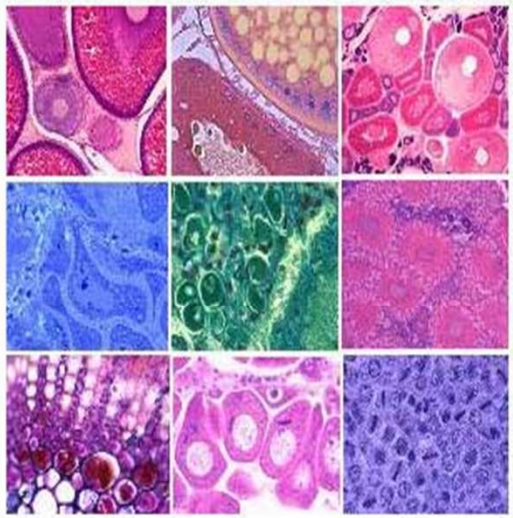
Histology, Epithelial Tissue



1. Tissues. Classification
2. General properties of basic tissues
3. Epithelial tissue – principal characteristics and functions
4. Classification of epithelium
5. Types of epithelia:
   - ✓ covering epithelia – types
   - ✓ glandular epithelia – types

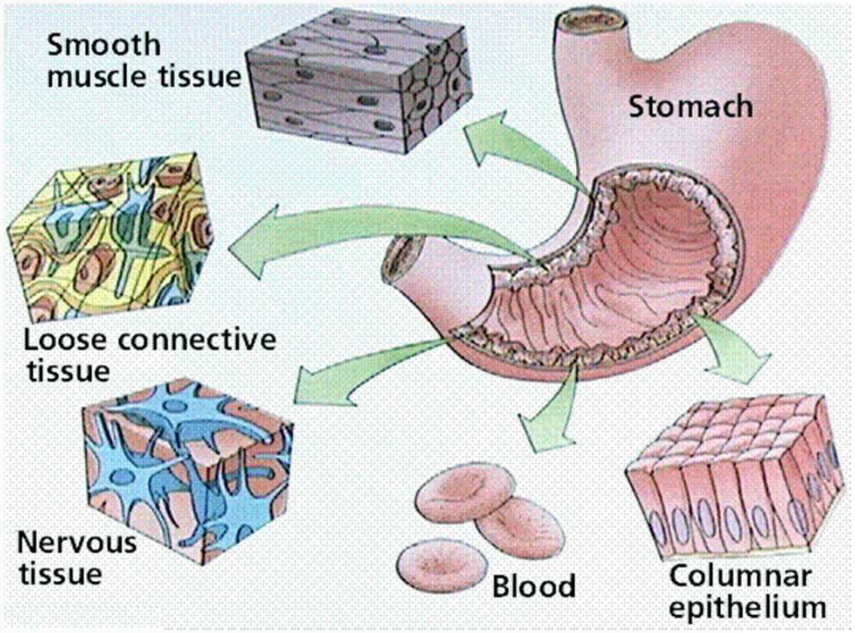
Tissues – concept

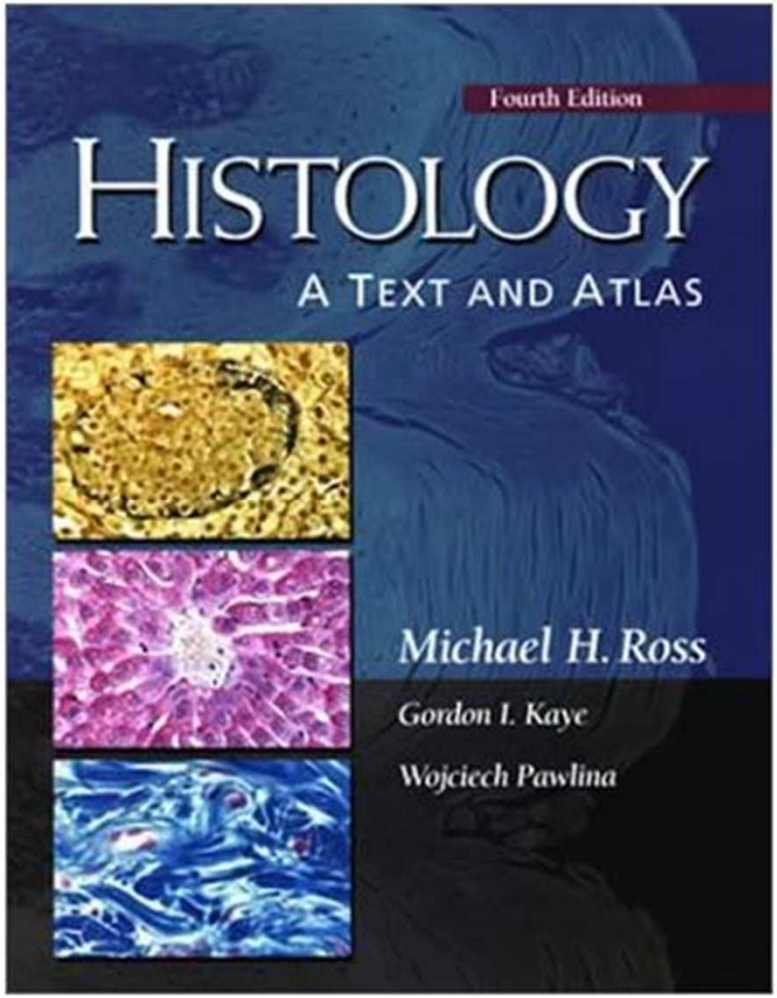
- Histology:

(Gr. *ἱστός*, *histos,* tissue + *logos,* study)

✓general histology

✓special histology = microscopic anatomy of the organ systems

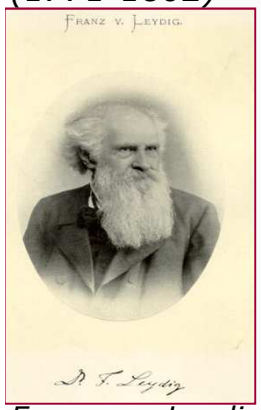




Tissues – classification

- *Marie François Xavier Bichat*, 1797; Fr. *tissu* = tissue
  1801 – 21 types of tissue
- *August Franz Josef Karl Mayer*, histology;
  1819 – 8 types of tissue
- *Franz von Leydig*, 1857
  – 4 basic types:
  - ✓ **Epithelial tissue**
  - ✓ **Connective tissue**
  - ✓ **Muscle tissue**
  - ✓ **Nervous tissue**

Marie Xavier Bichat (1771-1802)



Franz von Leydig (1821-1908)

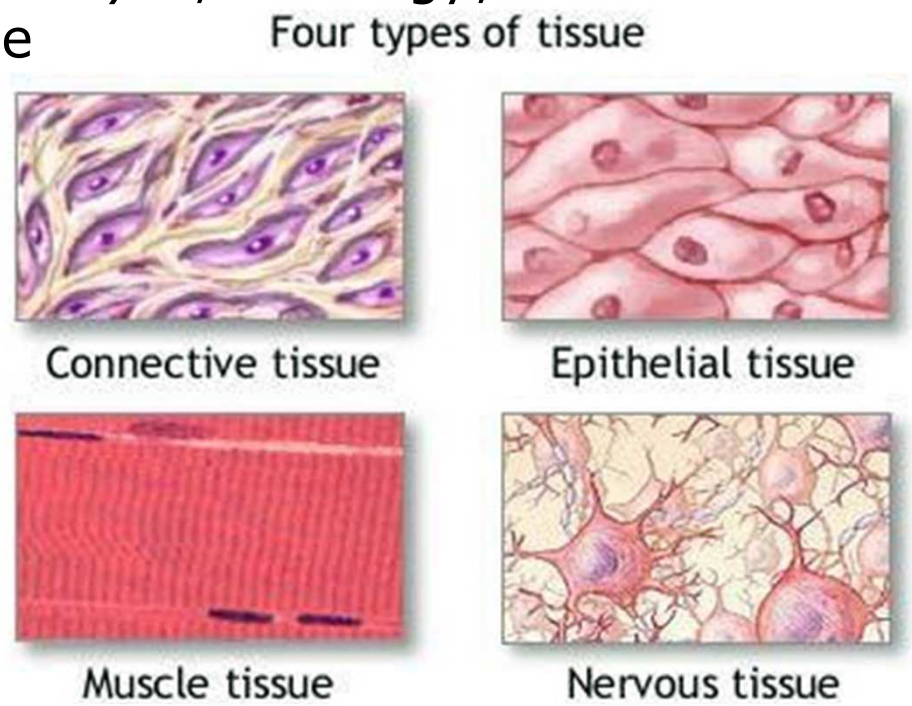
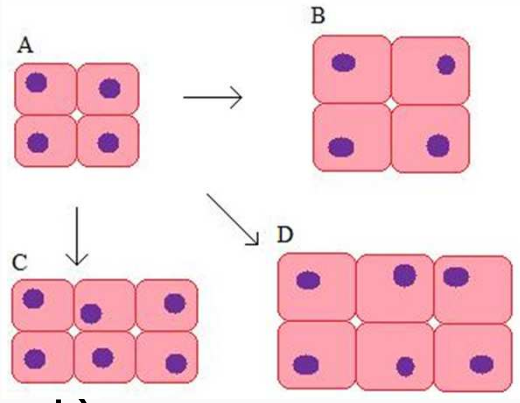


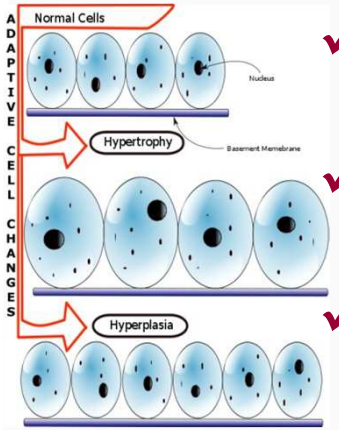
Table 4–1. Main Characteristics of the Four Basic Types of Tissues.

Tissue	Cells	Extracellular Matrix	Main Functions
Nervous	Intertwining elongated processes	None	Transmission of nervous impulses
Epithelial	Aggregated polyhedral cells	Very small amount	Lining of surface or body cavities, glandular secretion
Muscle	Elongated contractile cells	Moderate amount	Movement
Connective	Several types of fixed and wandering cells	Abundant amount	Support and protection

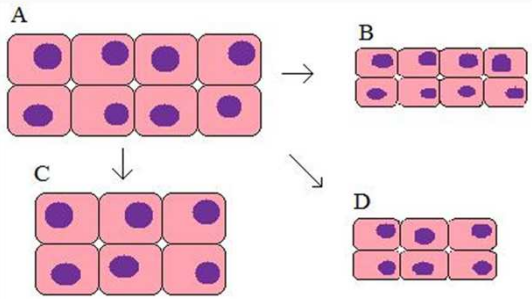
Tissues – general properties



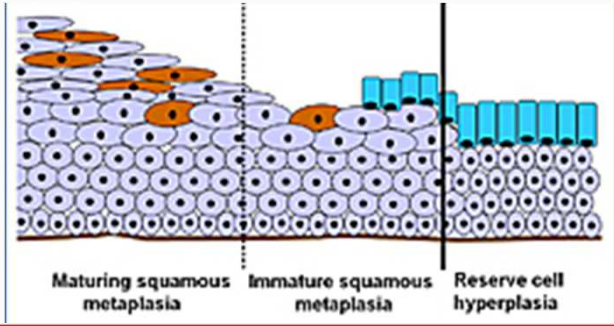
- ✓ Regeneration:
  - ➢ physiological – permanent and cyclic
  - ➢ reparative
- ✓ Degeneration



- ✓ Hypertrophy – increase in cell size (Gr. *ὑπέρ*, excess + *τροφή*, nourishment)
- ✓ Hyperplasia – increase in cell number (Gr. *ὑπέρ*, excess + *plésein*, to form)



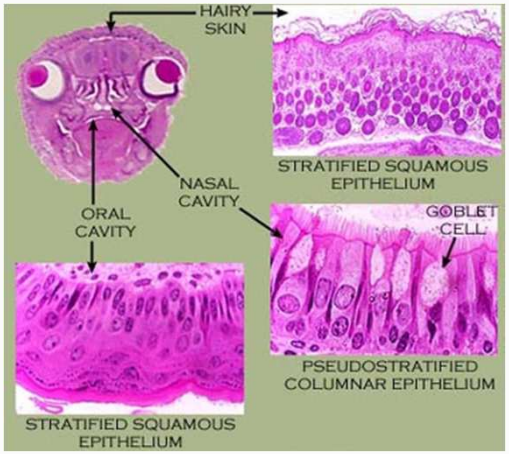
- ✓ Atrophy – wasting away of a part of the body:
  - ➢ numerical (myocardium)
  - ➢ volumetric
- ✓ Aplasia (Gr. *a*, not + *plésein*, to form)
- ✓ Metaplasia (Gr. change in form):
  - ➢ physiological
  - ➢ pathological



- ✓ Neoplasia (Gr. new growth) = tumor degeneration

Textus epithelialis:

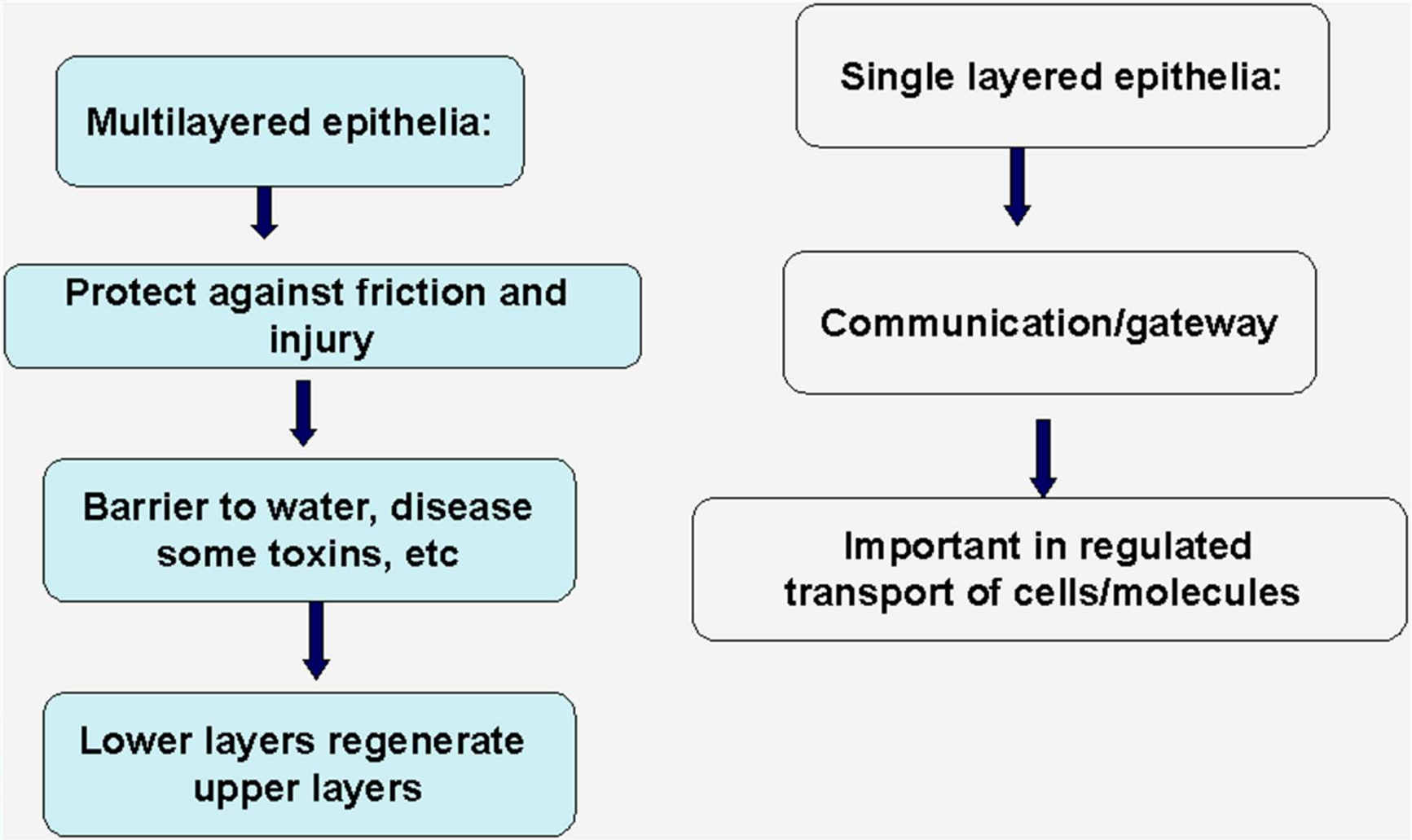
- Gr. *ἐπί*, *epi*, upon + *θηλή*, *thēlē*, nipple
- Origin – from all three germ layers of the embryo
- The tissue that:
  - ✓ covers surfaces in the body – epidermis
  - ✓ lines cavities of hollow organs – epithelium
    - ➢ digestive system
    - ➢ respiratory system
    - ➢ urinary system
    - ➢ reproductive (genital) system
    - ➢ cardiovascular system



- Many glands are also formed from epithelial tissue (sweat and sebaceous glands, pancreas, liver) – parenchyma

Epithelial tissue – functions

- **Main functions:**
  - ✓ protection (barrier), transport and secretion



Epithelial tissue – characteristics

- **Common features:**

✓ epithelial cells rest on a basement membrane

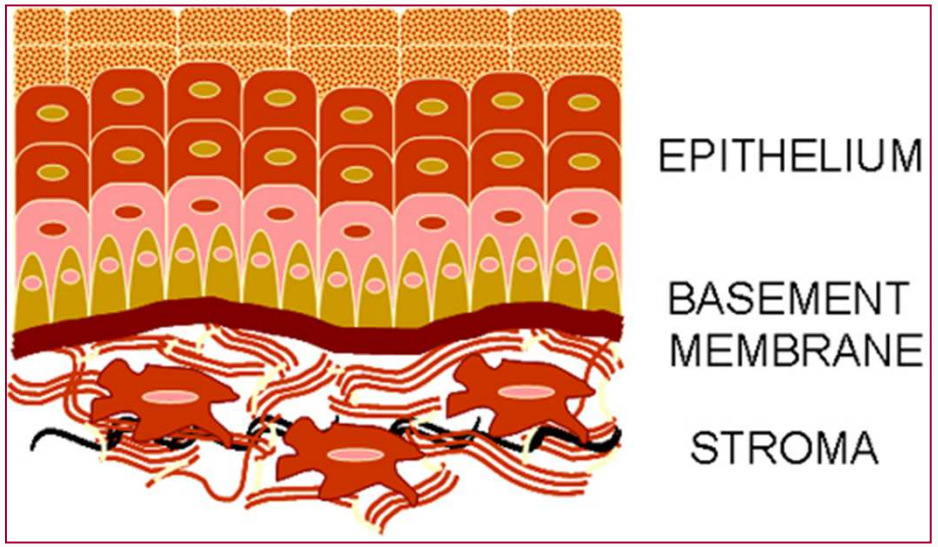
✓ morphological and functional cell polarity – basal and free apical poles

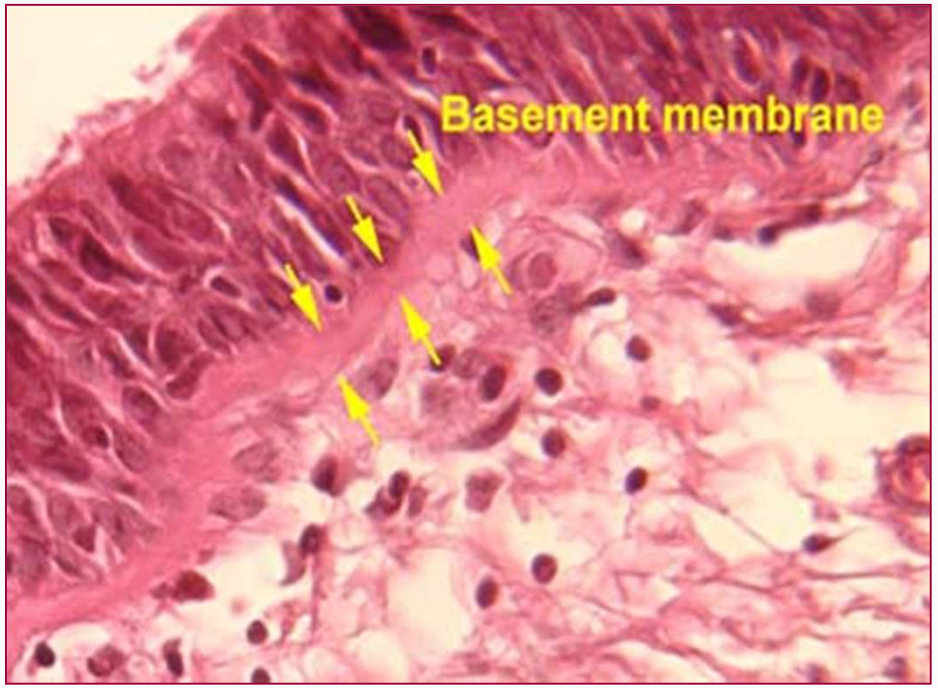
✓ avascular tissue – lacks blood vessels

✓ rich innervation

✓ limited intercellular space

✓ high regeneratory capacity

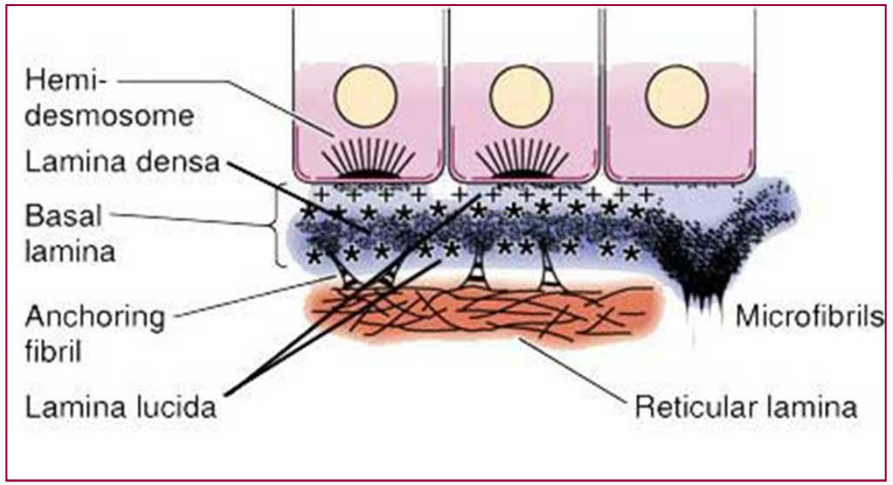


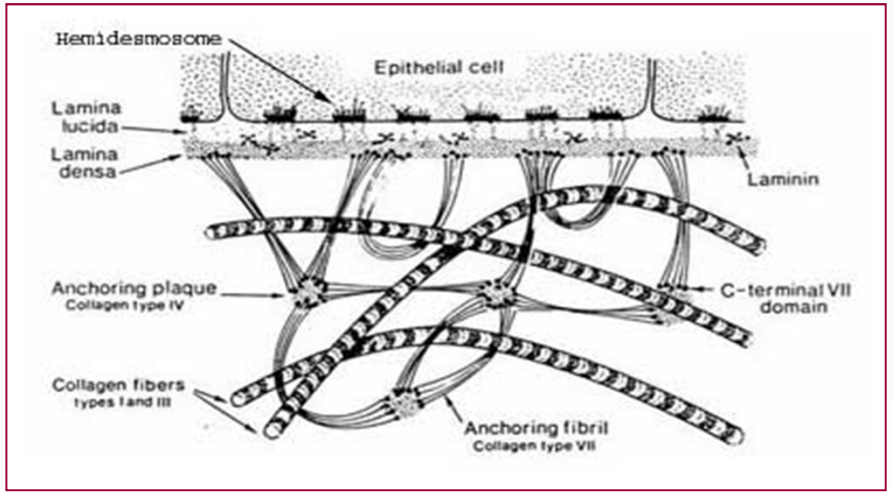


Basement membrane

Main components:

- ✓ Basal lamina, *lamina basalis:* 50-100 nm
  - ➢ proteins: **type IV collagen**, (types XV and XVIII)
  - ➢ heparane sulfate proteoglycans: perlecan, agrin
  - ➢ glycoproteins: laminin, entactin (or nidogen)
- ✓ Anchoring fibrils:
  - ➢ type VII collagen
- ✓ Reticular lamina, *lamina reticularis:*
  - ➢ type III collagen



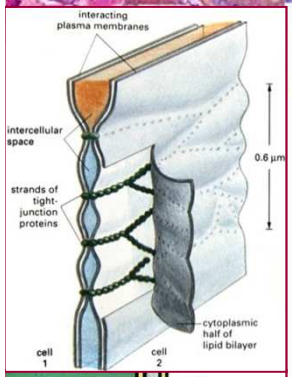


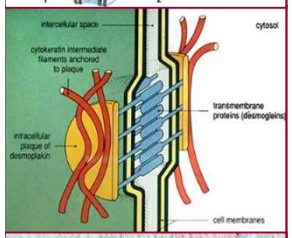
Major functions:

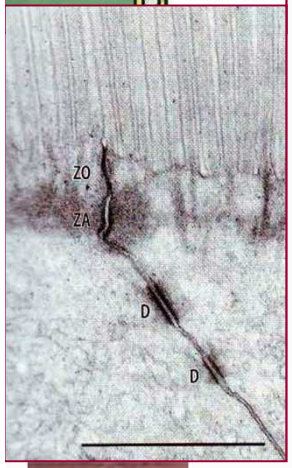
- ➢ elastic support
- ➢ semiconductive filter

- ✓ *Lamina basalis* – 120-250 nm:
  - ➢ lamina densa – 60-120 nm
  - ➢ lamina rara (lucida) externa et interna – 40 nm
- ✓ *Lamina reticularis s. fibroreticularis* – type III collagen

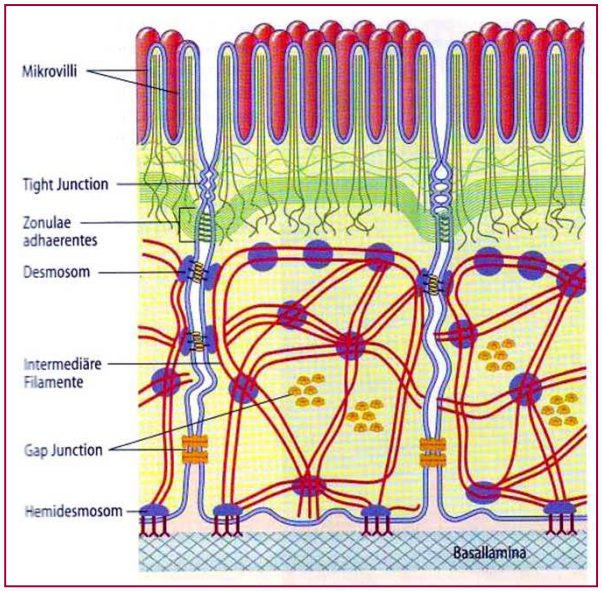
Intercellular junctions

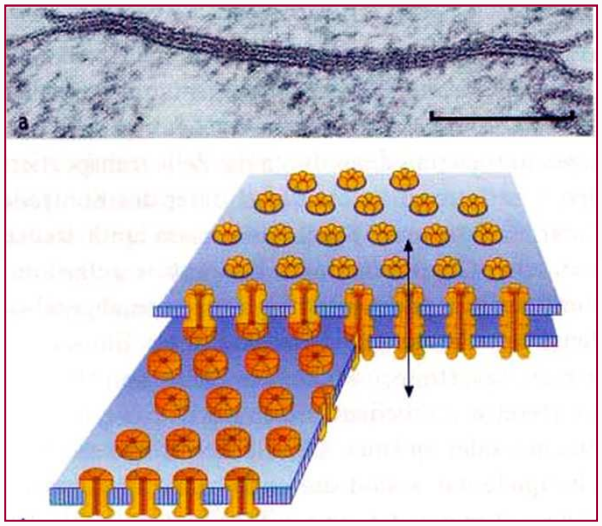






- 3 types intercellular junctions:
- Barrier (impermeable) junctions:
  - ✓tight junction, *zonula occludens*
  - ✓occluding strip, *fascia occludens*
  - ✓occluding spot, *macula occludens*
- Adhering (anchoring) junctions:
  - ✓*punctum adhaerens*
  - ✓belt desmosome, *zonula adhaerens*
  - ✓spot desmosome, *macula adhaerens*
    (Gr. *desmos,* band + *soma,* body)
- Communicating junctions:
  - ✓gap junction, *nexus*
  - ✓synapse
- Junctional complex

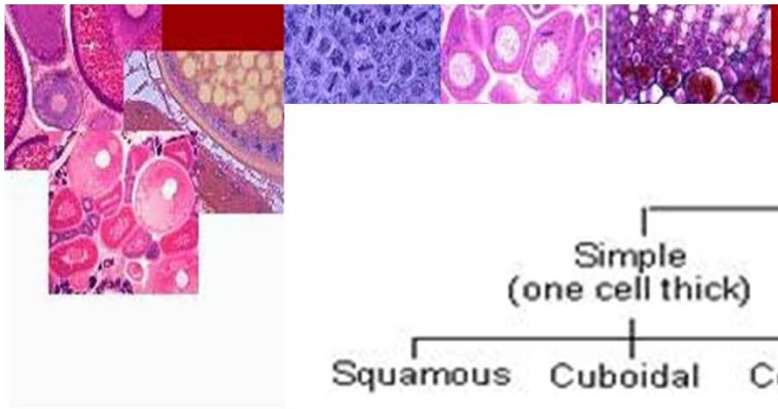


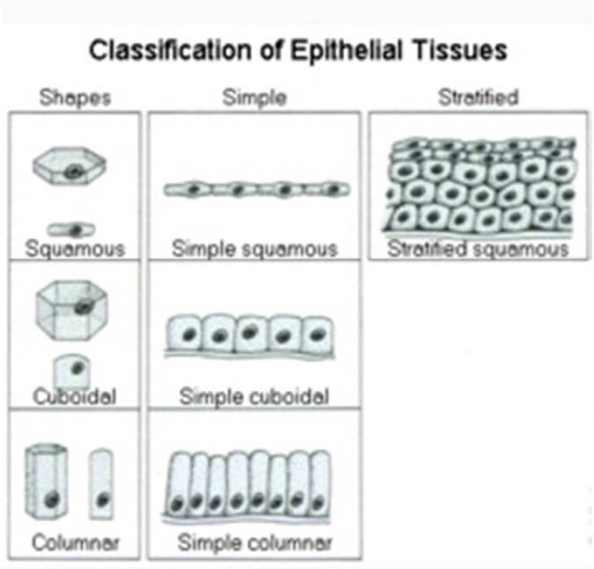


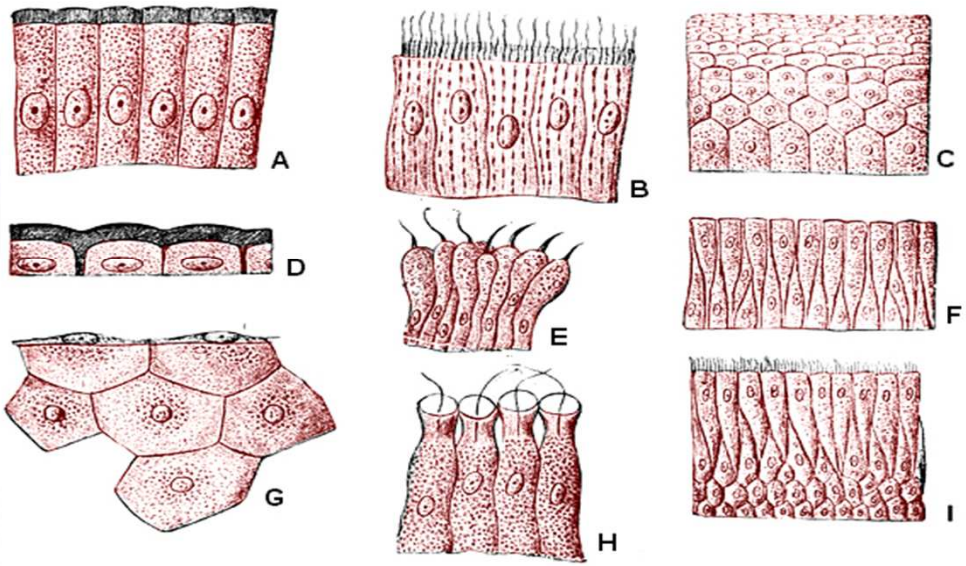
Epithelial tissue – classification

Simple epithelium – classification

Epithelial tissue – classification

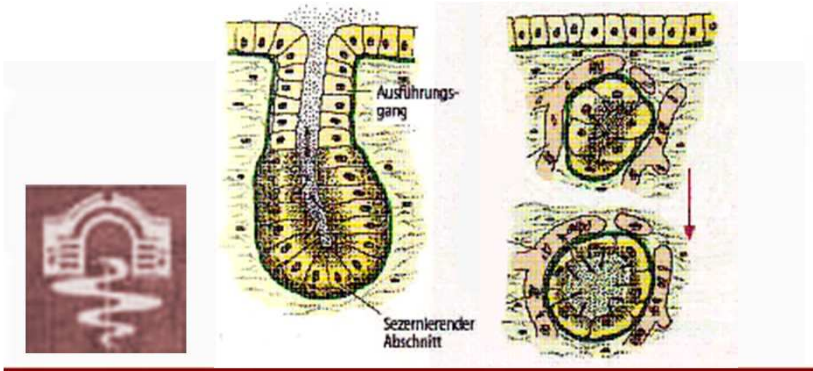


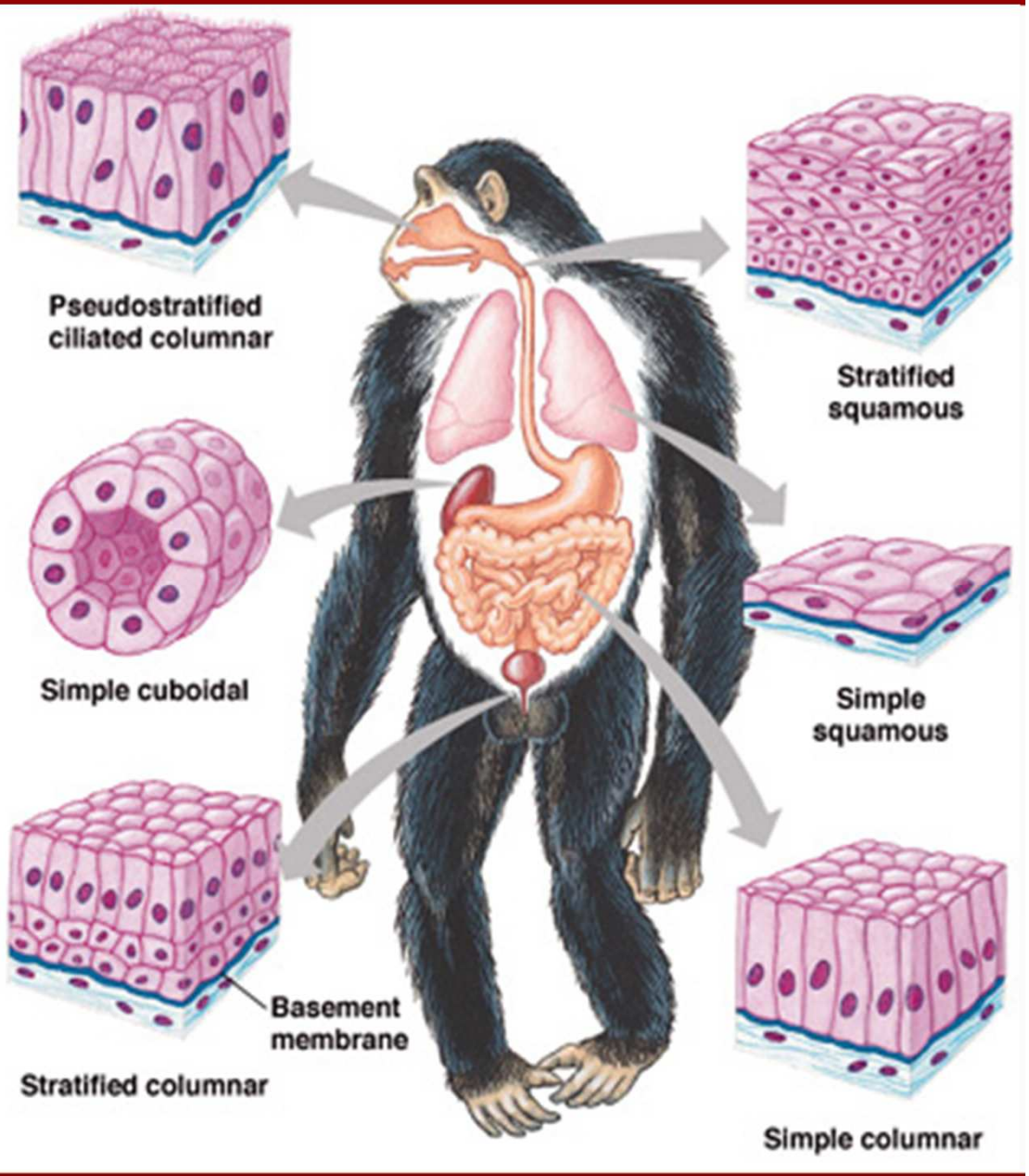




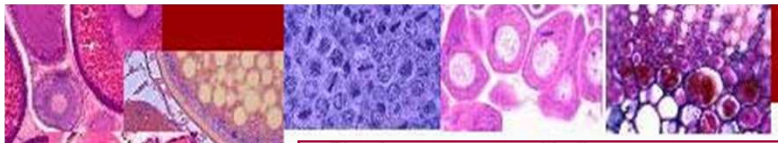
Epithelial tissue – classification

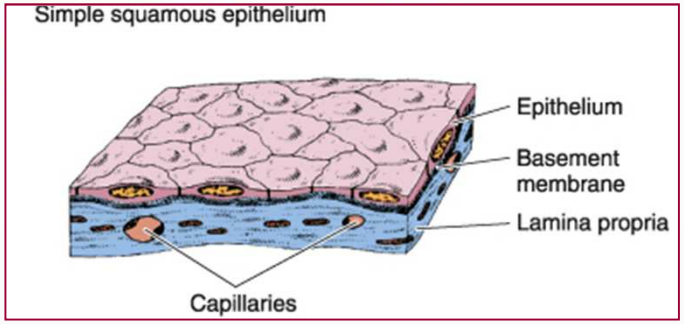
- Covering epithelia:
  - ✓ simple
    - ➢ squamous
    - ➢ cuboidal
    - ➢ columnar
    - ➢ pseudostratified ciliated columnar
  - ✓ stratified
    - ➢ squamous nonkeratinized
    - ➢ squamous keratinized
    - ➢ columnar
    - ➢ transitional (of *Henle*)
- Glandular epithelia:
  - ✓ exocrine
  - ✓ endocrine

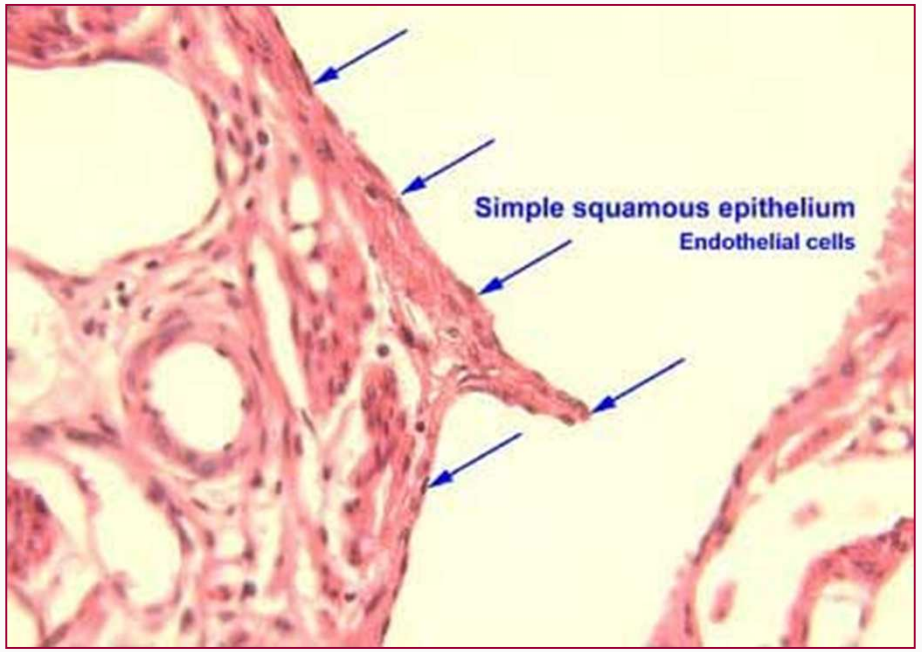




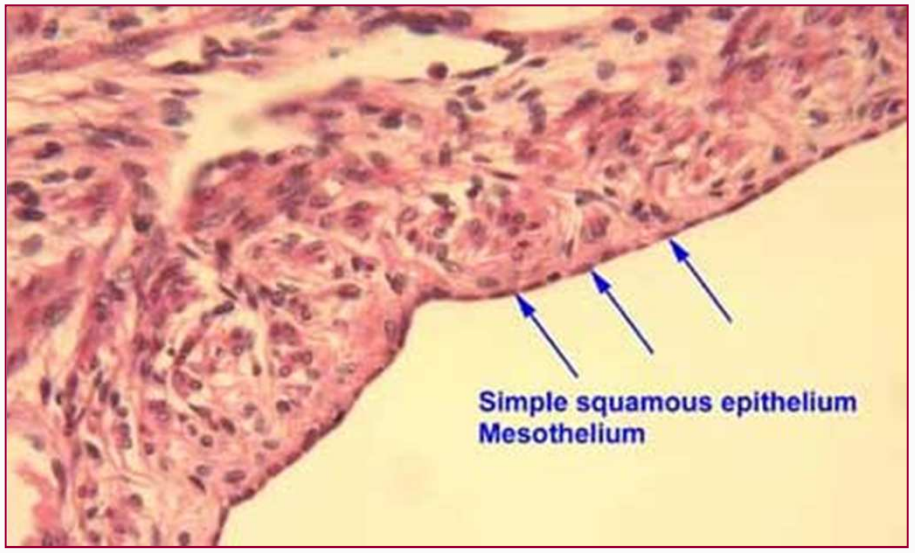
Simple squamous epithelium



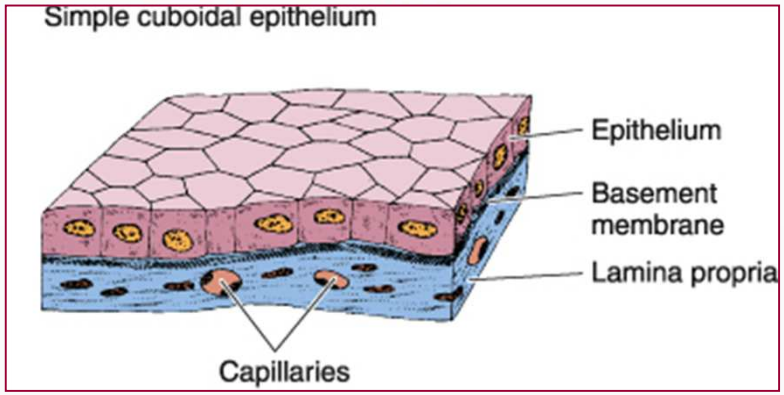


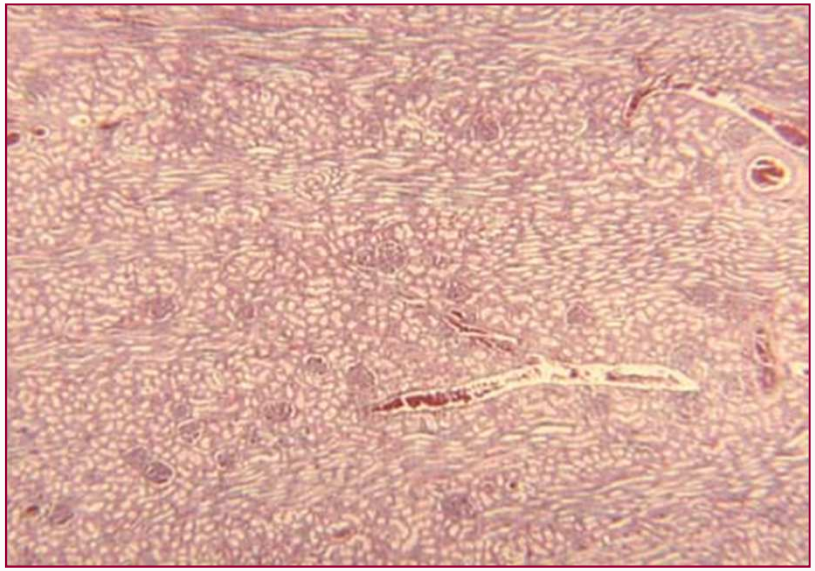


- Epithelium that lines blood and lymph vessels (endothelium, vasothelium)
  - ✓ squamous in shape cells
  - ✓ a prominent, protruding nucleus
  - ✓ covering and metabolic functions
- Epithelium that lines certain body cavities, such as the pleural and peritoneal cavities (mesothelium)

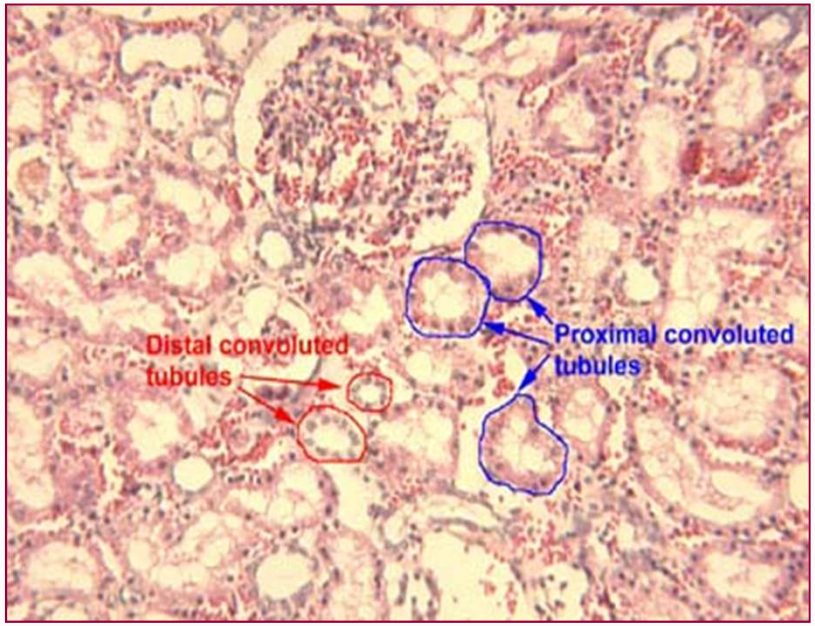


Simple cuboidal epithelium



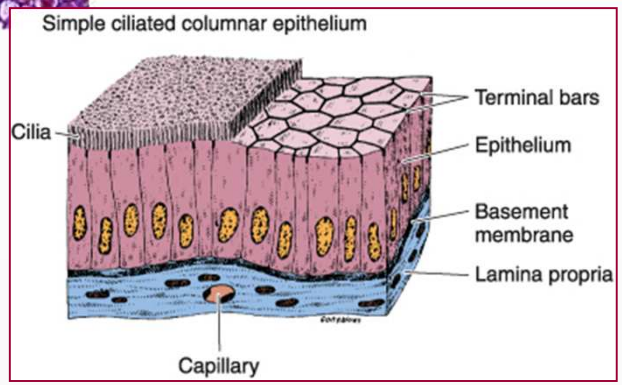


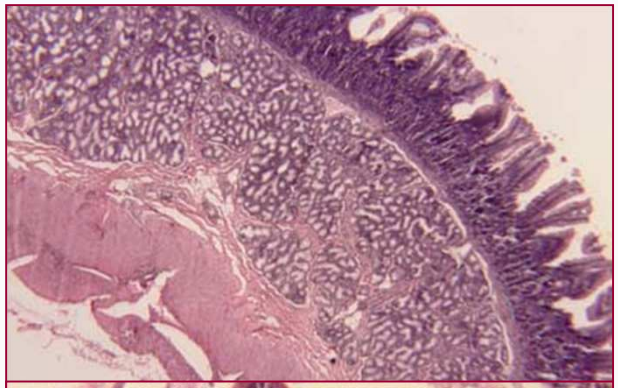
- covering:
  - ✓ ducts of the exocrine glands
  - ✓ ovary
- absorption:
  - ✓ walls of renal tubules
- secretion:
  - ✓ thyroid gland (follicles)

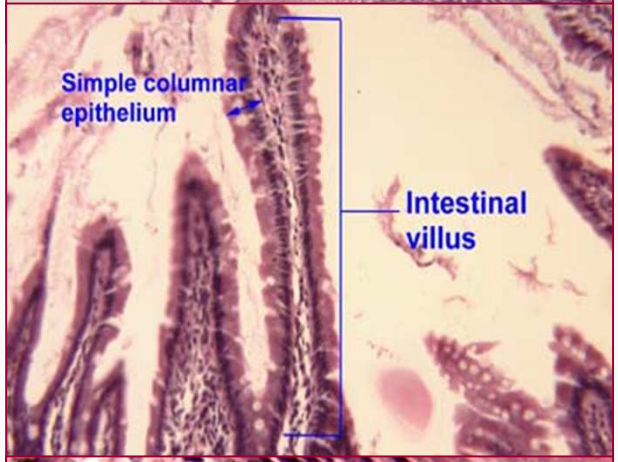


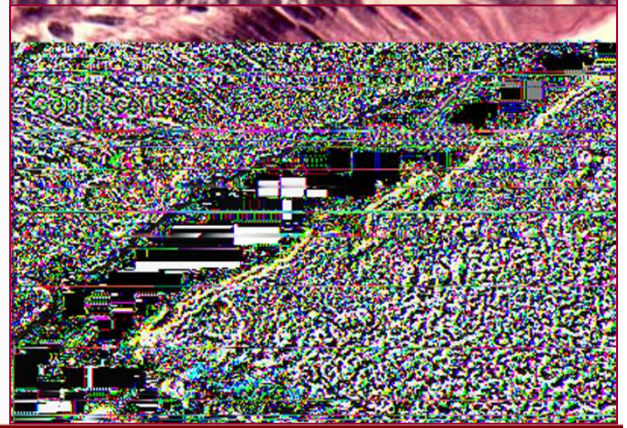
Simple columnar epithelium

- covering:
  - ✓ ducts of the exocrine glands
- absorption:
  - ✓ intestinal villi
- secretion:
  - ✓ stomach
  - ✓ large intestine
  - ✓ uterus
- ciliated:
  - ✓ Fallopian tubes
  - ✓ distal bronchi



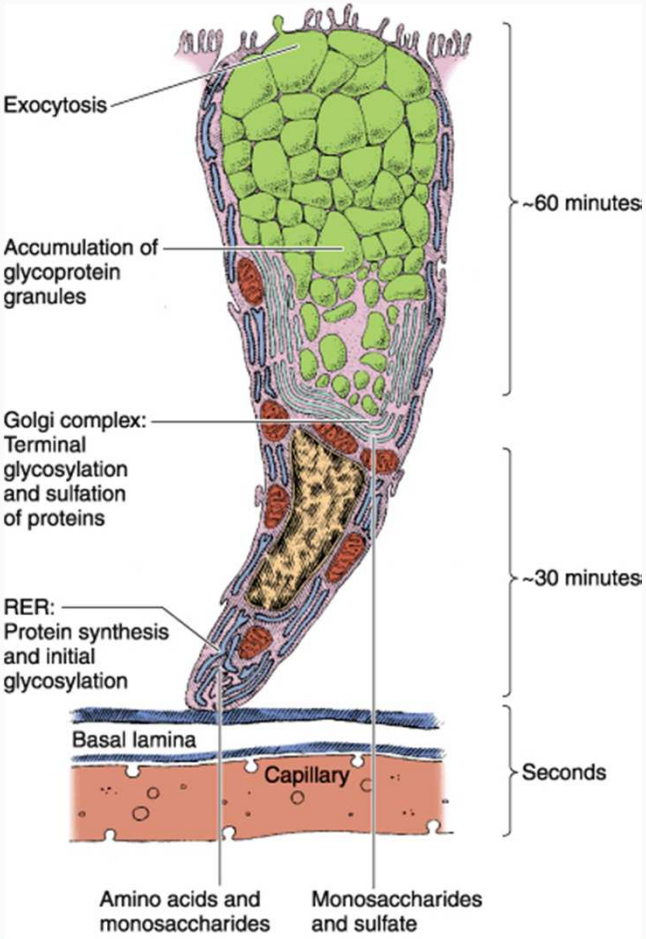




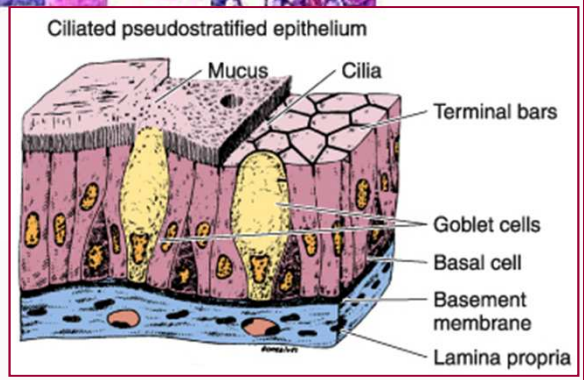


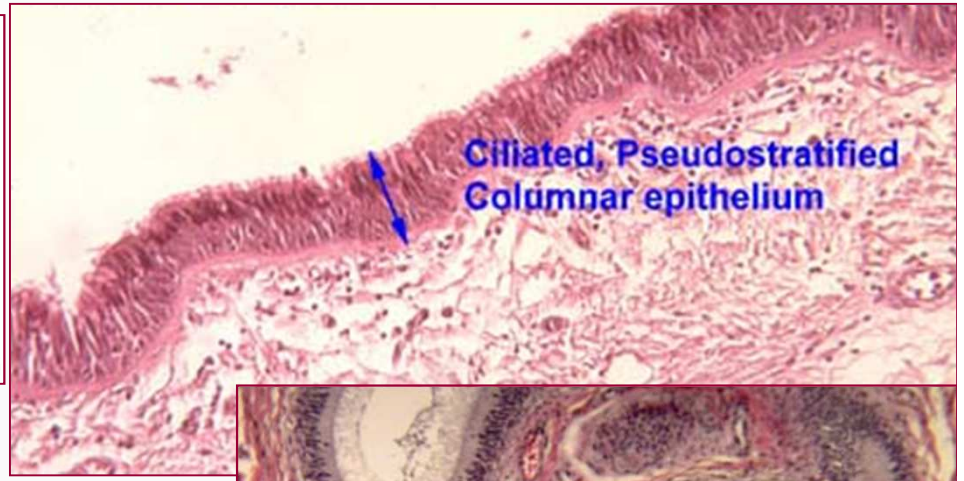
Simple columnar epithelium

- types of cells:
  - ✓ absorptive cells, enterocytes (90%) – 30 µm
  - ✓ mucous (goblet) cells
  - ✓ basal (stem) cells

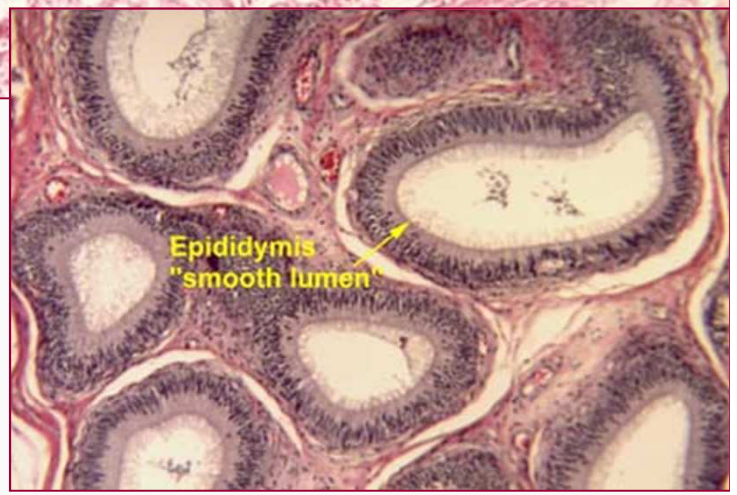


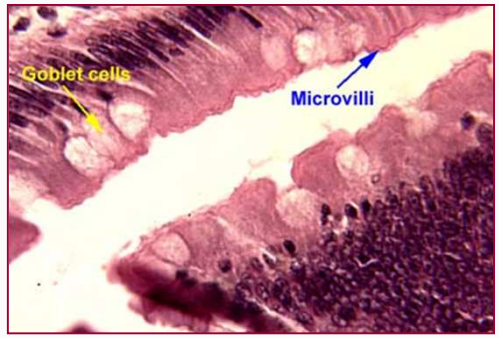
Pseudostratified columnar epithelium



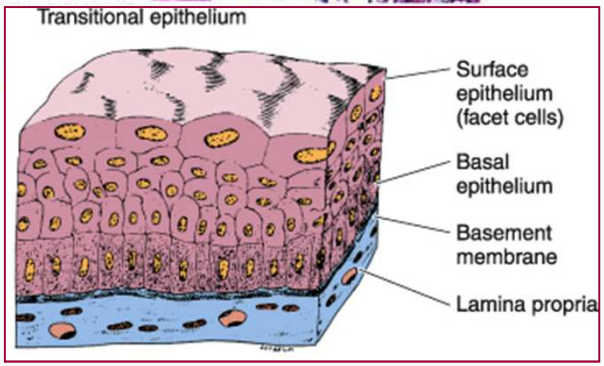


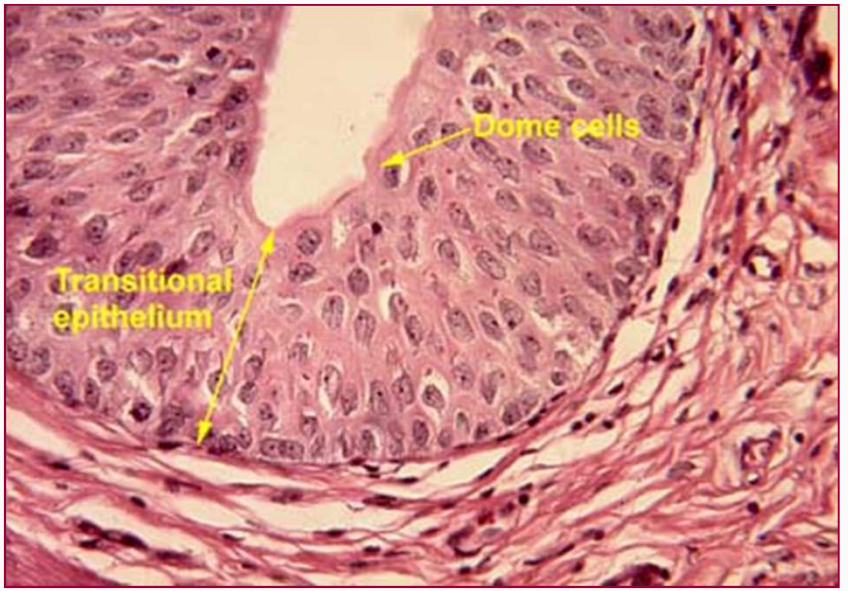
- covering:
  - ✓ large ducts of the exocrine glands
- ciliated:
  - ✓ upper respiratory tract
  - ✓ epididymis



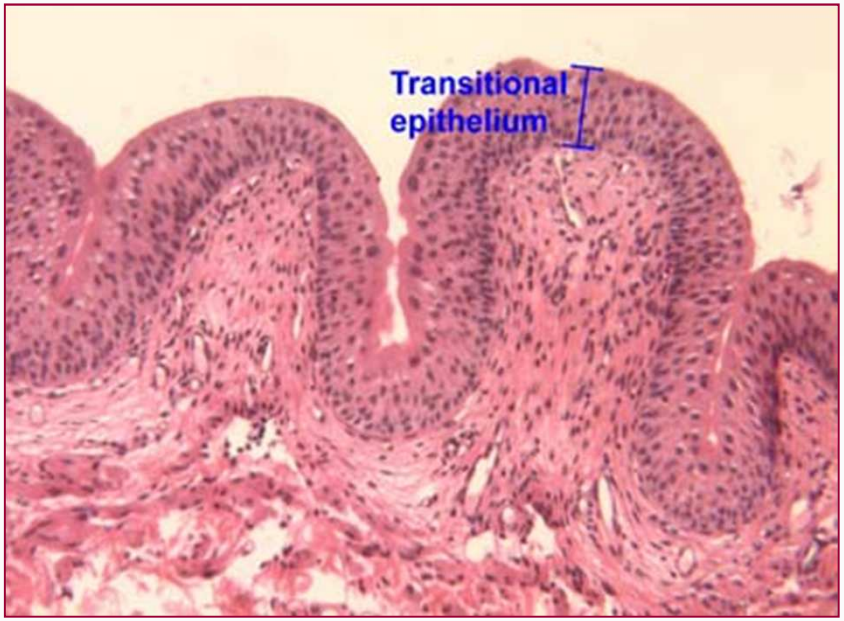


Transitional epithelium





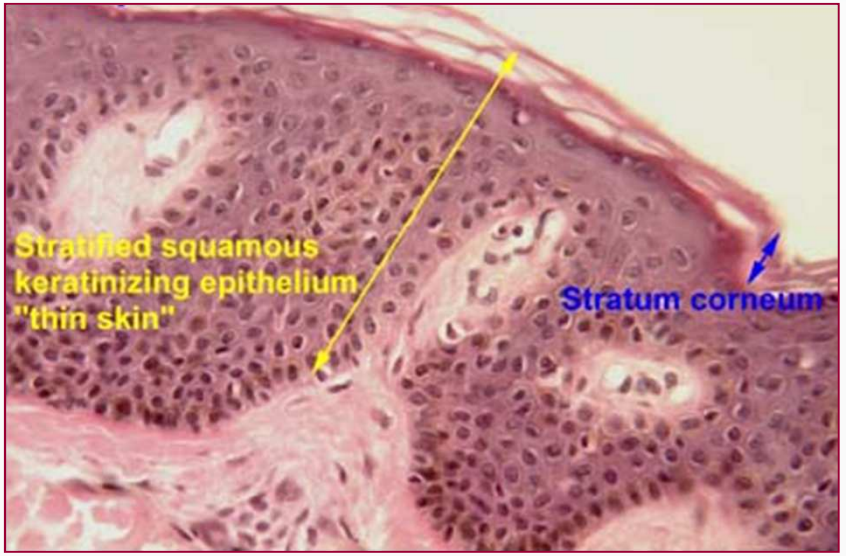
- Uroepithelium (urothelium):
  - ✓ lining of renal calyces
  - ✓ urinary tract – ureters & bladder

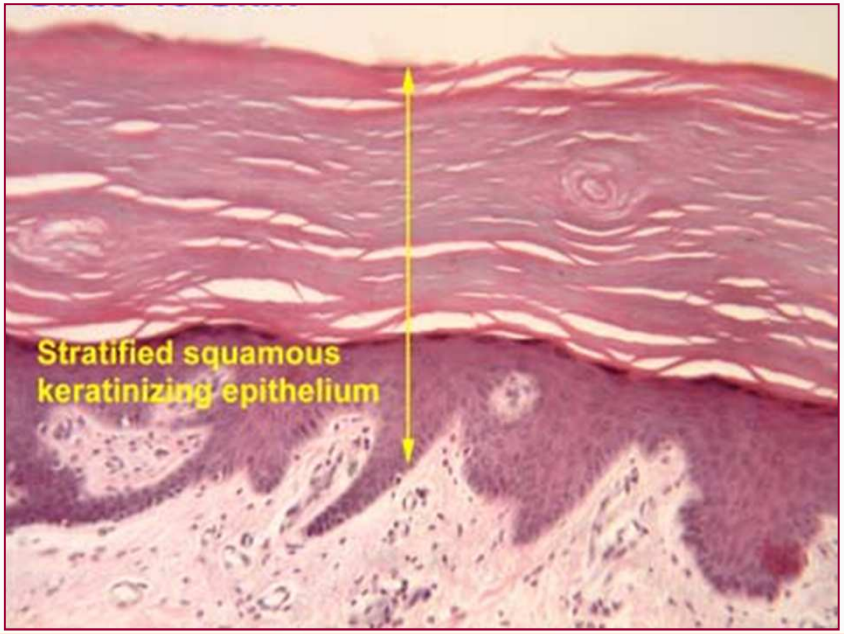


- The form of the cells changes according to the degree of distention of the organ:
  - ✓ five or six cells in thickness
  - ✓ small basal cells
  - ✓ larger pear-shaped cells in the middle layers
  - ✓ superficial cells are rounded and frequently binucleate

Stratified squamous keratinizing

- Skin (epidermis):
  - covers dry surfaces
  - most superficial cells involute and are transformed into dead scales of protein (keratin) without discernible nuclei
  - 5 layers of keratinocytes:

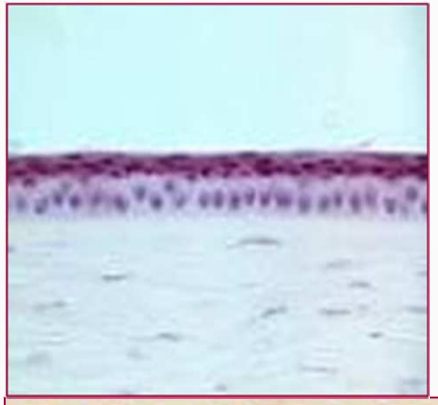


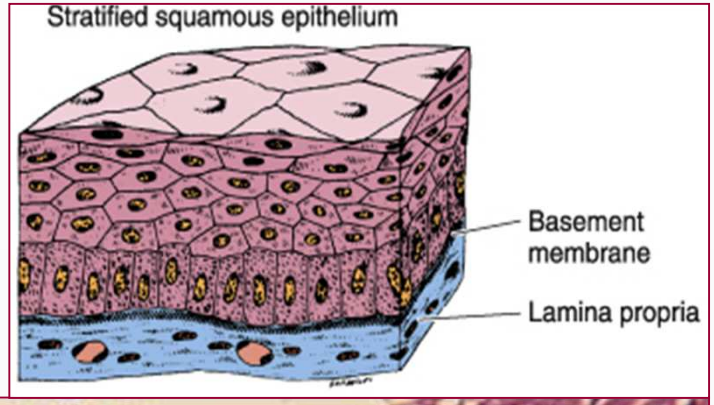


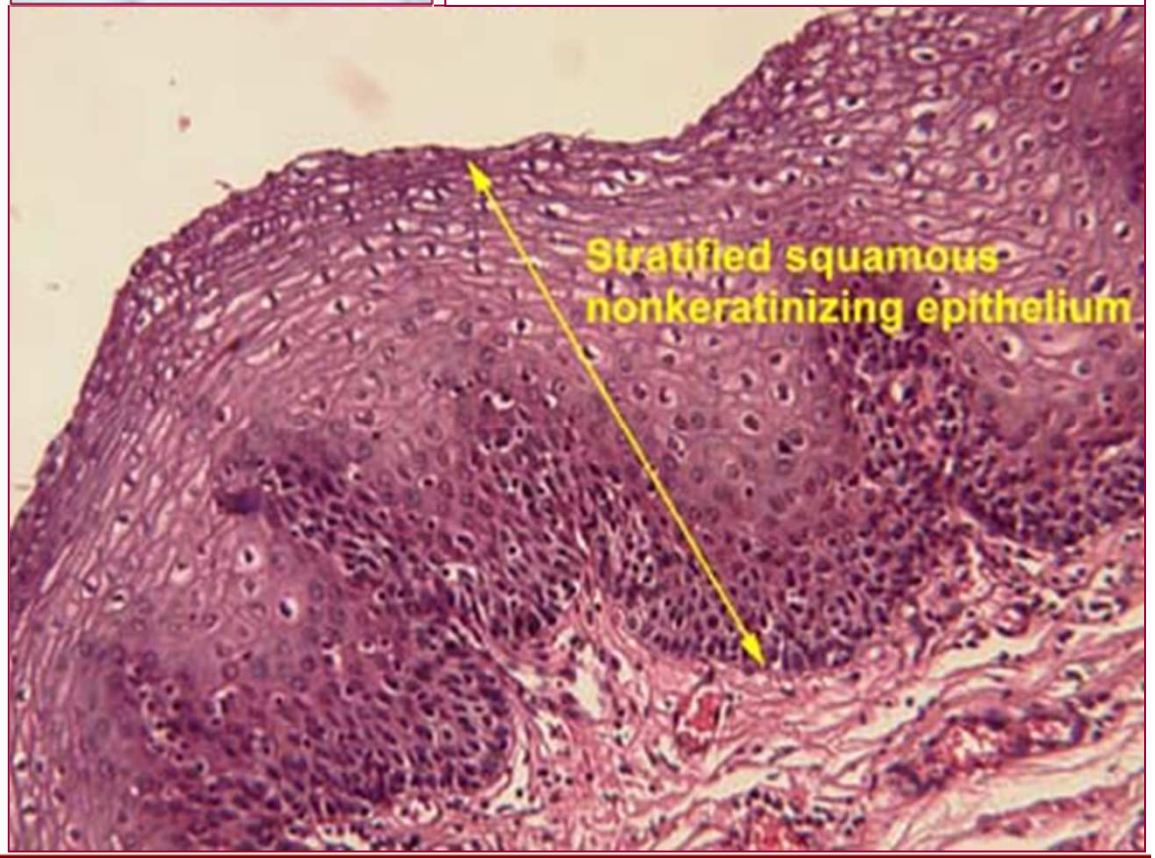
- ✓ *stratum basale*
- ✓ *stratum spinosum*
- ✓ *stratum granulosum*
- ✓ *stratum lucidum*
- ✓ *stratum corneum* – keratin

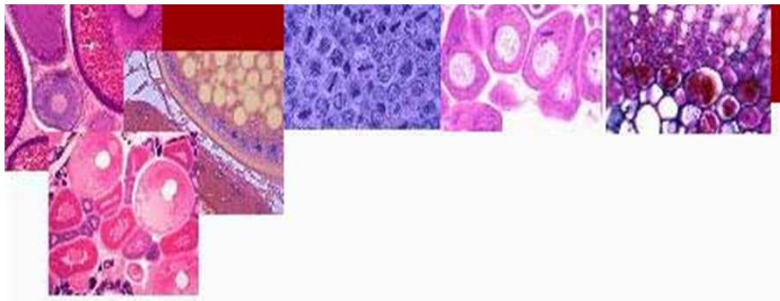
Stratified squamous nonkeratinizing

- Mucous epithelium – covers wet surfaces:
  - ✓ oral cavity
  - ✓ oropharynx
  - ✓ esophagus
  - ✓ anal canal
  - ✓ vagina
- Metaplasia
- Corneal epithelium



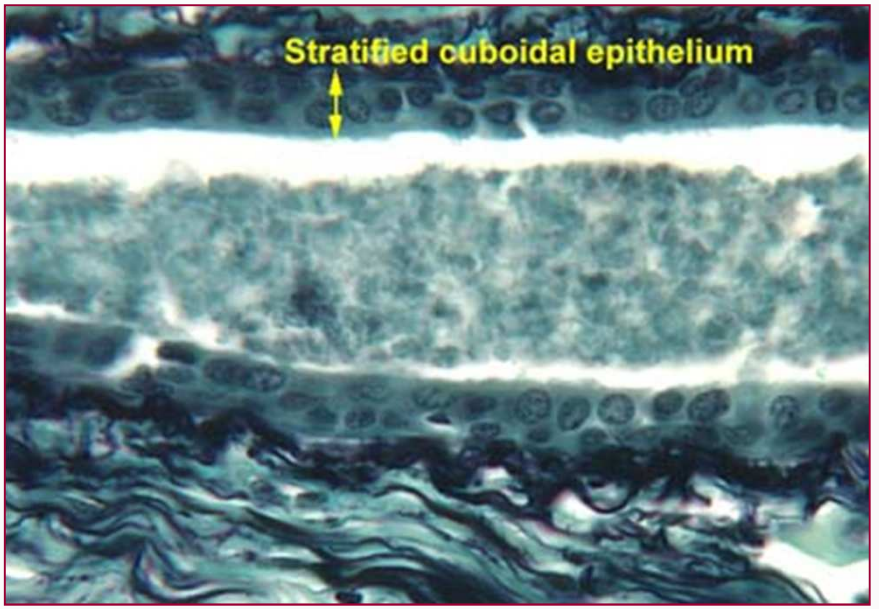


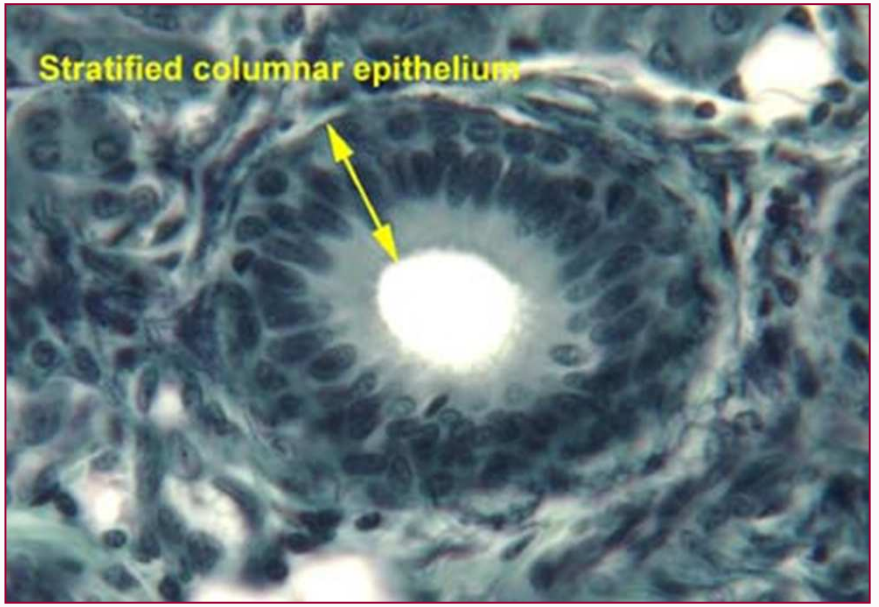




Stratified cuboidal/columnar epithelium

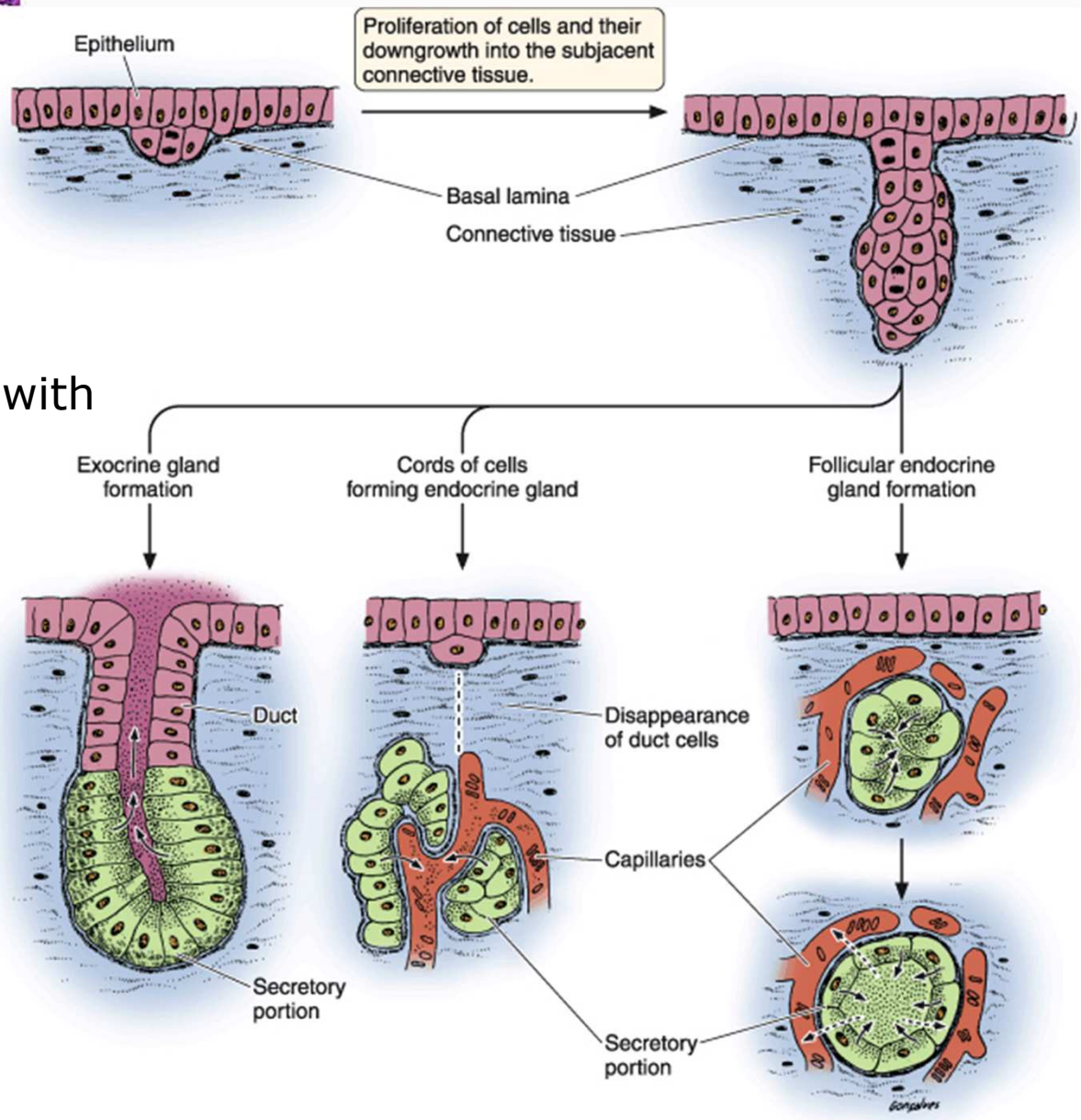
- Bilayered cuboidal epithelium:
  - ✓ ducts of the sweat glands
- Stratified columnar epithelium:
  - ✓ rare – only in small areas
  - ✓ large ducts of salivary glands
  - ✓ part of the urethra
  - ✓ ocular conjunctiva





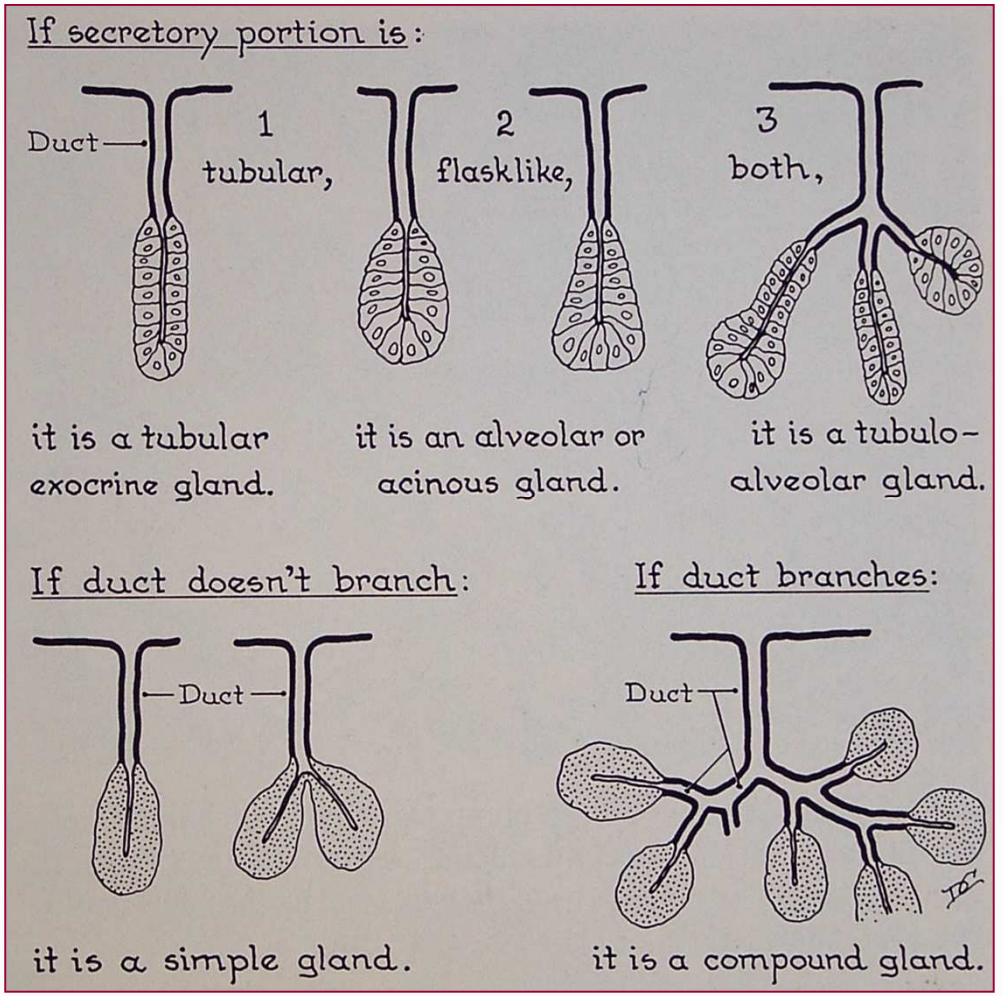
Types of glandular epithelia

- Exocrine glands
  (Gr. *exo,* outside, + *krinein,* to separate):
  - ✓ retain their connection with the surface epithelium
  - ✓ tubular ducts
- Endocrine glands
  (Gr. *endon,* within, + *krinein*)
  - ✓ connection with the surface is lost during development
  - ✓ ductless



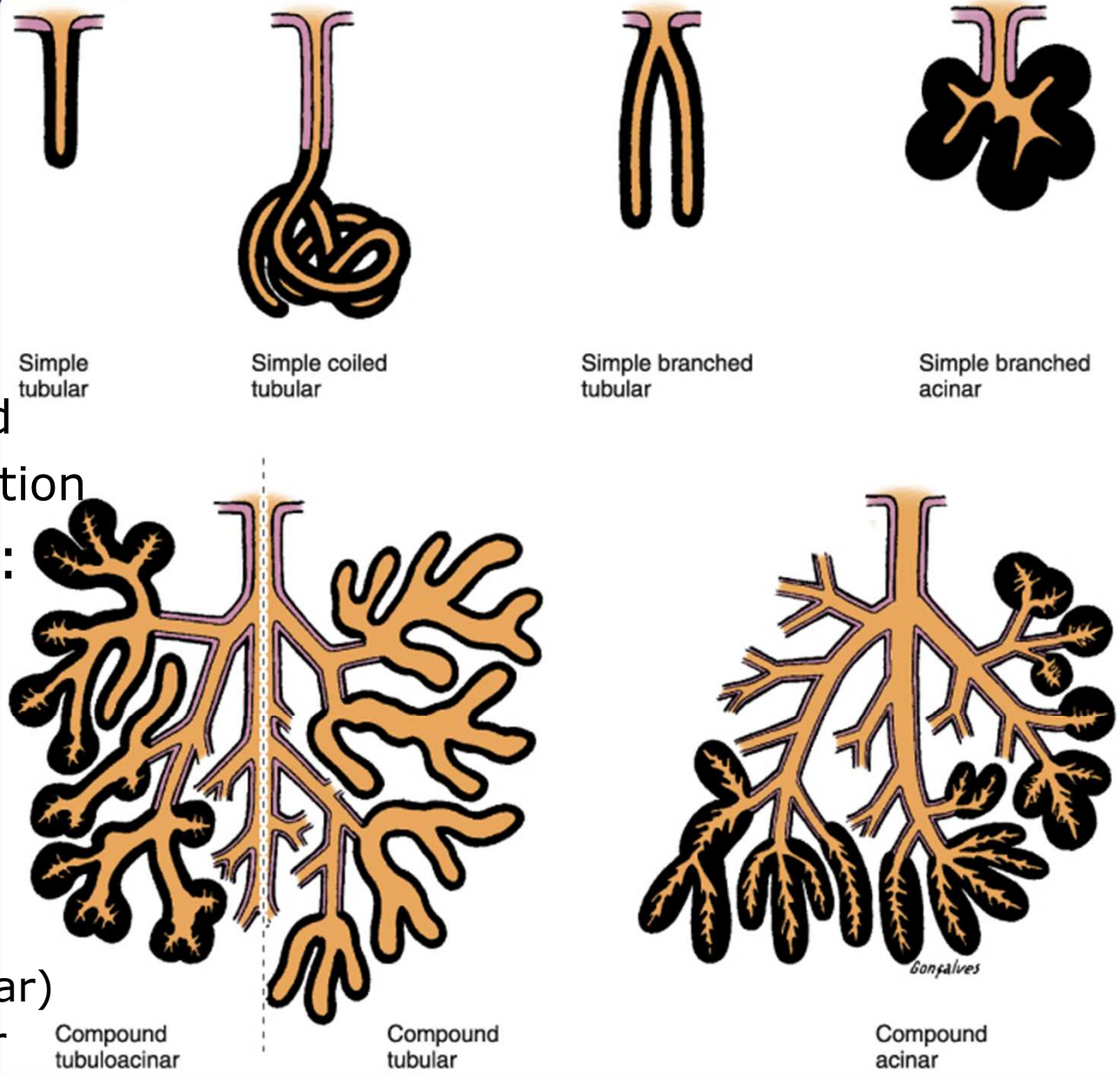
Exocrine glands

- General composition:
  - ✓ secretory portion
  - ✓ ducts
- Some exocrine glands:
  - ✓ salivary glands
  - ✓ exocrine pancreas
  - ✓ prostate
  - ✓ sebaceous and sweat glands
  - ✓ mammary glands etc.



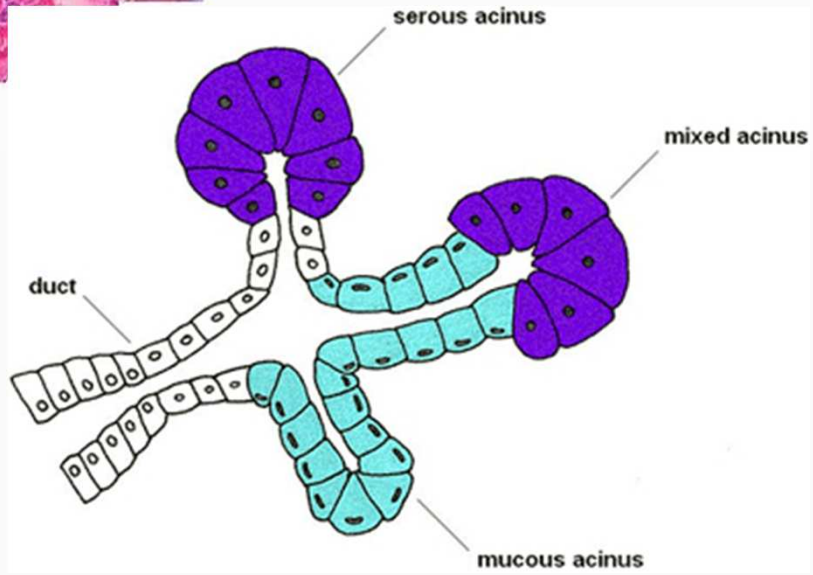
Principal types of exocrine glands

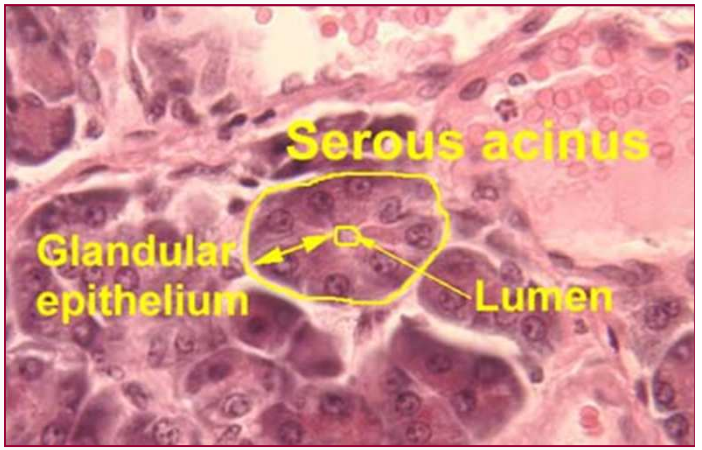
- Many ways of classifying:
  - ✓ structure
  - ✓ product secreted
  - ✓ method of secretion
- Structural types:
  - ✓ simple (unbranched)
    - ➢ tubular
    - ➢ acinar
  - ✓ compound (branched)
    - ➢ tubular
    - ➢ acinar (alveolar)
    - ➢ tubuloalveolar

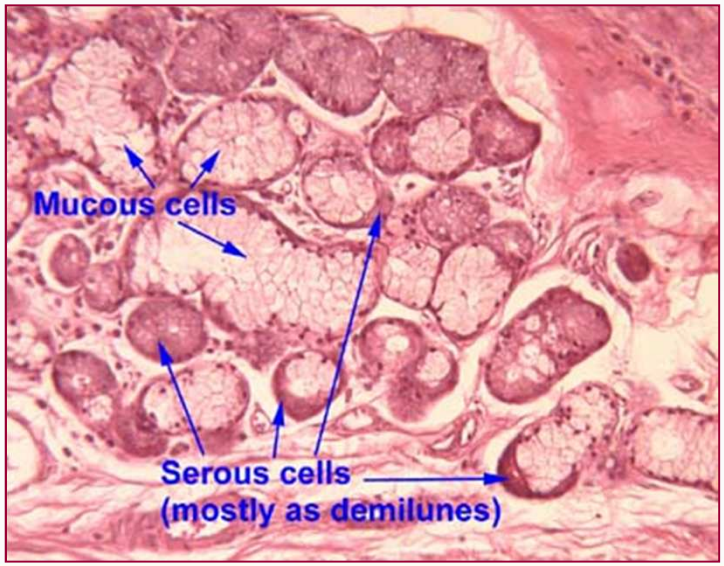


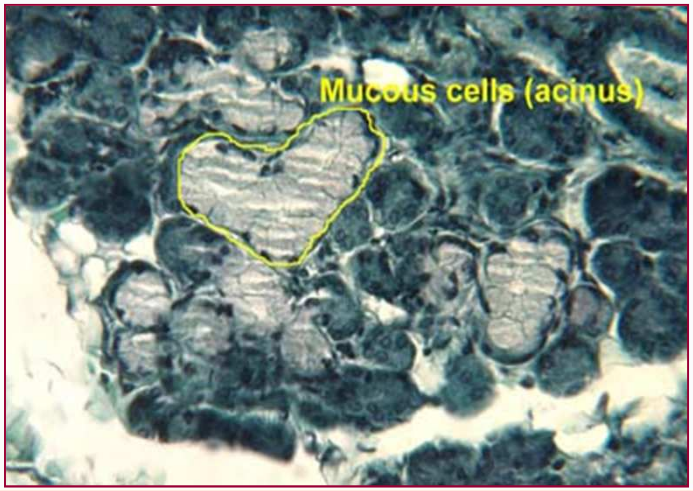
Exocrine glands – types

- Exocrine glands – product secreted:
  - ✓ serous (*glandula serosa*)
  - ✓ mucous (*glandula mucosa*)
  - ✓ mixed (*glandula seromucosa*)



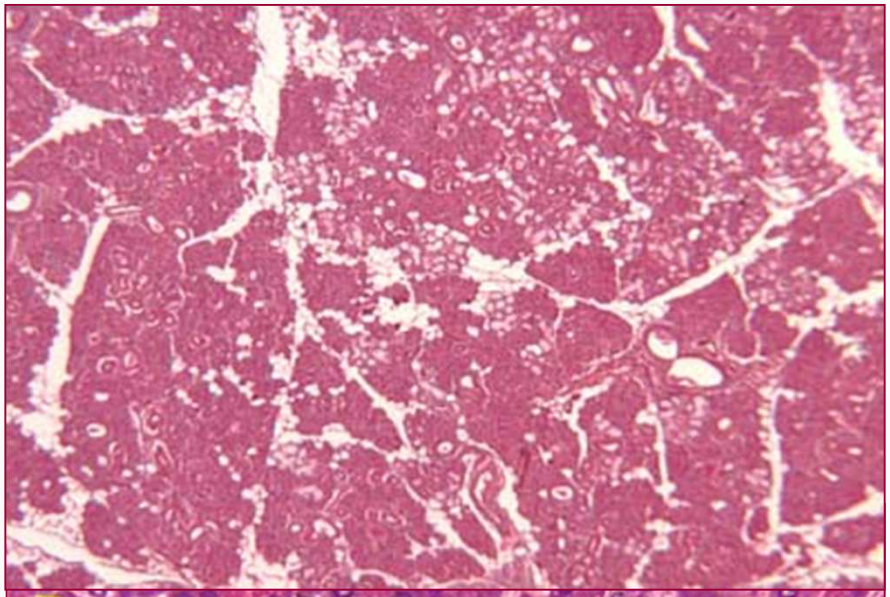


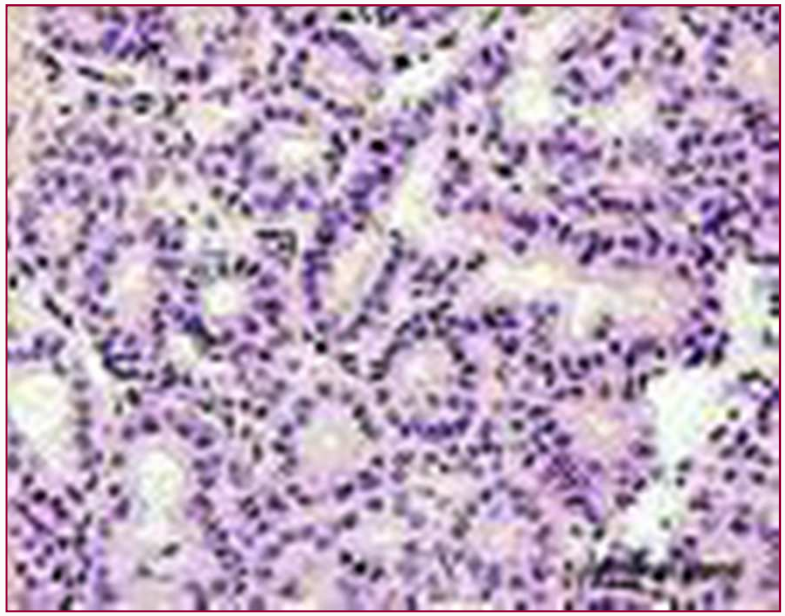


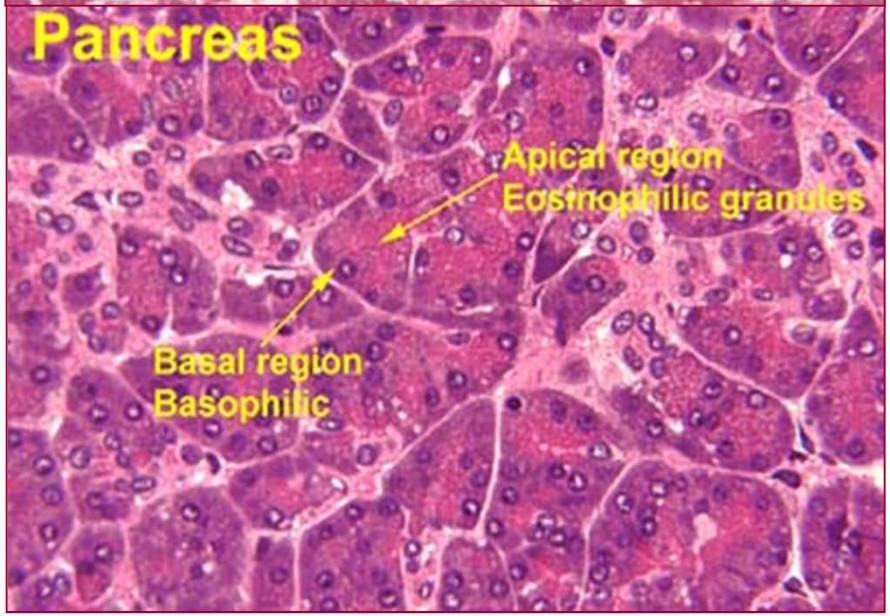


Serous glands

- Serous glands – examples:
  - ✓ parotid gland
  - ✓ lacrimal gland
  - ✓ exocrine pancreas
- Serous cells:
  - ✓ arranged in acini
  - ✓ produce a watery material, isotonic with blood plasma

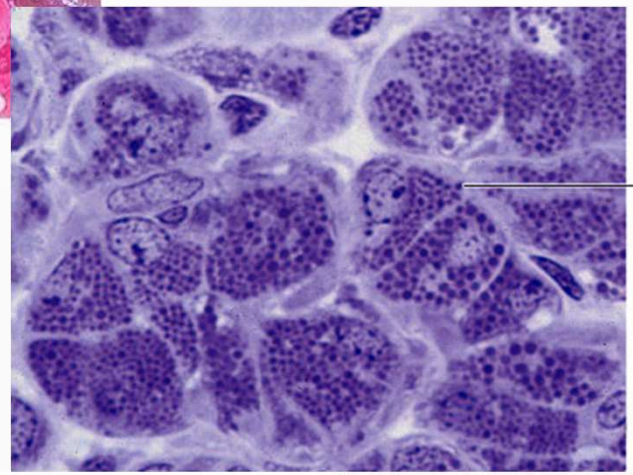


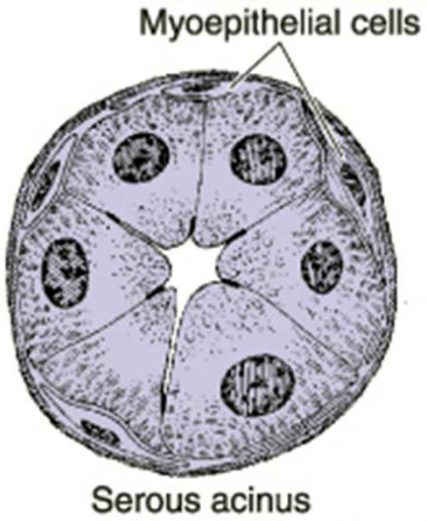


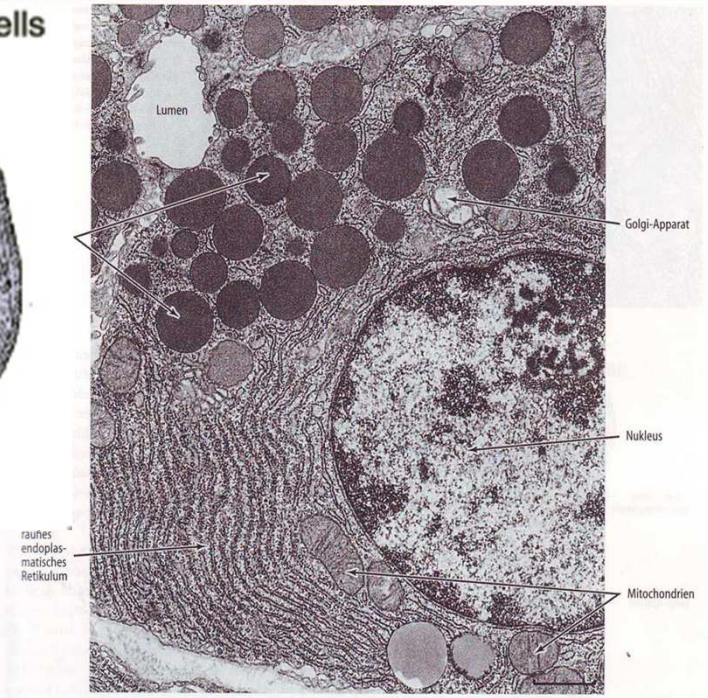


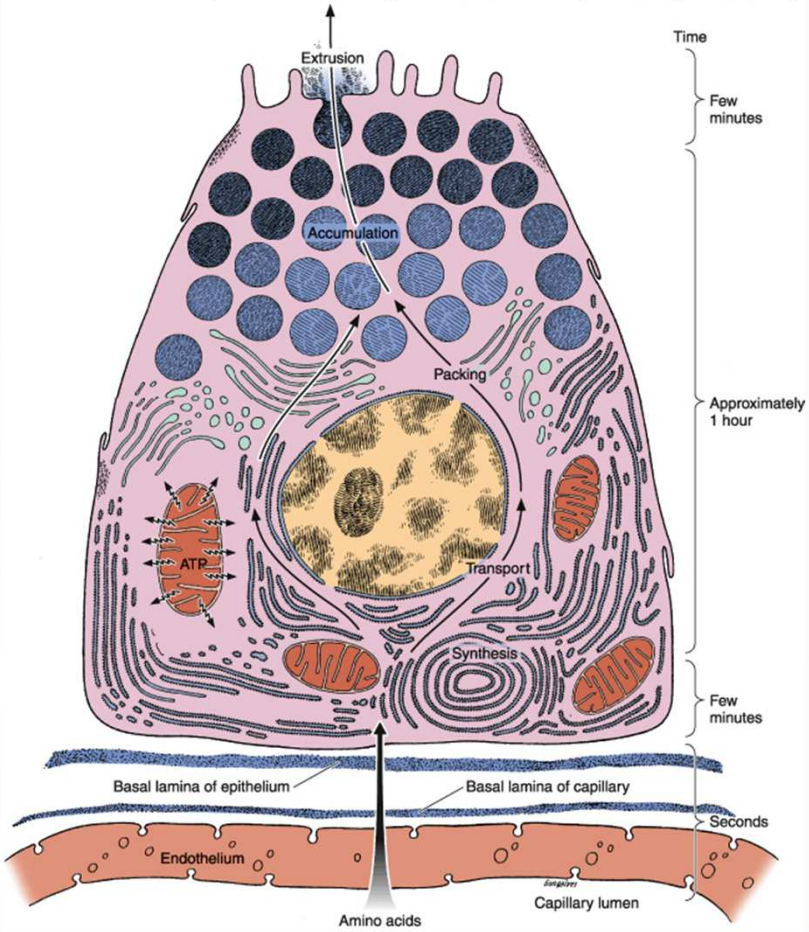
Serous acinus

- ✓a spherical mass of cells (serocytes):
  - ➢ with a small lumen in the center
  - ➢ polarized, pyramidal in shape cells
    - containing zymogen granules
    - secrete a fluid, rich in proteins (enzymes)





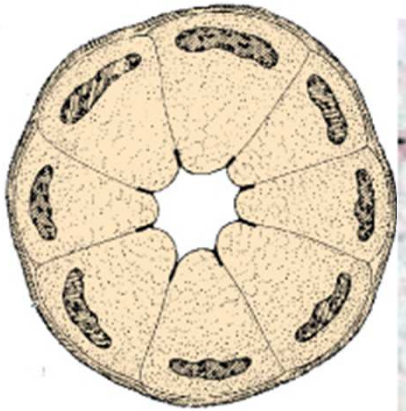




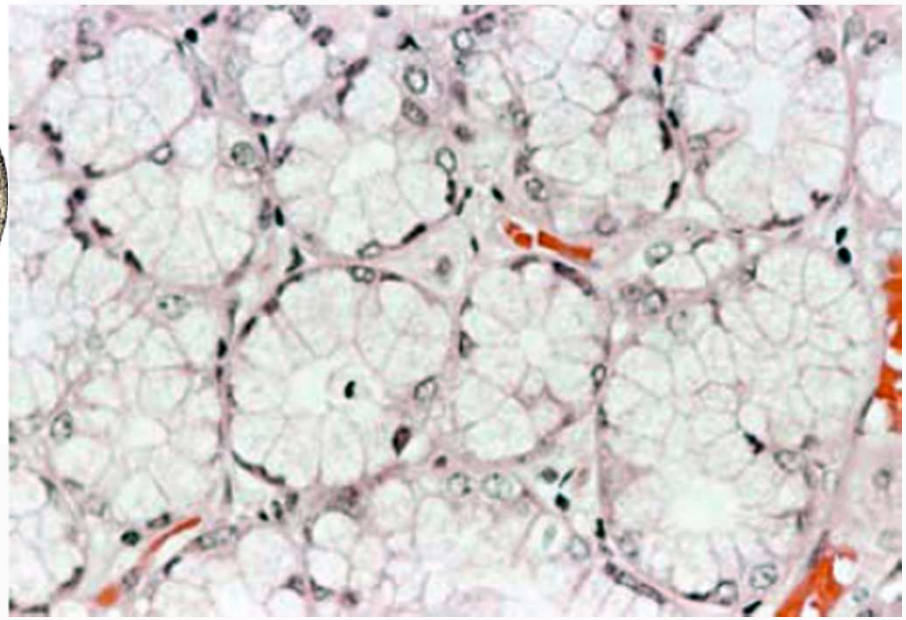
Mucous acinus

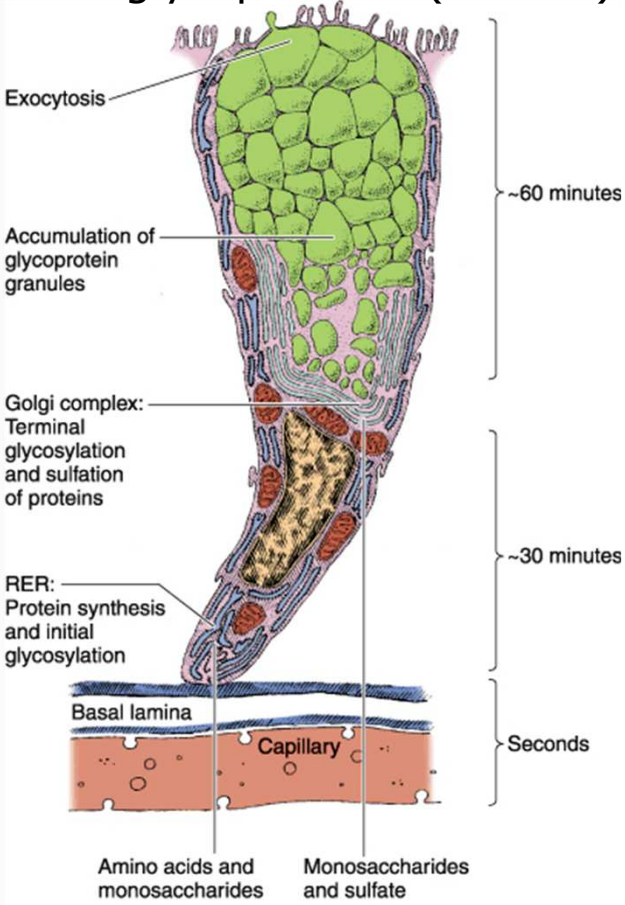
- ✓a spherical mass of cells (mucocytes):
  - ➢with a larger lumen in the center
  - ➢cuboidal to columnar in shape cells, organized as tubules
    - containing PAS-positive mucous material
    - produce a viscous lubricating gel, rich in glycoproteins (mucins)

- Mucous glands – examples:
  - ✓ labial and buccal glands
  - ✓ esophageal and pyloric glangs
  - ✓ Brunner's duodenal glands



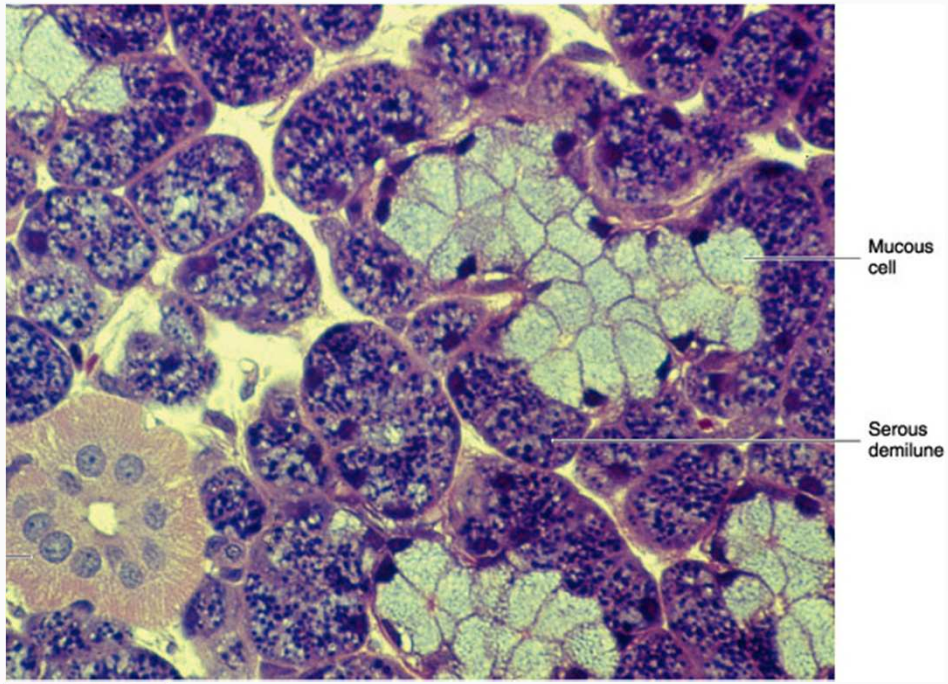
Mucous tubule

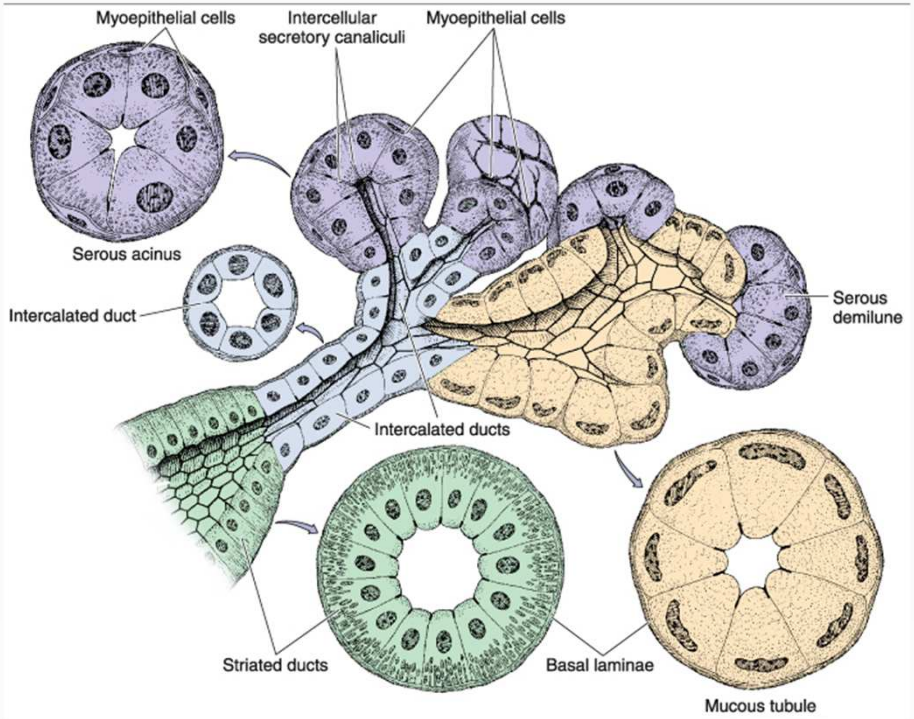




Mixed acinus

- ✓a spherical mass of cells:
  - ➢with a large number of mucous cells forming tubules
  - ➢relatively fewer serous cells, constituting serous demilunes (of *Gianuzzi* or *Heidenhein*)
  - ➢myoepithelial cells surround each secretory portion



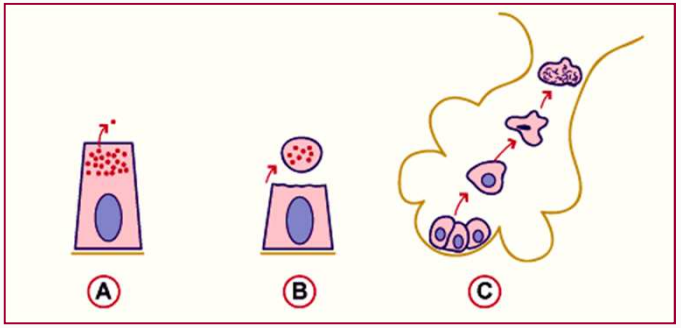


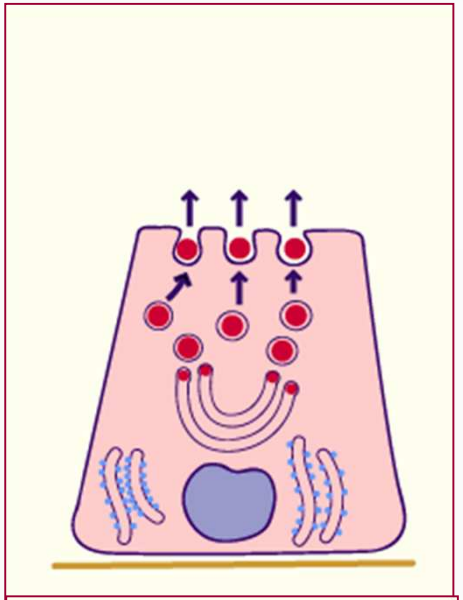
- Mixed glands – examples:
  - ✓ most salivary glands
  - ✓ anterior lingual glands

Types of glandular exocrine secretions

- Exocrine glands

– method of secretion:





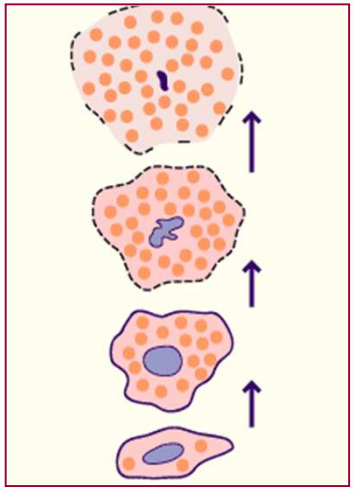
✓merocrine (eccrine) glands – exocytosis:

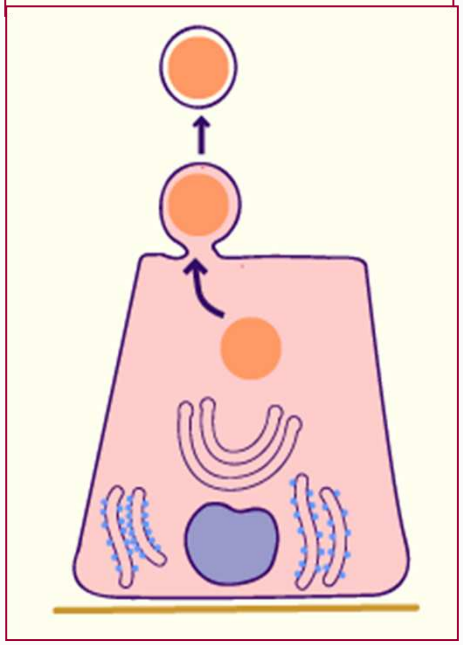
Gr. *meros,* part + *krinein,* to separate

- ➢most of the exocrine glands (eg, the pancreas)
- ➢some endocrine glands

✓apocrine glands: Gr. *apo,* away from + *krinein*

- ➢aromatic glands
- ➢large sweat glands
- ➢mammary glands





✓holocrine glands:

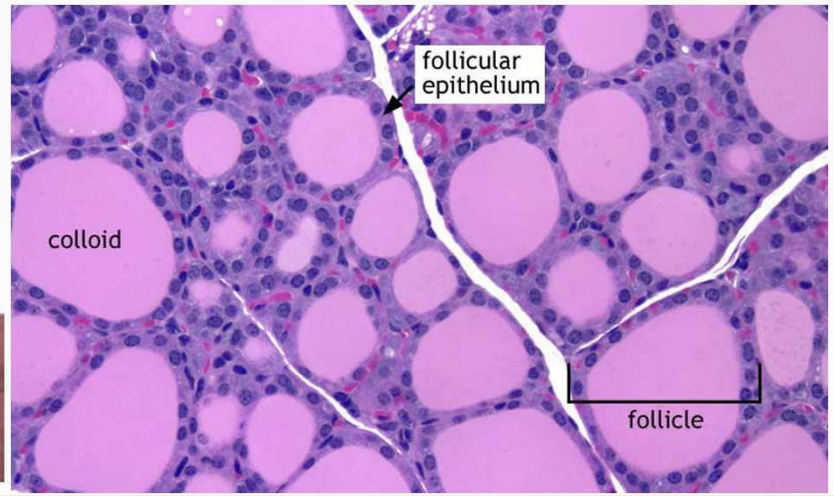
Gr. *holos*, whole + *krinein*

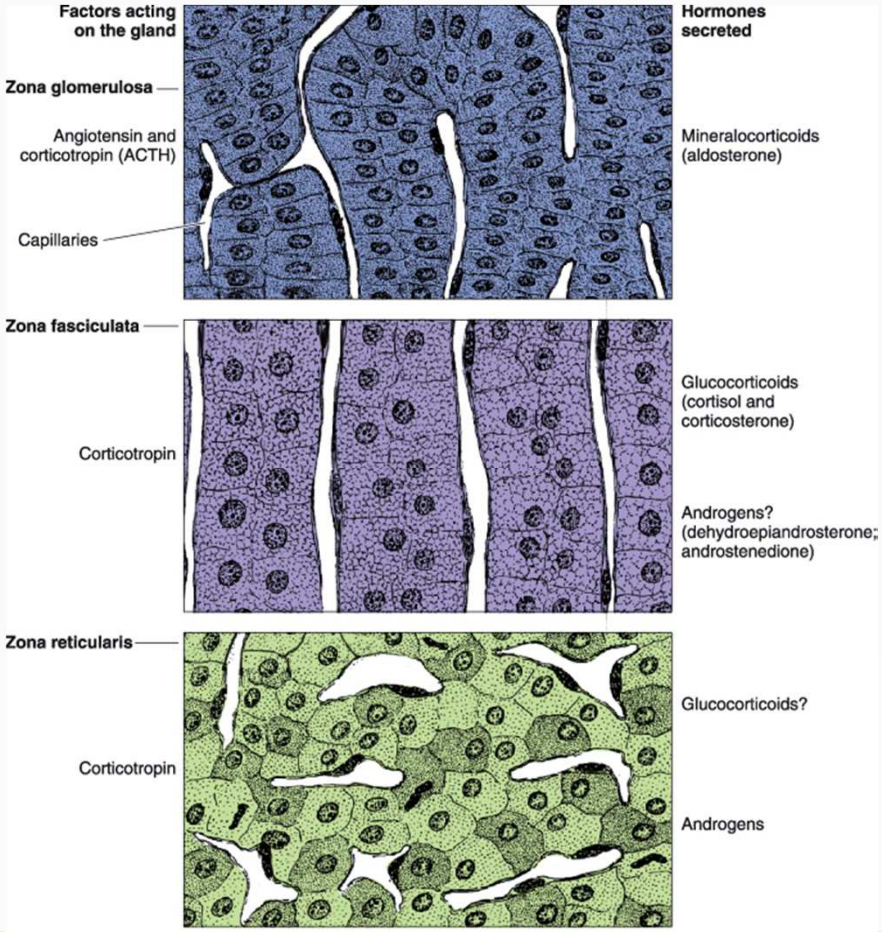
- ➢sebaceous glands in the skin
- ➢tarsal (Meibomian) glands

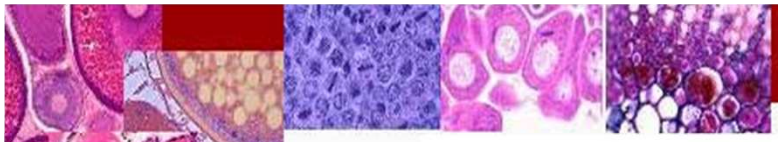
Endocrine glands

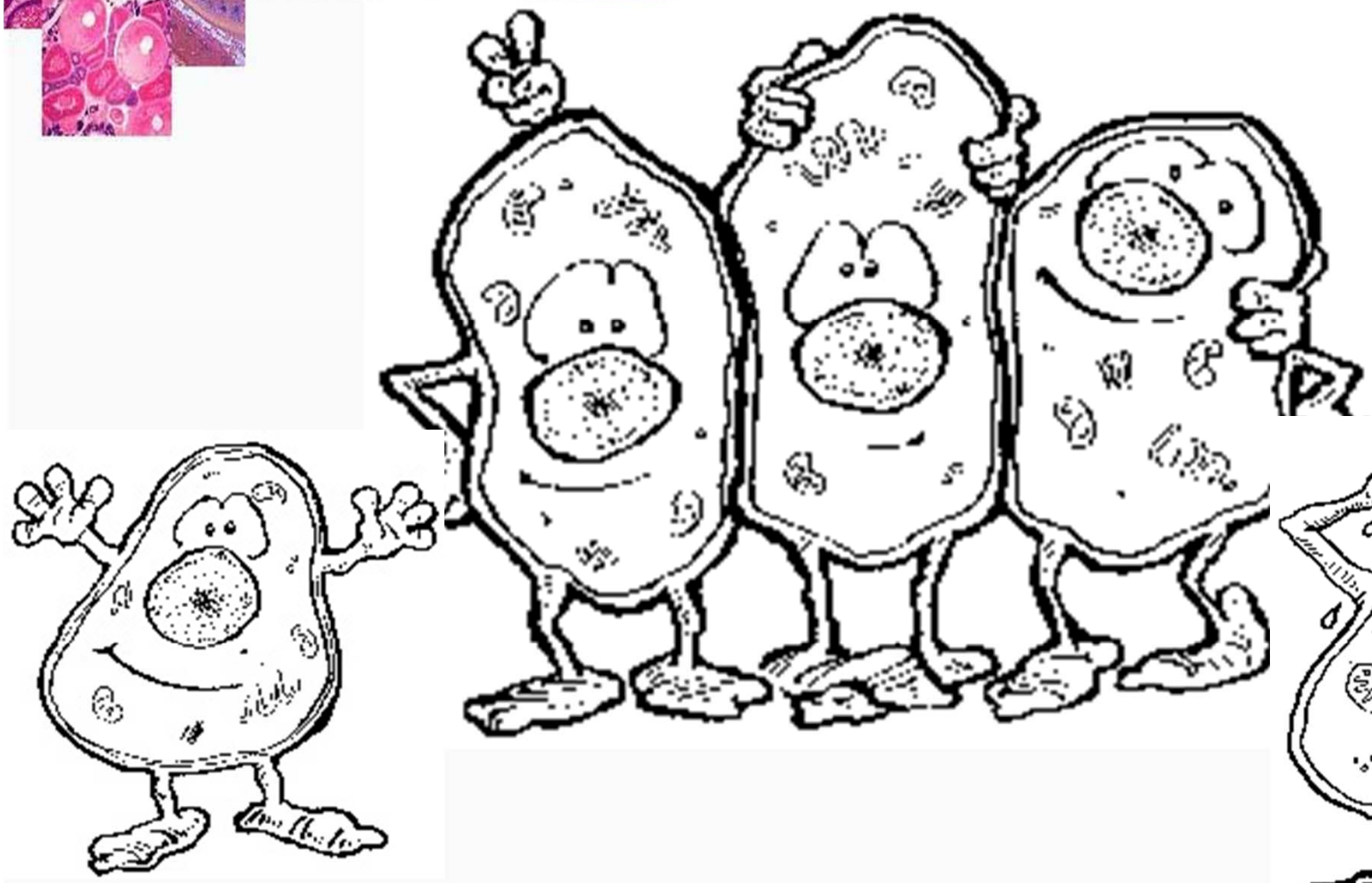
- Endocrine glands:
  - ✓ secrete their products, hormones, directly into the blood
  - ✓ ductless

- Endocrine glands – types:
  - ✓ endocrine cells may form anastomosing cords
    - ➢ anterior lobe of the pituitary
    - ➢ parathyroid gland
    - ➢ adrenal gland
  - ✓ endocrine cells may arrange as vesicles or follicles
    - ➢ thyroid gland









Thank you …