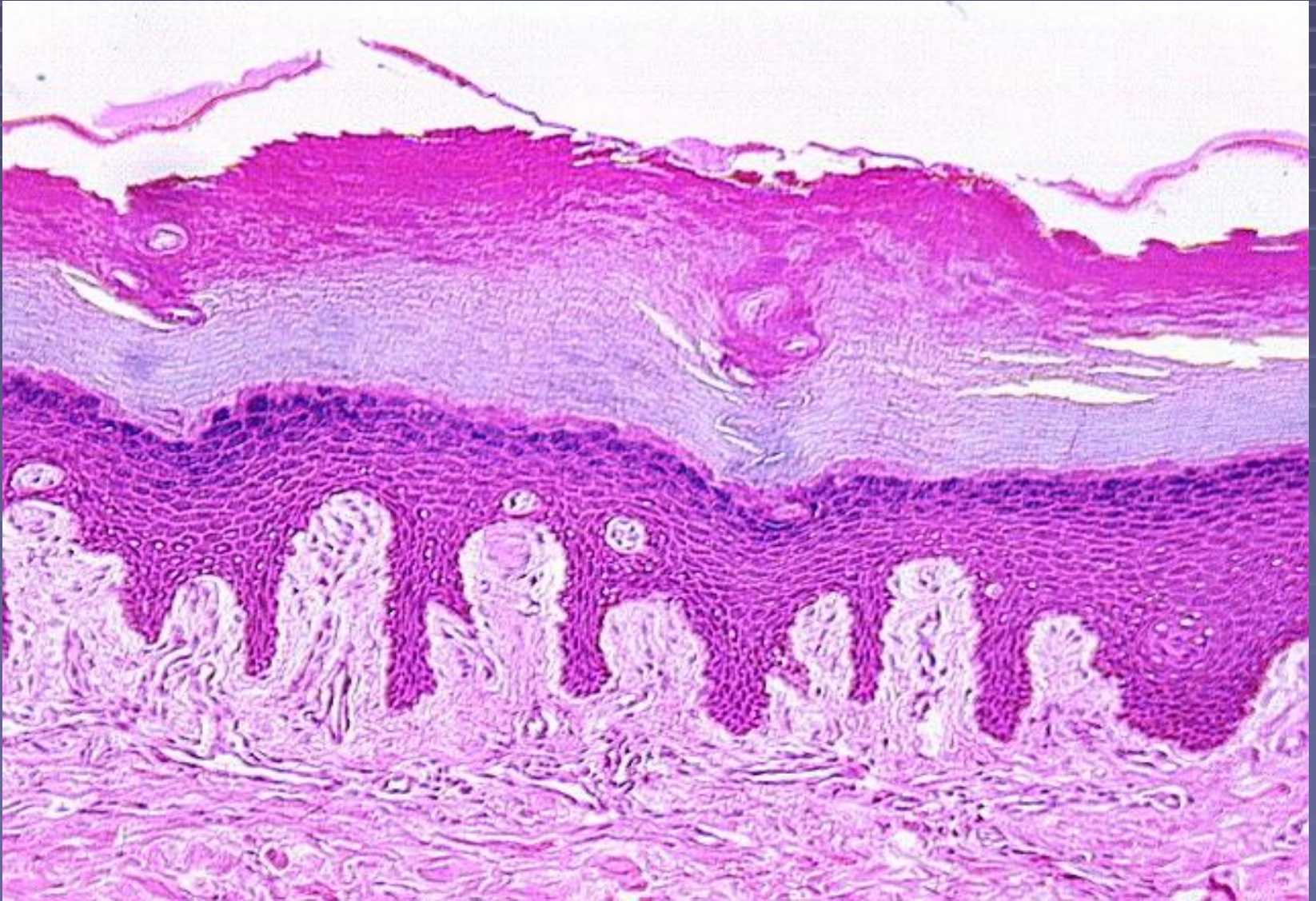


DENSE IRREGULAR CONNECTIVE TISSUE

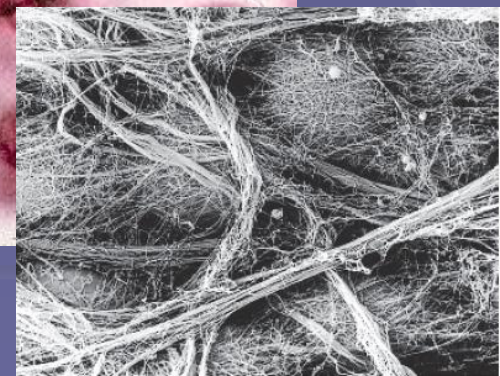
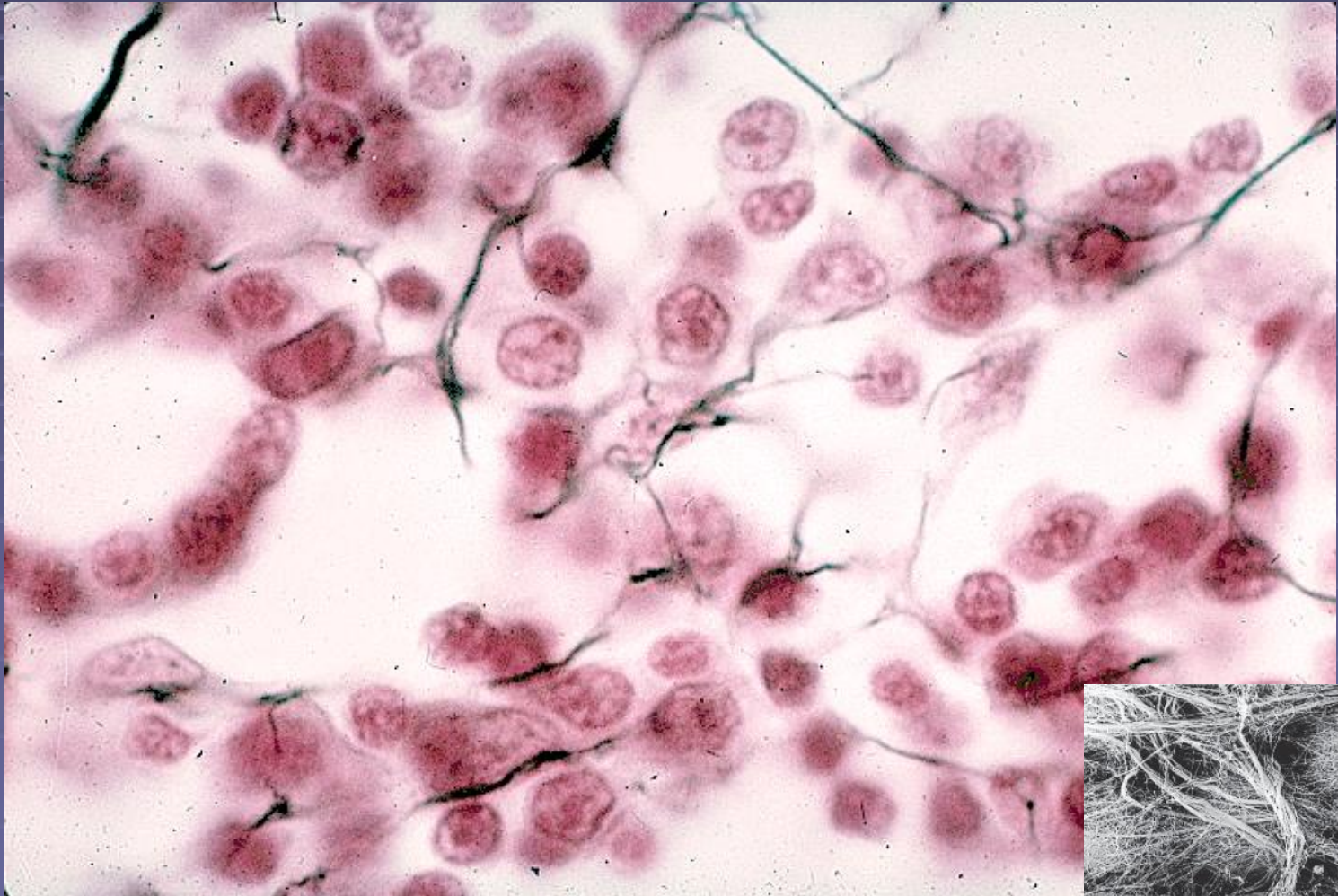


LOOSE CONNECTIVE TISSUE

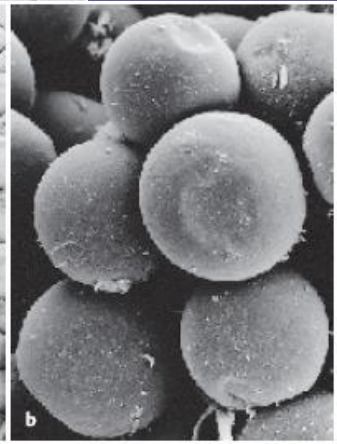
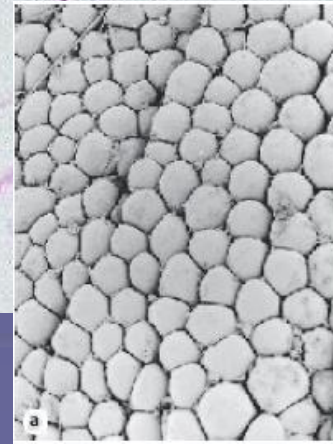
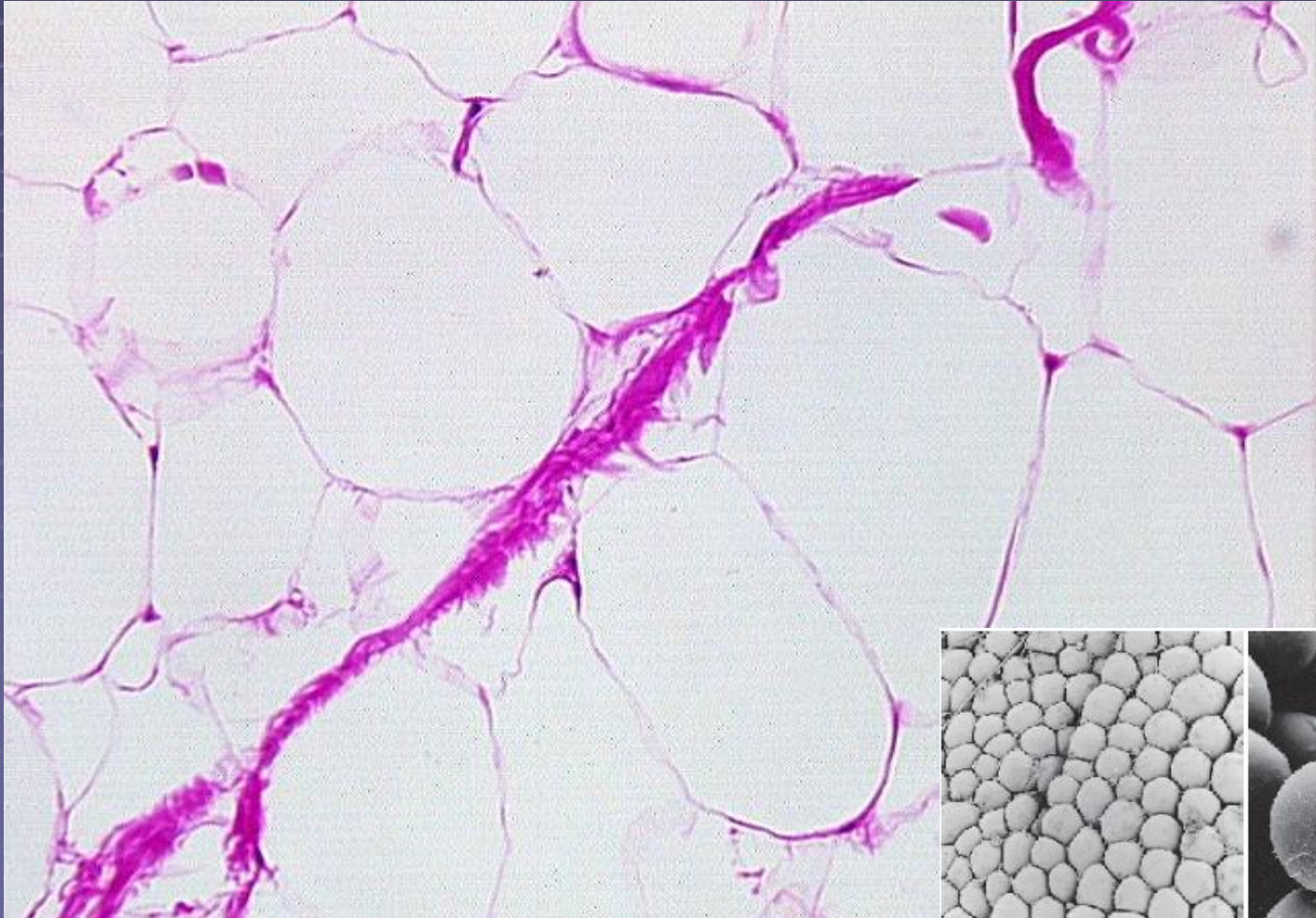
skin



RETICULAR CONNECTIVE TISSUE



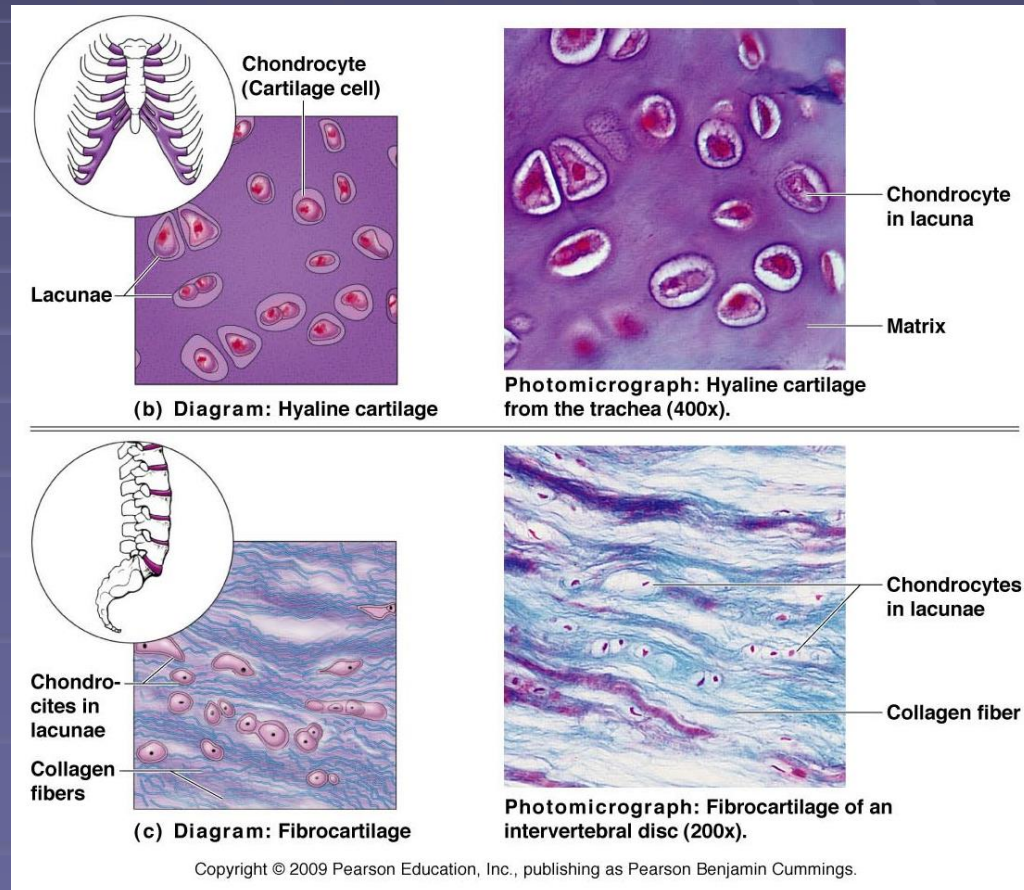
ADIPOSE TISSUE



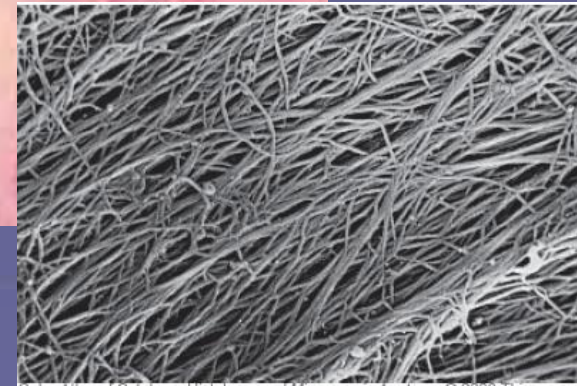
CONNECTIVE TISSUE

■ CARTILAGE

- hyaline
 - joints, ribs, nasal cartilages
- elastic
 - auricle, Eustachian tube, laryngeal cartilages
- fibrocartilage
 - intervertebral discs, symphysis



HYALINE CARTILAGE

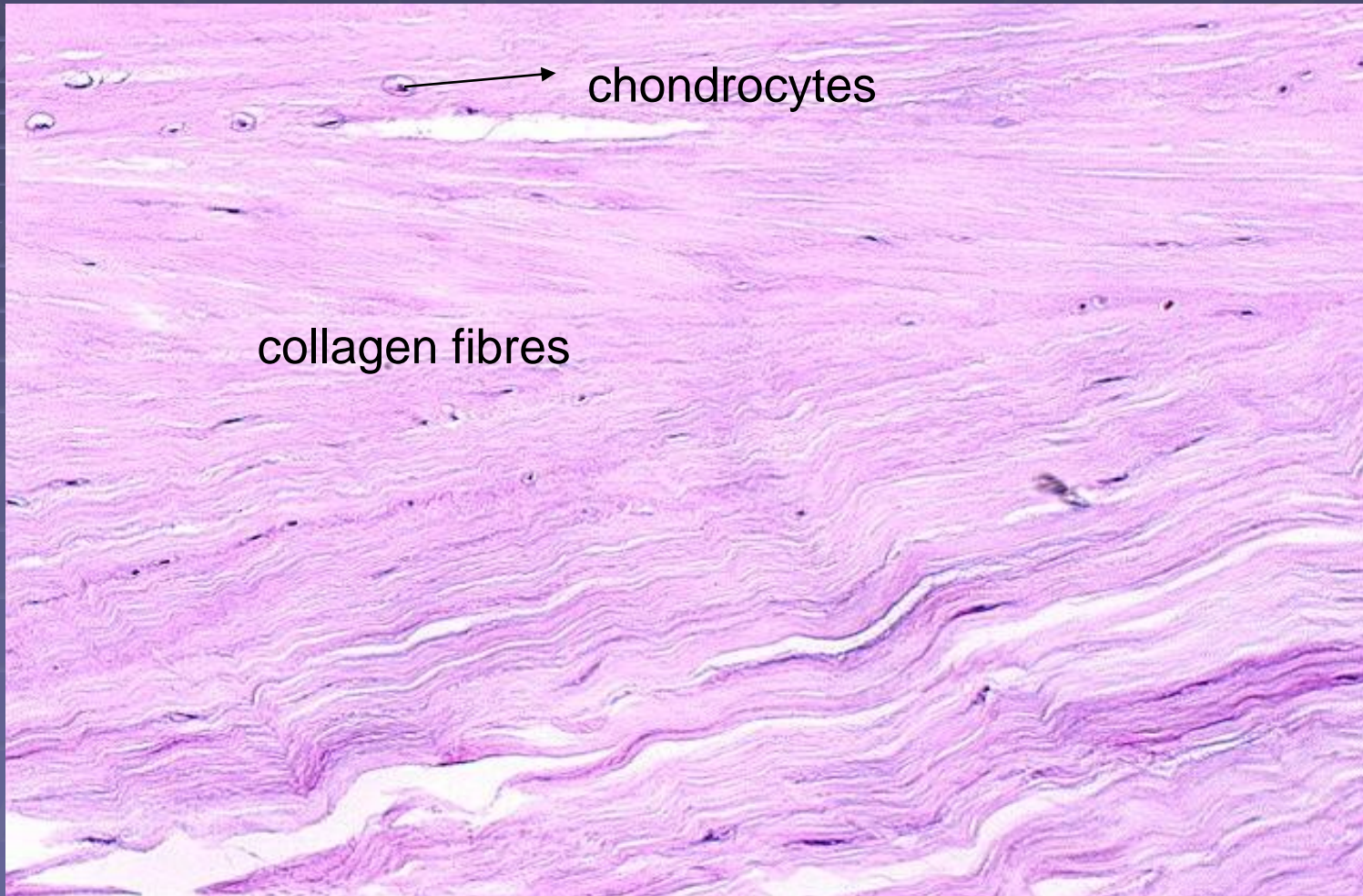


ELASTIC CARTILAGE



FIBROCARILAGE

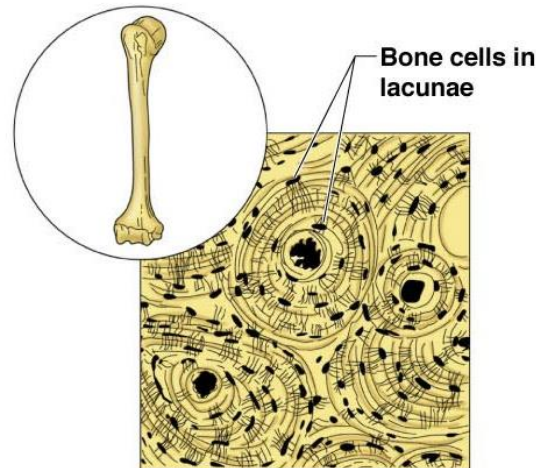
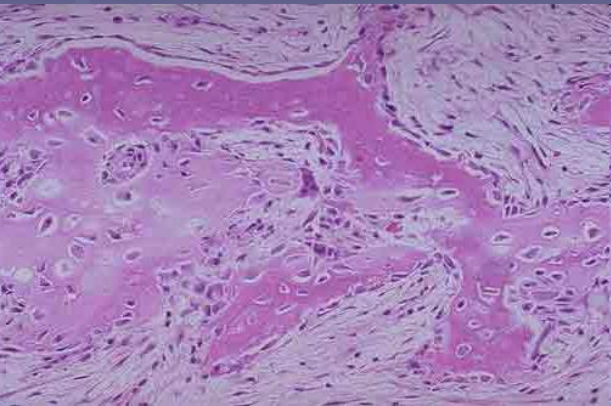
intervertebral discs



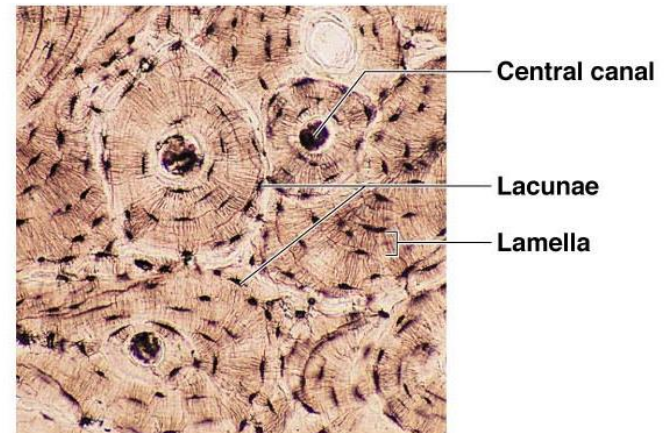
CONNECTIVE TISSUE

■ BONE

- woven – tooth cementum
- lamellar → compact – diaphyses of long bones
→ spongy – epiphyses of long bones, flat skull bones, short bones



(a) Diagram: Bone



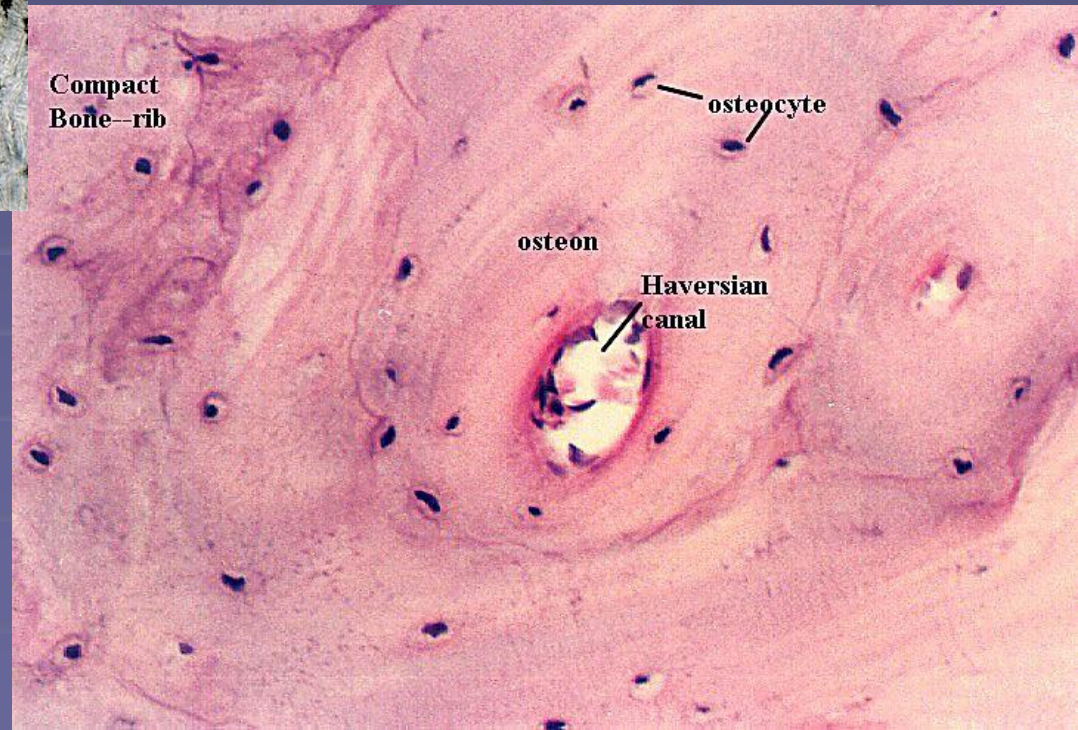
Photomicrograph: Cross-sectional view of ground bone (250x).

LAMELLAR COMPACT BONE

rib



Compact
Bone—rib



osteon

Haversian
canal

osteocyte

MUSCULAR TISSUE

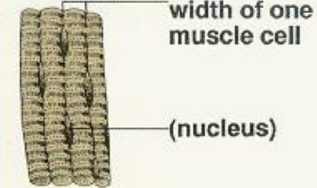
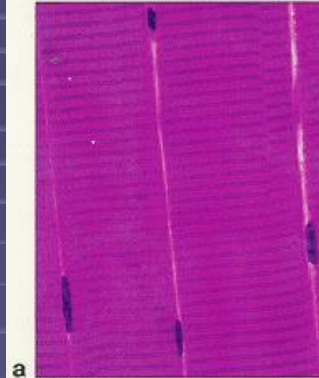
■ skeletal / striated

■ smooth

- the wall of the vessels
- gastrointestinal system

■ cardiac

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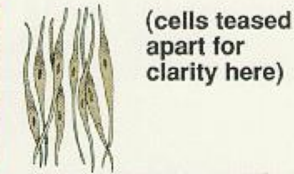
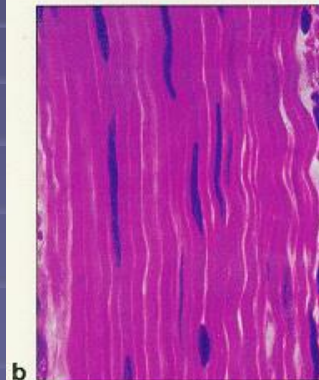


TYPE: Skeletal muscle

DESCRIPTION: Long, striated cells with multiple nuclei

COMMON LOCATIONS: In skeletal muscles

FUNCTION: Contraction for voluntary movements

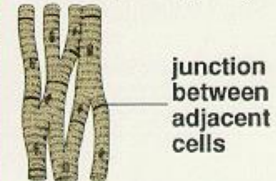
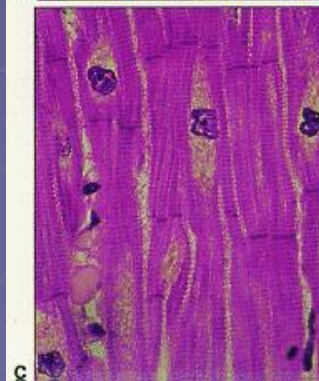


TYPE: Smooth muscle

DESCRIPTION: Long, spindle-shaped cells, each with a single nucleus

COMMON LOCATIONS: In hollow organs (e.g., stomach)

FUNCTION: Propulsion of substances along internal passageways



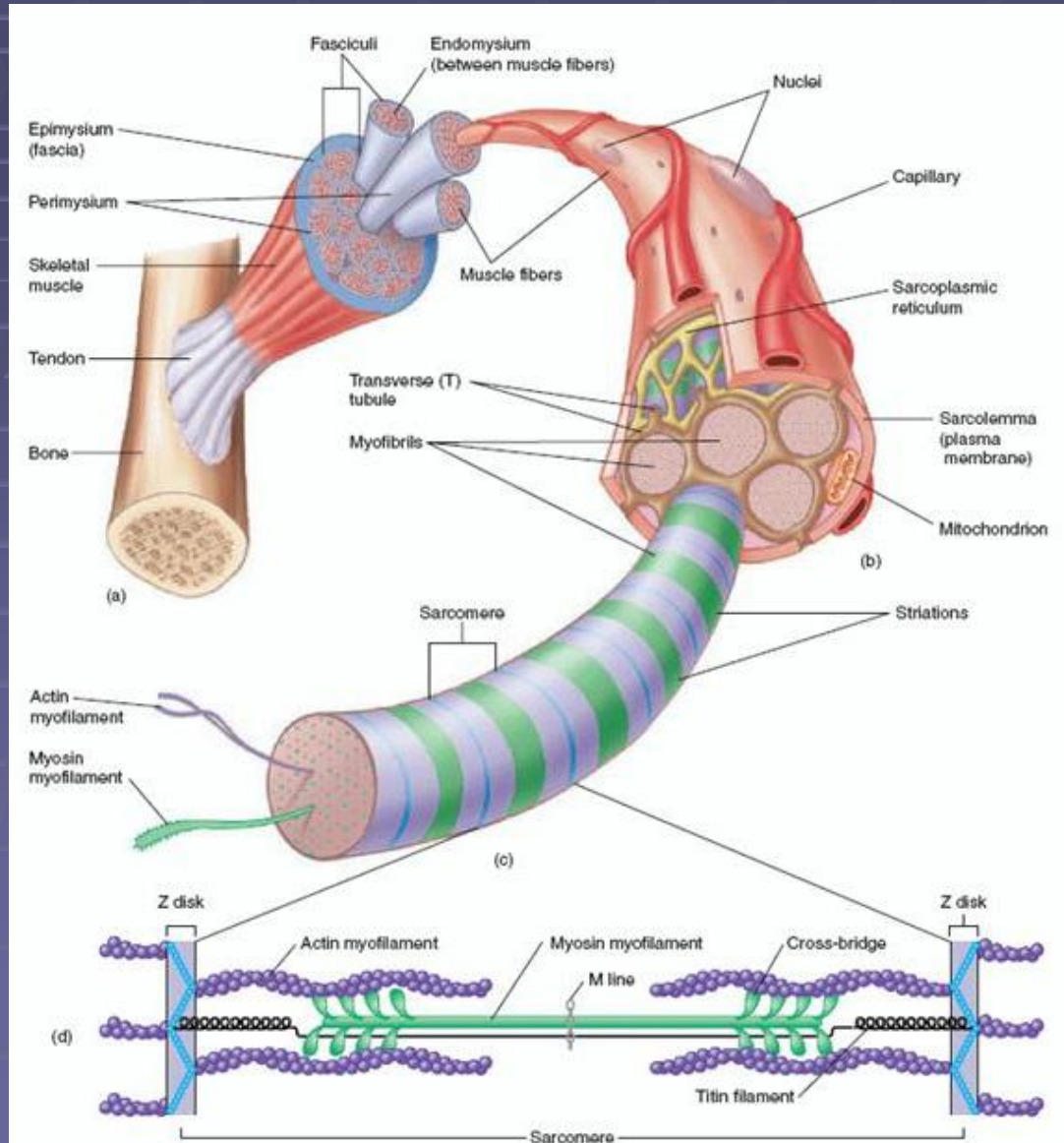
TYPE: Cardiac muscle

DESCRIPTION: Branching, striated cells fused at plasma membranes

COMMON LOCATIONS: Wall of heart

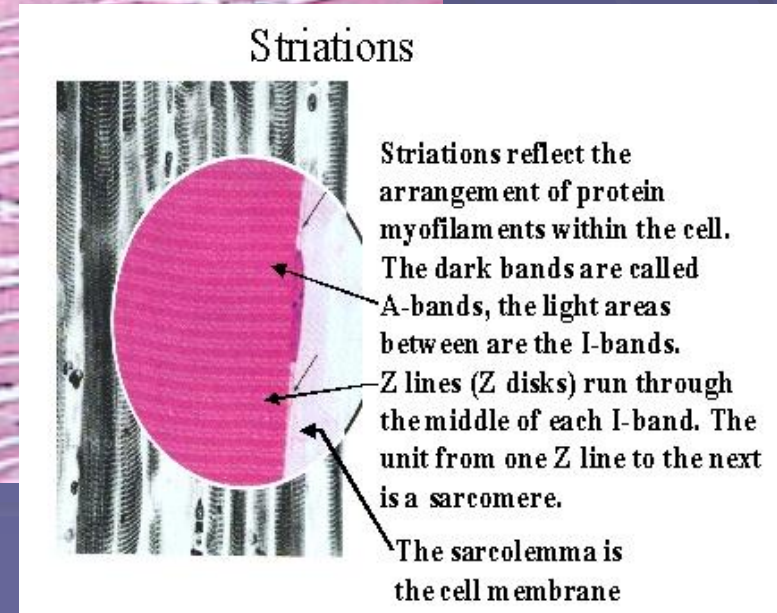
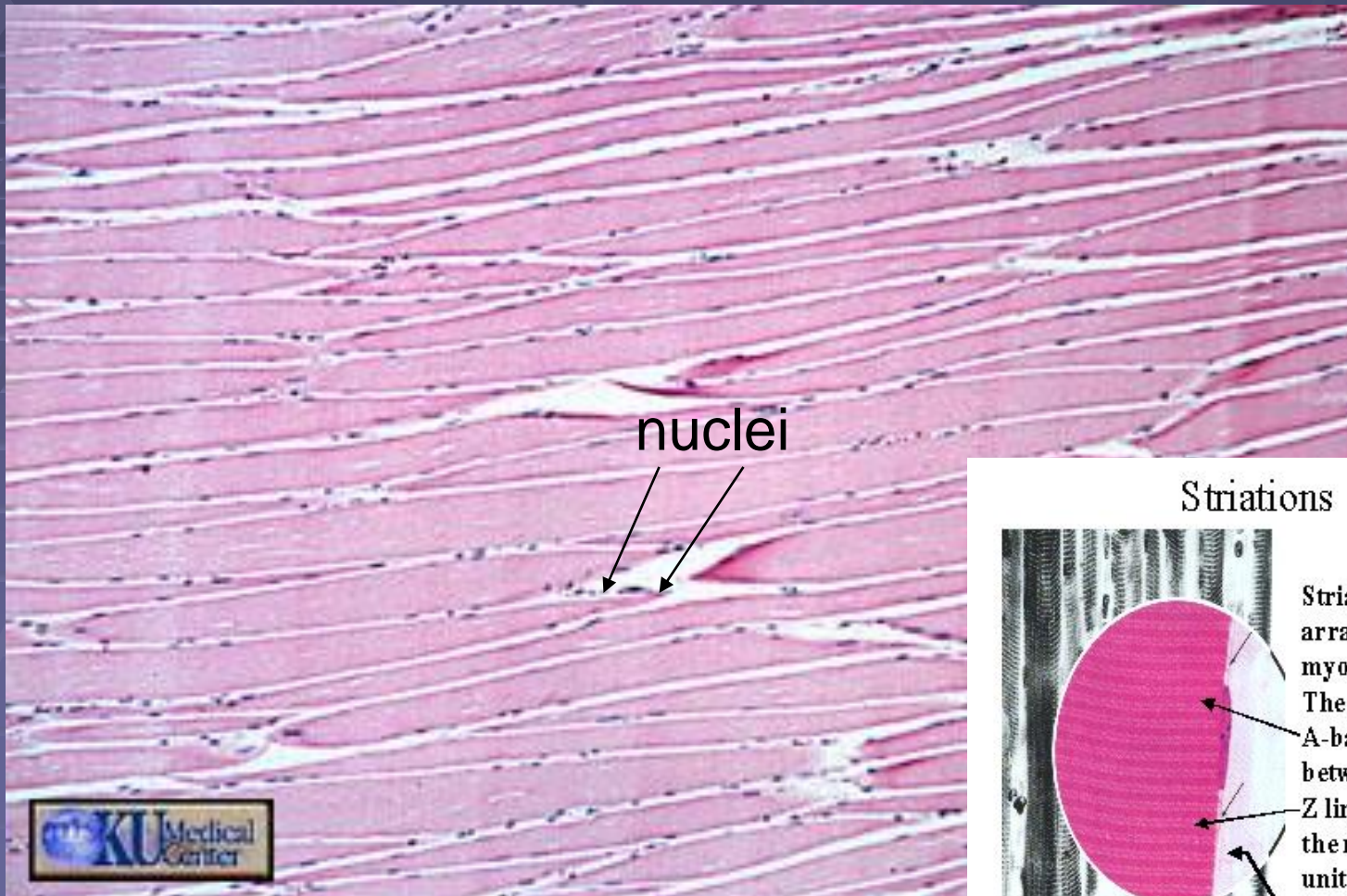
FUNCTION: Pumping of blood in the circulatory system

SKELETAL / STRIATED MUSCLE



STRIATED SKELETAL MUSCLE

longitudinal cut

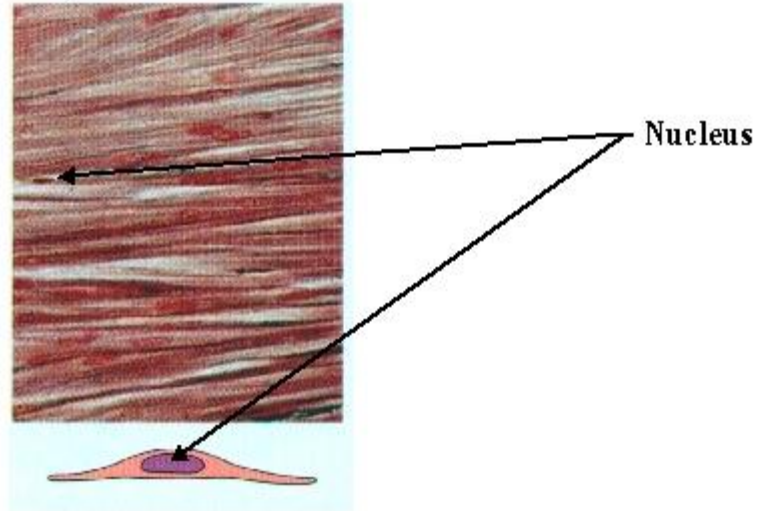


SMOOTH MUSCLE



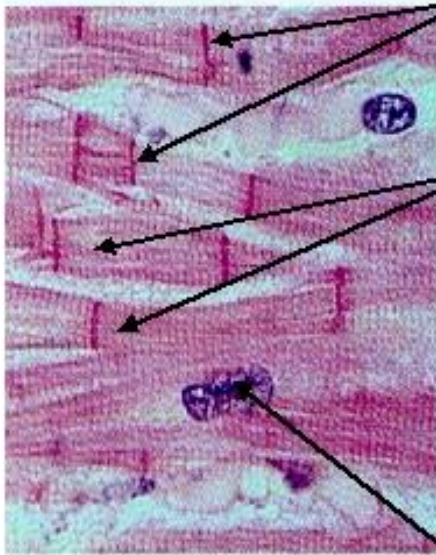
Smooth Muscle Characteristics

Smooth muscle cells connect to form **single-unit syncytia** similar to cardiac muscle. But impulses and contractions occur much more slowly in smooth than in cardiac muscle.



CARDIAC MUSCLE

Cardiac Muscle Characteristics

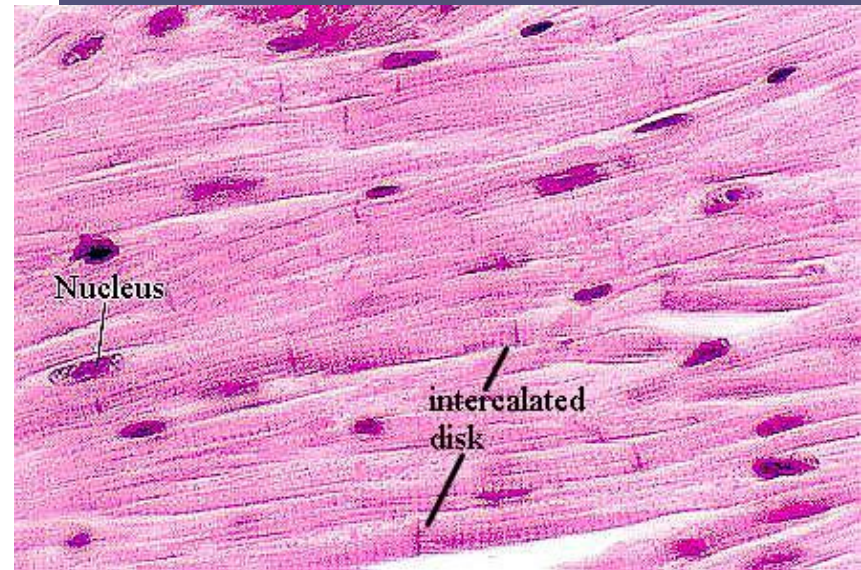


Intercalated disks

Cardiac muscle cells are faintly striated, branching cells, which connect by means of intercalated disks to form a functional network. The action potential travels through all cells connected together in the syncytium causing them to function as a unit.

nucleus

Cardiac myocytes are branched, mono-nucleated cells



NERVOUS TISSUE

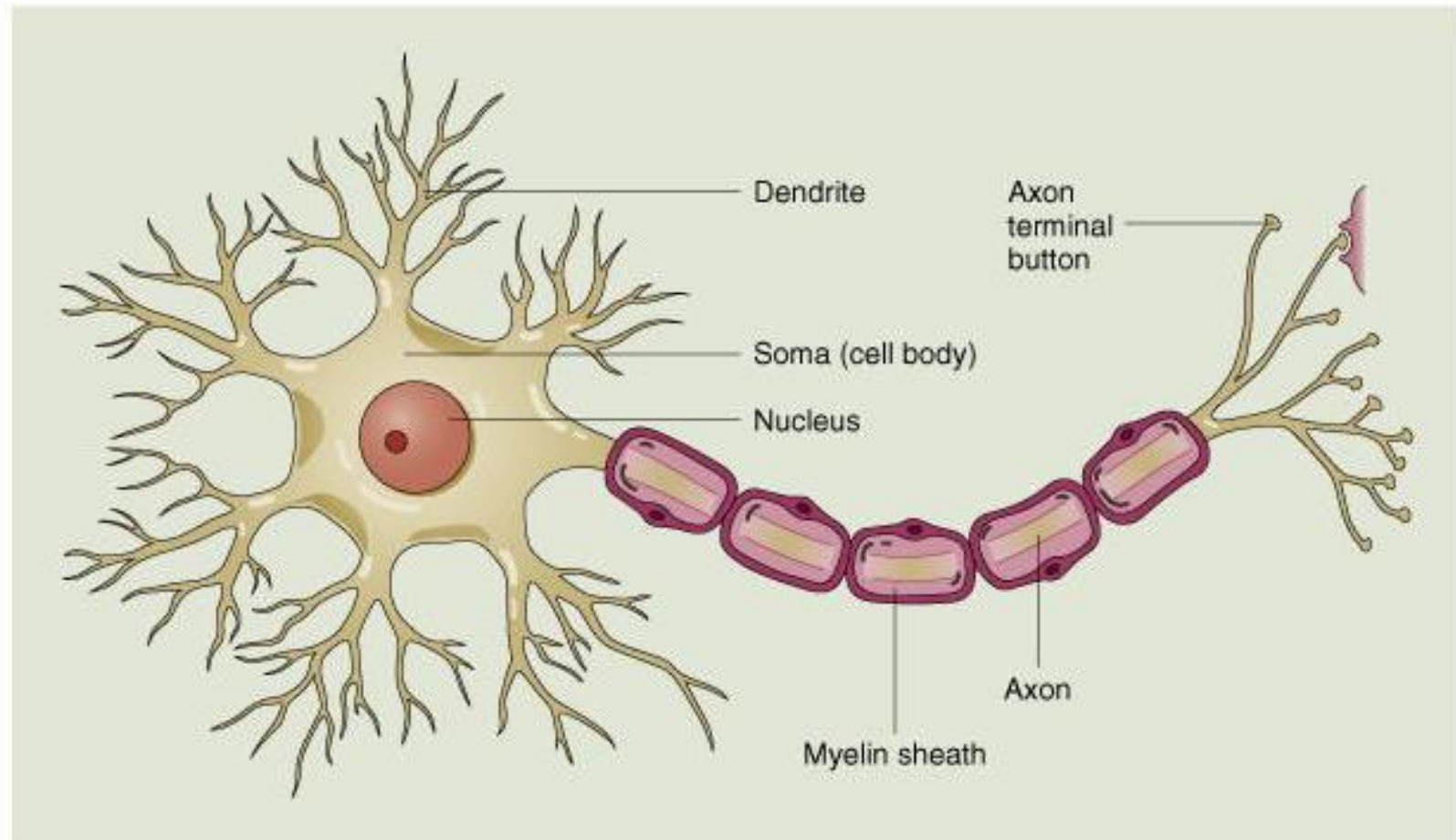
■ NEURON

- excitable cell that processes and transmits various information by electrochemical signals
 - soma (body)
 - dendrites
 - axon

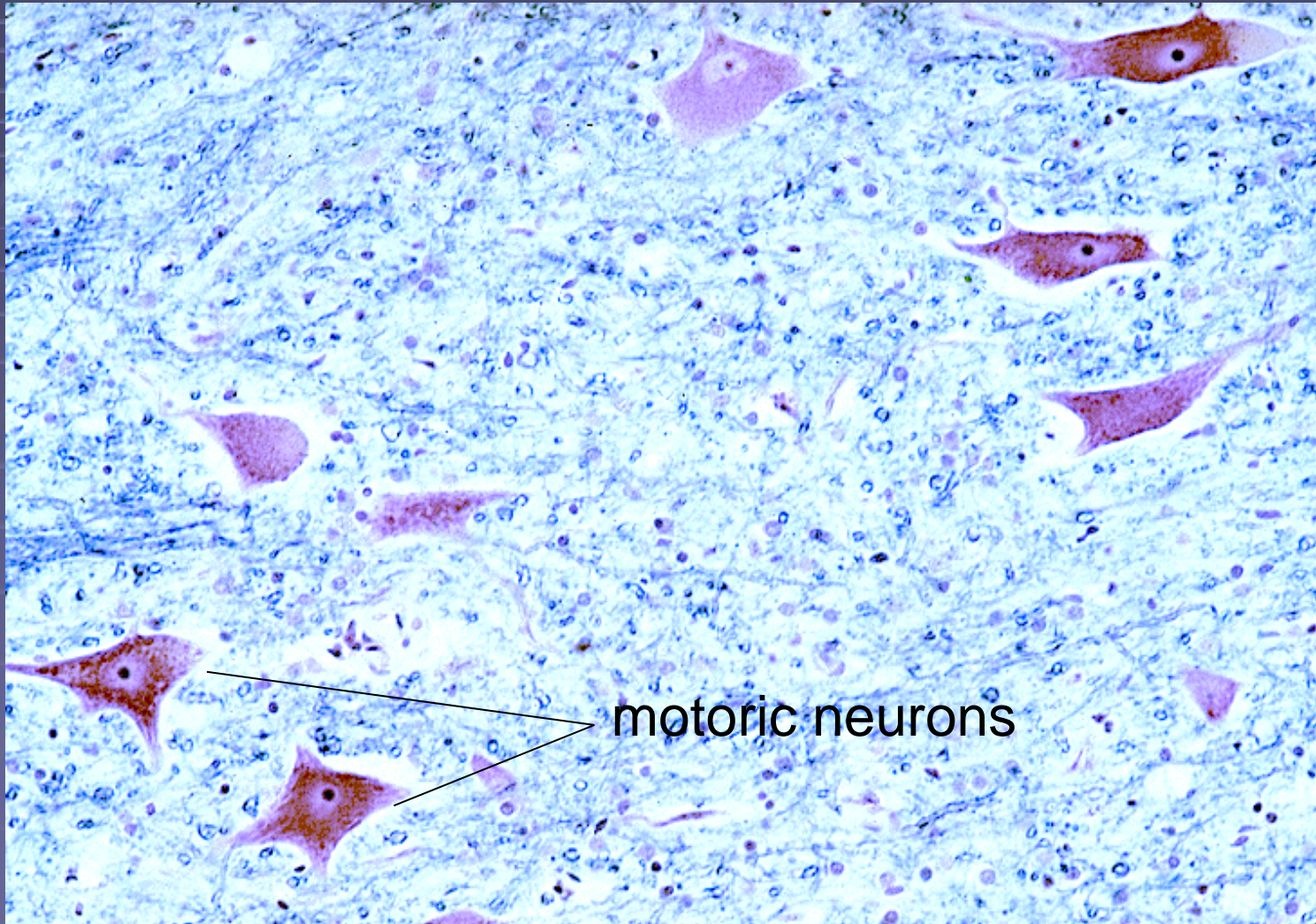
■ NEUROGLIA

- non-neuronal cells providing nutrition and support for neurons and improve signal transmission in the nervous system

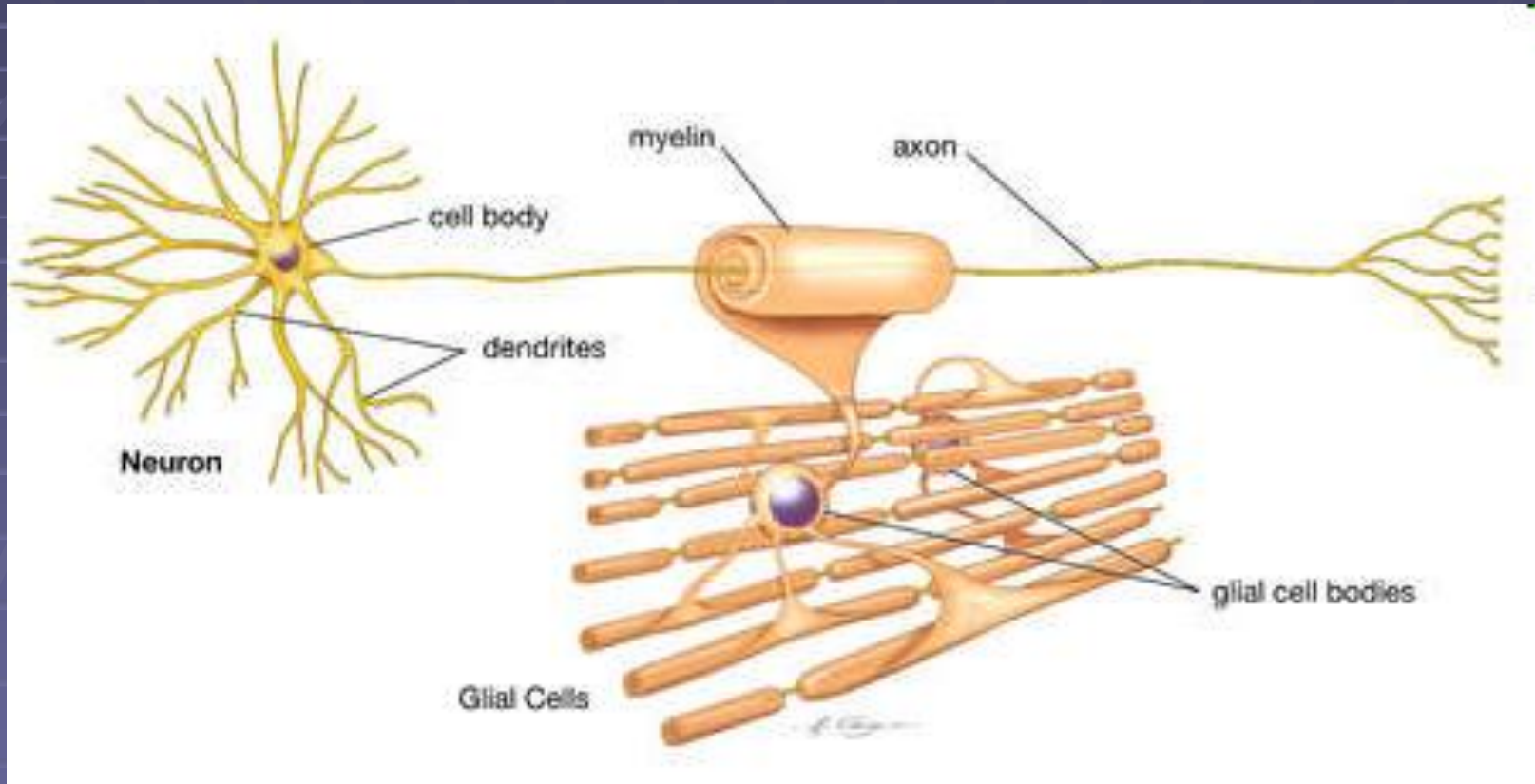
NEURON



NEURONS in spinal cord

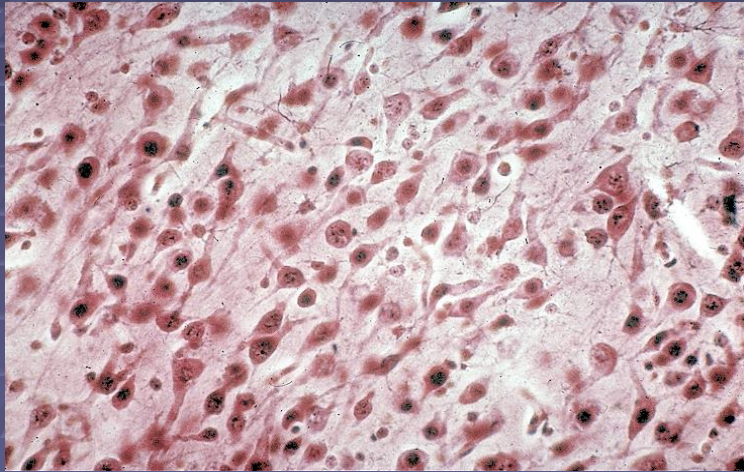


NEUROGLIA

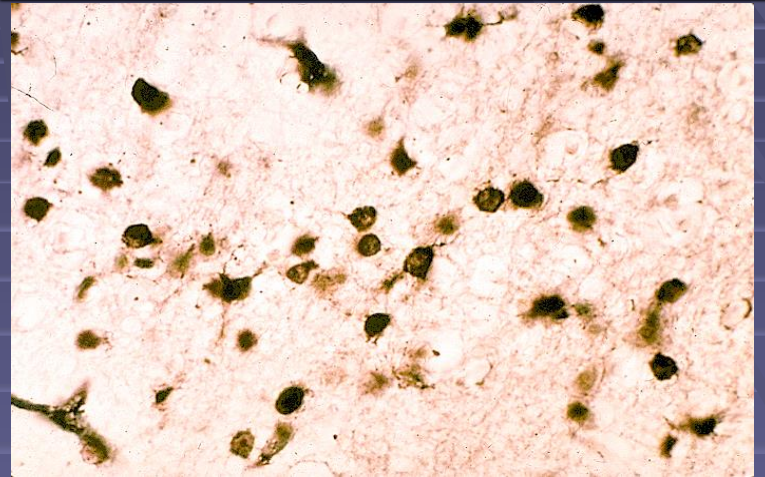


NEUROGLIA

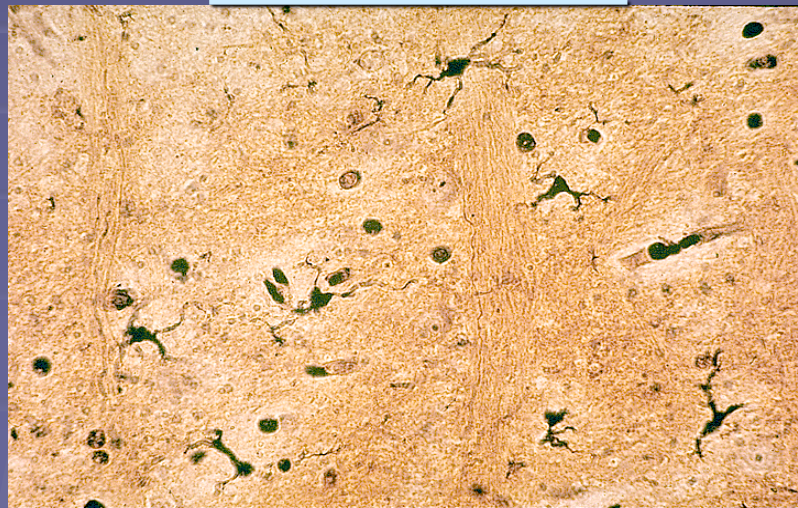
ASTROCYTES



OLIGODENDROCYTES



MICROGLIA



NERVOUS TISSUE

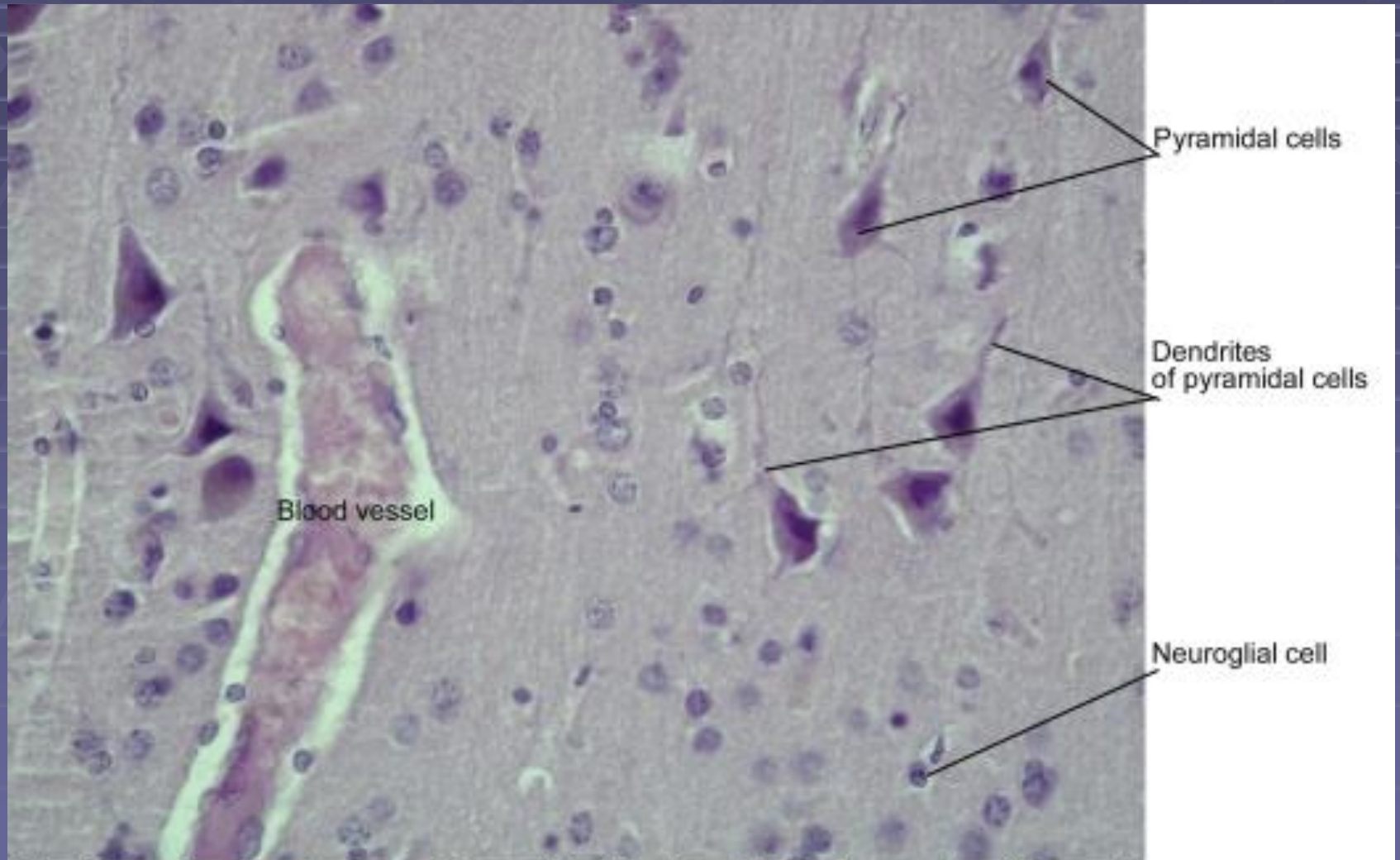
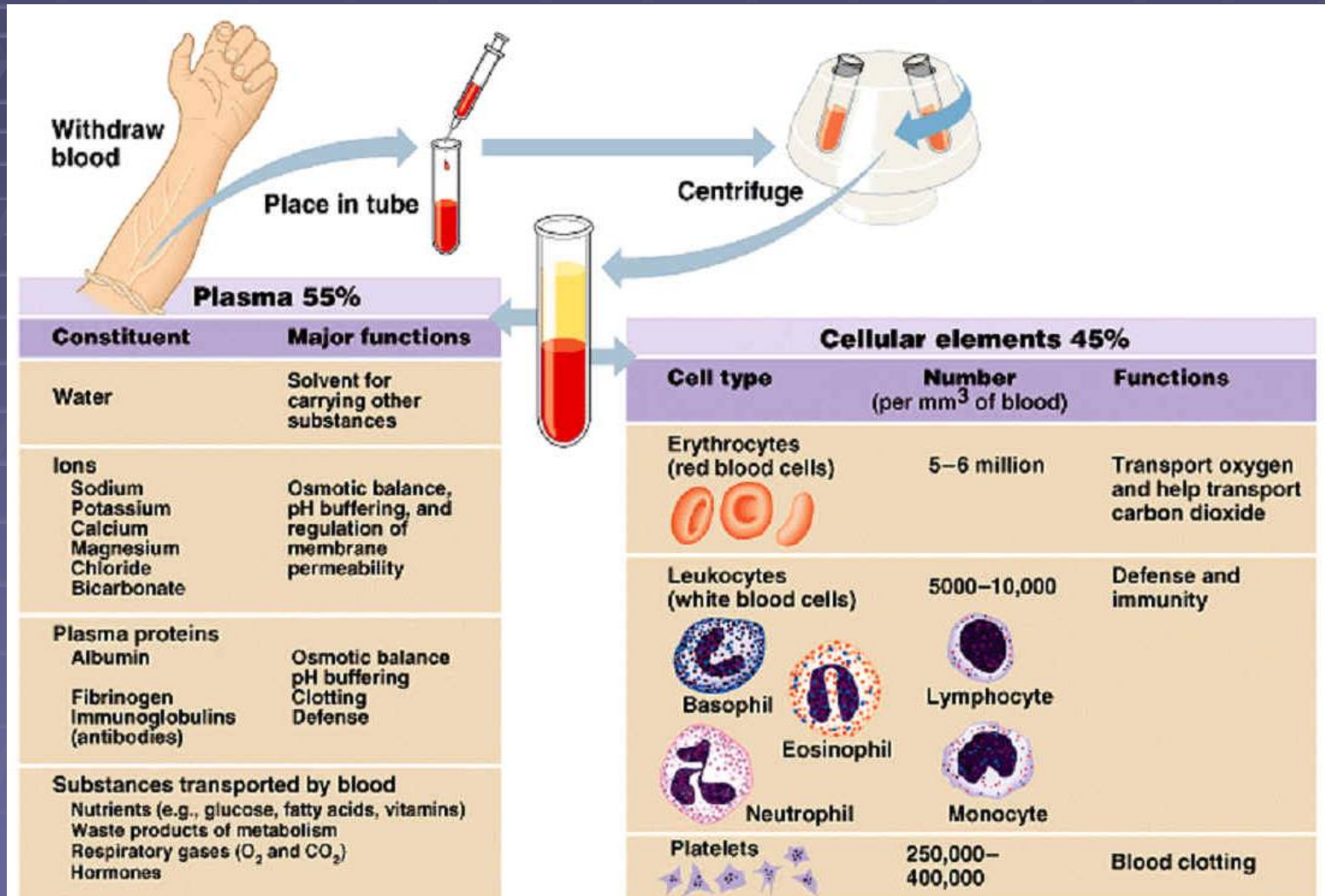
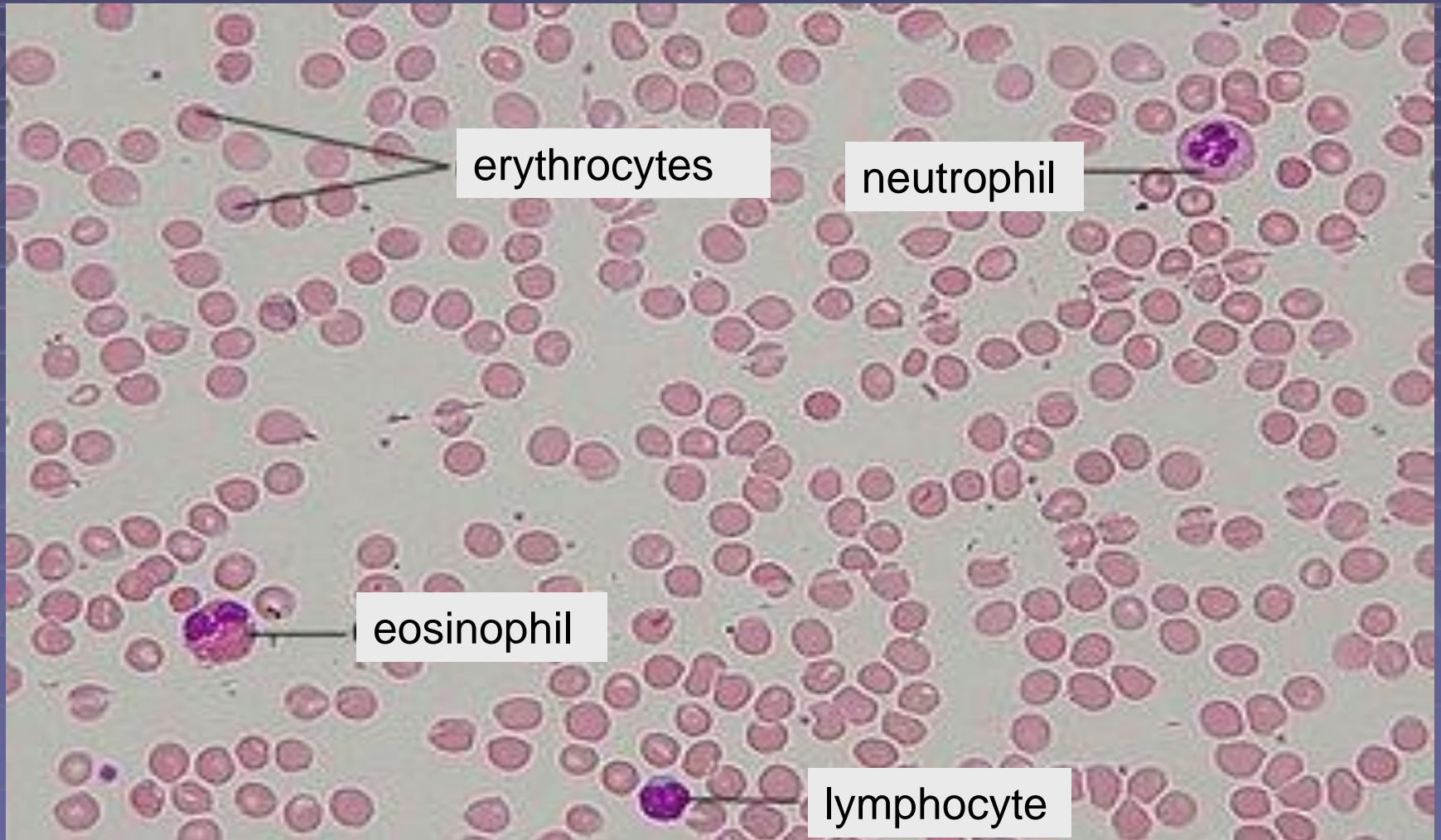


Fig.5 Cerebrum, Cortex, Pyramidal Cells, Stain: hematoxylin-eosin

BLOOD

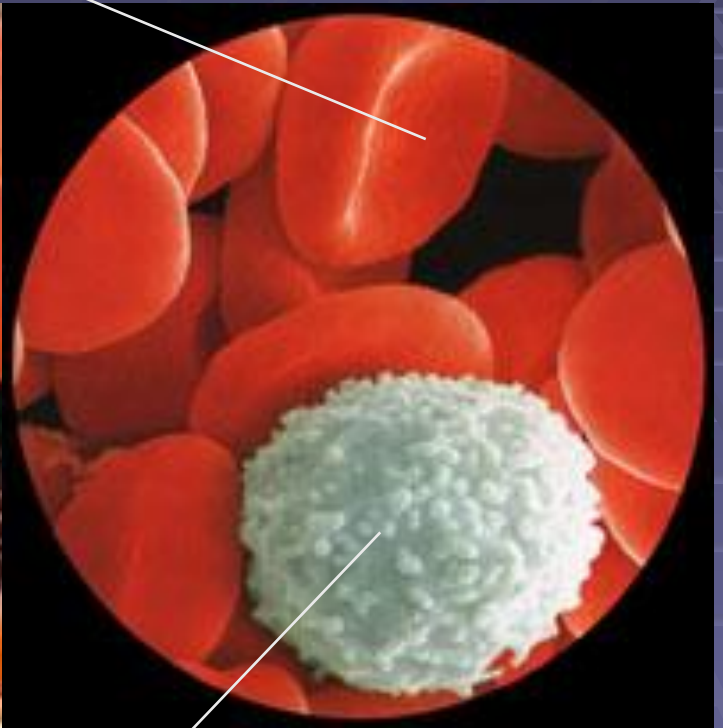


BLOOD FILM



ERYTHROCYTES

red blood cells / erythrocytes



white blood cell/ leucocyte

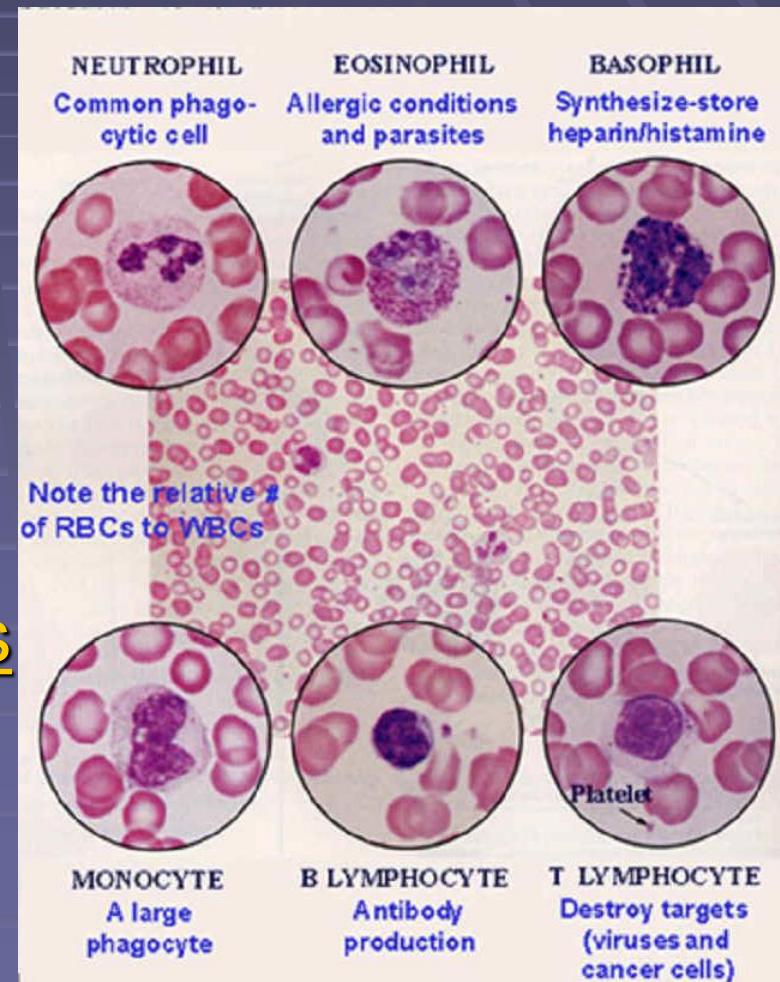
WHITE BLOOD CELLS /Leukocytes/

■ GRANULOCYTES

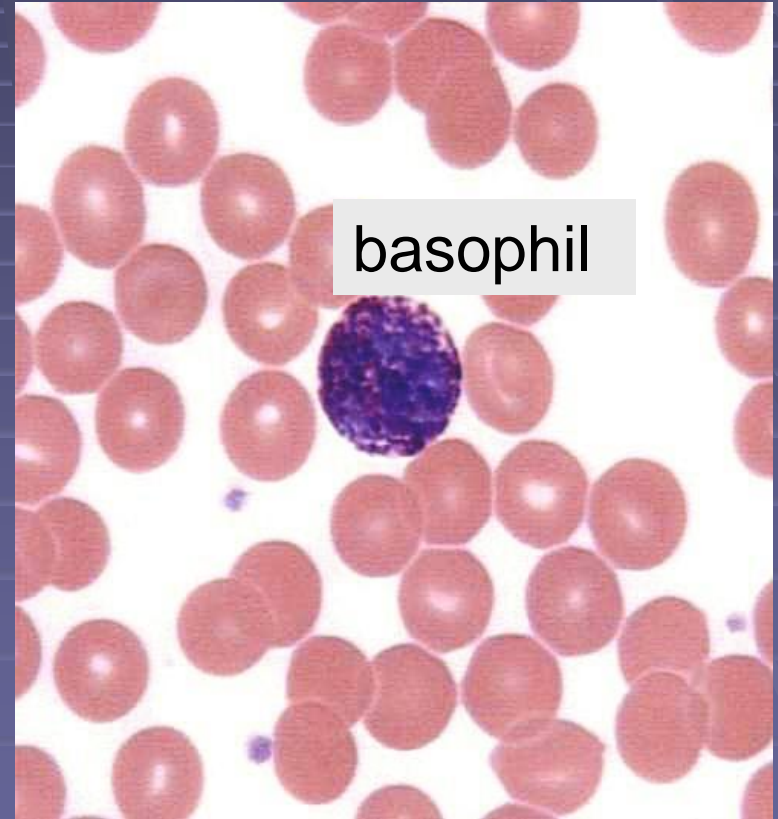
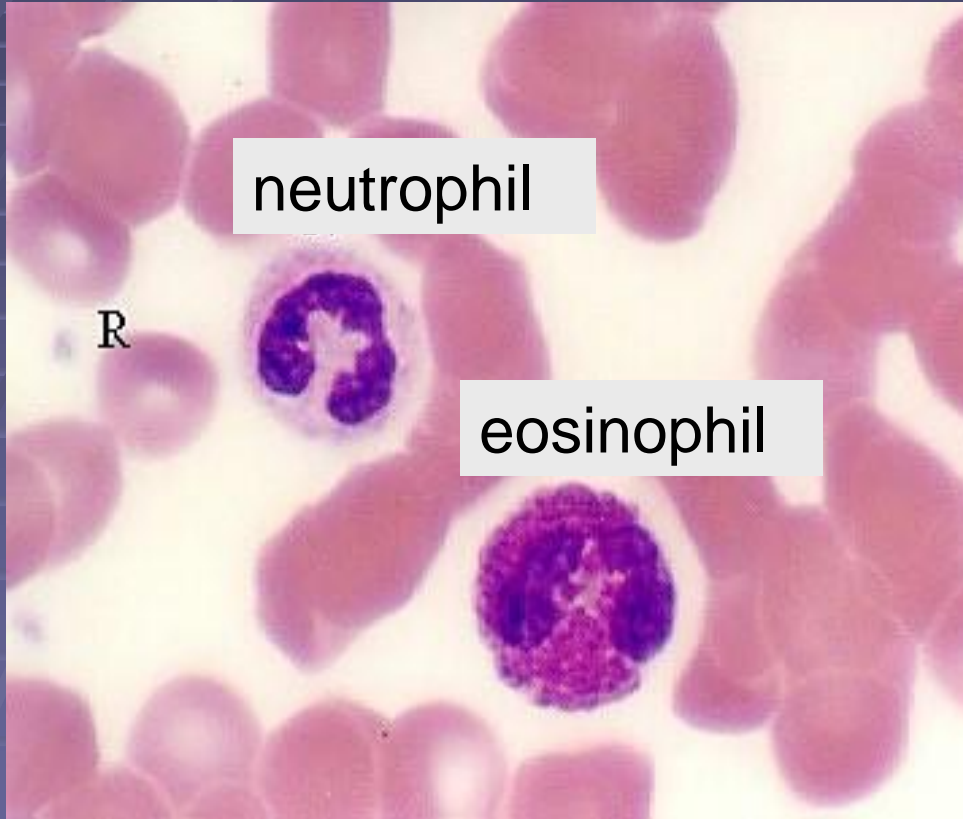
- neutrophil
- basophil
- eosinophil

■ AGRANULOCYTES

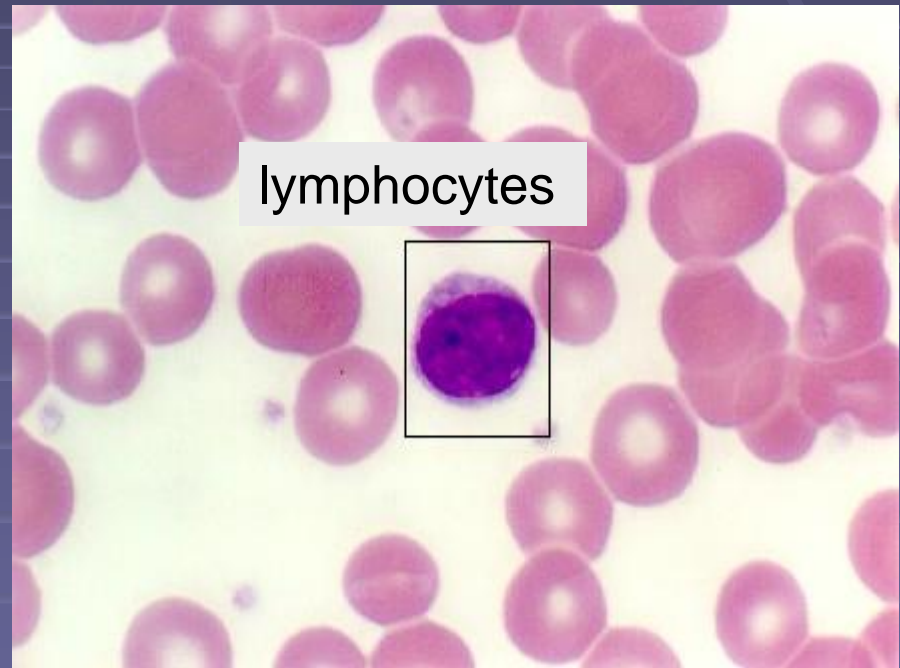
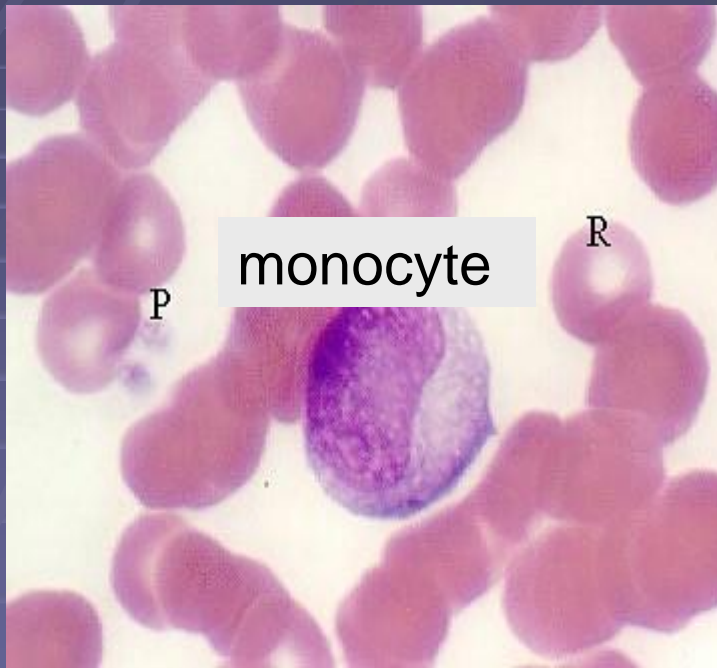
- monocytes, macrophages
- lymphocytes



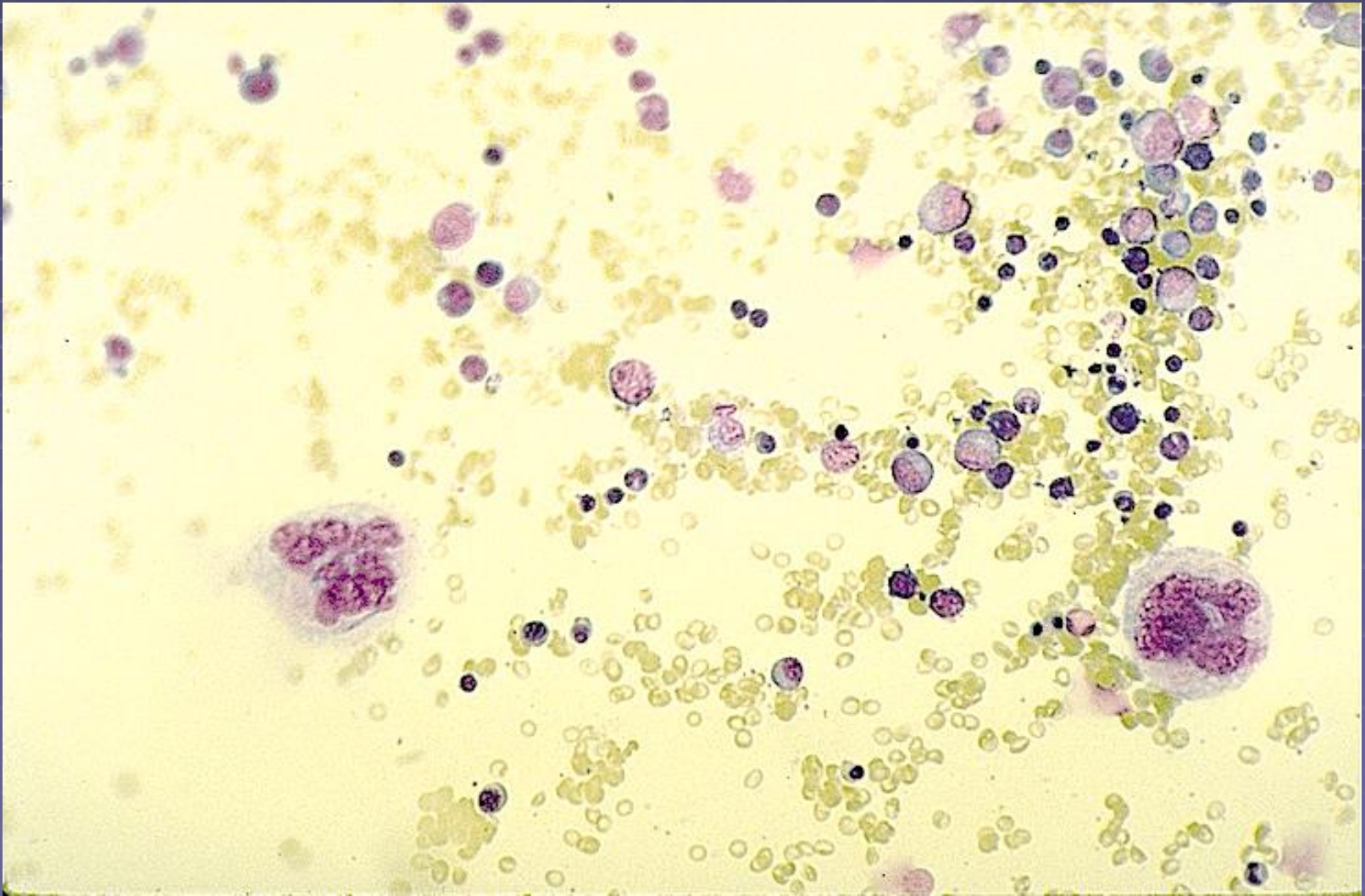
GRANULOCYTES



AGRANULOCYTES



TROMBOCYTES



Blood cells development

