AGA 2110

LECTURE 3 – TISSUES

EPITHELIAL TISSUE

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LEARNING OUTCOMES

❑ Leaning outcomes

Students should know:

i. Definition of a tissue
ii. The 4 basic types of tissues
iii. Location of the 4 tissues and their general functions

TERMINOLOGY

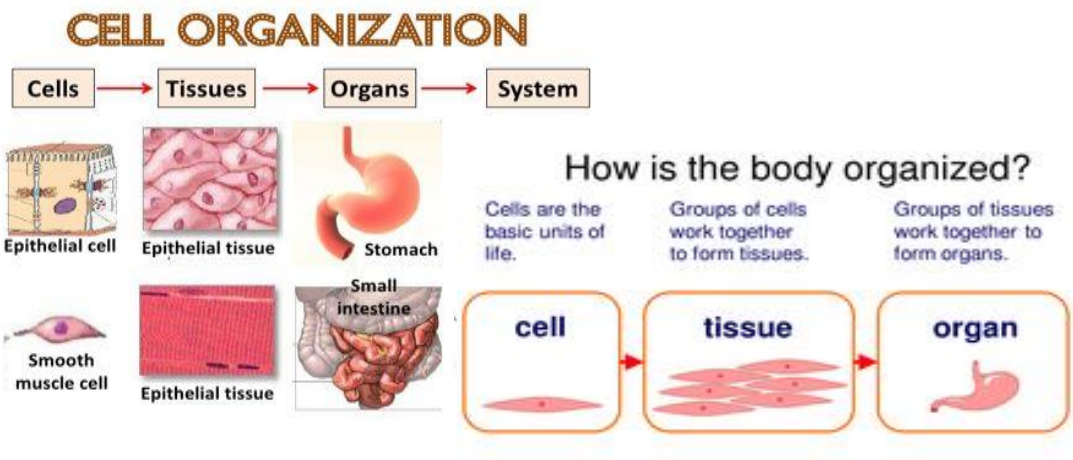
KEY TERMS

- Viscera – general term for internal organs of the abdomen and thorax
- Cilia - Fine hair like structures on luminal surface of cells which propel mucus & fluid across luminal surface of cell in one direction
- Avascular – lacking blood vessels
- Vascular – containing blood vessels
- Basement membrane - extracellular layer that anchors epithelial tissue to surrounding tissue
- Membranes - are sheets of epithelial & connective tissues that serve as organ coverings & cavity linings.

LEVELS OF ORGANISATION OF AN ANIMAL'S BODY

- **Cell** – A functional unit of an animal
- **Tissue** –Tissues are groups (sheets) of similar cells that have a common function.
- **Organs** - structures made up of two or more tissues organized to carry out a particular function eg kidney, liver
- **Organ system** – A number of organs that work together to accomplish a common purpose. Eg digestive system, respiratory system

ORGANISATION OF AN ANIMAL'S BODY



TISSUES - DEFINITION

A group of cells that are **similar** in **structure** and perform a **common** or **related function**.

- ❑ Different types of tissues can be found in different organs
- ❑ There are 4 basic types of tissues in the body

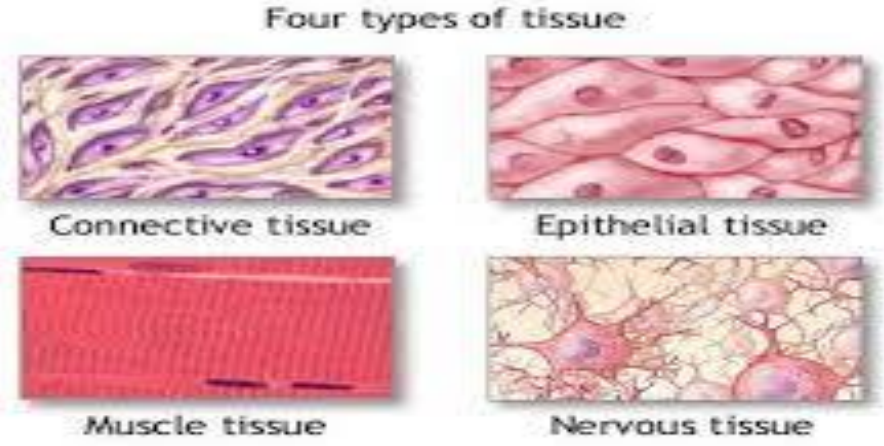
a) Epithelial tissue

b) Connective tissue

c) Muscle tissue

d) Nerve tissue

THE FOUR BASIC TYPES OF TISSUE



TISSUES - DEFINITION

❑ Each tissue has a characteristic role in the body.

a) **Epithelial tissue** - Lines body surfaces & body cavities & forms glands. Role is to secrete and absorb materials.

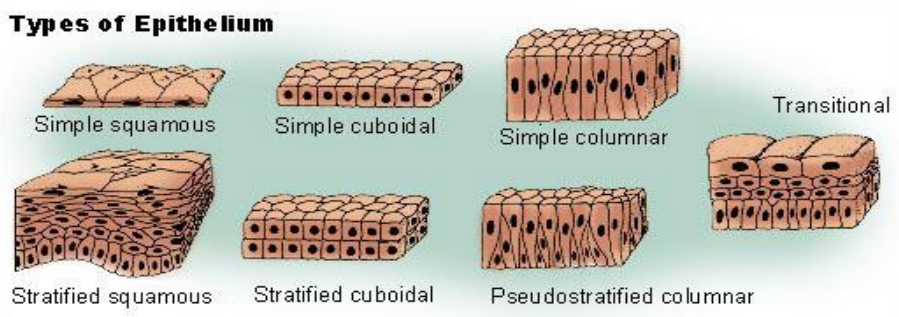
b) **Connective tissue** – Holds the body together & gives it support.

c) **Muscle tissue** – Provides movement

d) **Nerve tissue** – Completes work. Communication – transmits information around the body & controls body functions.

EPITHELIAL TISSUE

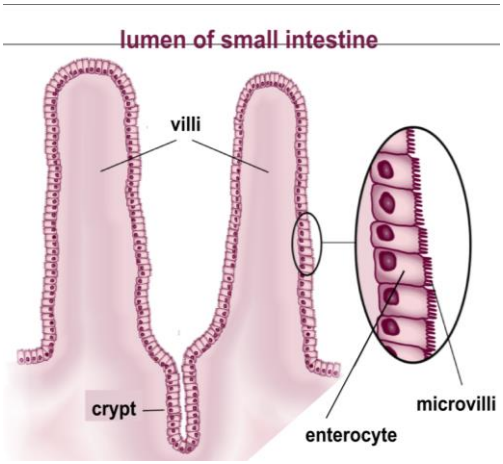
- Epithelial tissues - sheets of similar cells that cover body surfaces & line internal organs
- Consists almost entirely of cells as seen below

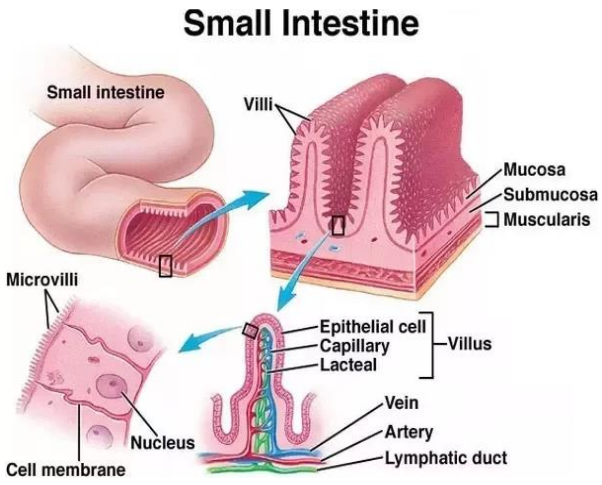


EPITHELIAL TISSUE

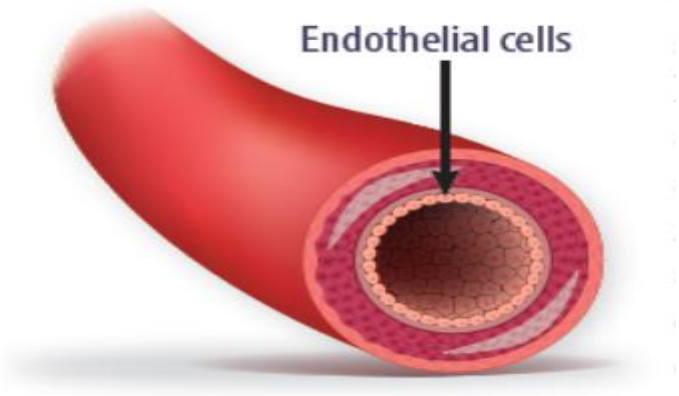
- where is epithelial tissue found?
- Covers the body surfaces, form lining of most internal cavities, lines hollow organs & forms glands
  - Outside surface of the body
  - Lining of digestive, respiratory & urogenital systems
  - Heart and blood vessels
  - Linings of many body cavities

LOCATION OF EPITHELIAL TISSUE IN THE BODY





Blood vessel endothelial cells



GENERAL FUNCTIONS OF EPITHELIAL TISSUE

i. Protect, cover & line underlying structures (tissues) – eg skin
ii. Absorb nutrients - Eg GIT
iii. Filter biochemical substances
iv. Secreting biochemical substances; e.g., pancreatic cells & goblet cells (mucus), mammary gland (milk).
v. Excretion biochemical substances – e.g sweat and urine
vi. Can detect changes in the environment & play an important role in the reception of sensory input

GENERAL CHARACTERISTIC OF EPITHELIUM

- Epithelial cells are organized into tightly packed groups that form sheets of tissue
- The sheets of tissue are composed of either a single layer or multiple layers of cells, depending on where they are located in the body.
- Although the size & shape of the cells vary, epithelia share certain common characteristics.

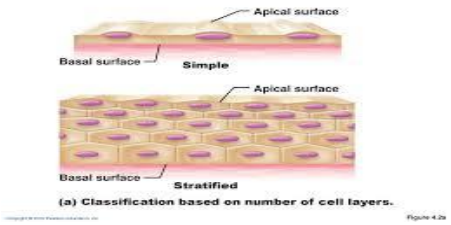
CHARACTERISTIC OF EPITHELIAL CELLS

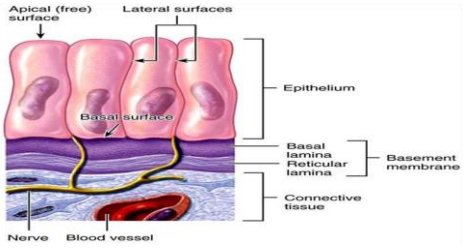
1. EPITHELIAL CELLS ARE POLAR

- ❑ They have a sense of direction relative to the surrounding
- ❑ They have 2 surfaces

a. **apical surface** - side of the cell that faces the lumen or body cavity

b. **basal surface** - side of the cell that faces the underlying connective tissue.

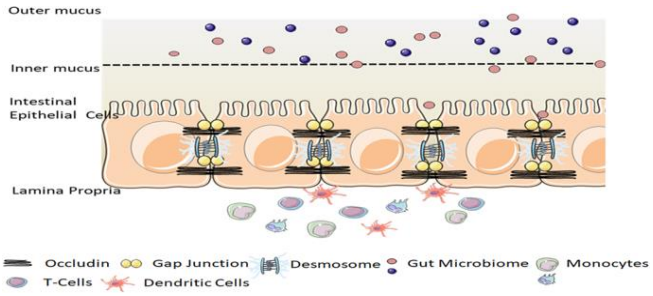




CHARACTERISTIC OF EPITHELIAL CELLS

2. Epithelial cells have lateral surfaces that are connected to neighbouring cells by junctional complexes

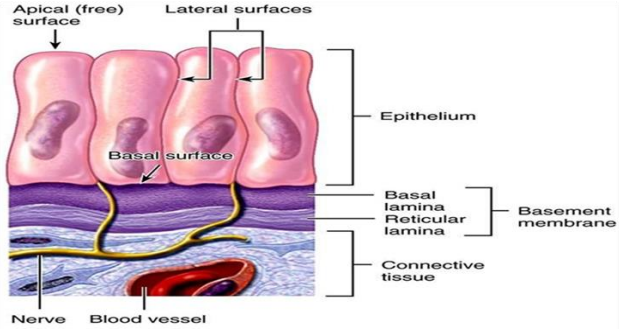
- ❑ cells lie in close apposition to one another, leaving little room for extracellular matrix



CHARACTERISTIC FEATURES OF EPITHELIAL CELLS

3. **All epithelial cells lack blood vessels or capillaries**.

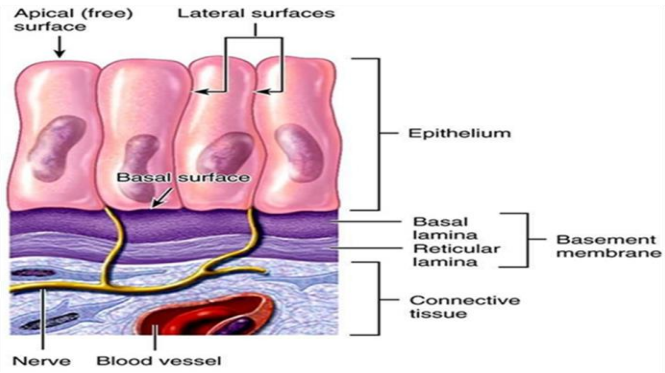
- ❑ They are avascular
- ❑ They rely on the underlying connective tissue to provide oxygen & nutrients.



CHARACTERISTIC FEATURES OF EPITHELIAL CELLS

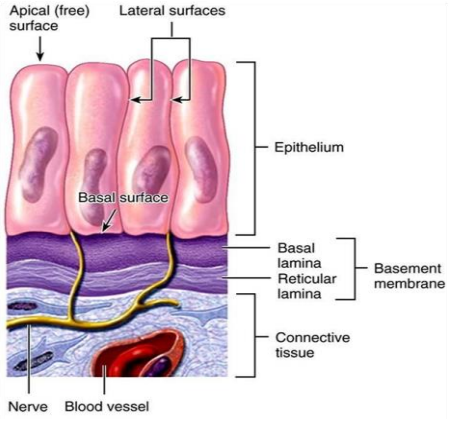
4. Most epithelial cells are innervated & provide valuable sensory input

- ❑ However, some epithelia lack nerves such as those in the;
  - stomach
  - intestines
  - cervix



SUMMARY CHARACTERISTICS OF EPITHELIAL CELLS

- ✓ Are avascular (no blood supply)
- ✓ Innervated
- ✓Have apical & basal surfaces
- ✓ lie in close apposition to one another hence have little or no extracellular matrix

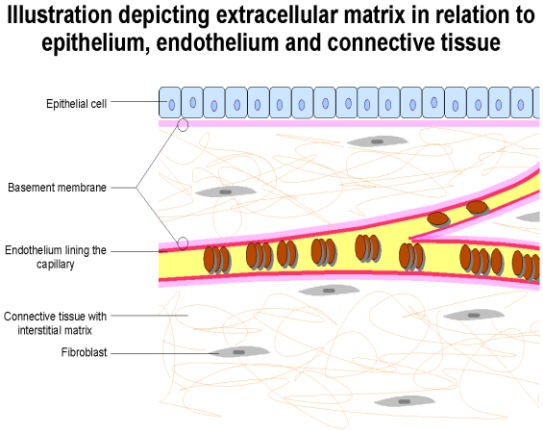


BASEMENT MEMBRANE

- ❑ It is the foundation of the epithelial cells.
- ❑ It is a non-living meshwork of fibers that cements the epithelial cell to the underlying connective tissue.
- ❑ It is manufactured & laid down by epithelial cells in varying degrees of thickness
- ❑ Oxygen & nutrient molecules needed by epithelial cells **diffuse** through the basement membrane from capillaries in the connective tissue
- ❑ Similarly waster materials from the cells diffuse across the BM into the underlying blood vessels in the connective tissue

RELATIONSHIP BETWEEN EPITHELIAL CELLLS, BASEMENT MEMBRANE & CONNECTIVE TISSUE

- Basement membrane a thin, delicate membrane of protein fibres and mucopolysaccharides separating an epithelium from underlying connective tissue.

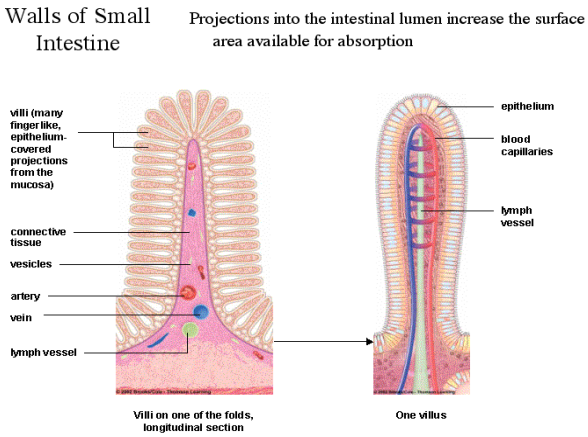


SURFACE SPECIALISATIONS OF EPITHELIAL CELLS

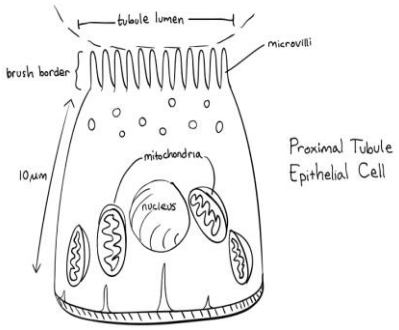
- Variations occur depending on
  i. location of epithelium in the body
  ii. Role of epithelium
- May have microvilli or cilia
- Surface of a cell covered with microvilli is called the **brush border**
- **Brush border –** increases surface area for absorption
- **Cillia –** propel mucus & debri from away from lungs

BRUSHBORDER

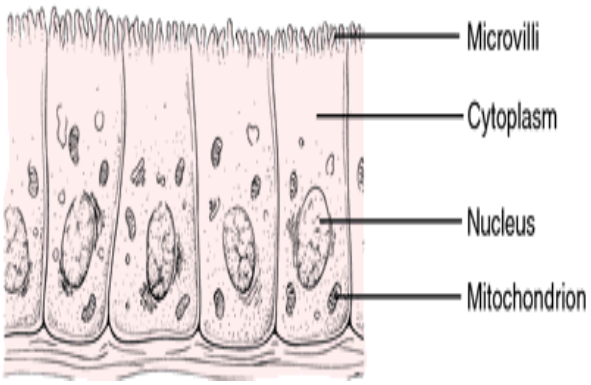
Composition of the villi

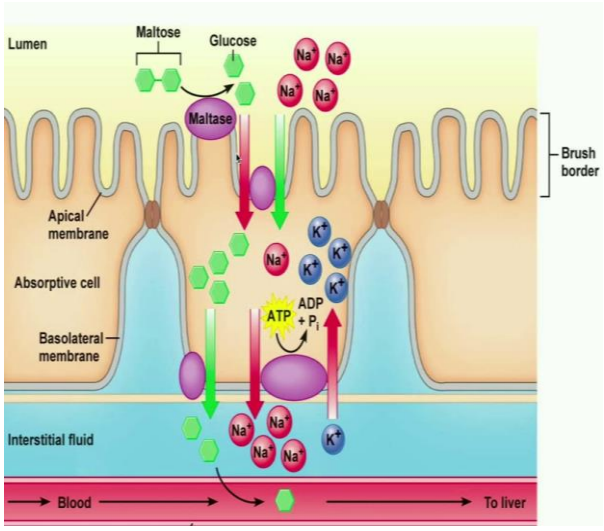


Cell with brush border

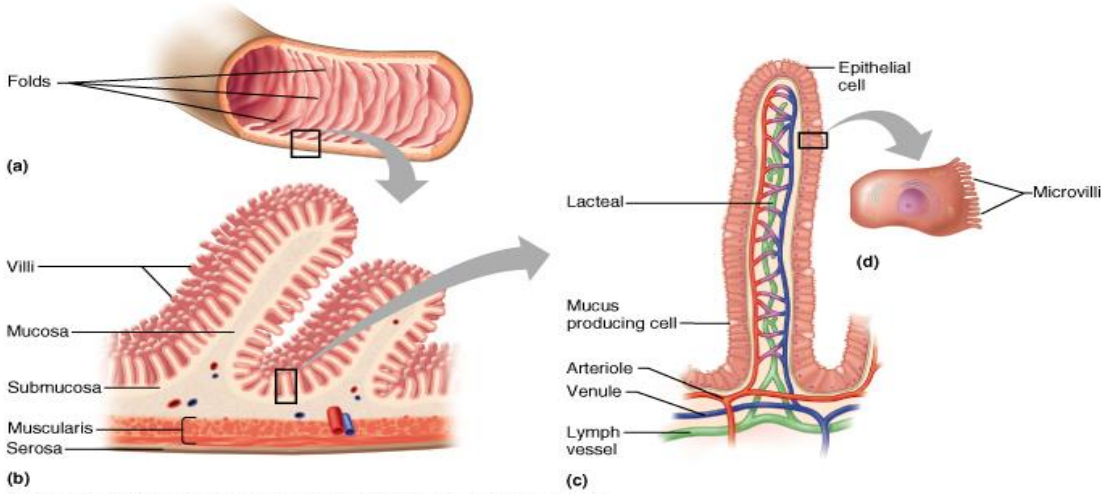


Brush border



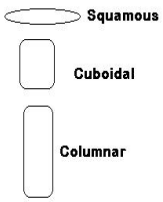


BRUSH BORDER



CLASSIFICATION OF EPITHELIAL TISSUE

- Epithelial tissue is classified according to the shape of the cells composing the tissue and by the number of cell layers present in the tissue.
- Cell shapes are classified as being either squamous (flattened and thin), cuboidal (equal sides), or columnar (rectangular, taller than it is wide).



CLASSIFICATION OF EPITHELIAL TISSUE

❑ Epithelial tissues are identified by

A. Shape of cells

B. Number of layers of cells

A. **NUMBER OF LAYERS OF CELLS**

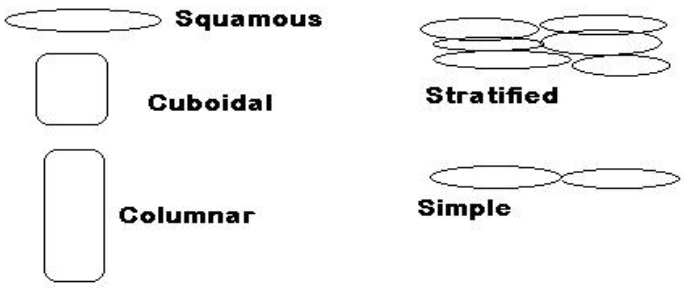
i. **Simple** – single layer of epithelial cells

ii. **Stratified** – 2 or more layers of epithelial cells

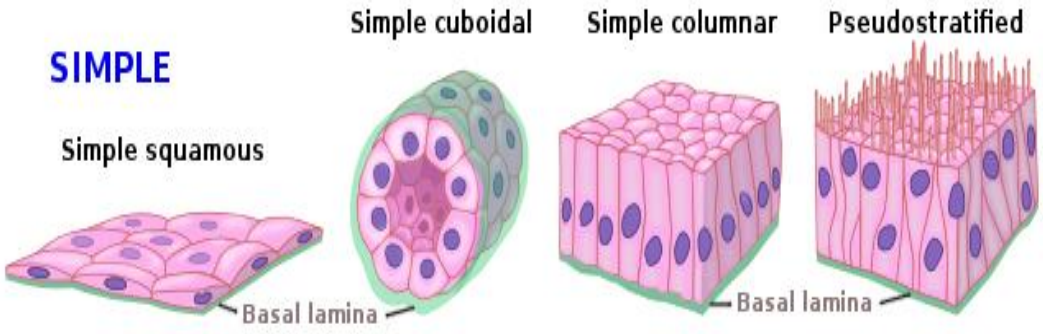
iii. **Pseudostratified** - appears to be stratified, but all cells contact basement membrane so it is in fact simple

pay attention to prefix or suffix as you study anatomy

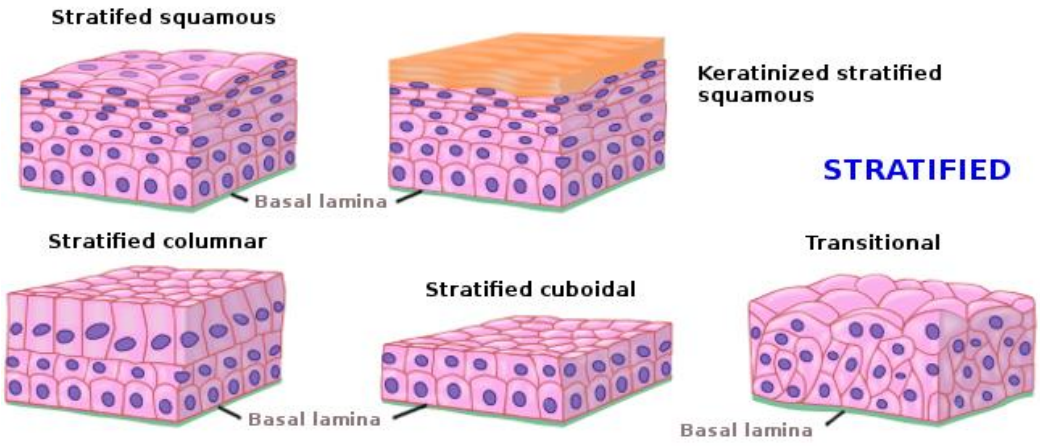
CELL SHAPES



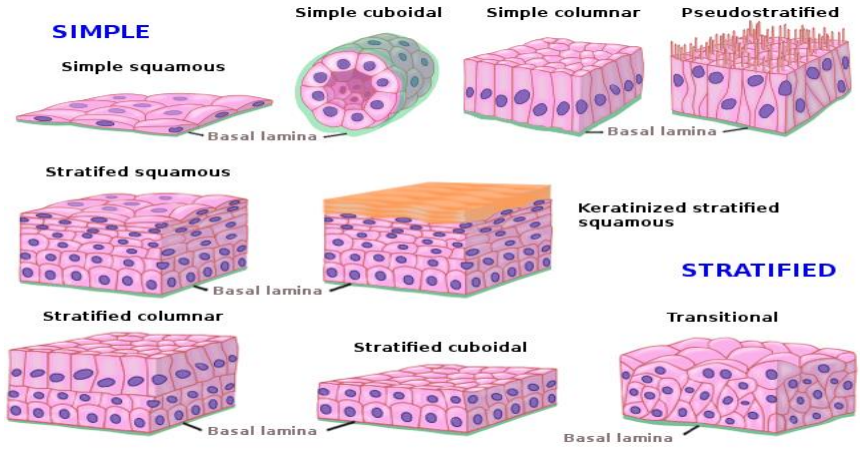
TYPES OF EPITHELIAL CELLS – SINGLE LAYER OF CELLS



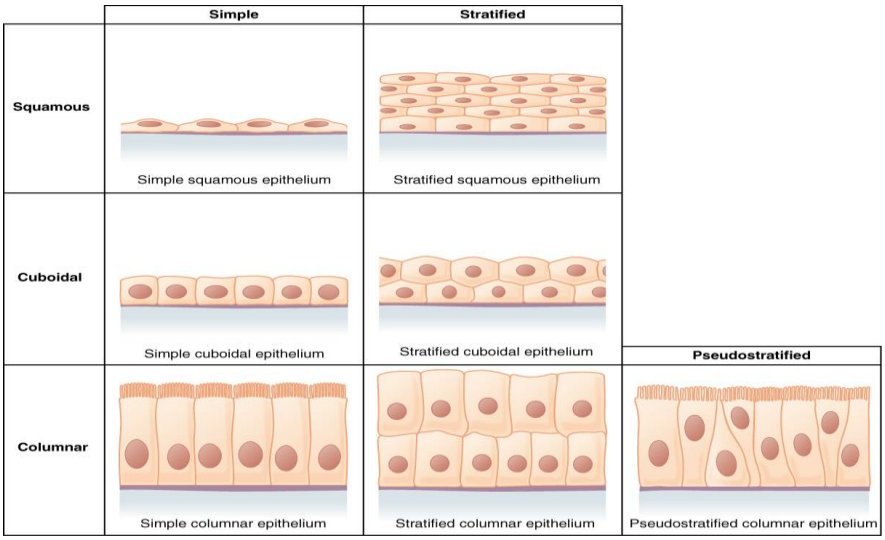
TYPES OF EPITHELIAL CELLS – 2 OR MORE LAYERS



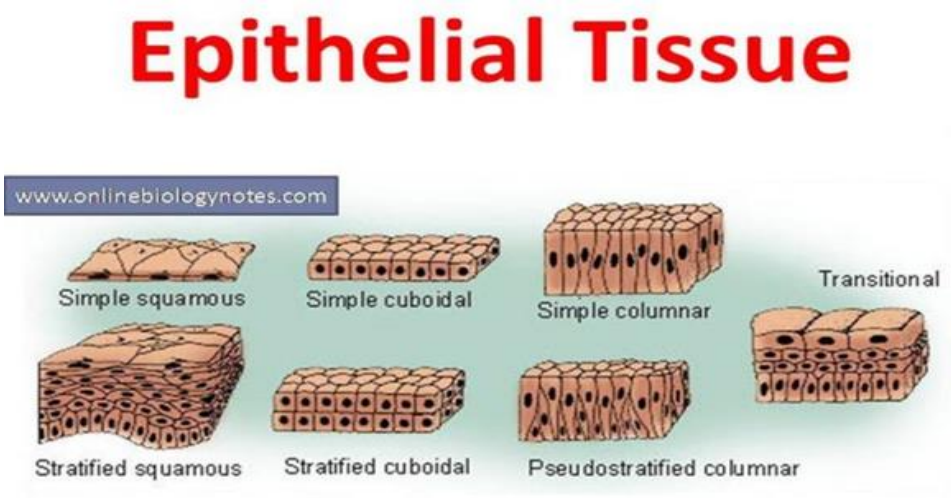
TYPES OF EPITHELIAL CELLS



CLASSIFICATION OF EPITHELIAL TISSUE BY NUMBER OF LAYERS OF CELLS



CLASSIFICATION OF EPITHELIAL TISSUE BY NUMBER OF LAYERS OF CELLS

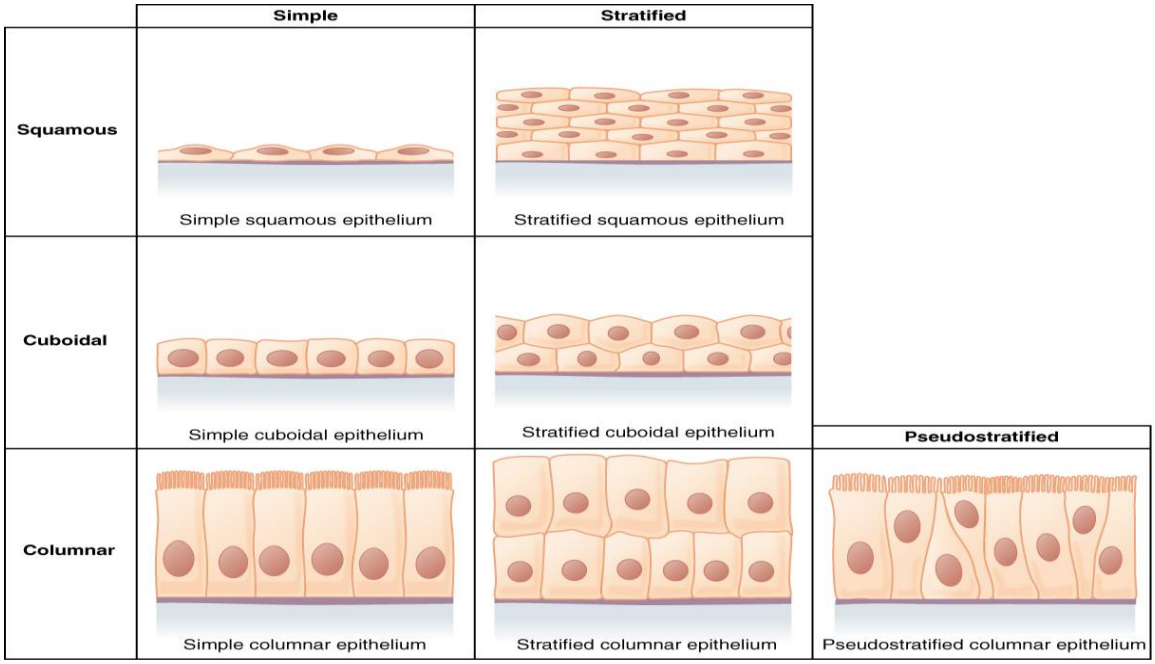


CLASSIFICATION OF EPITHELIAL TISSUE

B. **SHAPE OF CELLS**

- In cross section, epithelial cells may take on many shapes;

i. **Squamous** – flat, scale like
ii. **Cuboidal** - about equal in height and width
iii. **Columnar** - taller than wide



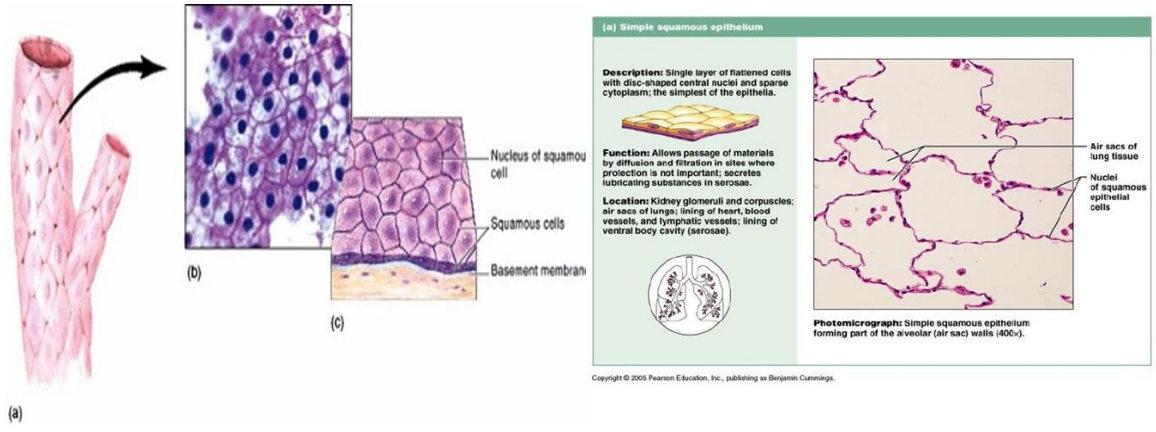
1. SIMPLE SQUAMOUS EPITHELIUM

- ❑ It is delicate & thin, give the appearance of thin scales
- ❑ The nuclei of the cells appear flat, horizontal, & elliptical
- ❑ The cells are elliptical, have single central nucleus & are arranged in a single layer.
- ❑ Epithelium is found lining surfaces involved in the passage of either gas or liquid eg alveoli & in the filtration membranes of kidneys.
- ❑ Also lines the chest (pleura) & abdominal cavities (peritoneum)
- ❑ Also lines blood and lymphatic vessels - special name is **endothelium**

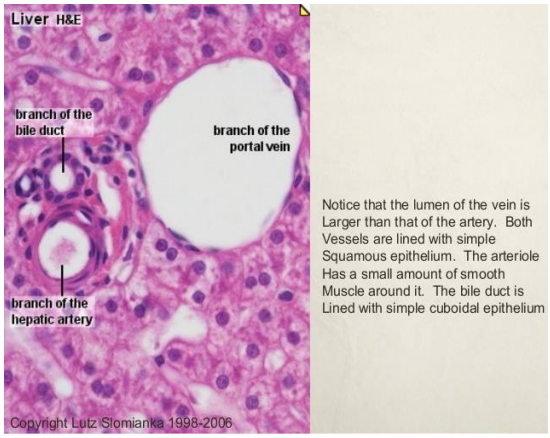
1. SIMPLE SQUAMOUS EPITHELIUM

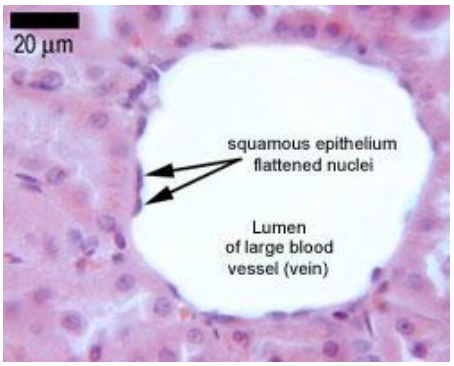
- Simple squamous epithelium, because of the thinness of the cells, is present where rapid passage of chemical compounds is necessary such as the lining of capillaries & the small air sacs of the lung.
- This epithelial type is also found composing the mesothelium which secretes serous fluid to lubricate the internal body cavities.

1. SIMPLE SQUAMOUS EPITHELIUM

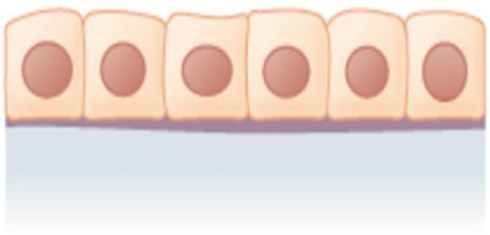


SIMPLE SQUAMOUS EPITHELIUM





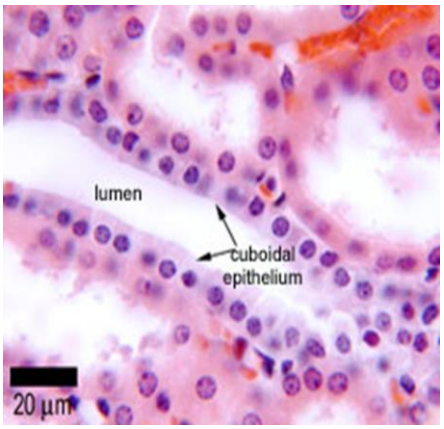
SIMPLE CUBOIDAL EPITHELIUM



- In ducts and secretory portions of small glands & in kidney tubules

SIMPLE CUBOIDAL EPITHELIUM

- ❑ Consists of a simple layer of cubic cells
- ❑ Has round, dark-staining nuclei seen to be aligned in a single row that resembles a string of pearls (beads)
- ❑ In the body epithelium is found where where secretion & absorption take place – ie in the glands and ducts. Examples aré;
- ✓ Thyroid and salivary glands
- ✓ Hepatic ducts



SIMPLE CUBOIDAL EPITHELIUM

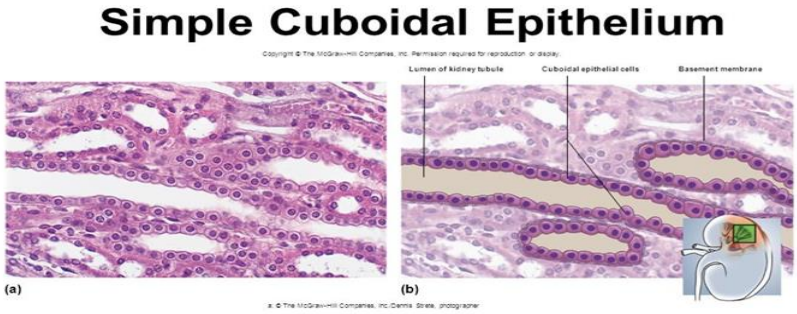


Figure 5.5a Figure 5.5b,i

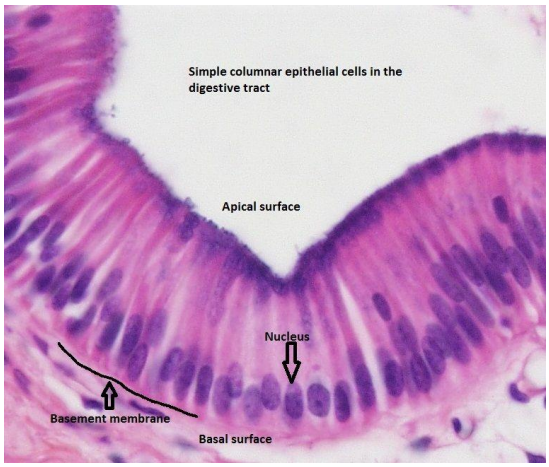
- single layer of square or round cells
- absorption and secretion, mucus production and movement
- liver, thyroid, mammary and salivary glands, bronchioles, and kidney tubules

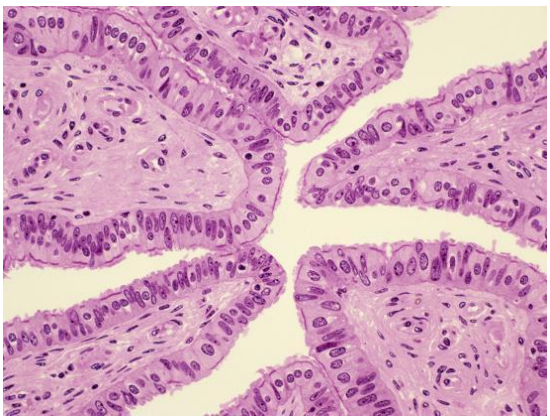
5-16

SIMPLE COLUMNAR EPITHELIUM

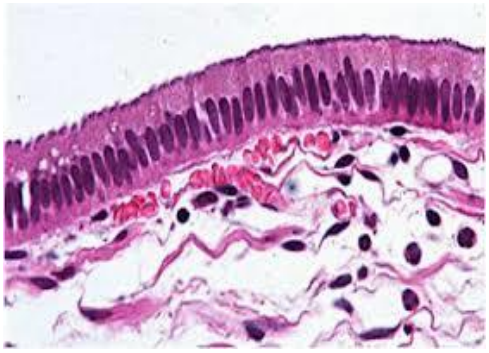
- ❑ Cells are elongated & closely packed together
- ❑ The nuclei are not centrally located like in cuboidal cells, but rather are aligned in a row at the base of the cell near the basement membrane
- ❑ Epithelia lines the length of the gastrointestinal tract from stomach to the rectum
- ❑ Epithelium is associated with absorption & secretion & is found in many excretory ducts, as well as in the digestive tract.
- ❑ In the GIT, apical surface of the epithelial cells has microvilli
- ❑The other cell is called a goblet cell because of its wineglass shape, secretes mucus

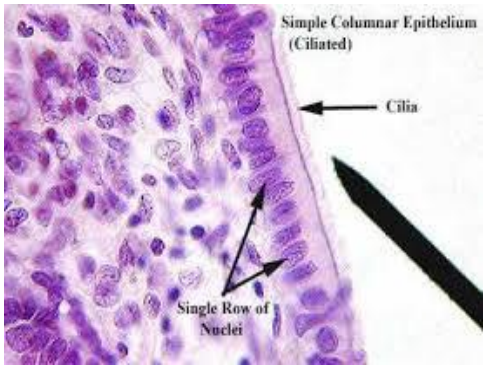
SIMPLE COLUMNAR EPITHELIUM

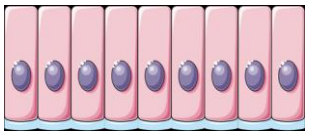




SIMPLE COLUMNAR EPITHELIUM







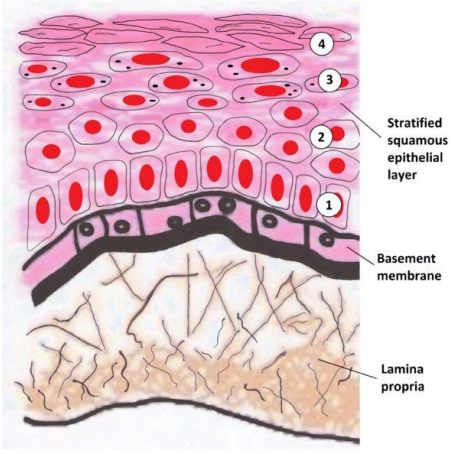
SIMPLE COLUMNAR EPITHELIUM WITH GOBLET CELLS

- ❑ Goblet cells are found scattered among the epithelial lining of organs, such as the intestinal and respiratory tracts
- ❑ The main role of goblet cells is to secrete mucus in order to protect the mucous membranes where they are found

STRATIFIED SQUAMOUS EPITHELIUM

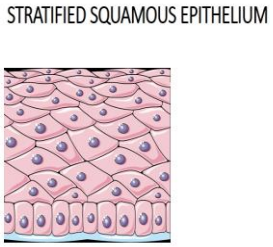
- consists of various cell layers
- It occurs in regions of the body that are subject to mechanical and chemical stresses eg **linings of the mouth**, **esophagus**, **vagina** & **rectum**
- The epithelial cells that make up the outer surface are continually being worn away or sheared off, but they are replaced at an equal rate by cells from deeper layers.
- Cuboidal cells form the base of stratified squamous epithelium.

STRATIFIED SQUAMOUS EPITHELIUM



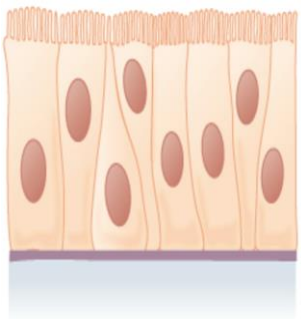
STRATIFIED SQUAMOUS EPITHELIUM

- Stratified epithelium has many different cell shapes are visible within the same tissue
- Classification is based on the shape of the cell that resides on the exposed or luminal surface of the tissue

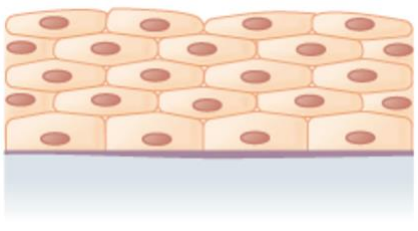


TYPES OF EPITHELIAL TISSUE

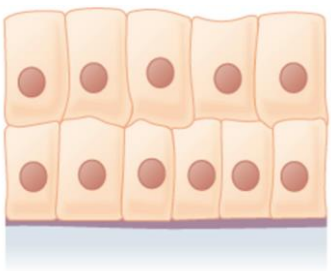
Pseudostratified columnar



Stratified squamous



Stratified columnar



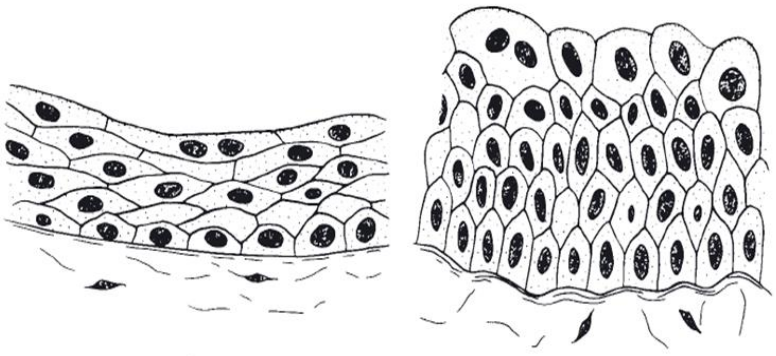
TRANSITIONAL EPITHELIUM

- Transitional epithelium describes a form of specialized stratified epithelium in which the shape of the cells, and the number of layers present, can vary depending on the degree of stretch within a tissue
- So called because of the gradual changes in the shapes and layering of the cells as the epithelium lining the expanding hollow organ is stretched.
- Transitional epithelium is found only in the urinary system, specifically the ureters & urinary bladder
- When the bladder is empty, this epithelium is convoluted and has cuboidal-shaped apical cells with convex, umbrella shaped, surfaces
- As the bladder fills with urine, this epithelium loses its convolutions and the apical cells transition in appearance from cuboidal to squamous.
- It appears thicker and more multi-layered when the bladder is empty, and more stretched out and less stratified when the bladder is full and distended.

TRANSITIONAL EPITHELIUM

- Bladder size varies with the amount of urine it can store
- Micturition is the term used for expulsion of urine from the bladder
- Micturition is a reflex action that is stimulated by stretch receptors in the bladder wall that respond to the increased size of the bladder.
- The transitional epithelial tissues that are found in the urinary bladder provide the bladder the ability to significantly stretch with increasing volumes of urine. The visceral muscle found in the walls of the bladder also give the bladder it ability to hold larger volumes of urine without bursting.
- Due to the elastic fibers found in the walls of the bladder, the cells of the walls are able to stretch and flatten to accommodate large volumes of urine as shown in **diagram A** .Because of the elastic natural of the wall, after undergoing compress the cells in the wall are able to go back to their original shape as shown in diagram B.

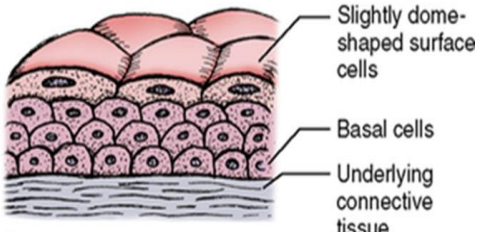
TRANSITIONAL EPITHELIUM



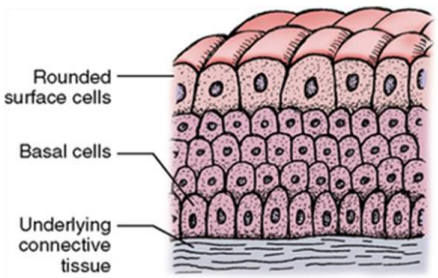
. Transitional epithelium. *A*) Bladder full, wall distended. *B*) Bladder empty, wall relaxed.

STRECHED(A) VS ORIGINAL SIZE BLADDER (B)

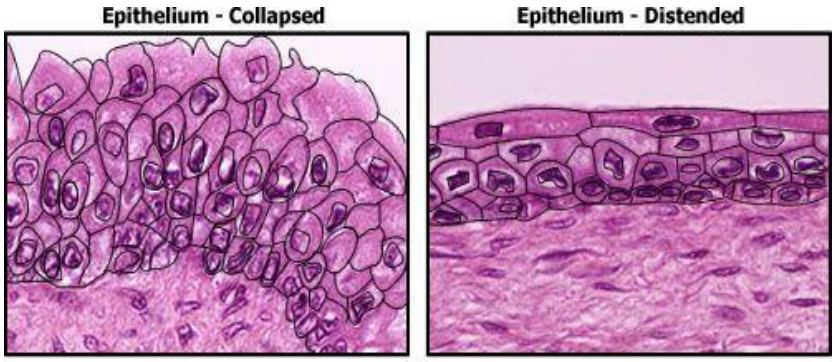
A



B



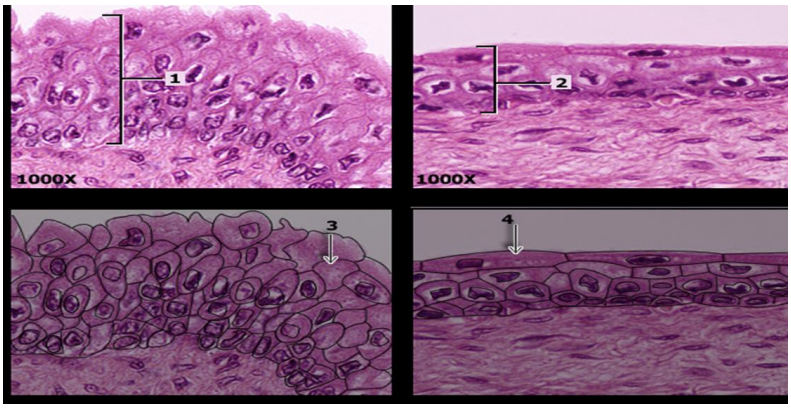
TRANSITIONAL EPITHELIUM



TRANSITIONAL EPITHELIUM

Relaxed bladder

Distended bladder



GLANDS

- ❑ Glands of the body are either

i. Exocrine

ii. Endocrine

- ❑ Both are secretory but difference exists

i. Exocrine glands – secrete outside the body, they have ducts to convey secretions to the surface of the body.

ii. Endocrine glands – secrete within the body, no ducts. Hence also called ductless glands.

EXOCRINE GLANDS

- ❑ Exocrine glands are glands that produce and secrete substances onto an epithelial surface by way of a duct.
- ❑ Examples of exocrine glands include sweat, salivary, mammary, lacrimal, sebaceous and mucous glands
- ❑ Exocrine glands are classified according to the method of secretion
- ❑ There are 3 types of exocrine glands named based on how their products are secreted.

1. **Merocrine glands**
2. **Apocrine glands**
3. **Holocrine glands**

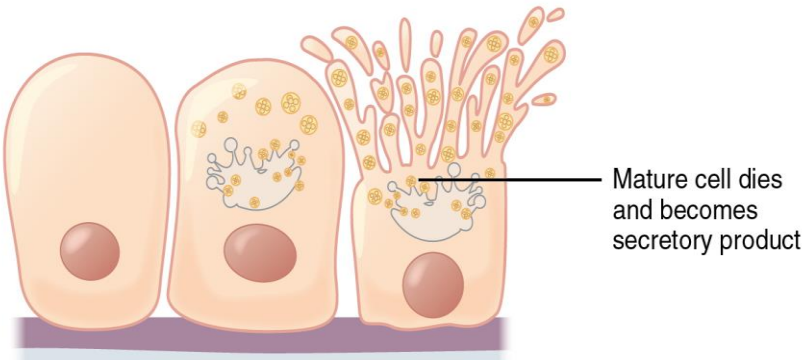
EXOCRINE GLANDS

1. **Merocrine secretion** – cells excrete their substances by exocytosis; for example, pancreatic acinar cells

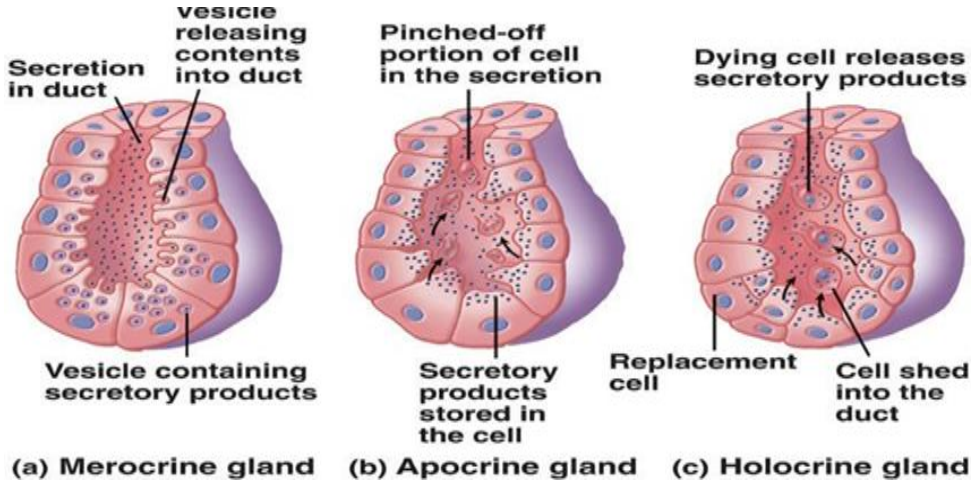
2. Apocrine secretion – a portion of the cell membrane that contains the excretion buds off

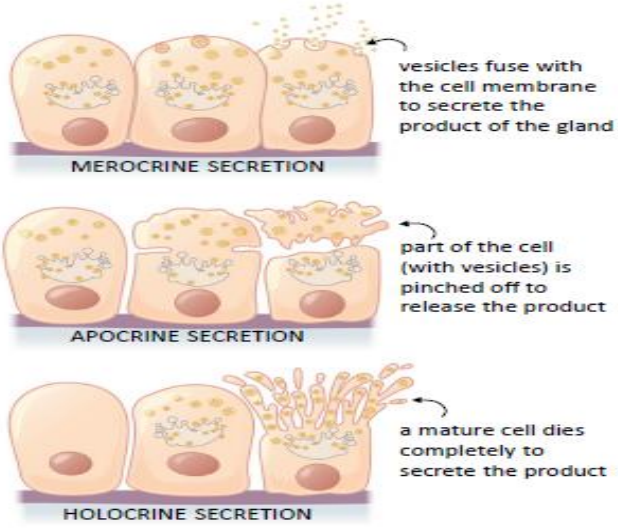
3. Holocrine secretion – the entire cell disintegrates to excrete its substance; for example, sebaceous glands of the skin and nose.

3. HOLOCRINE SECRETION



TYPES OF EXOCRINE GLANDS





GLANDS (Glandular Epithelium)

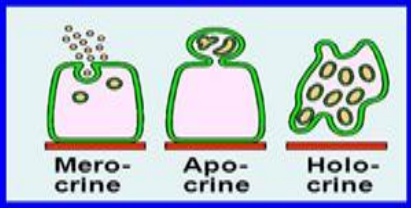
Classification:

3- **According to mode of secretion:**

a. **Merocrine**: No part of the cell is lost with the secretion, e.g. salivary glands.

b. **Apocrine**: The top of the cell is lost with the secretion, e.g. mammary gland.

c. **Holocrine**: The whole cell detaches with the secretion, e.g. sebaceous glands.



EPITHELIAL MEMBRANES

- An epithelial membrane a sheet of tissue that covers organs & lines cavities & also line or covers the skin
- A membrane – a selective barrier. It allows some things to pass through and stops others. Things like ions, molecules etc

Eg of membrane is cell membrane

- Epithelial membranes consist of a surface layer of epithelium and an underlying layer of connective tissue.

EPITHELIAL MEMBRANES

- 3 Types of epithelial membranes that are of importance in the body are;

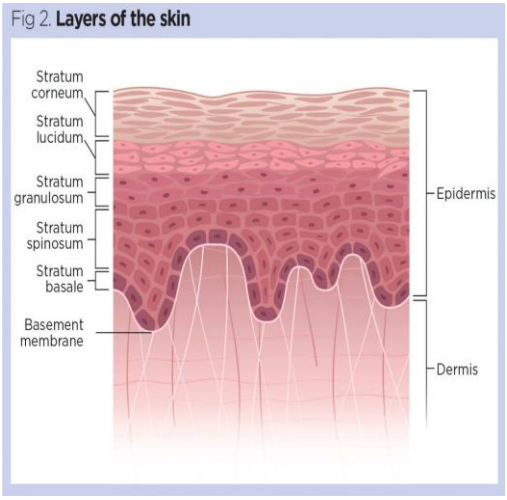
A. Cutaneous membrane (skin)
B. Mucous membranes (Mucosae)
C. Serous membranes (Serosae)
D. Synovial membrane (joints)

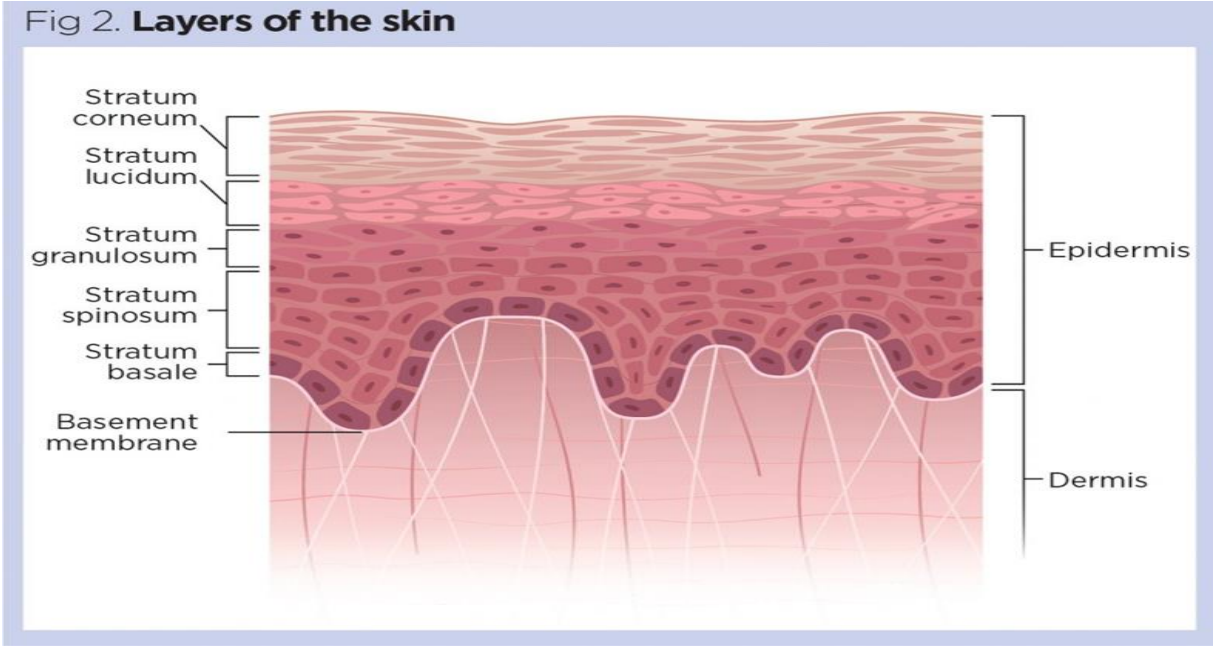
EPITHELIAL MEMBRANES

THE CUTANEOUS MEMBRANE

- also called The skin
- is the outer covering of the body, made up of sheets of stratified squamous epithelial tissue and connective tissue.
- Unlike the other two membrane types(serous and mucous), the apical surface of the epithelial layer is dry.
- The cutaneous membrane serves to protect the internal organs from pathogens such as bacteria and viruses & from environmental insults.

CUTANEOUS MEMBRANE



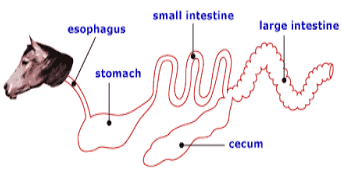


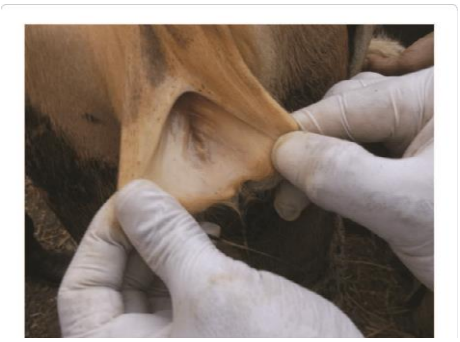
EPITHELIAL MEMBRANES

A. MUCOUS MEMBRANES

- ❑ Referred to as mucosae
- ❑ Line the hollow organs & cavities that open on directly to the external environment.
- ❑ These membranes line most of the organs of the digestive, respiratory, urinary & reproductive systems, parts of the eye & ear
- ❑ The surface epithelium may vary in type, but it is always kept moist by mucus.

AREAS WHERE MUCOUS MEMBRANE IS FOUND





EPITHELIAL MEMBRANES

B. MUCOUS MEMBRANES

- ❑ Many mucous membranes secrete mucus, used to trap foreign substances for removal and to lubricate and protect organs
- ❑ All mucous membrane secrete some fluids to provide a moist environment.
- ❑ Mucous membranes function in secretion, absorption, and protection

EPITHELIAL MEMBRANES

C. SEROUS MEMBRANES

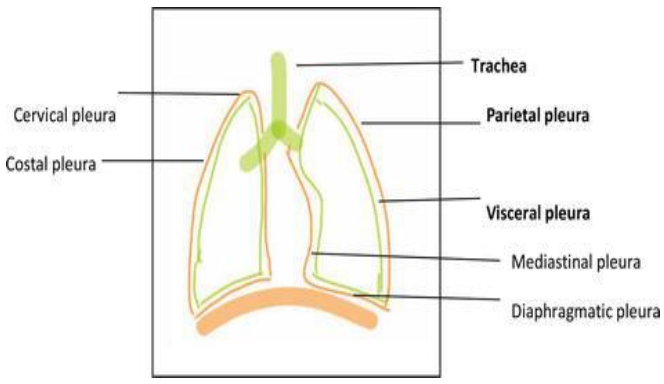
- ❑ line the body cavities that do not directly open to the outside eg thoracic and abdominal cavities & organs located in those cavities
- ❑ The surface epithelium is mesothelium over a thin layer of loose connective tissue.
- ❑ The mesothelium provides fluid that serves to moisten & lubricate.

• Examples of serous membranes are;

- Pleura (lining the thorax)
- pericardium (lining the heart)
- peritoneum (lining the abdomen)

LOCATION OF THE SEROUS MEMBRANE

LOCATION OF THE SEROUS MEMBRANE



D. SYNOVIAL MEMBRANE

- A synovial membrane is a type of connective tissue membrane that lines the cavity of a joint
- For example, synovial membranes surround the joints of the shoulder, elbow, and knee which form synovial fluid, a natural lubricant for the joints.