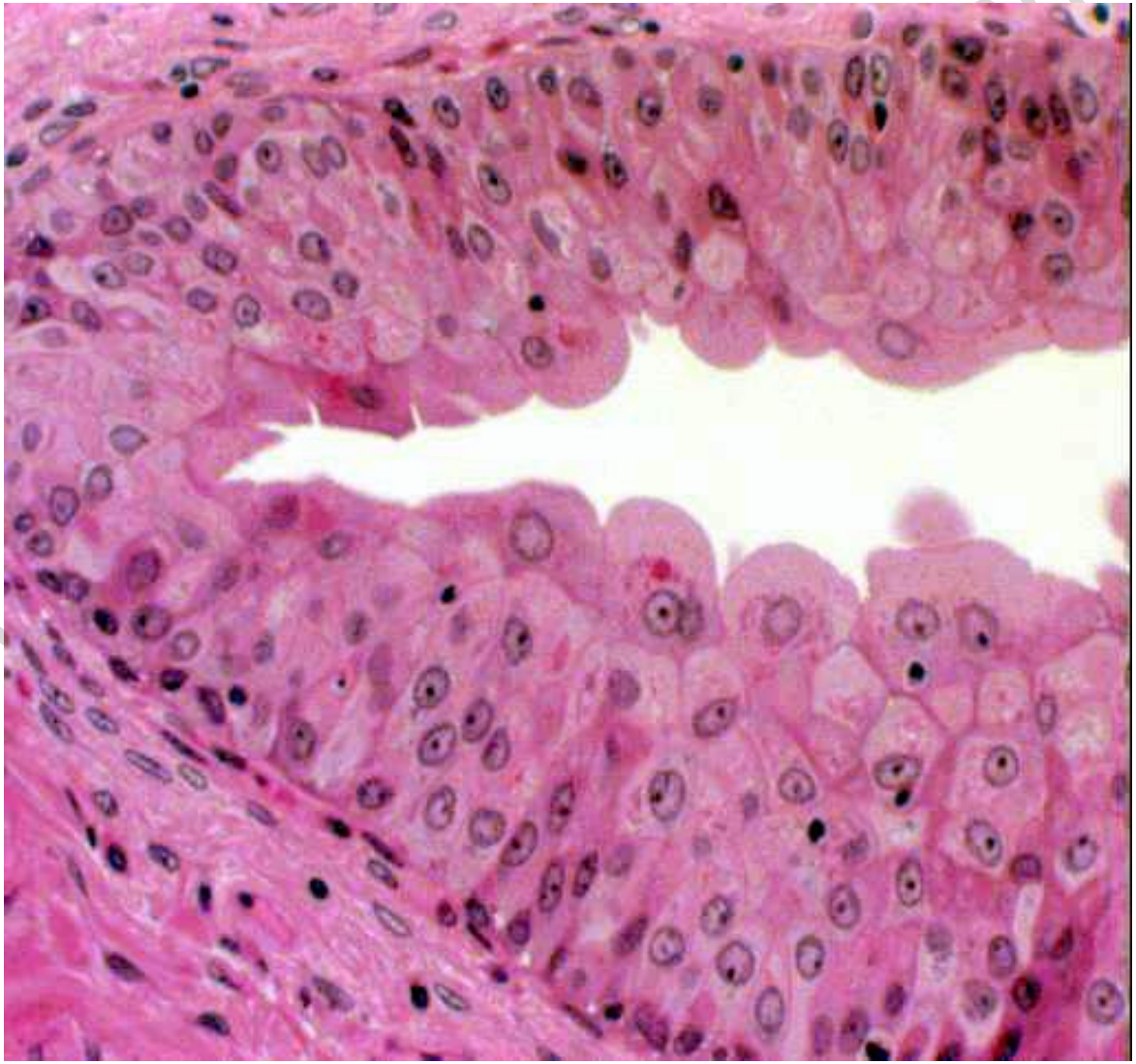
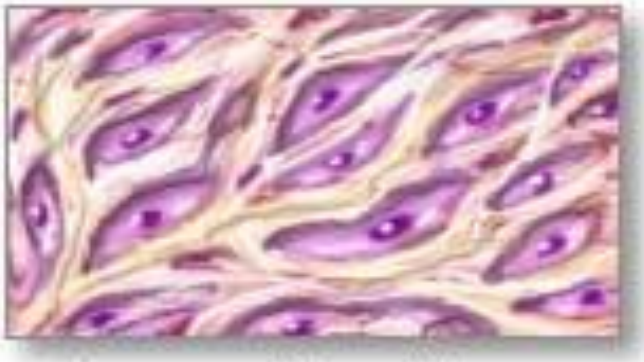
EPITHELIUM



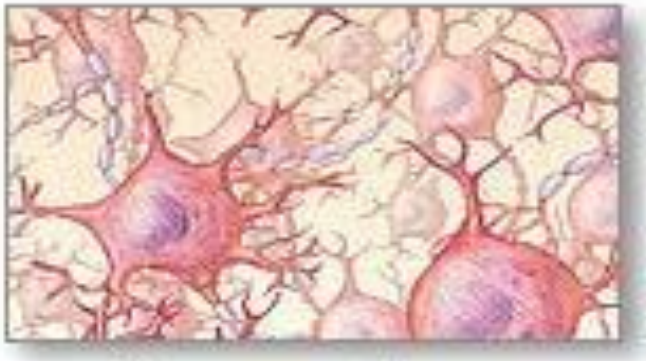
Four types of tissue



Connective tissue

Epithelial tissue

Muscle tissue



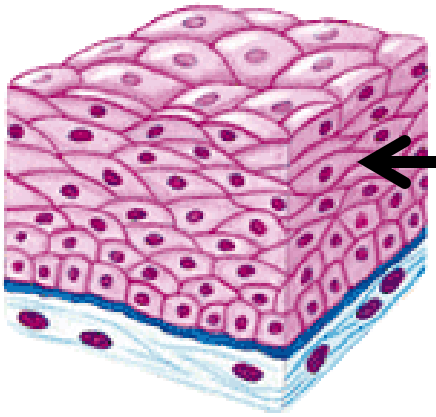
Nervous tissue

A.D.A.M.

EPITHELIUM

LAYER OR LAYERS OF CELLS RESTING ON THE BASEMENT MEMBRANE

EXTERIOR OF BODY



CELLS

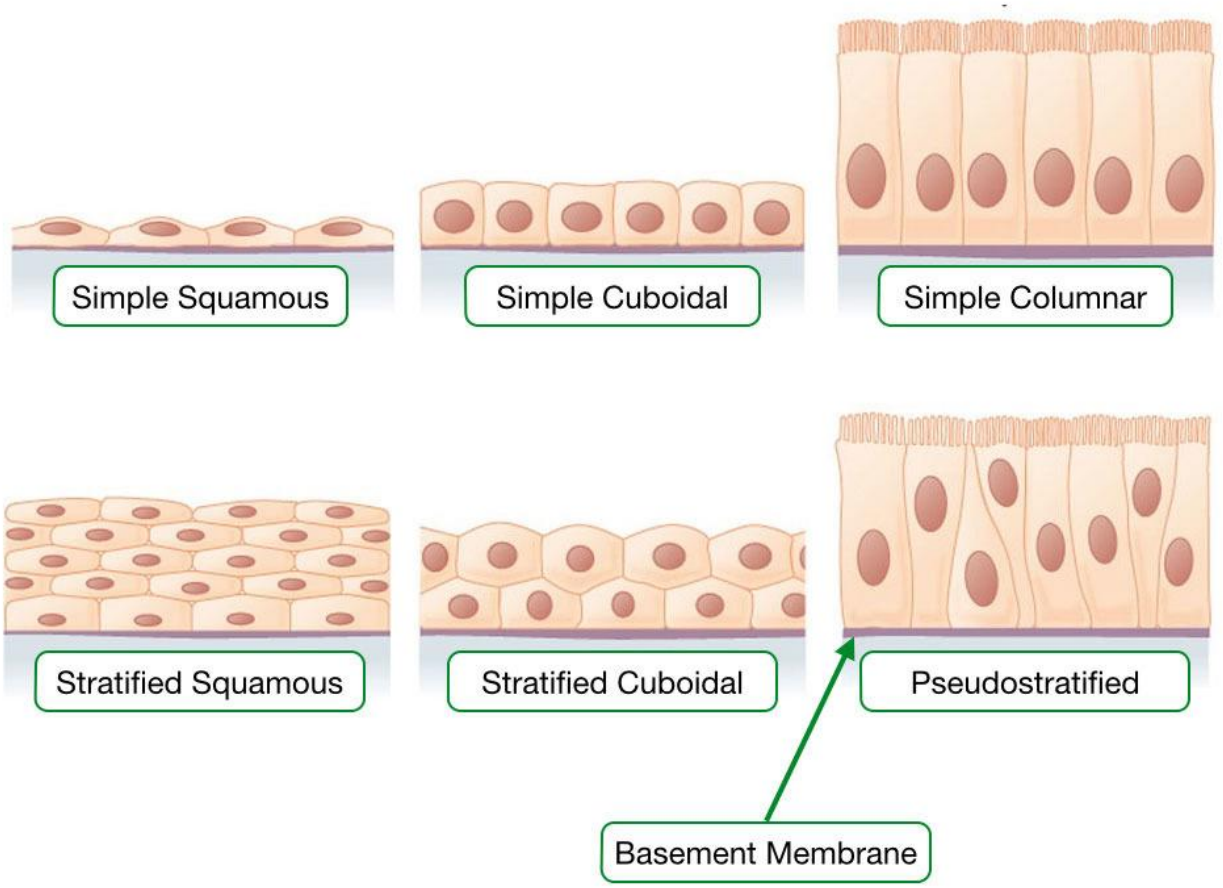
BODY CAVITY

BASEMENT MEMBRANE

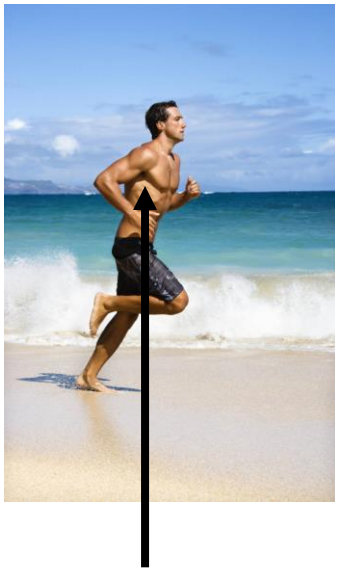
NOTE: Basement membrane is non cellular. Lamina propria is a connective tissue layer situated below the basement membrane.

Word Epithelium is composed of 2 words

EPI - UPON **THELIA – GROWTH or NIPPLE**

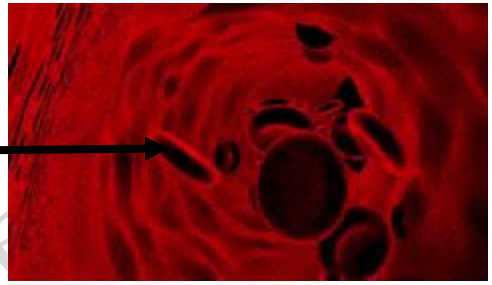


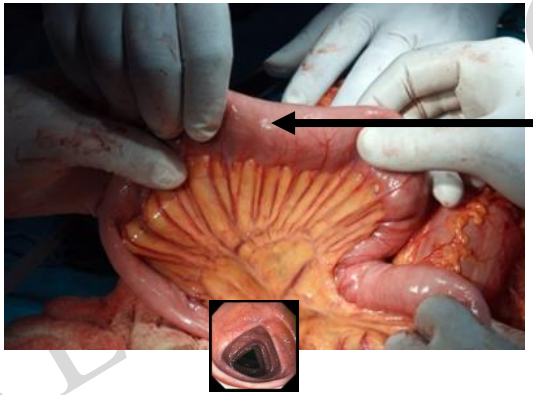
The epithelial tissue covers the body from outside and lines organs and cavities within the body from inside.



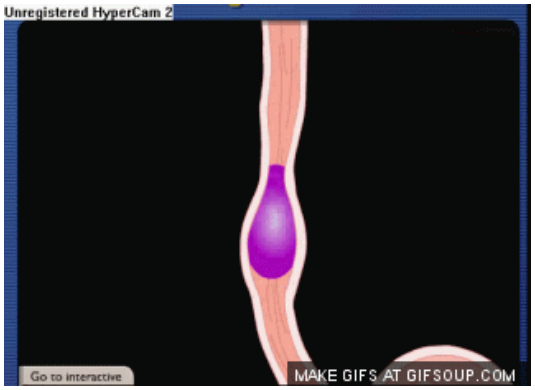
OUTER COVERING OF BODY - SKIN

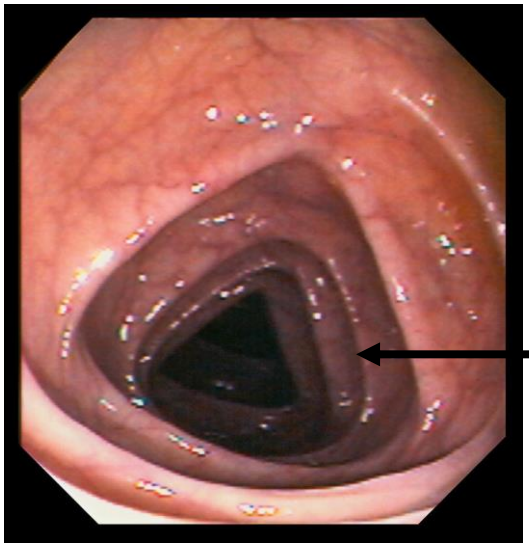
BLOOD VESSEL



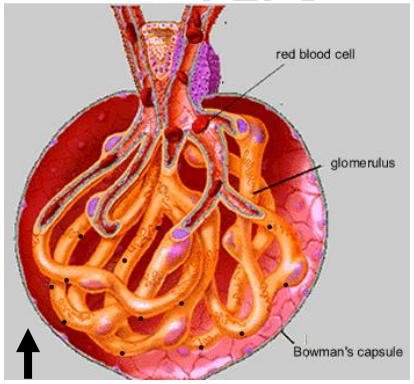


SMALL INTESTINE





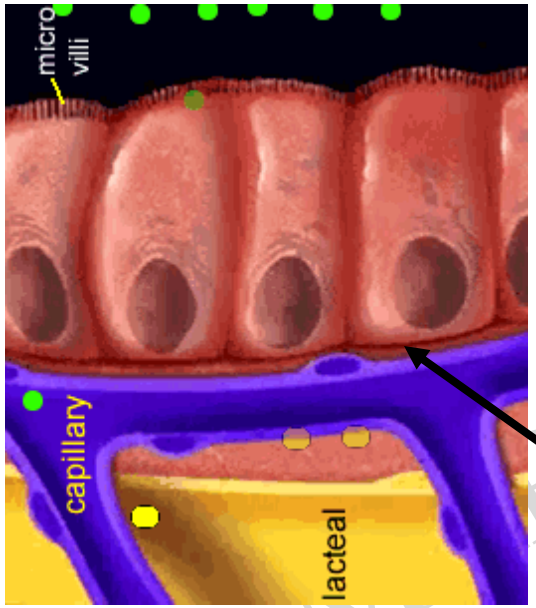
INNER LINING OF INTESTINES

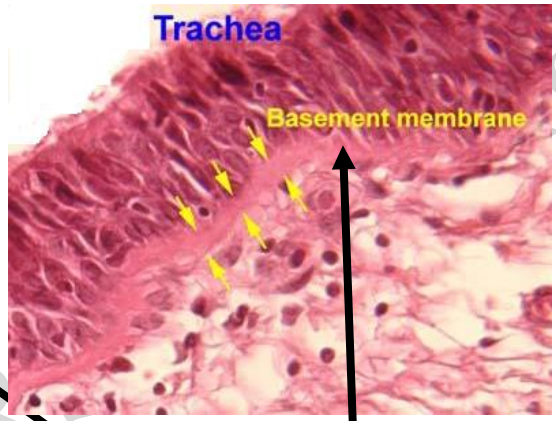


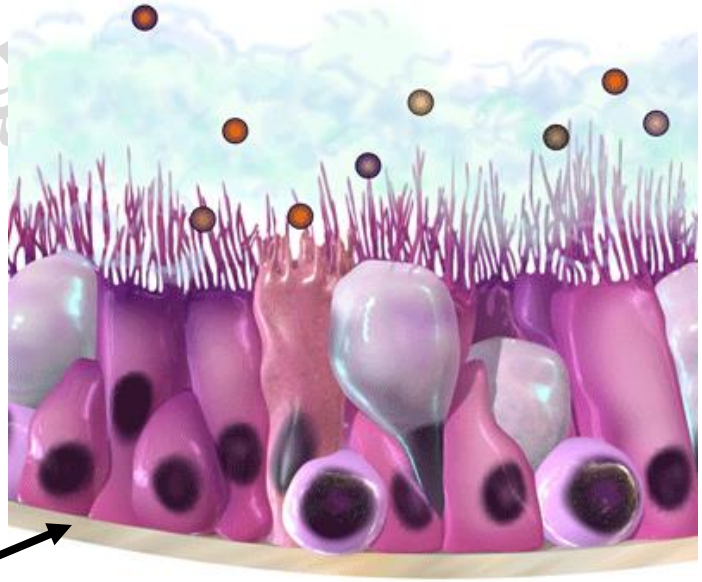
FILTRATION WITHIN GLOMERULUS OF KIDNEY

BASEMENT MEMBRANE

The cells of epithelium rest upon a common non-cellular supporting layer called basement membrane.



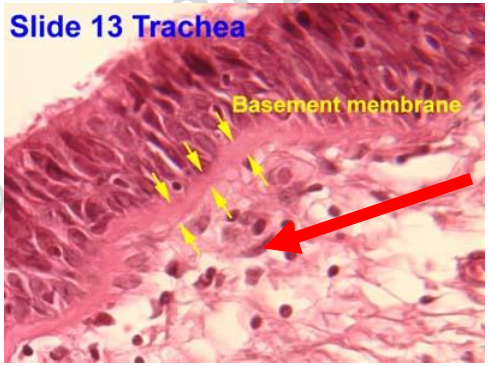




BASEMENT MEMBRANE

BASEMENT MEMBRANE

Epithelial cells lie on a layer of connective tissue called as basement membrane.



LAMINA PROPRIA

PARTS

BASAL LAMINA

(glycoprotein)

LAMINA RARA

(POLYSACCHARIDES)

LAMINA DENSA

(COLLAGEN FIBRES)

RETICULAR LAMINA

(RETICULAR FIBRES COLLAGEN FIBRES SUSPENDED IN MUCOPOLYSACCHARIDES MATRIX)

Basement membrane is secreted by epithelial cells and connecting tissue (both)

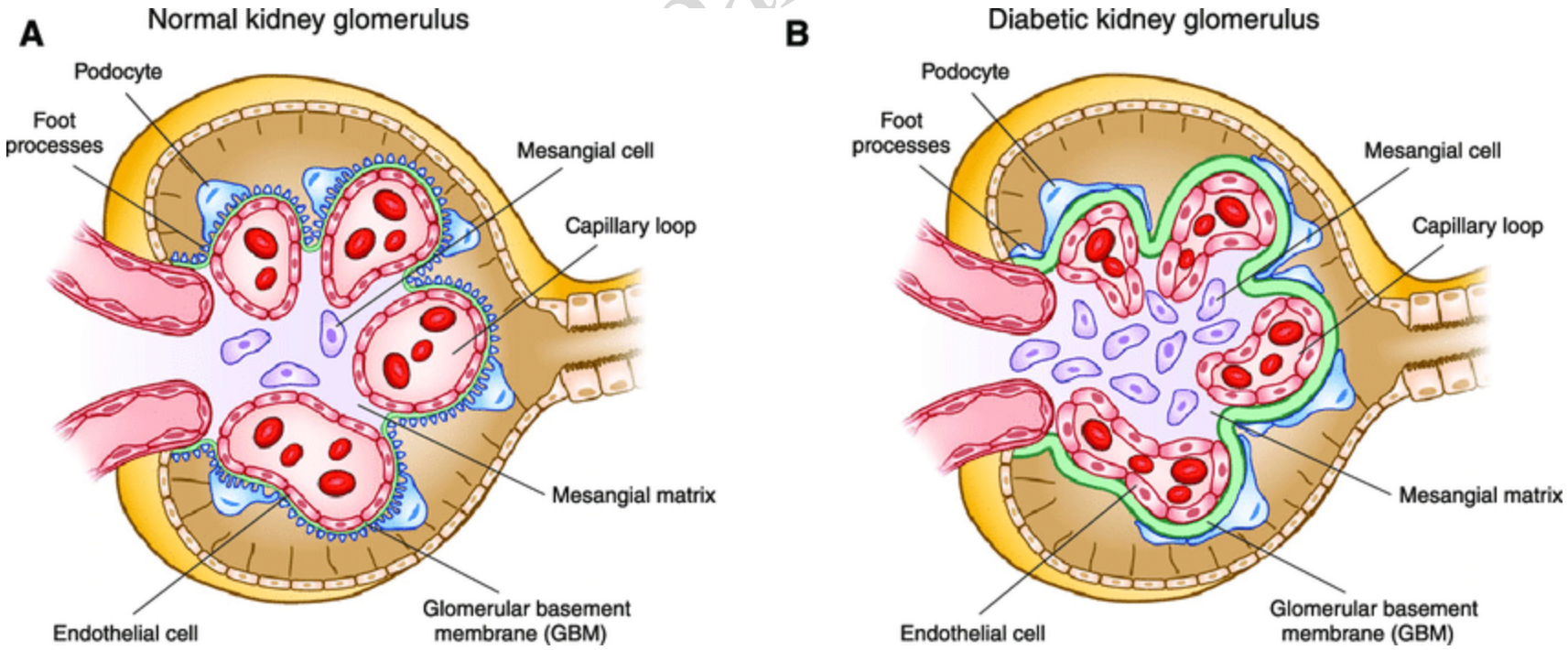
Lamina propria is a "basement membrane" attached to epithelial tissue.

MARS Learning Centre

Under certain conditions , basement membranes become markedly thickened, due to increased production of collagen.

In untreated cases of diabetes mellitus,the basement membrane of small blood vessels (capillaries) thickens, especially in the eyes and kidneys.

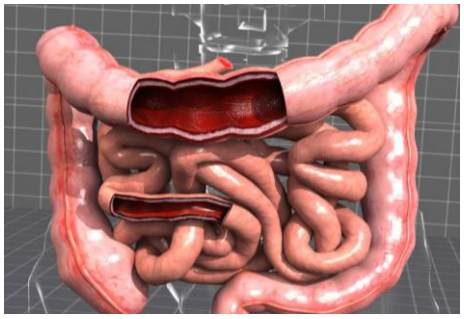
Because of this the blood vessels cannot function properly, and blindness and kidney failure may result.



EPITHELIUM CAN BE CLASSIFIED INTO 2 TYPES

COVERING EPITHELIAL TISSUE

It is characterised by distribution of epithelium over the surface, both external and internal.



GLANDULAR EPITHELIUM

Epithelium associated with glands.

MARS Learning Centre

COVERING EPITHELIAL TISSUE

SIMPLE EPITHELIUM

(SINGLE LAYERED)

- SQUAMOUS
- CUBOIDAL
- COLUMNAR
- CILIATED
- PSEUDOSTRATIFIED
- SENSORY
- GERMINAL

COMPOUND EPITHELIUM

(MULTI LAYERED)

- STRATIFIED SQUAMOUS KERATINISED EPITHELIUM
- STRATIFIED SQUAMOUS NON KERATINISED EPITHELIUM
- TRANSITIONAL EPITHELIUM OR UROTHELIUM

MARS Learning Centre

CHARACTERISTIC FEATURES OF EPITHELIUM

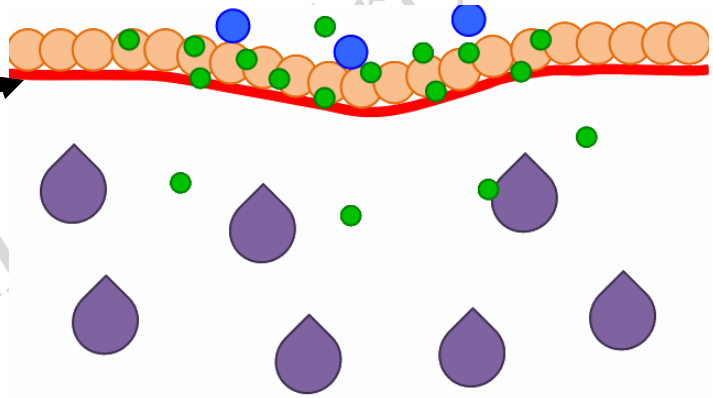
Composed of cells with minimal extracellular space

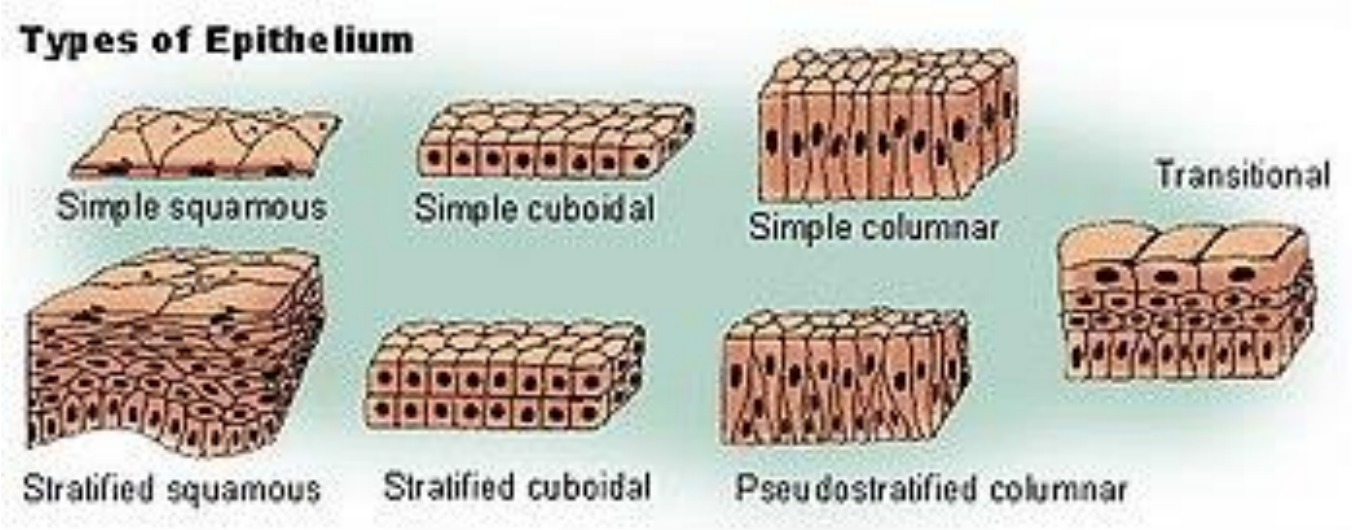
Connected by cell to cell contacts

Rests on basement membrane

Avascular (no blood supply)

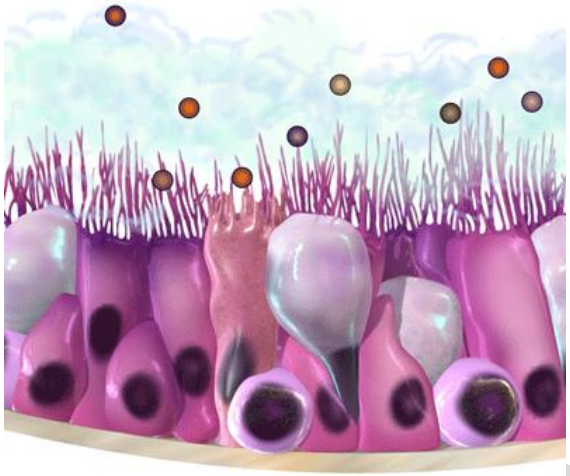
Shows structural specializations in response to functions



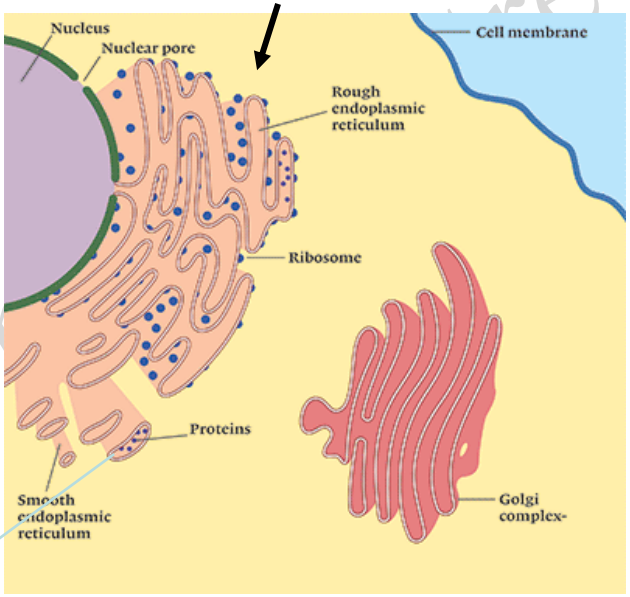


FUNCTIONS OF EPITHELIUM

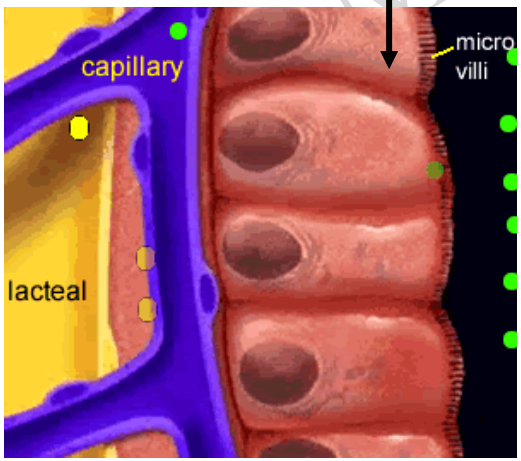
1.PROTECTION



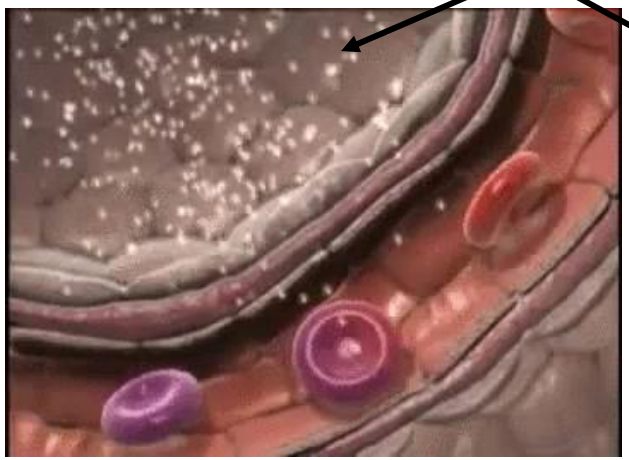
2.SECRETION

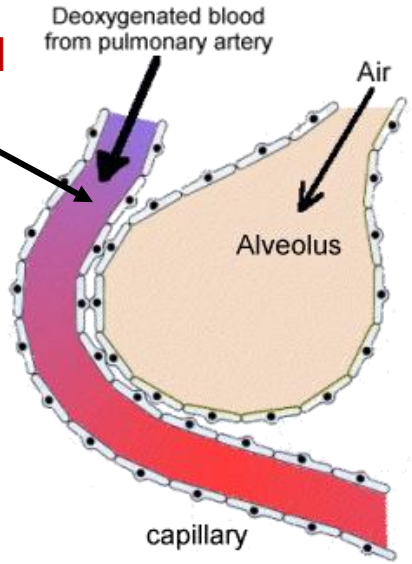


3.ABSORPTION



4.DIFFUSION





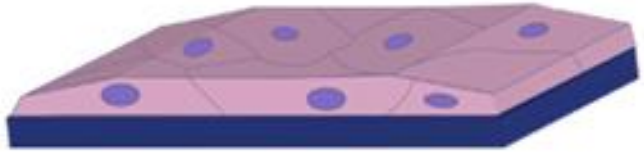
MARS Learning Centre

SIMPLE EPITHELIUM

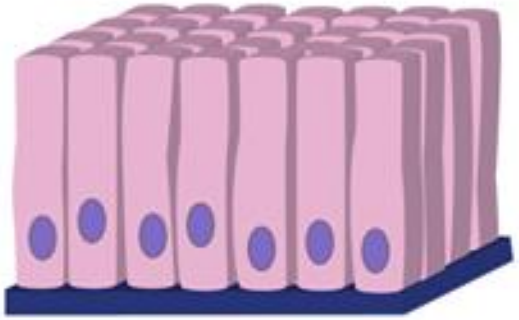
It has a single layer of cells resting on a basement

Based on the shape of cell – 3 types

Simple Cuboidal



Simple Squamous



Simple Columnar

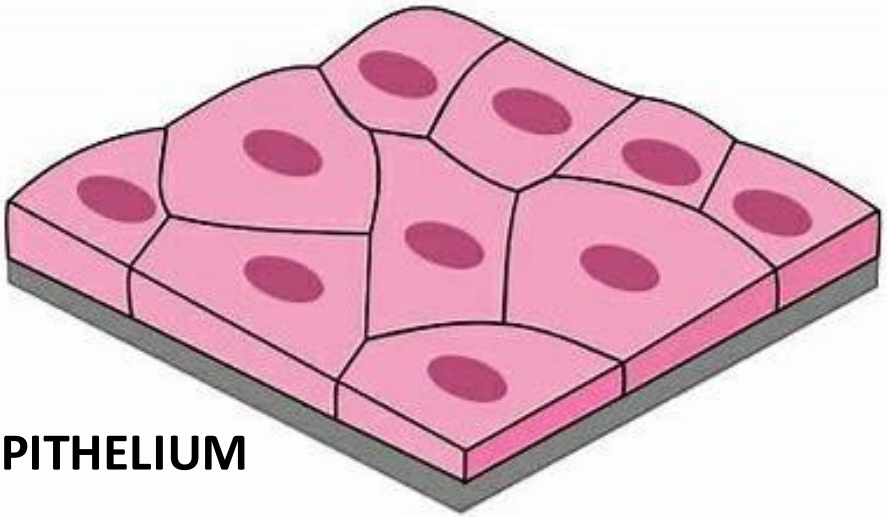
SIMPLE SQUAMOUS EPITHELIUM

Consists of thin,flat,disc like cells with a central flattened nucleus

They are closely fitted like the tiles on a floor. Hence, it is also called as **PAVEMENT MEMBRANE.**

Location: air sacs of lungs,kidney, inner lining of blood vessels and heart

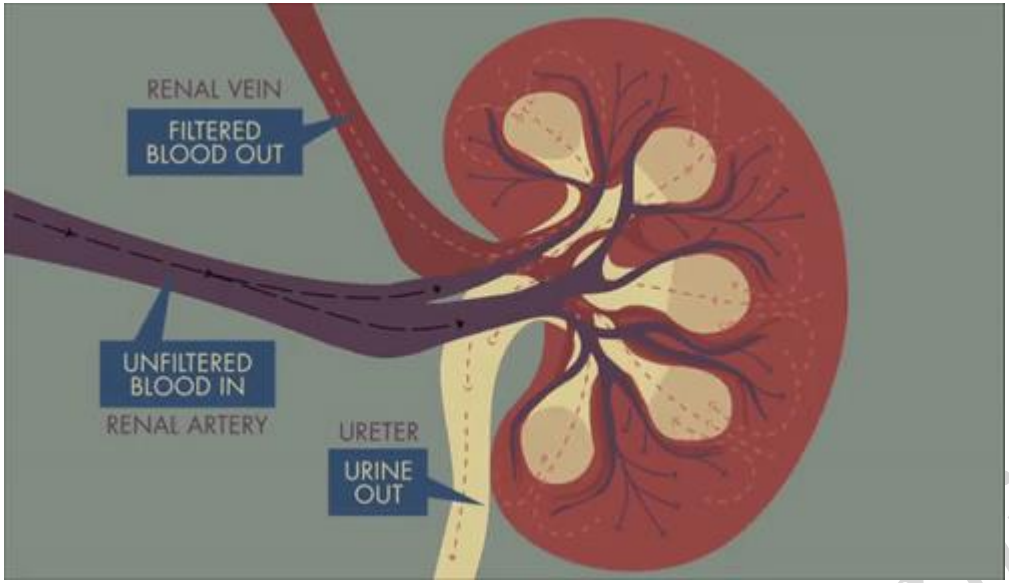
Function: present at sites of filtration (such as blood filtration in kidneys)
diffusion (such as diffusion of oxygen into blood vessels of lungs)



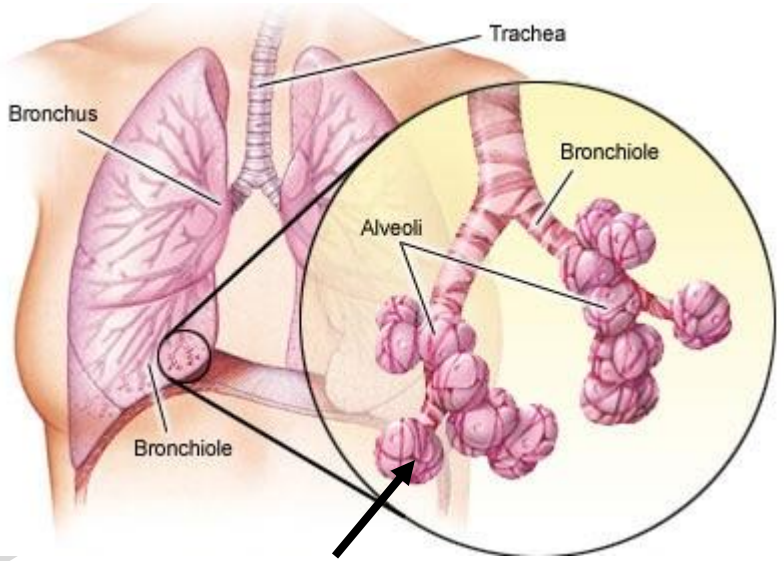
SIMPLE SQUAMOUS EPITHELIUM

If the membranes of cells have wavy appearance then it is called as TESSALATED SQUAMOUS (OCCURS IN ENDOTHELIUM AND MESOTHELIUM)

MARS Learning Centre

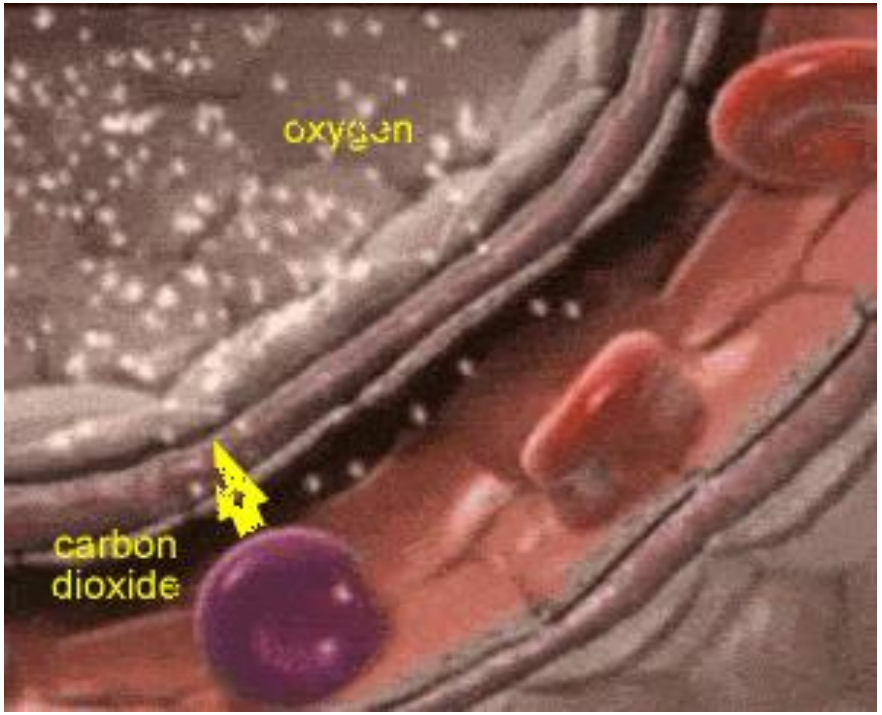


KIDNEY FILTRATION

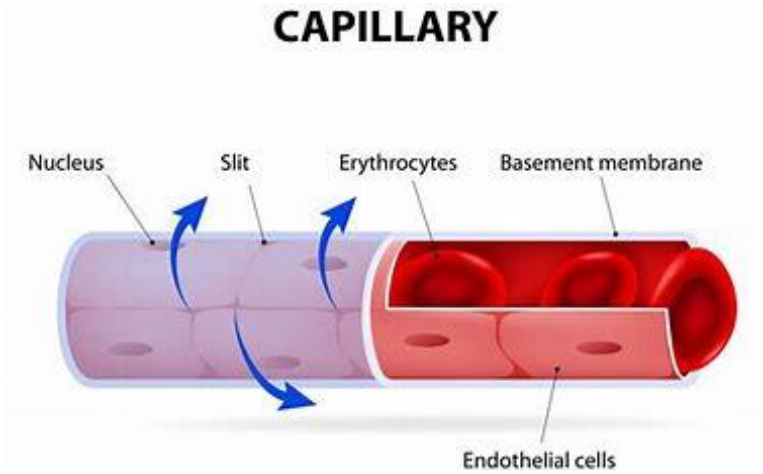


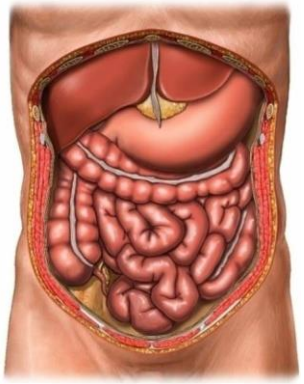
LUNG ALVEOLI DIFFUSION

MARS Learn



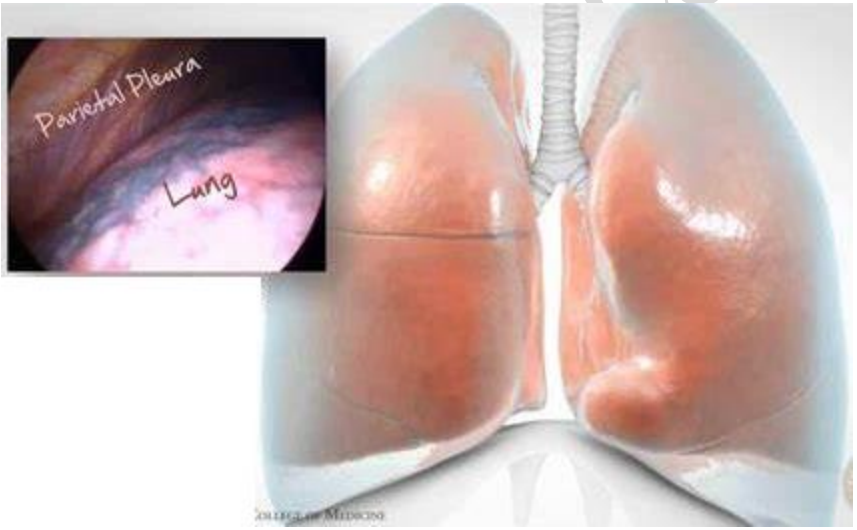
Simple squamous epithelium forms the epithelial layer of pleura, peritoneum and pericardium known as **MESOTHELIUM**

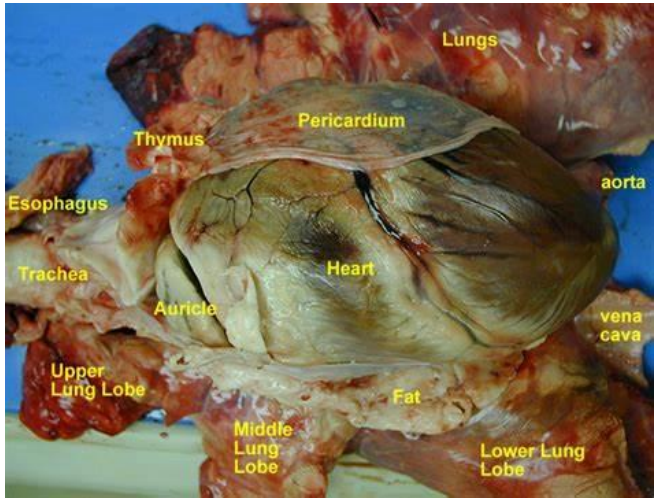




ENDOTHELIUM: simple squamous epithelium lining the blood vessels is called as endothelium.

PERITONEUM: Is the covering of abdominal organs



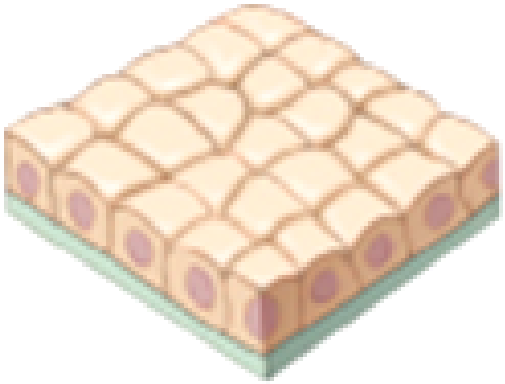


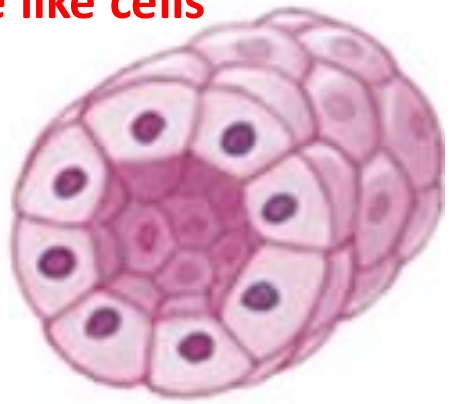
PLEURA: Is the covering of lungs

PERICARDIUM: Is the covering of heart

SIMPLE CUBOIDAL EPITHELIUM

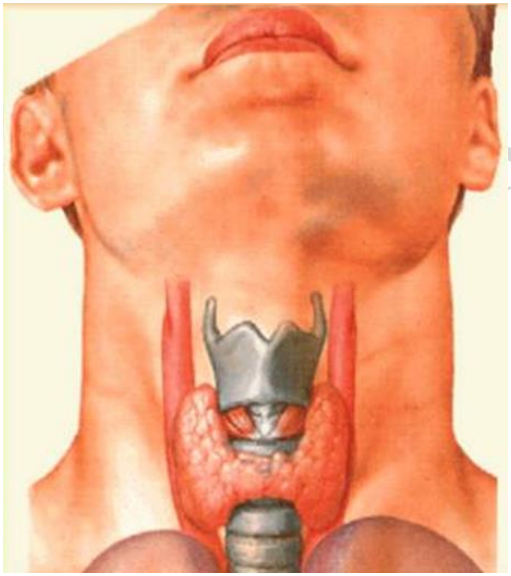
Consists of single layer of cube like cells

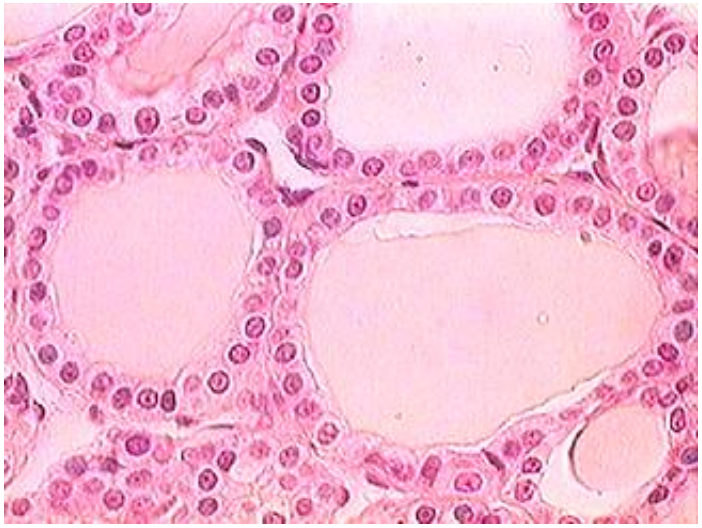




Simple cuboidal

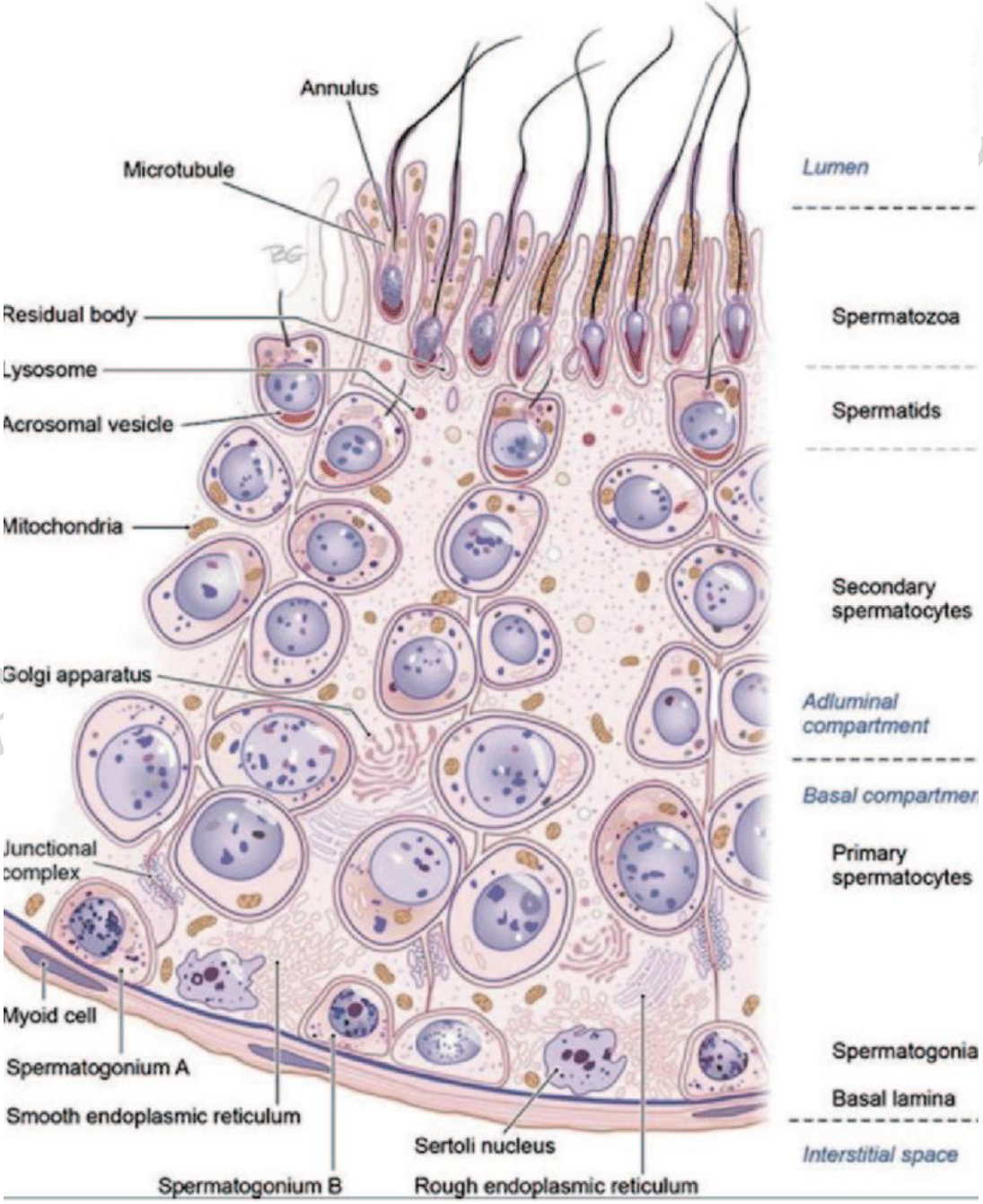
S Learning



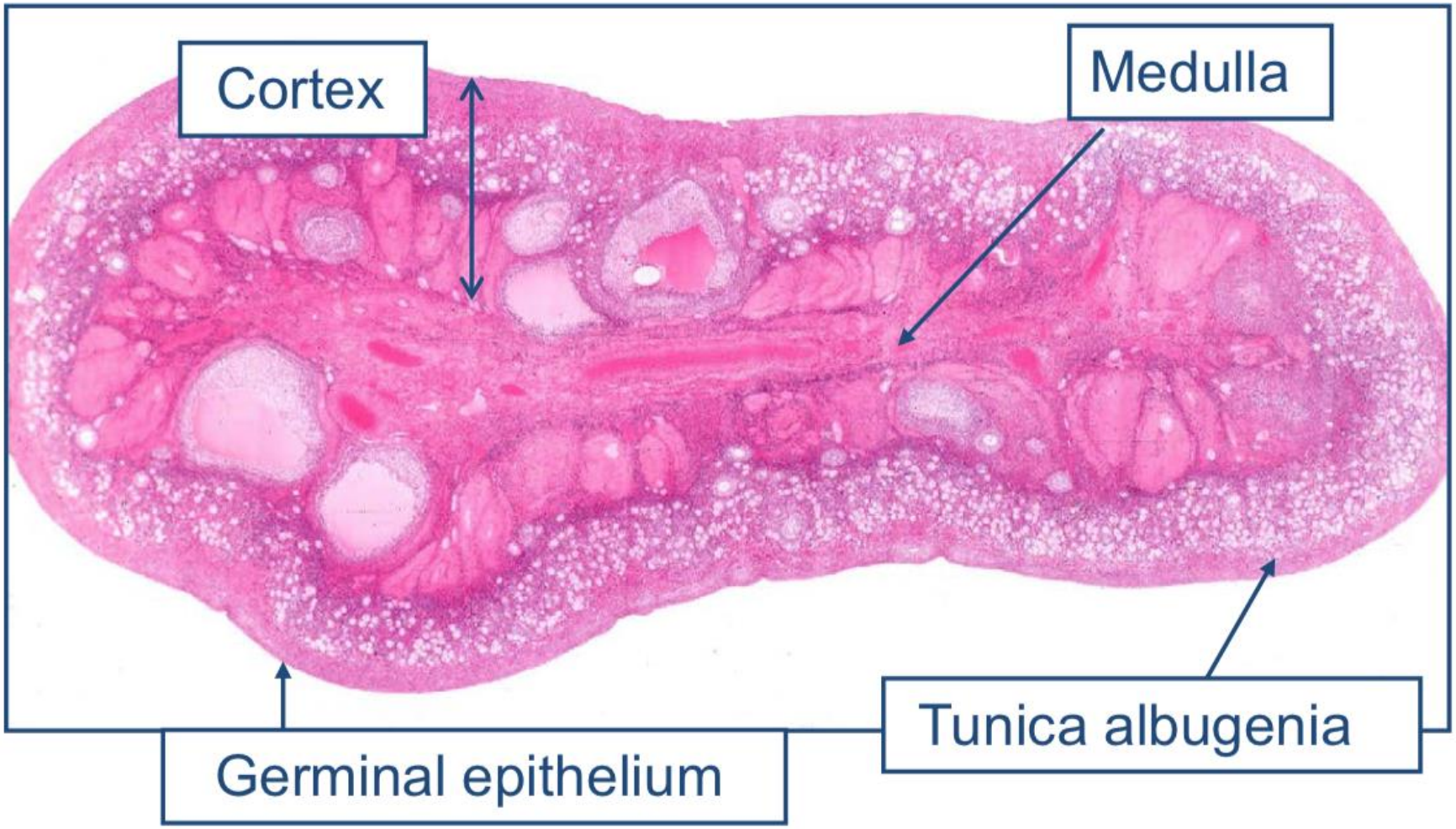


The lining of gonads (seminiferous tubules and germinal lining of ovary) is called germinal epithelium.

GERMINAL EPITHELIUM IN SEMINIFEROUS TUBULES



GERMINAL EPITHELIUM OF OVARY

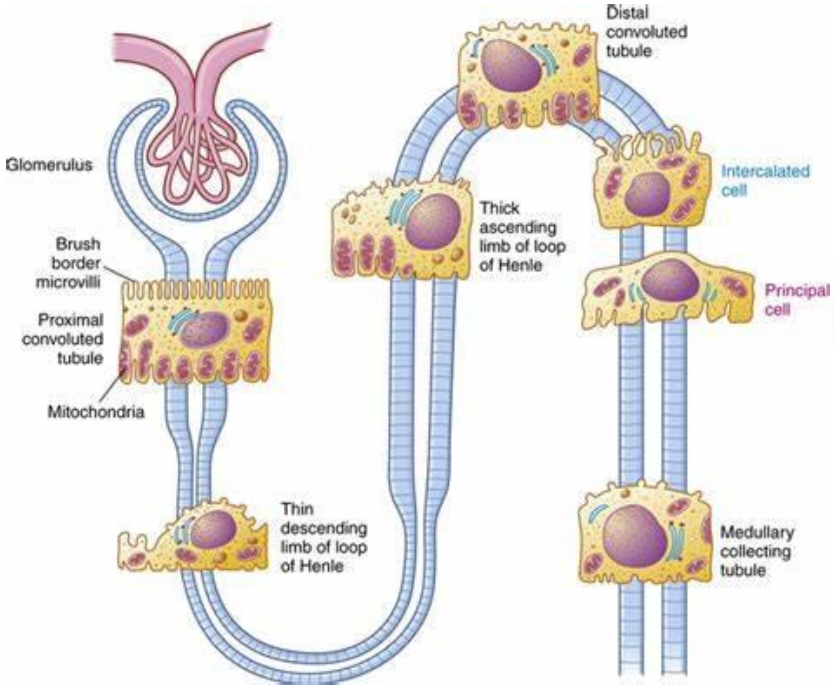


SIMPLE CUBOIDAL EPITHELIUM

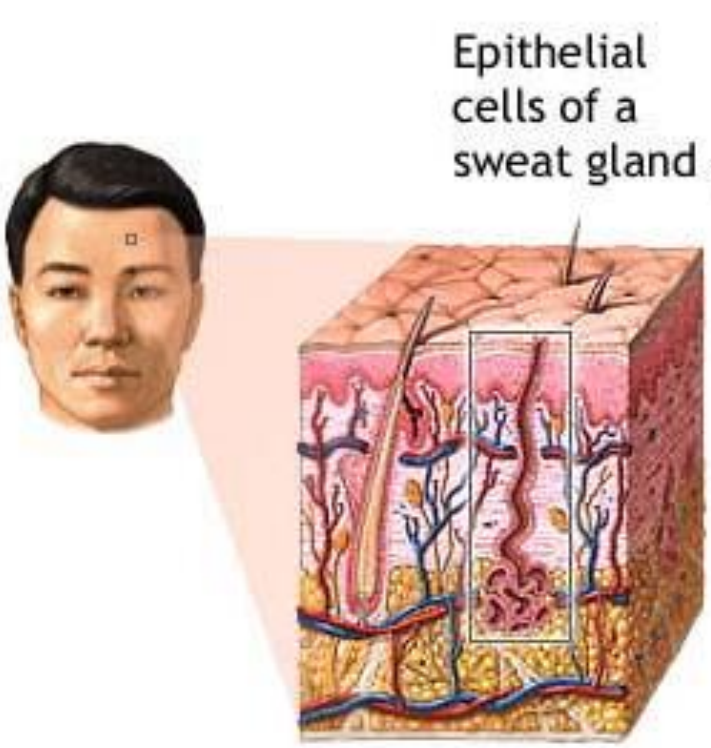
Is a single layer of cube shaped cells, with round centrally located nucleus.

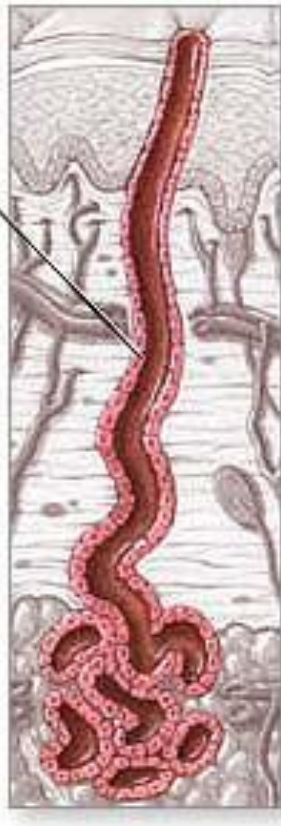
LOCATION: ducts of many glands, kidney tubules

FUNCTION: Secretion and absorption



KIDNEY TUBULES

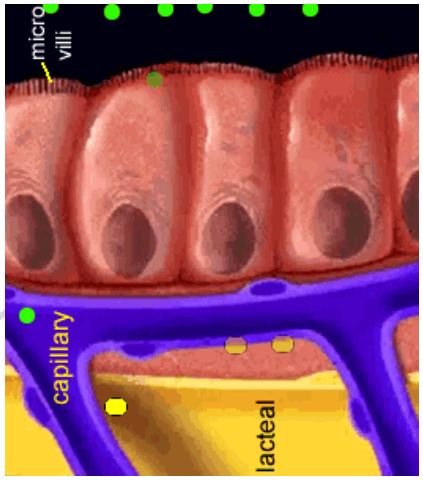




NOTE: The epithelium of proximal convoluted tubule (PCT) of nephron in the kidney has microvilli.

SIMPLE COLUMNAR EPITHELIUM

Consists of cells that are much taller than wide.



Nucleus is elongated

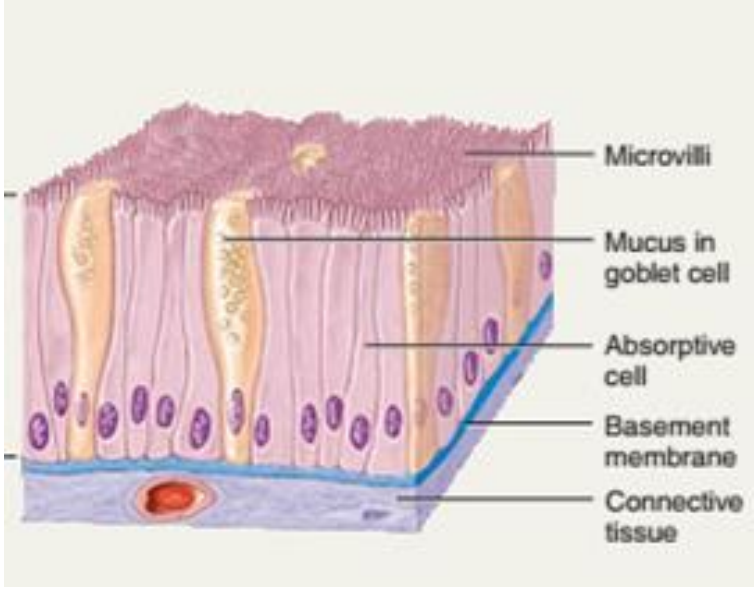
Microvilli are present on the apical surface

Goblet cells are modified columnar epithelial cells that secretes mucus, a slightly sticky fluid.

LOCATION: Lining of stomach and intestine.

FUNCTION: Secretion and absorption

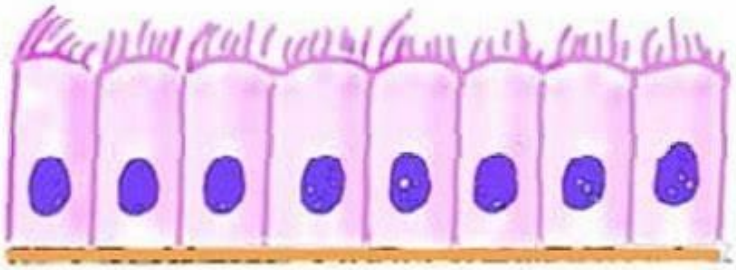
NOTE: If the columnar or cuboidal cells bear cilia on their free surface they are called ciliated epithelium.



The absorptive epithelia in the gut is considered POLARISED because the structures on the apical surface are different than those on the basal surface.

MARS Learning C

CILIATED SIMPLE COLUMNAR EPITHELIUM



Is a single layer of ciliated column like cells

With oval nuclei near the base of cells

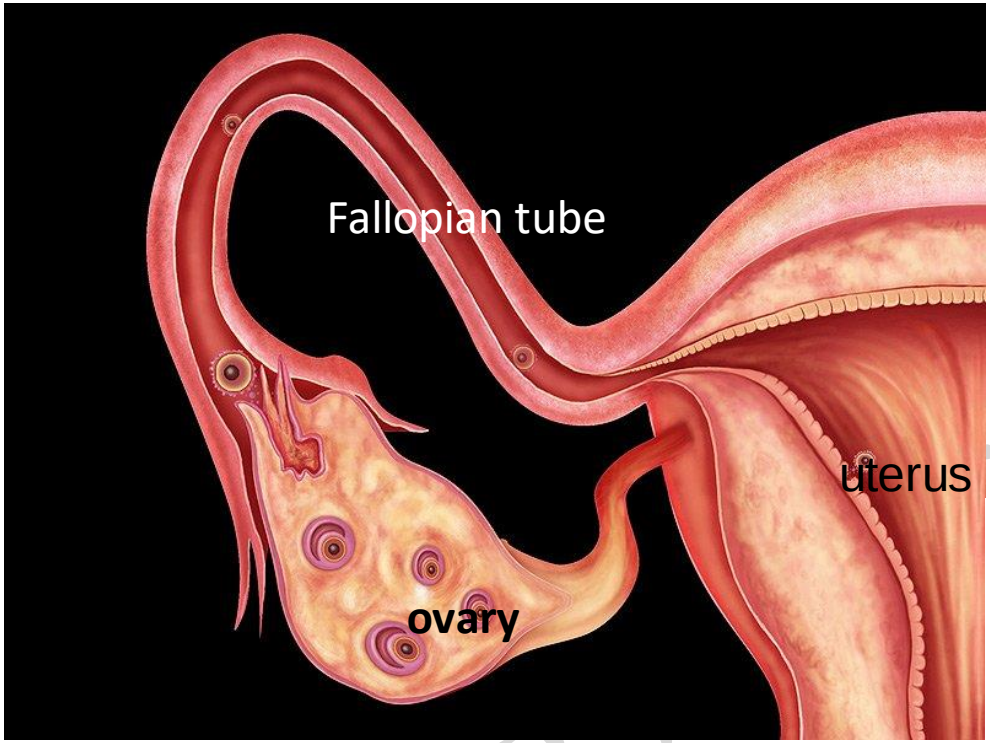
Goblet cells are usually interspersed

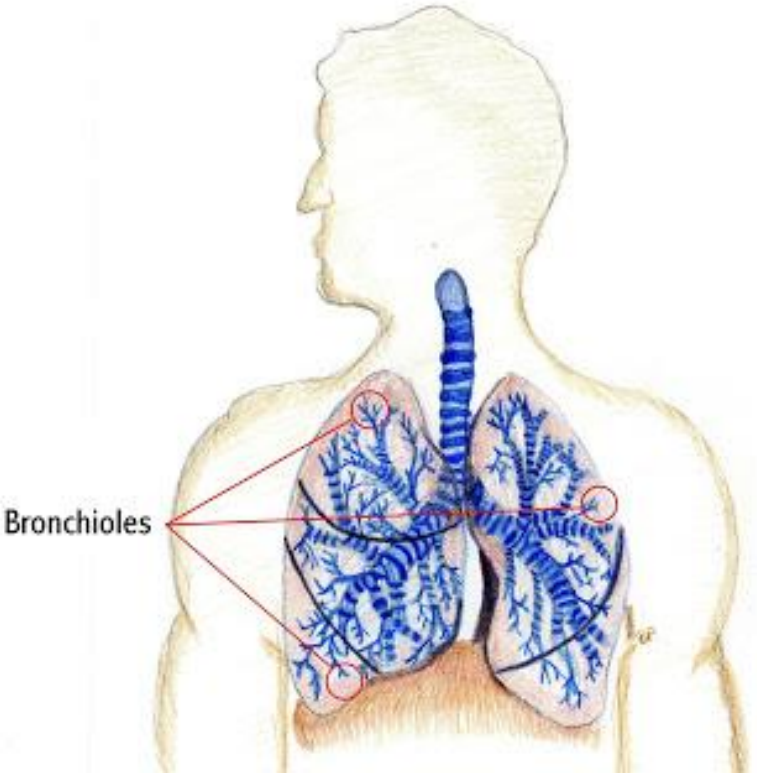
LOCATION: LINES SOME BRONCHIOLES (SMALL TUBES) OF RESPIRATORY TRACT, UTERINE TUBES, UTERUS, EPENDYMA LINING VENTRICLES OF BRAIN AND CENTRAL CANAL OF SPINAL CORD.

FUNCTION: Cilia beat in unison, moving mucus and foreign particles toward throat where they can be coughed up and swallowed or spit out.
coughing and sneezing speed up movement of cilia and mucus.

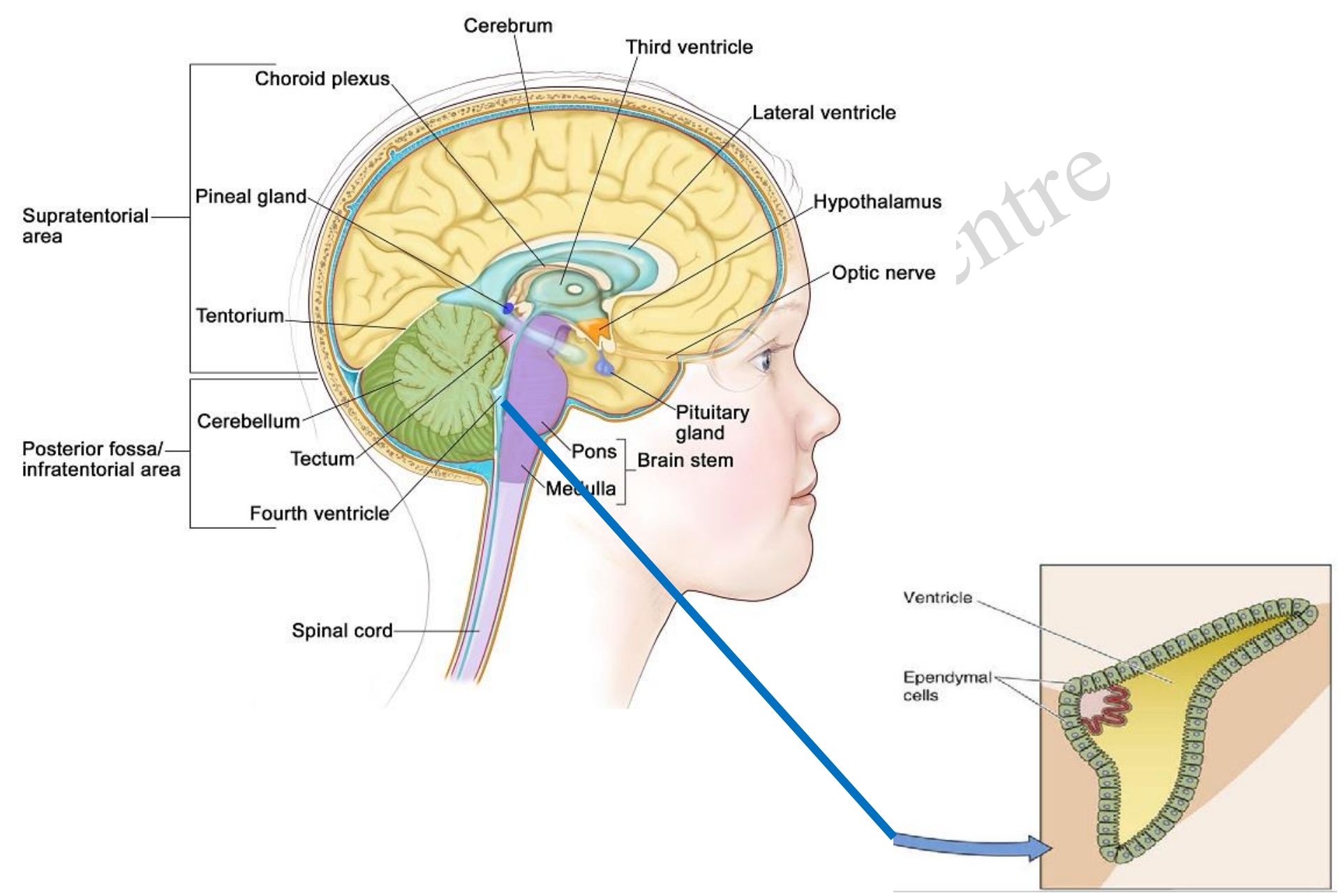
Cilia also help move oocytes expelled from ovaries through uterine tubes into uterus

MARS Learni





MARS ing Centre

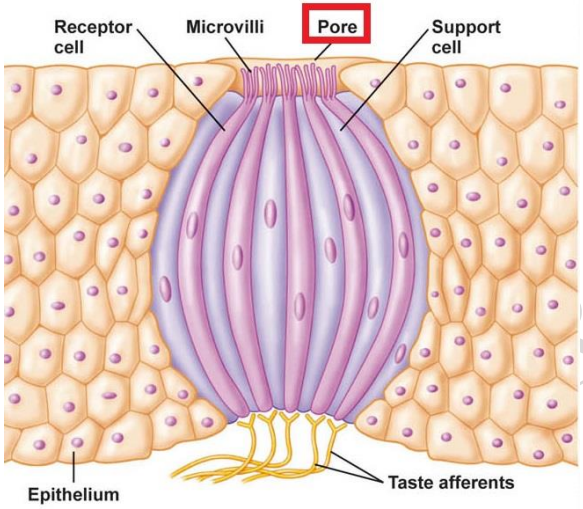


Ependymal cells line the ventricles of brain and central canal of spinal cord

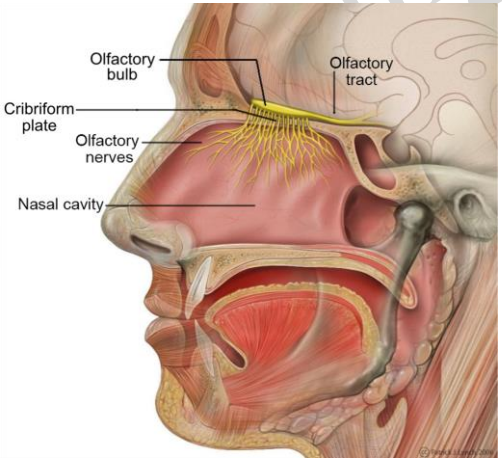
SENSORY EPITHELIUM

Modified columnar epithelium with supporting spindle shaped cells.

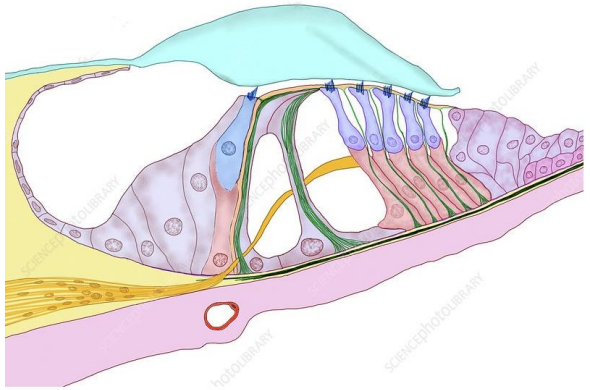
EG: Gustatory epithelium
Olfactory epithelium
Lining of internal ear (Statoacoustic epithelium)



GUSTATORY EPITHELIUM



OLFACTORY EPITHELIUM



LINING OF INTERNAL EAR

PIGMENTED EPITHELIUM

Cuboidal epithelium rich in melanin pigments

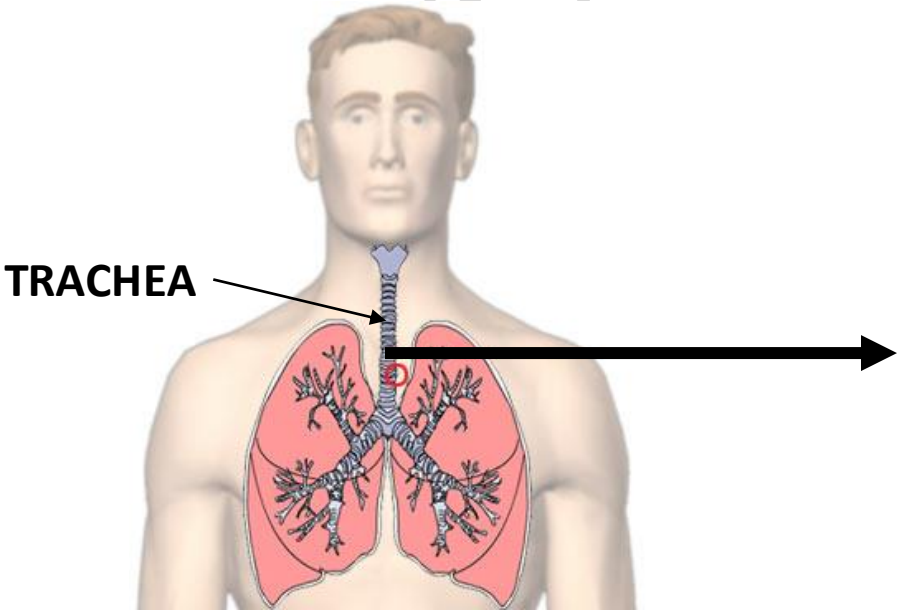
EG: Lining of retina
Choroid of eye

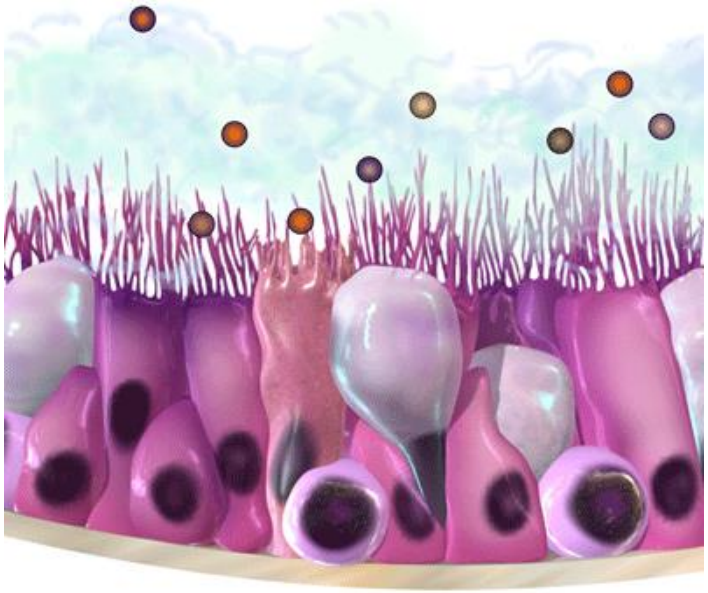
PSEUDOSTRATIFIED CILIATED COLUMNAR EPITHELIUM

Not a true stratified tissue; nuclei of cells are at different levels; all cells are attached to basement membrane, but not all reach the apical surface.

Location: **Pseudostratified ciliated columnar epithelium lines the airways of most of upper respiratory tract; pseudostratified non ciliated columnar epithelium lines larger ducts of many glands, epididymis, and part of male urethra.**

Function: **Secretion and movement of mucus by ciliary action.**





SS Learning Centre

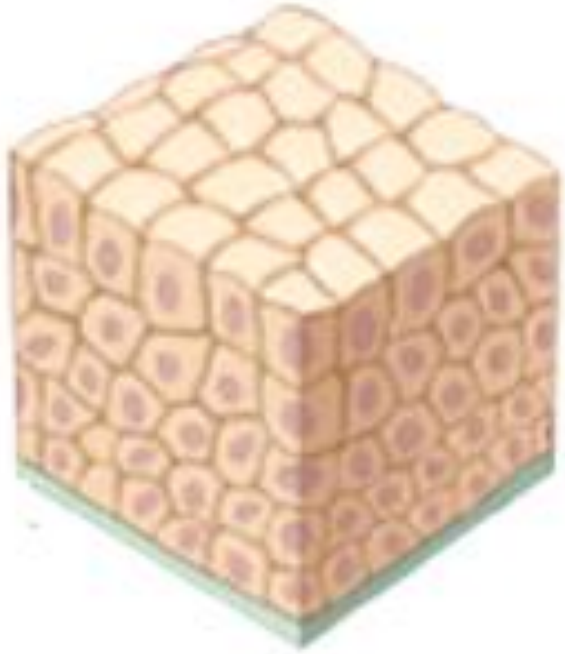
COMPOUND EPITHELIUM

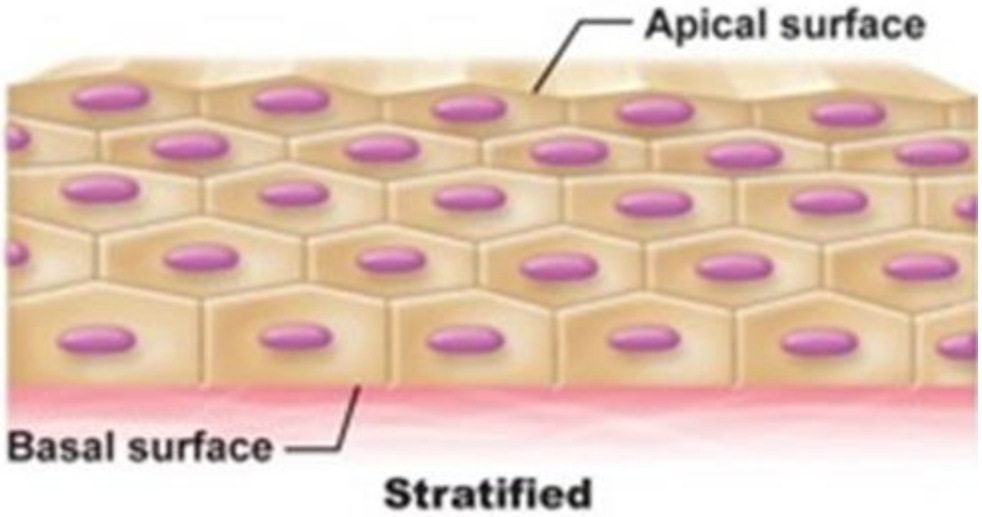
It has a multiple layers of cells resting on a basement membrane

3 types

1. Stratified squamous non keratinized.
2. Stratified squamous keratinized.
3. Transitional epithelium.

Learning Centre





STRATIFIED SQUAMOUS KERATINISED EPITHELIUM

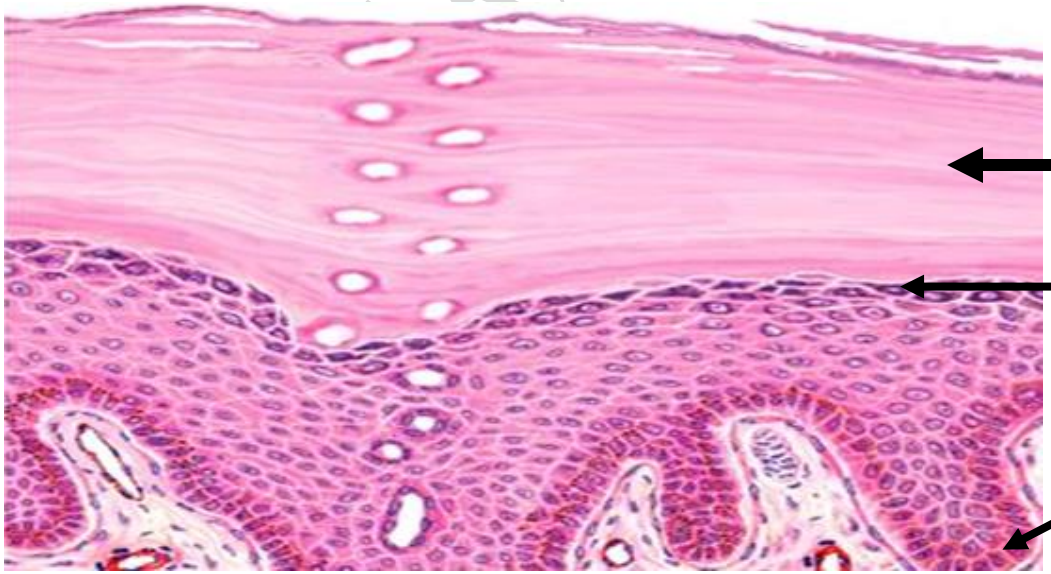
In stratified squamous keratinized epithelium the topmost few layers of cells contain a hard water proof protein, keratin, in the cytoplasm.

These cells are helpful in protection against abrasion and infection.

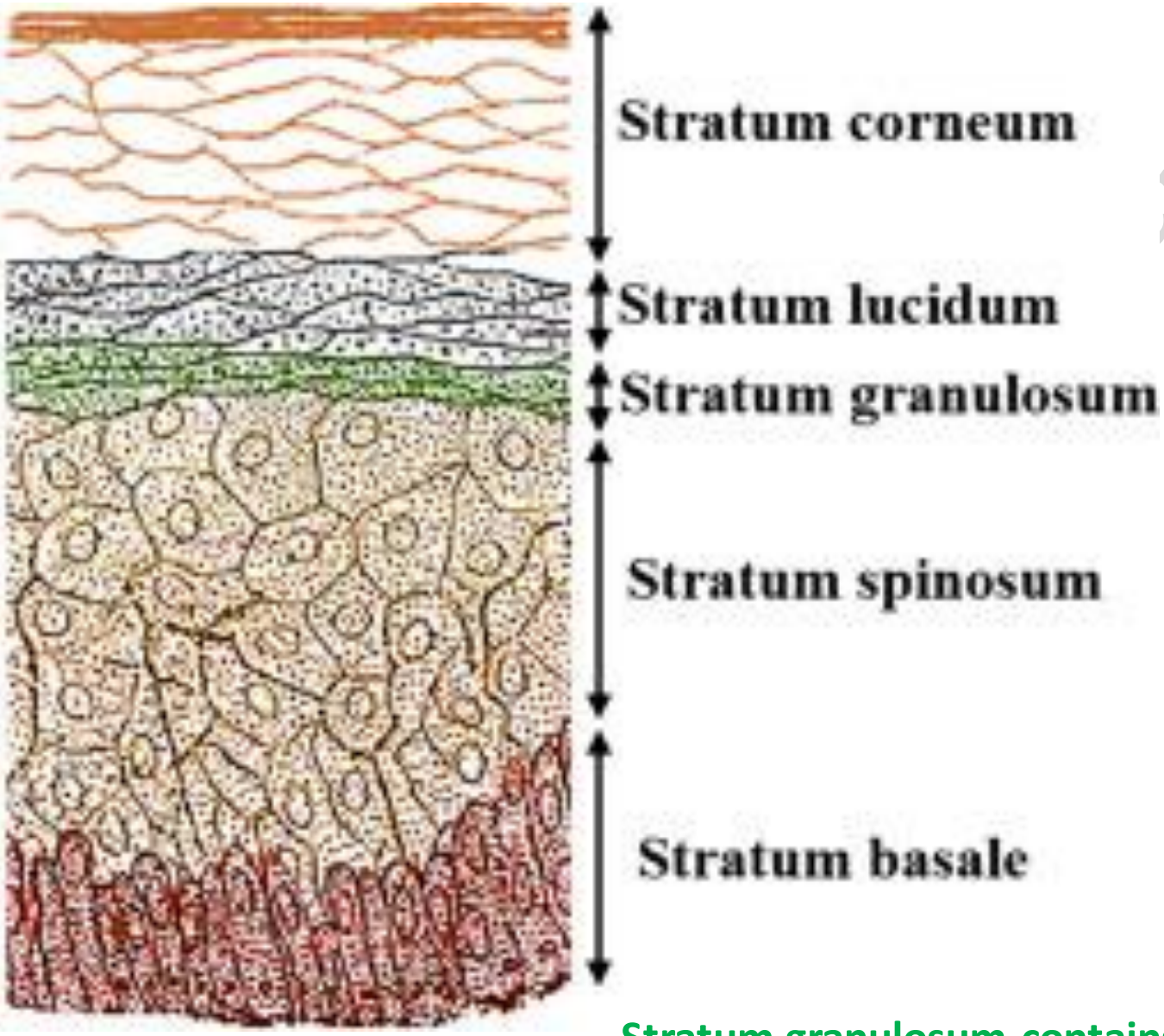
Eg: **epidermis of the hair and nails**.

Protecting against drying or dessication is one of the most important functions of these cells. Horns, scales and feathers.

RS Learning Centre



LAYERS OF EPIDERMIS



Stratum granulosum contains keratohyalin granules which form the keratin

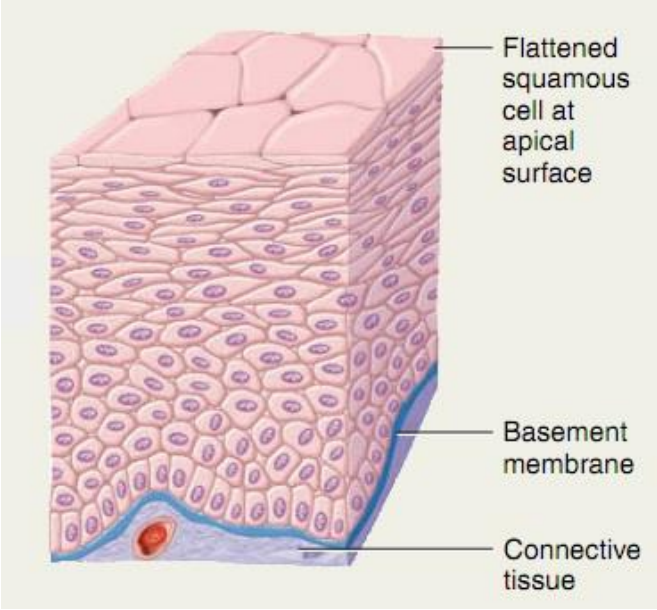
STRATIFIED SQUAMOUS NON KERATINISED EPITHELIUM

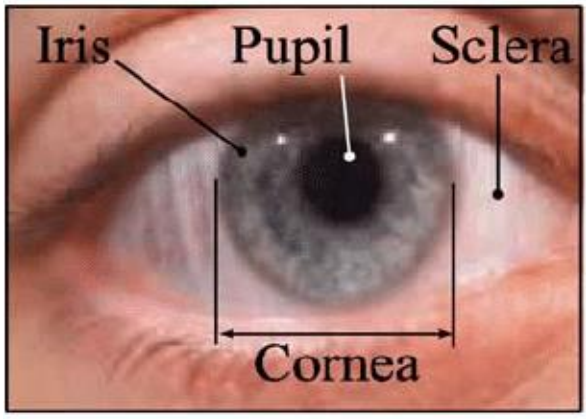
In non keratinized stratified squamous epithelium, cells do not have keratin in their upper layers.

Thus these cells do not have the ability to check water loss.

Eg: oral cavity, oesophagus, rectum and anal canal, cornea.

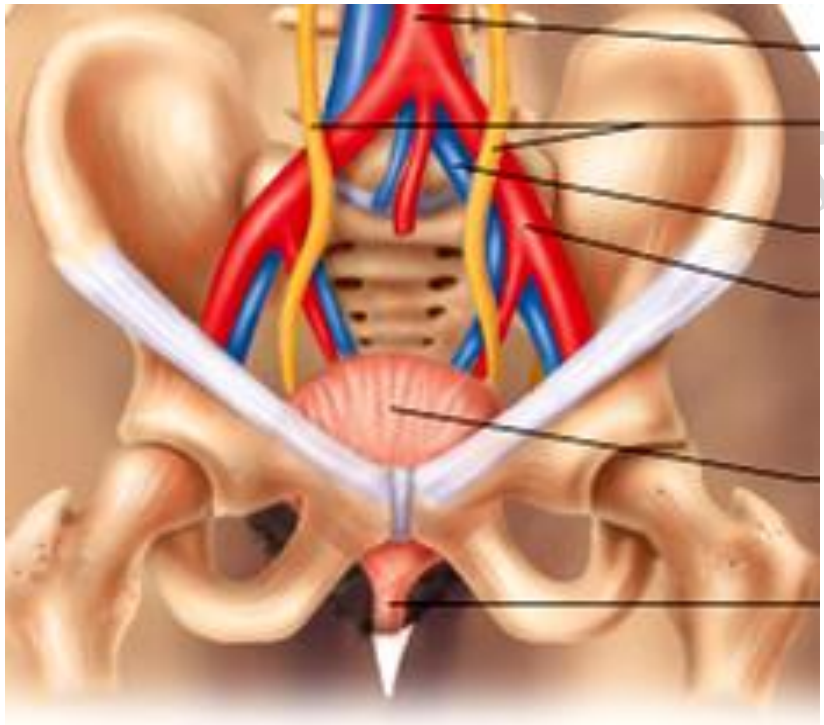
S Learning Centre

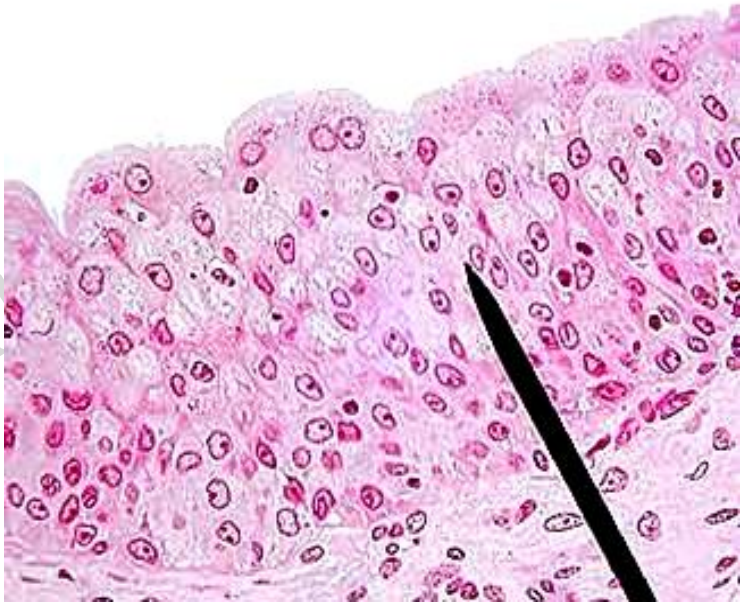


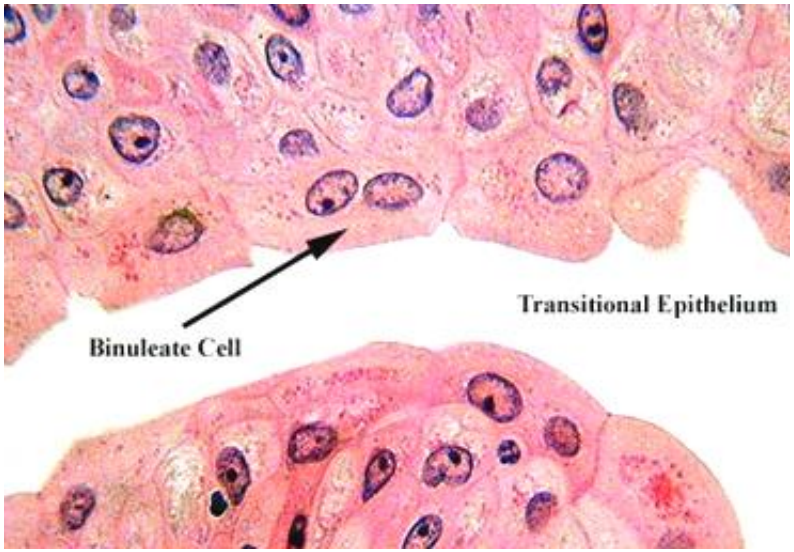


TRANSTIONAL EPITHELIUM

UROTHELIUM







URINARYBLADDER & URETHRA

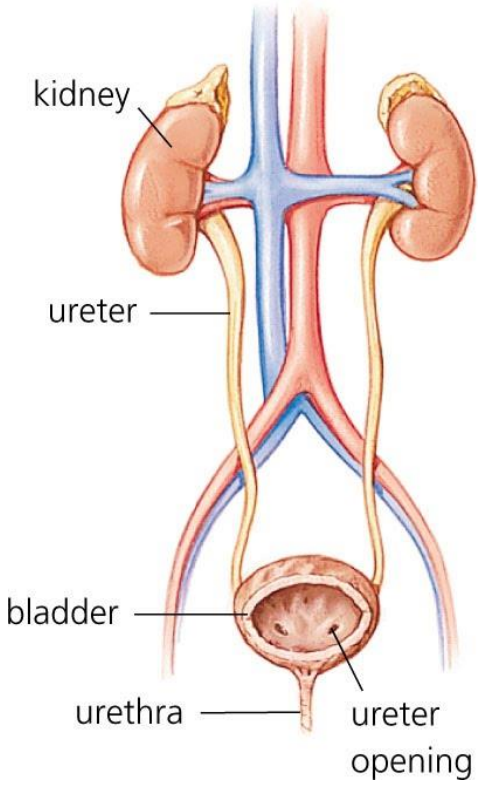
TRANSITIONAL EPITHELIUM OR UROTHELIUM

Transitional epithelium is a type of stratified epithelium.

This tissue consists of multiple layers of epithelial cells which can contract and expand in order to adapt to the degree of distension needed.

Transitional epithelium lines the organs of the urinary system and is known here as urothelium.

UMBRELLA SHAPE CELLS OR FACET CELLS IN URINARY BLADDER



RS Learning Centre

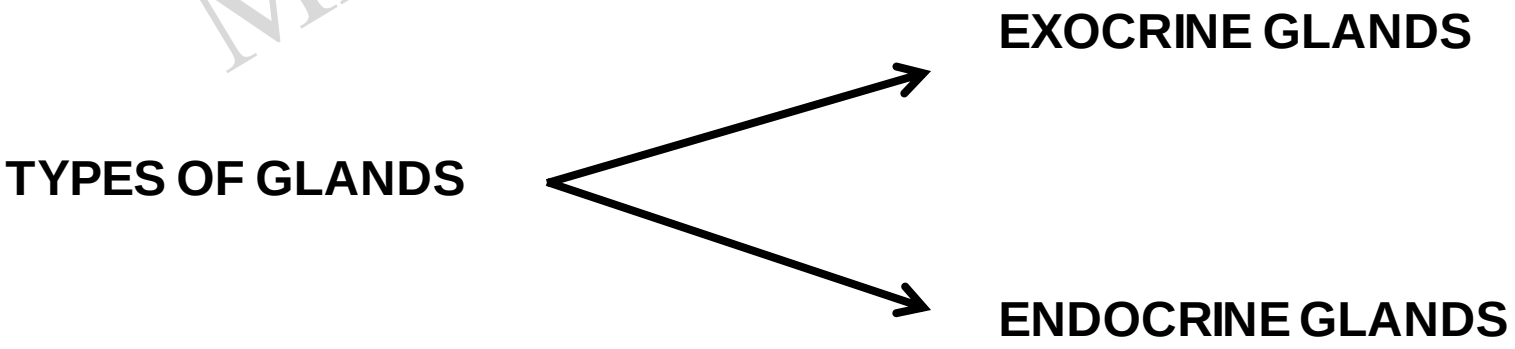
GLANDULAR EPITHELIA

Glandular tissue are one type of epithelial tissue and their function is to produce material to secrete.

GLAND: A cell , tissue or organ which secretes a useful material is called as a gland.

It is a form of epithelial tissue modified for its function namely secretion.

MARS Learning Centre

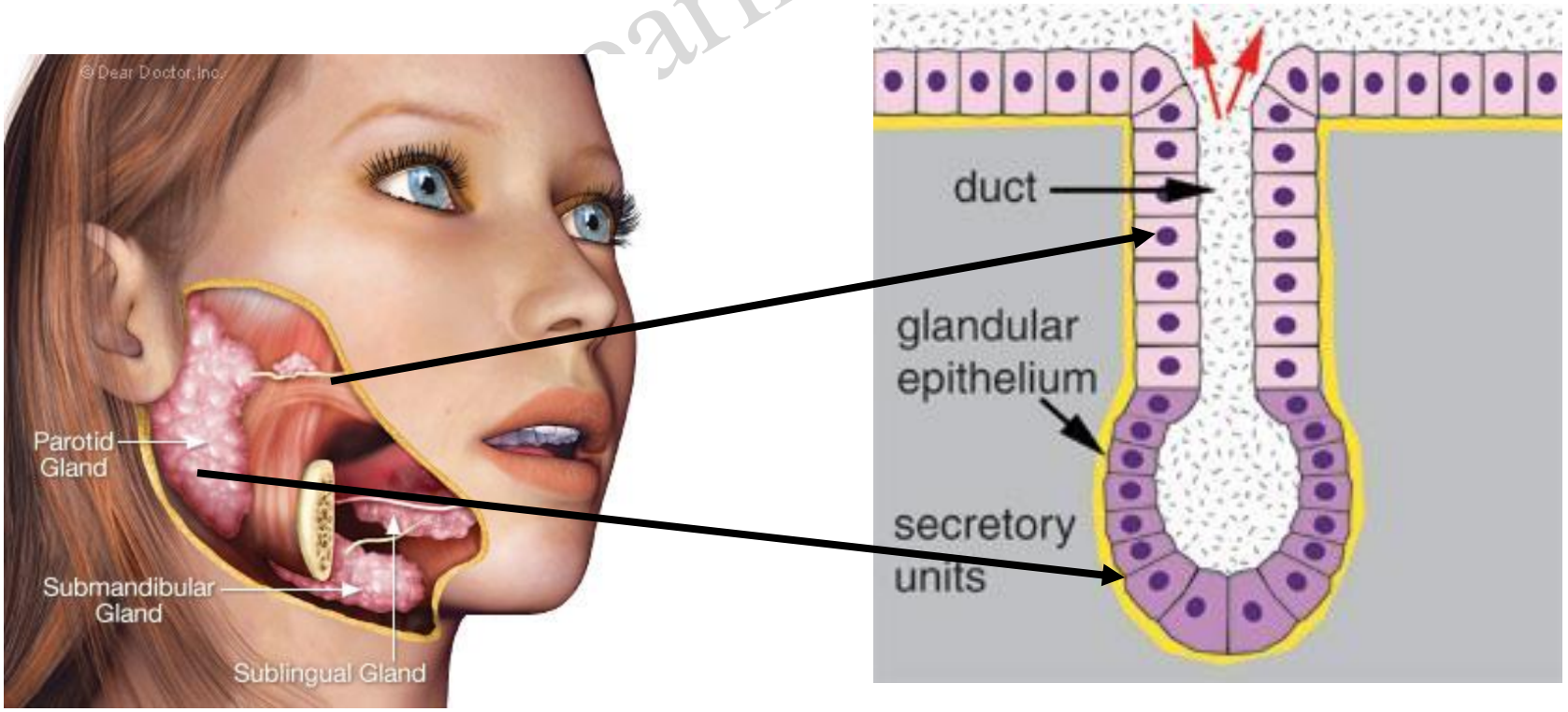


EXOCRINE GLAND:

Or DUCT GLANDS send their secretions through ducts to the sites of action.

Eg: salivary glands, sweat glands, mammary glands, earwax, digestive enzymes etc.

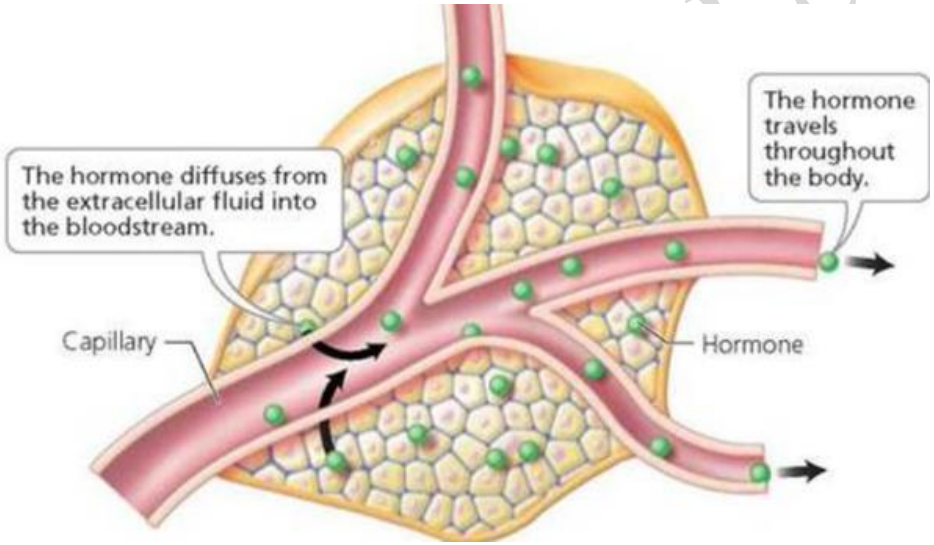
Learning Centre



ENDOCRINE GLAND:

Or DUCTLESS GLANDS discharge their secretions called hormones, into the blood that carries them to the target organs.

Eg: thyroid gland, adrenal gland, pituitary gland



EXOCRINE GLANDS

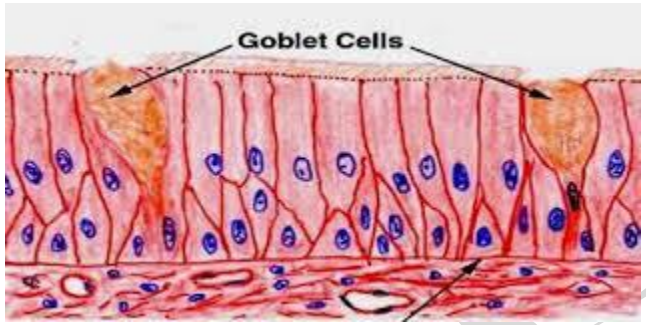
CAN BE FURTHER CLASSIFIED BASED ON

1. NATURE OF SECRETION
2. TYPE OF SECRETORY UNITS PRESENT WITHIN A SINGLE GLAND
3. SECRETORY NATURE OF GLANDS

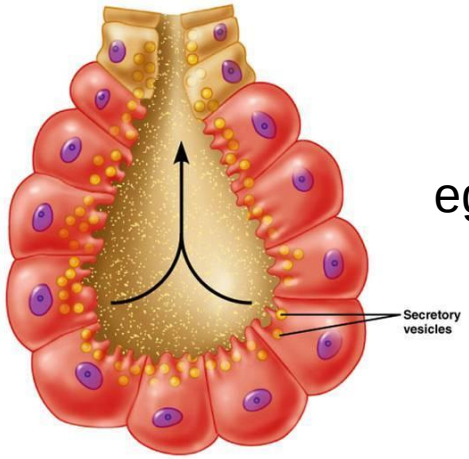
MARS Learning Centre

CLASSIFICATION OF GLANDS BASED ON THE NUMBER OF CELLS IN SECRETORY UNITS

1. **UNICELLULAR GLANDS:** **Are those containing only one cell as the secretory unit.**
   Eg: goblet cell



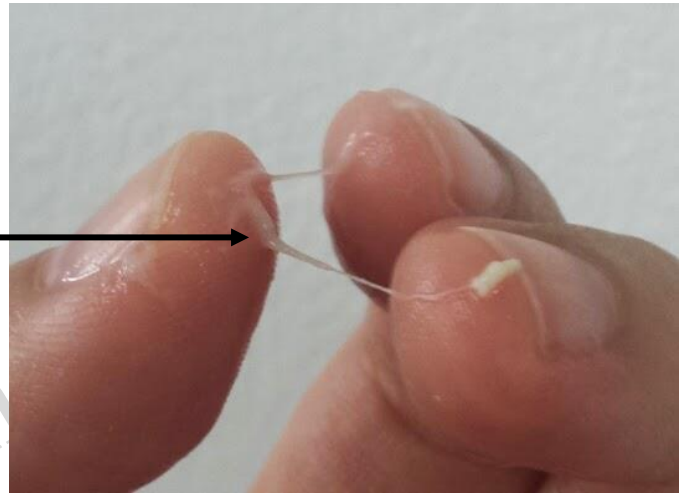
1. **MULTICELLULAR GLANDS:** **are those containing more than one cell in the secretory unit.**



eg: **most of the glands of the body(salivary glands)**

MARS Learning Centre

NATURE OF SECRETION



- **MUCOUS GLANDS**

Mucus is a thick secretion composed mainly of water, electrolytes, and a mixture of glycoproteins.

- **SEROUS GLANDS**

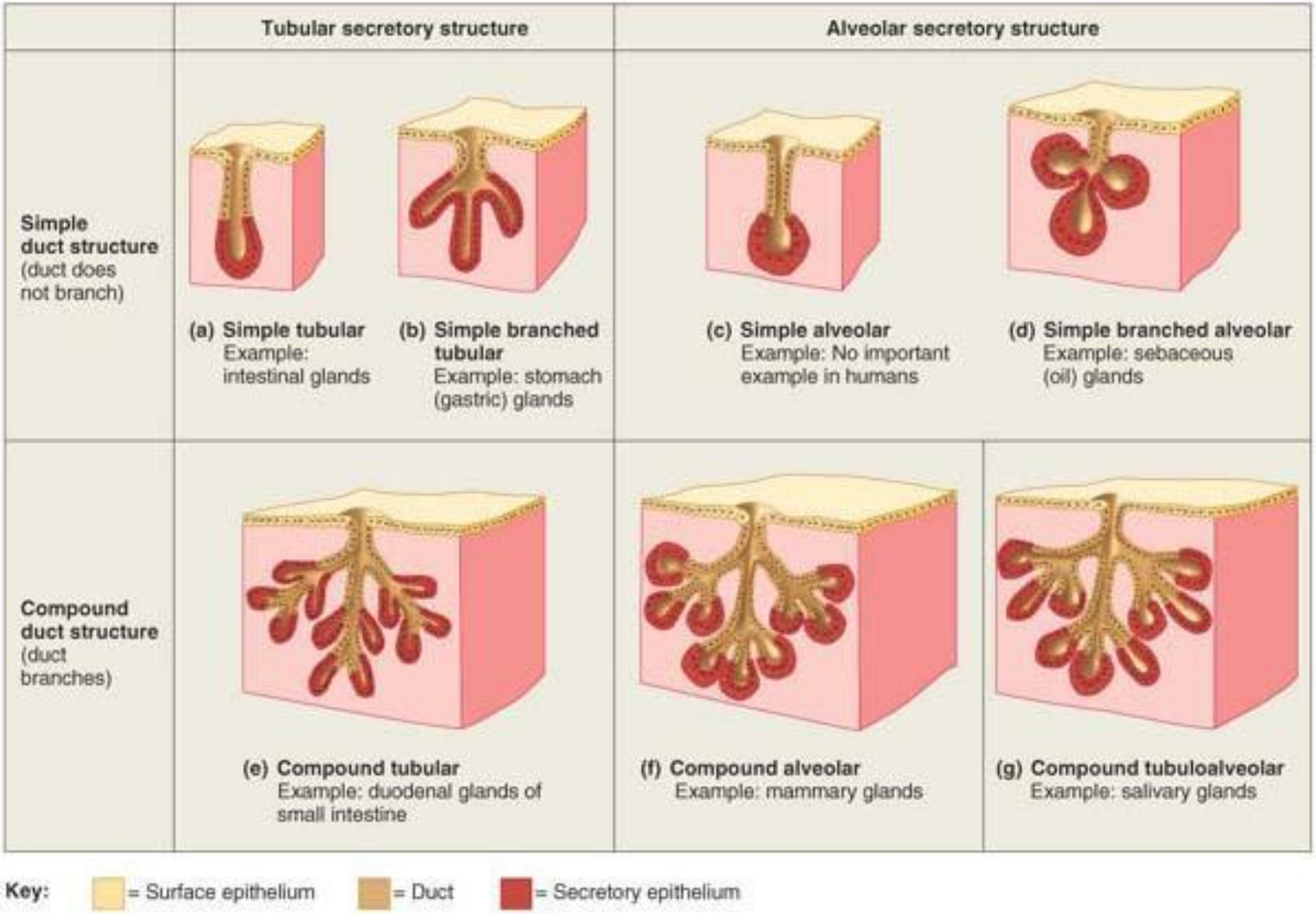
serous glands secrete mainly a watery fluid.

- **MIXED GLANDS**

contain both mucous and serous secretion.

MARS Learning

TYPE OF SECRETORY UNITS PRESENT WITHIN A SINGLE GLAND

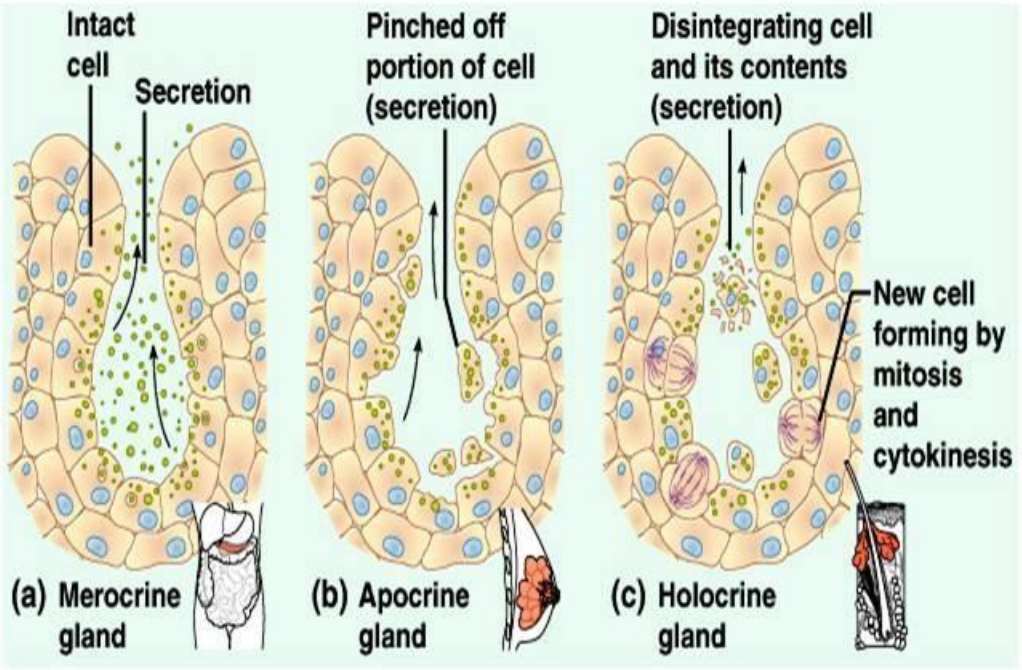


ON THE BASIS OF SECRETORY NATURE OF GLAND, THE GLANDS ARE OF 3 TYPES:

HOLOCRINE GLAND

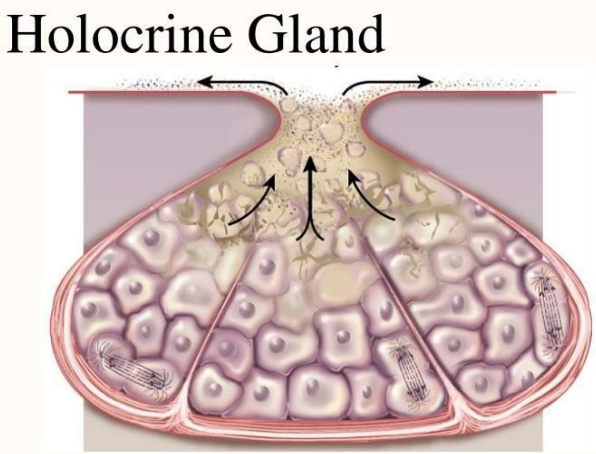
MEROCRINE GLAND

APOCRINE GLAND

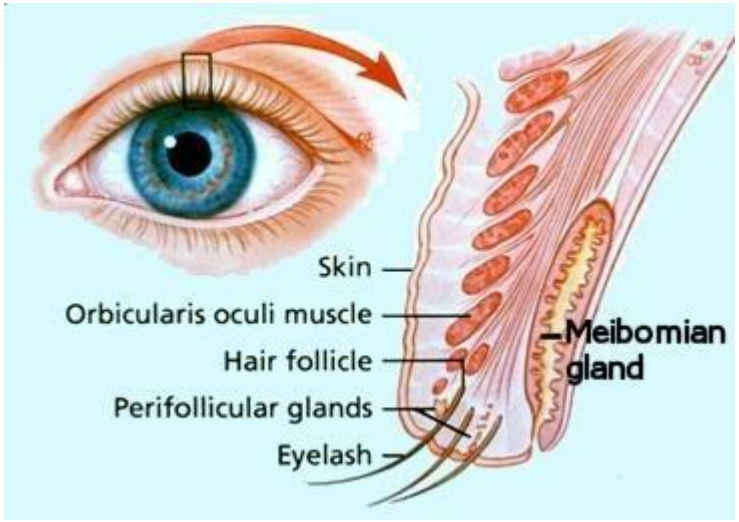


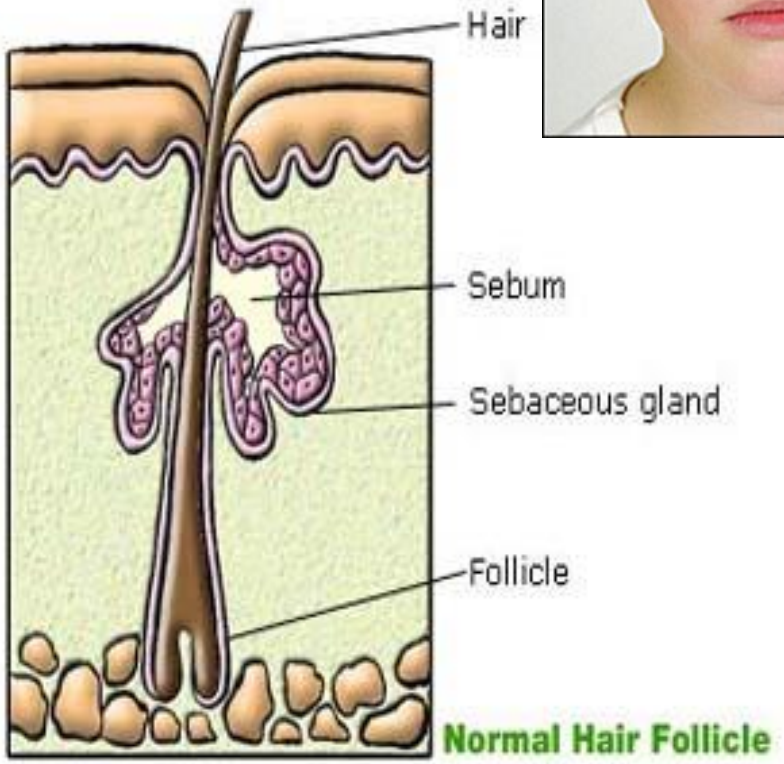
MA Learning Centre

HOLOCRINE : Those in which complete secretory unit disintegrates and comes out along with secretion. Eg: sebaceous gland meibomian and Zeis gland



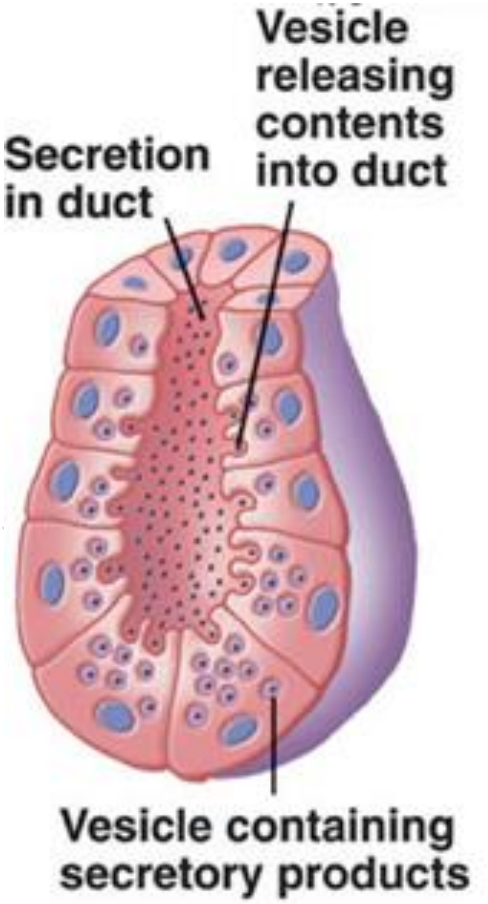
- Secretory cells disintegrate in order to deliver their accumulated product & some cell fragments
- Oil-producing glands of the scalp are an example

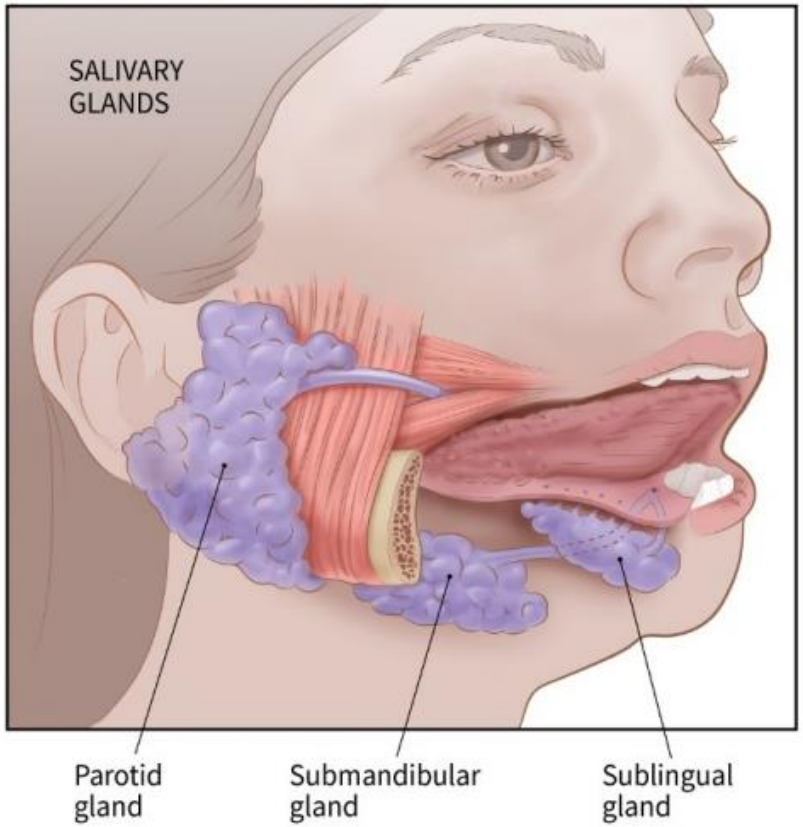




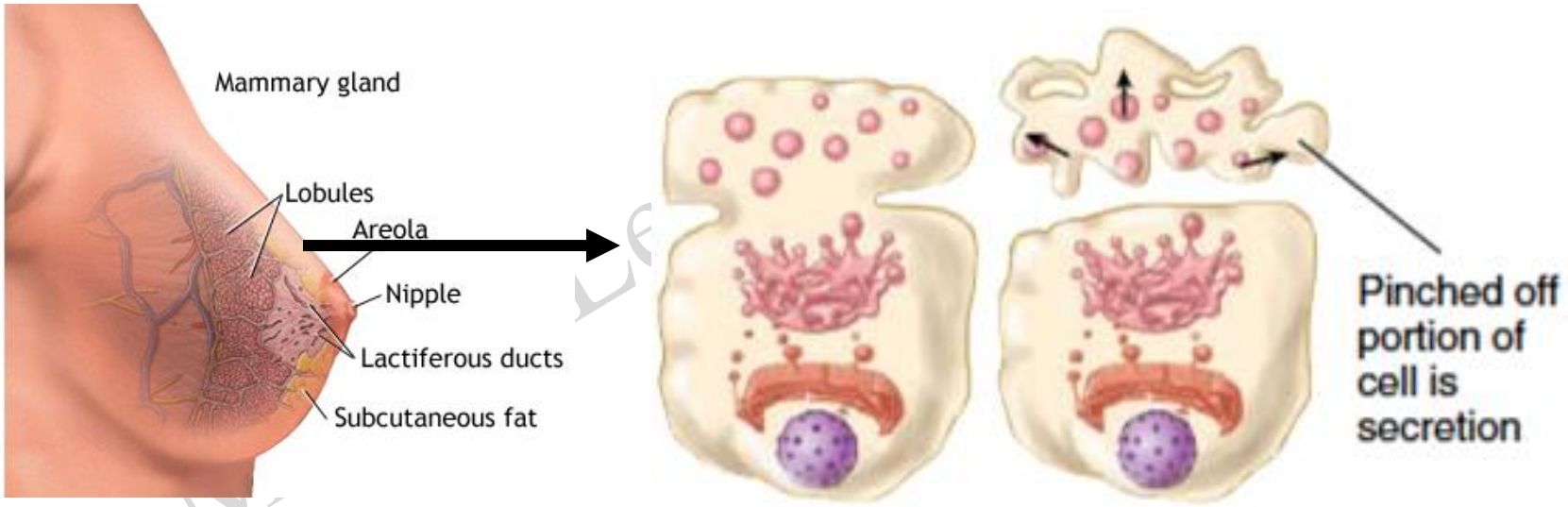
MEROCRINE / EPICRINE : **Secretion takes place by diffusion. Cells remain intact.**

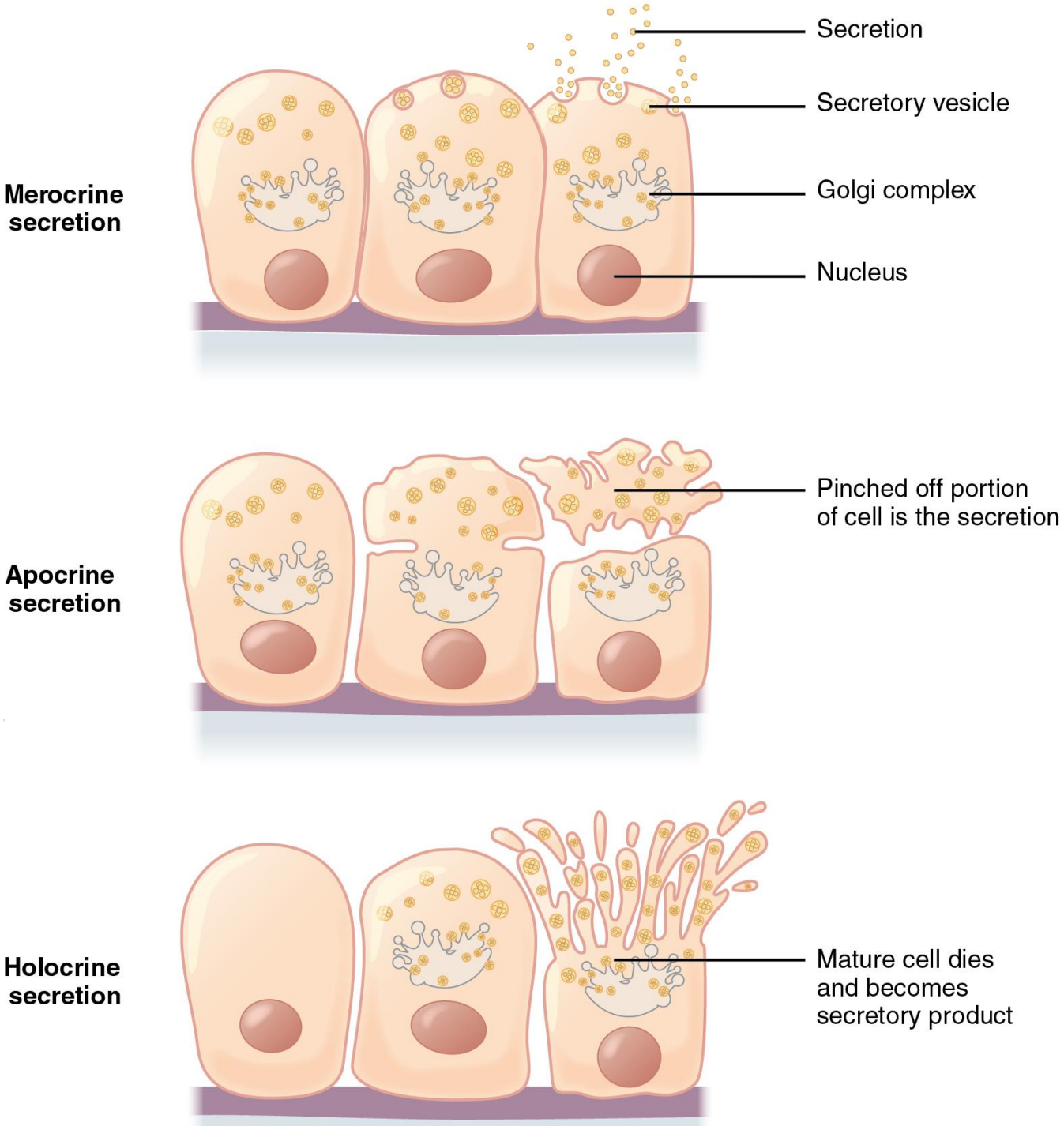
eg: sweat glands , salivary glands





APOCRINE: **Secretory product accumulate in the apical part of secretory unit. Later apical part breaks off from the cell and comes out with the secretion.** **Eg: mammary gland.**



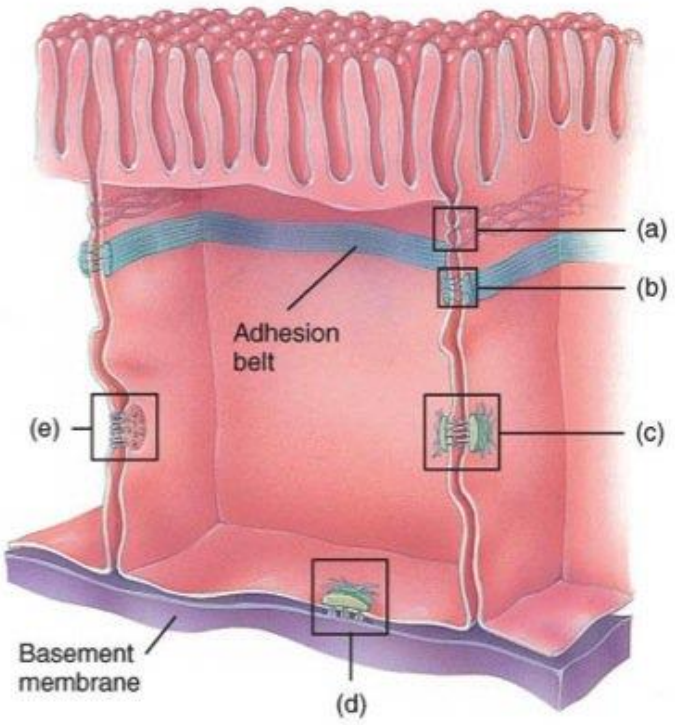

Merocrine secretion
Secretion
Secretory vesicle
Golgi complex
Nucleus
Apocrine secretion
Pinched off portion of cell is the secretion
Holocrine secretion
Mature cell dies and becomes secretory product

CELL CONTACTS / CELL JUNCTIONS

Cell junctions are contact points between the plasma membranes of tissue cells.

THERE ARE 5 TYPES:

1. **TIGHT JUNCTIONS**
2. **ADHERENS JUNCTION**
3. **DESMOSOMES**
4. **HEMIDESMOSOMES**
5. **GAP JUNCTIONS**



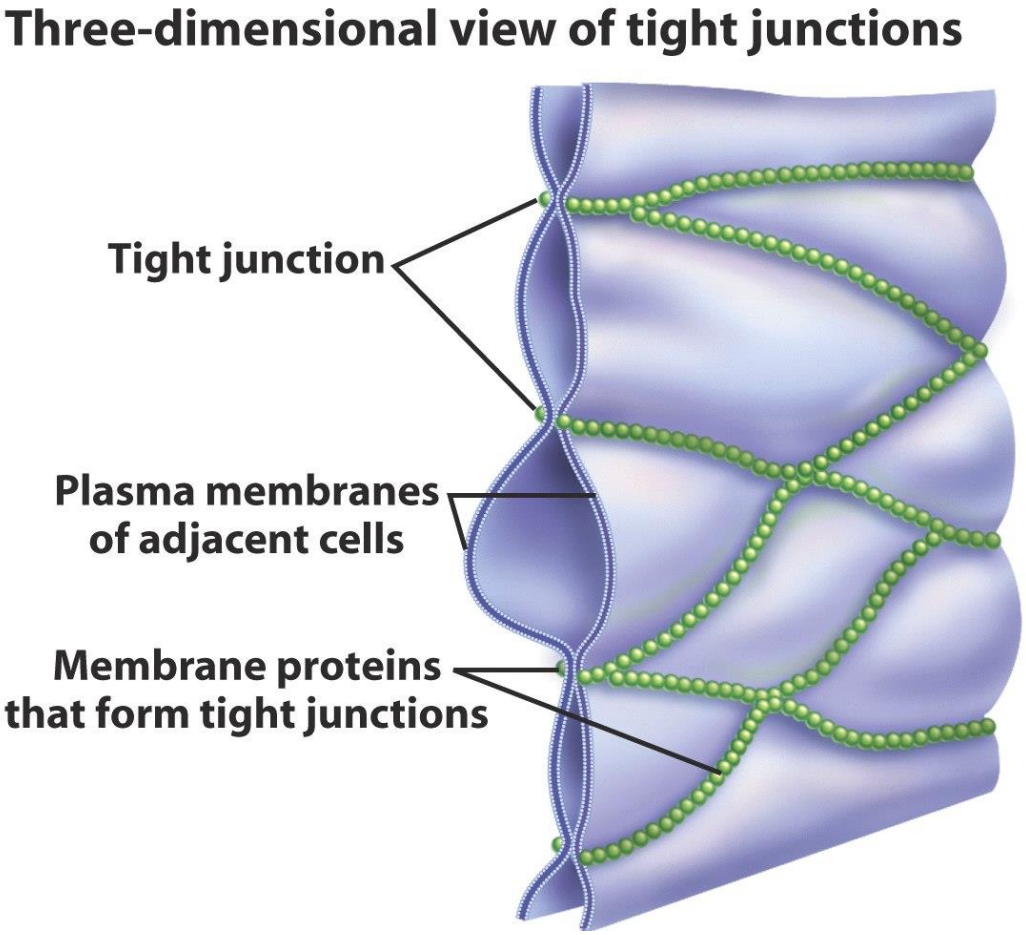
Cell Junctions

- A. Tight junctions
- B. Adherens junctions
- C. Desmosomes
- D. Hemidesmosomes
- E. Gap junctions

MAR

TIGHT JUNCTIONS/ OCCLUDING JUNCTIONS/ZONULA OCCLUDANCE

ing Centre

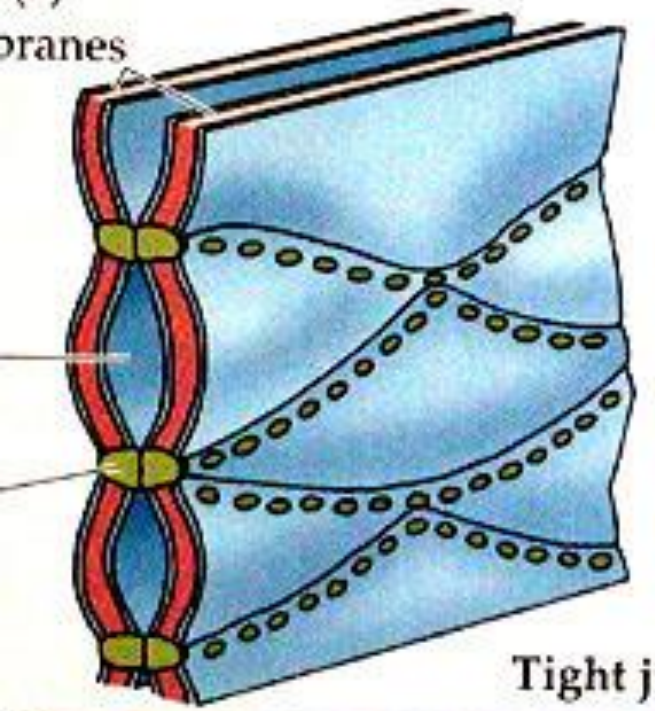


In a tight junction , the two plasma membranes are often fused and there is no intercellular space.

TIGHT JUNCTIONS

Eg: cells of epithelial tissue that lines the stomach
Intestines and urinary bladder.
Blood brain barrier

(a)



Tight junction

0.3 μm

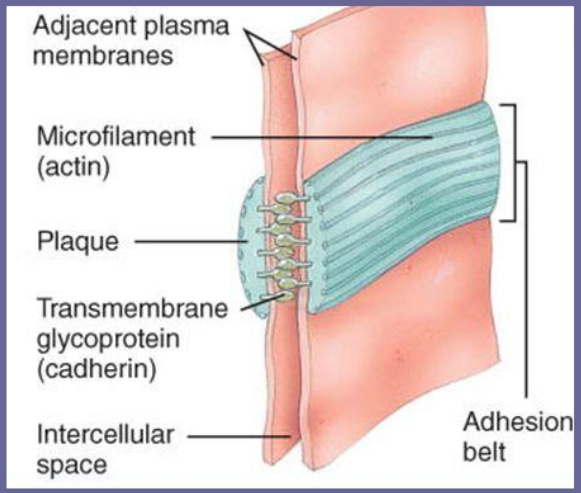
Tight junctions bar the movement of dissolved materials from the lumen through the space between epithelial cells. There is no intercellular space where there is a tight junction. Long rows of tight-junction proteins form a complex meshwork, seen at the bottom of the freeze-etched image.

ADHERENS JUNCTIONS

Contain plaque, a dense layer of proteins on the inside of the plasma membrane that attaches both to membrane proteins and to microfilaments of the cytoskeleton.

Learning Centre

Adherens Junctions



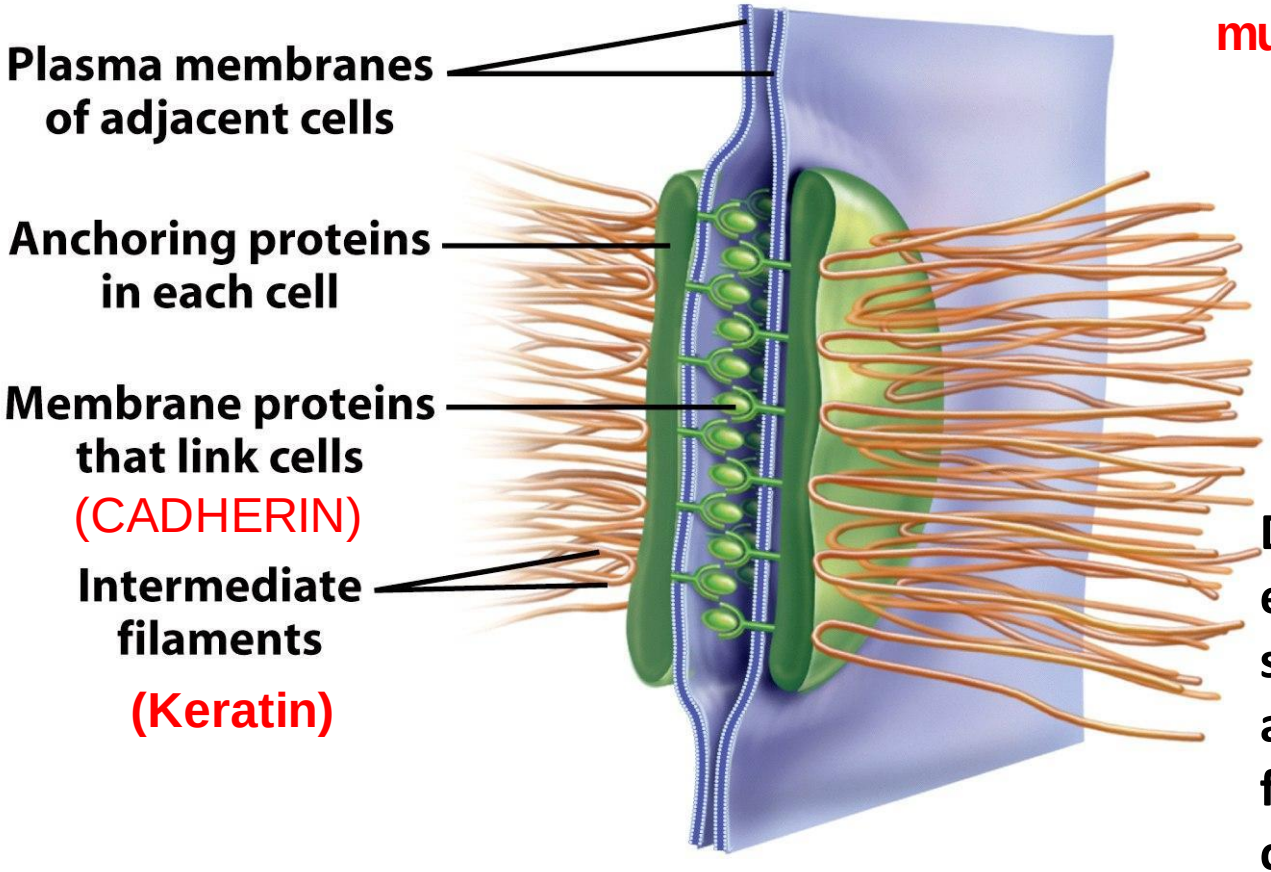
- Holds epithelial cells together
- Structural components
  - plaque = dense layer of proteins inside the cell membrane
  - microfilaments extend into cytoplasm
  - integral membrane proteins connect to membrane of other cell

Eg: adherens junctions
Help epithelial surfaces resist Separation during various contractile activities,as when food passes through the intestines

DESMOSOMES (ANCHORING JUNCTIONS MACULA ADHERENS)

Centre

Three-dimensional view of desmosome



Commonly seen in epidermis of skin, and among cardiac muscle cell in the heart.

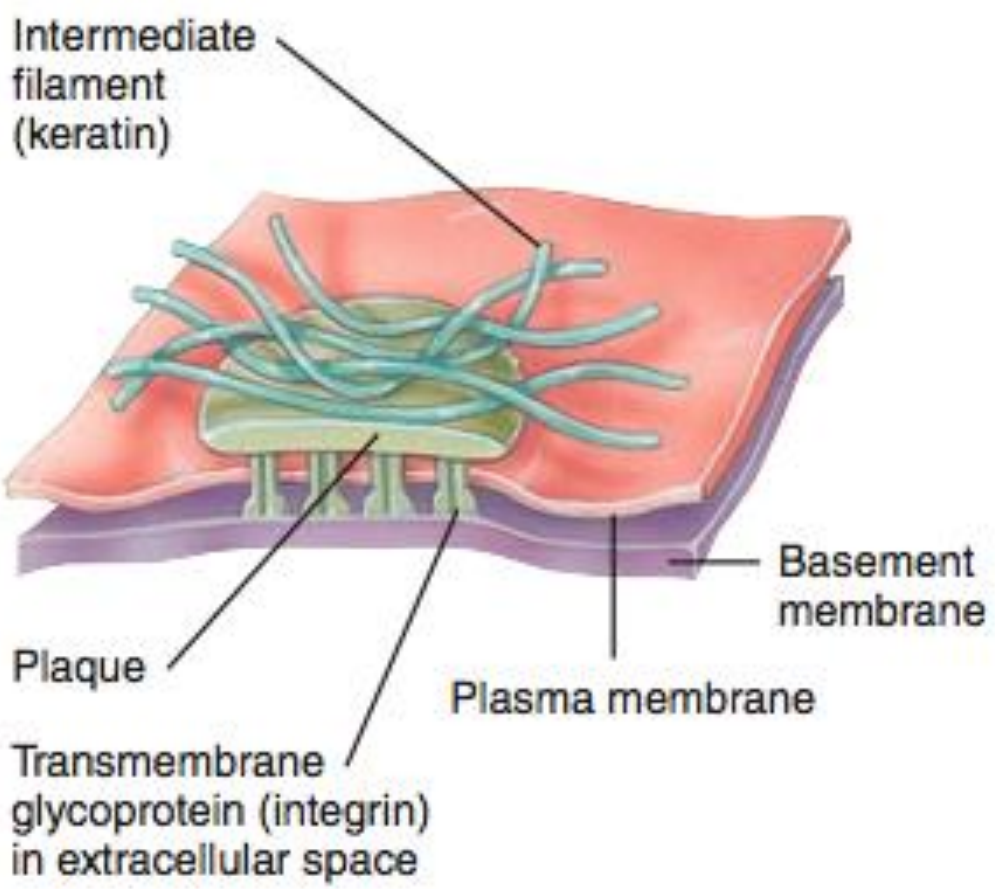
Desmosomes prevent epidermal cells from separating under tension and cardiac muscle cells from pulling apart during contraction.

HEMIDESMOSOMES

Hemidesmosomes anchor cells not to each other

But to the basement membrane.

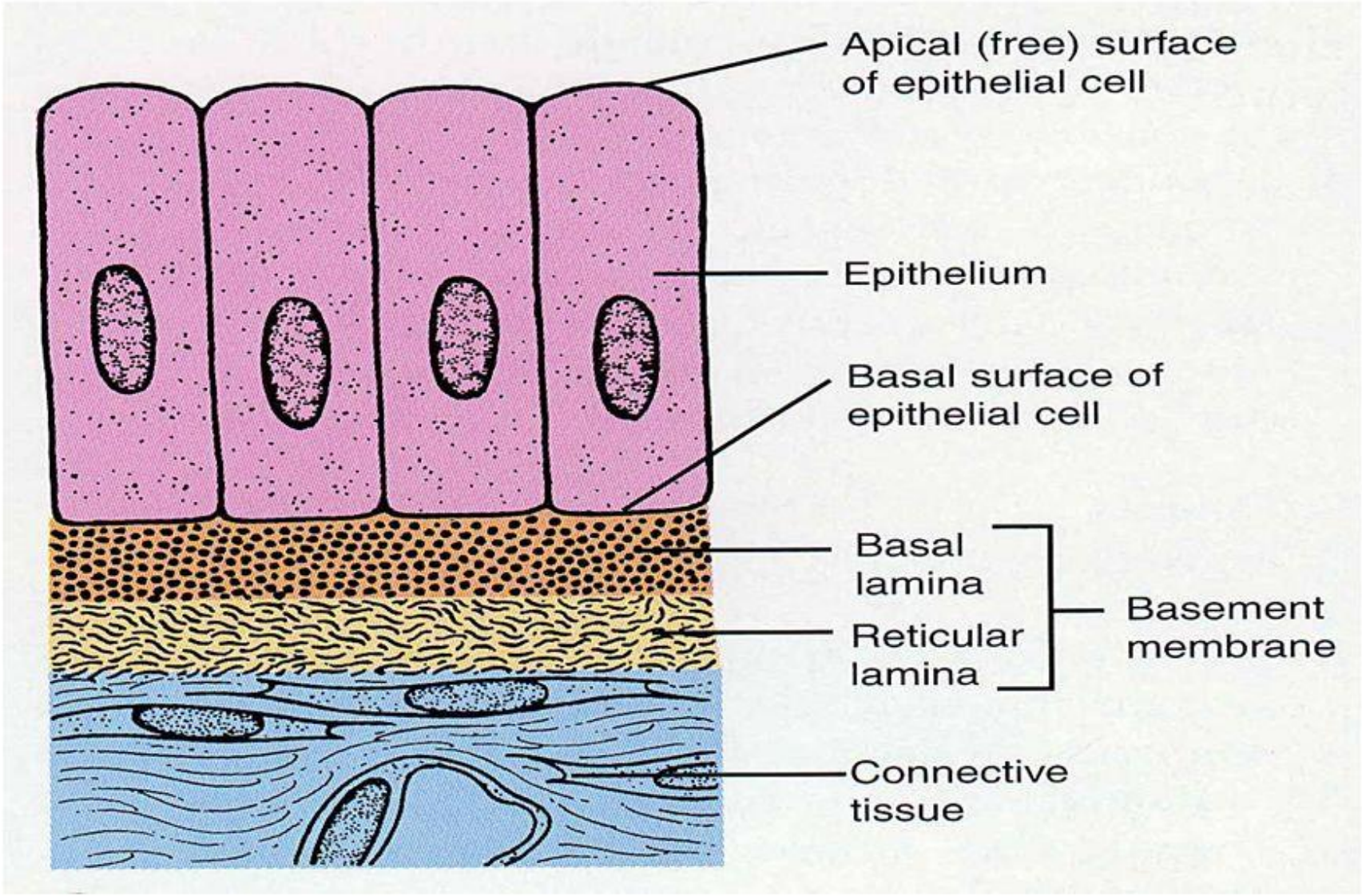
Centre



(LAMININ)

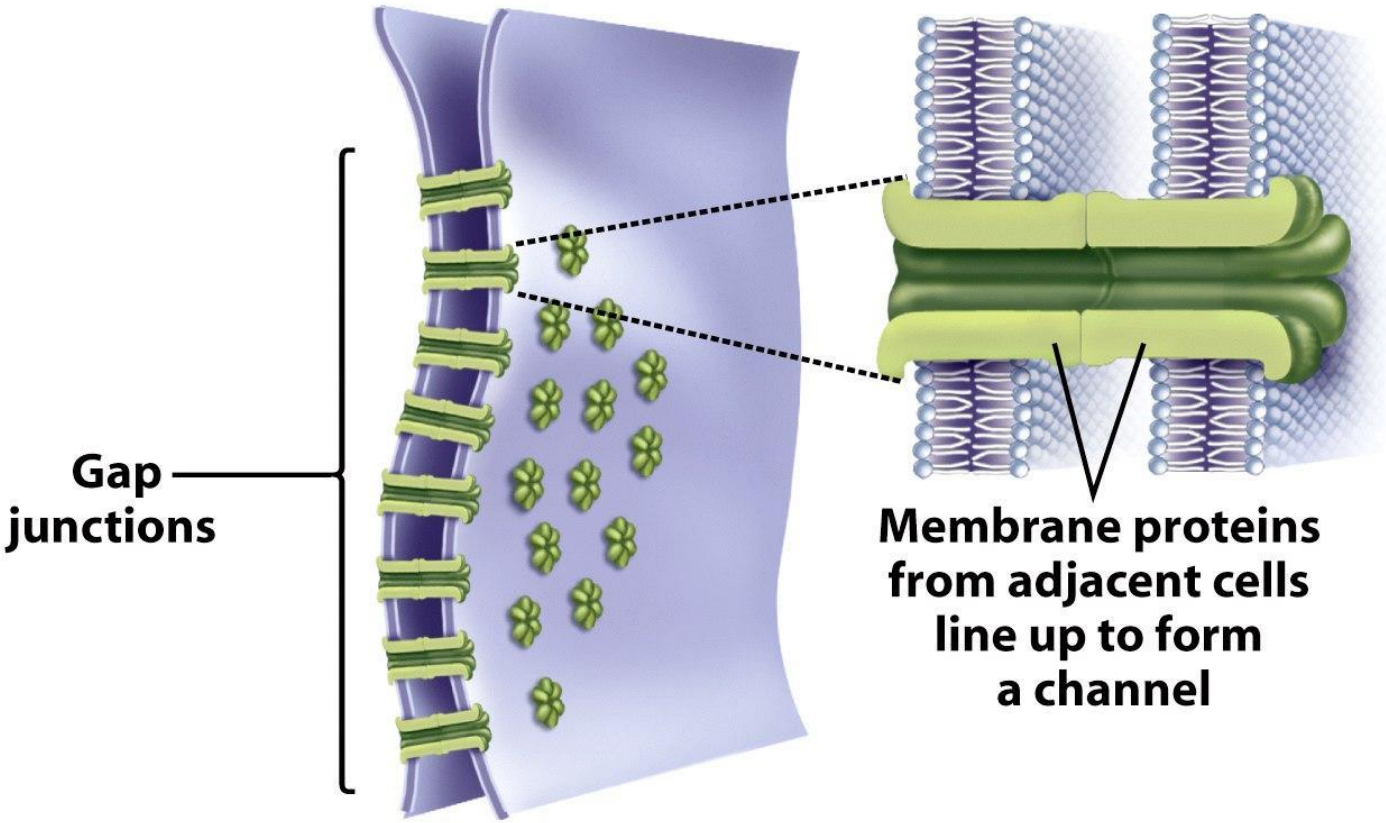
COMMON AT DERMIS – EPIDERMIS JUNCTION

Epithelial Tissues and Their Basement Membrane



GAP JUNCTIONS (COMMUNICATING JUNCTION)

Gap junctions create gaps that connect animal cells.

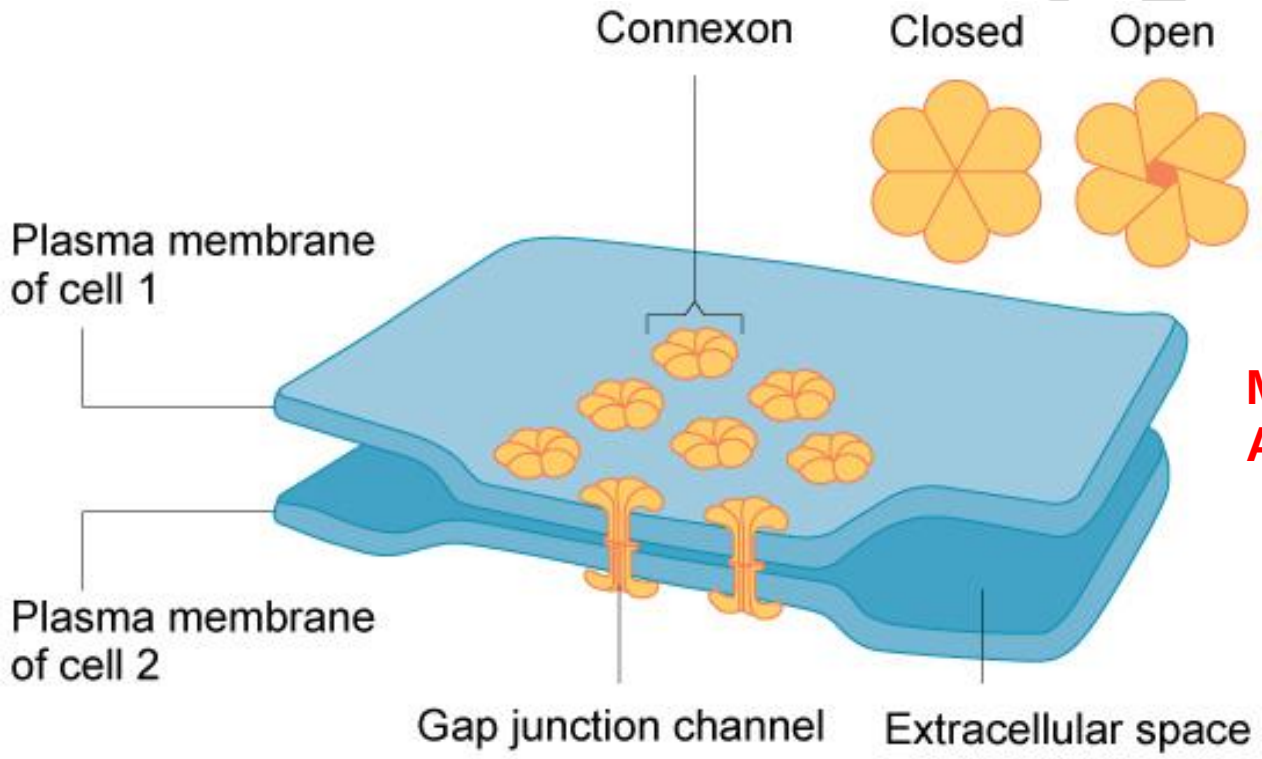


Gap junctions allow cells in a tissue to communicate with one another.

Movement through gap junctions is controlled by pH and Ca2+ concentration.

GAP JUNCTIONS

Gap junctions are a specialized intercellular connection between a multitude of animal cell-types. They directly connect the cytoplasm of two cells, which allows various molecules, ions and electrical impulses to directly pass through a regulated gate between cells.

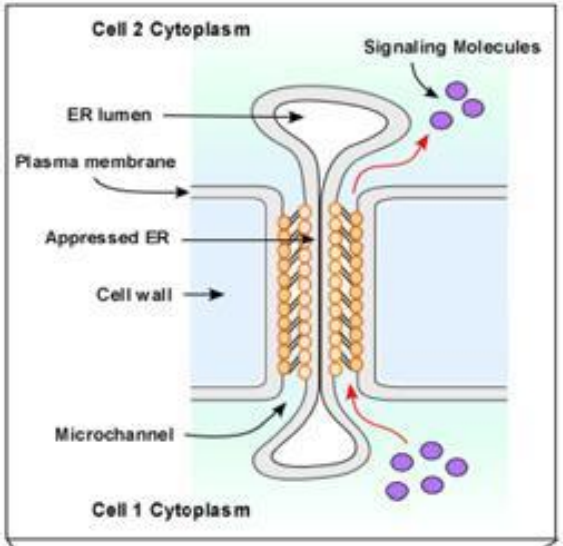


MEMBRANE PROTEINS ARE CONNEXINS

Transfer of nutrients takes place through gap junctions in avascular tissues such as lens and cornea of the eye.

Nerve and muscle impulses spread rapidly among cells through gap junctions.

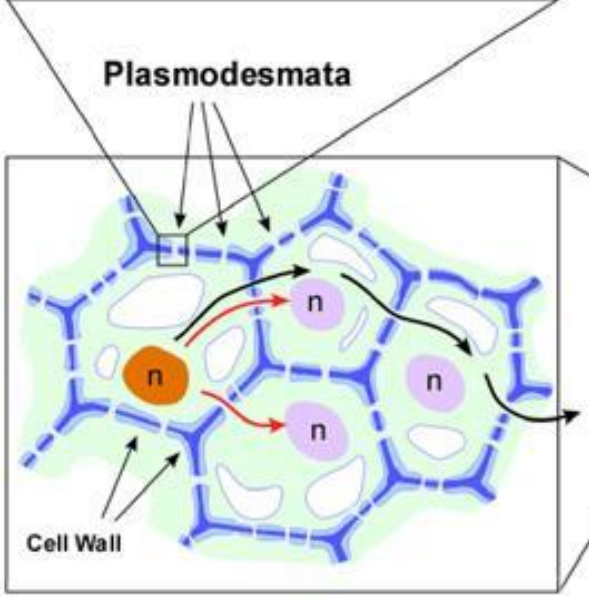
PLASMODESMATA



Plasmodesmata: Gateways for Cell-to-cell Exchange of Signaling Molecules

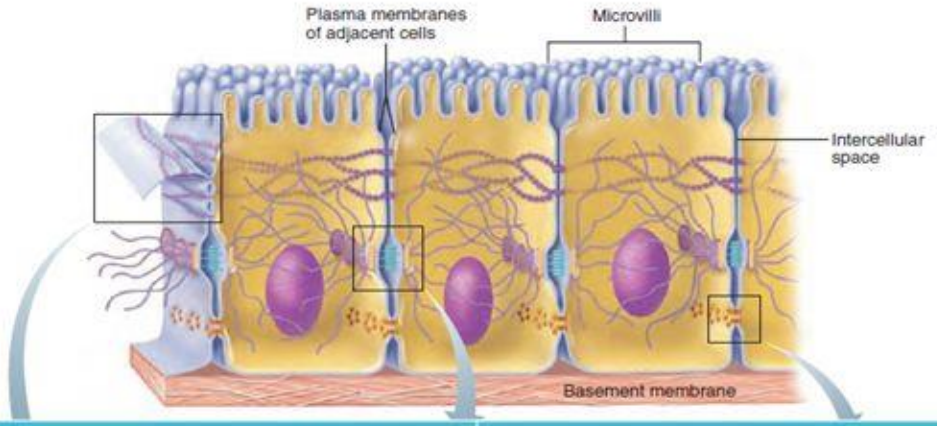
g Centre

Adjacent plant cells may actually be joined by extensions of cytoplasm that pass through openings in the cell walls and plasma membranes.



Similar to gap junctions in animal Cells.

Cell Junctions



Tight Junctions	Desmosomes	Gap Junctions
Impermeable junctions	**Anchoring junctions** bind to adjacent cells like Velcro	Allow for **intercellular communication**
Prevent molecules from passing through intercellular space	Form internal tension-reducing network of fibers; plaques on surface of membrane attach to protein filaments	Allow ions and small molecules to pass through channels formed by **connexon** protein cylinders
Example:	**Example:**	**Example:**
Lining of the digestive tract	Found in tissues subject to stress like skin; heart muscle	Found in electrically excitable tissue (heart; smooth muscle) to synchronize

Epithelial tissue arises from all the 3 germ layers , ECTODERM, ENDODERM and MESODERM.

Epithelial tissue is the first tissue to be formed in animals.

Founder of general histology is (word animal tissue) F.X. Bichet and plant tissue by Grew. Bichet is father of histology.

Marcello Malpighi is regarded as the father of animal histology.

The term epithelium was coined by Ruysh

Epithelial tissue is the only tissue with basement membrane.

Ciliated epithelium are of 3 types

KINOCILIA (basal body, 9+2, motile , RS and reproductive)
STEREOCILIA (no basal body, less motile, epidydimis)
MICROVILLI (no basal body. Small intestine)

Power of regeneration is found in epithelial tissue.

Keratinocytes are in the epidermis which is epithelial tissue.

MARS Learning Centre

keratinocytes produce keratin, the protein of the epidermis, which is epithelial tissue.

Melanocytes produce melanin to protect the skin from ultraviolet radiation and it results in tanning of the skin.

MARS Learning Centre

THANK YOU

MARS Learning Centre