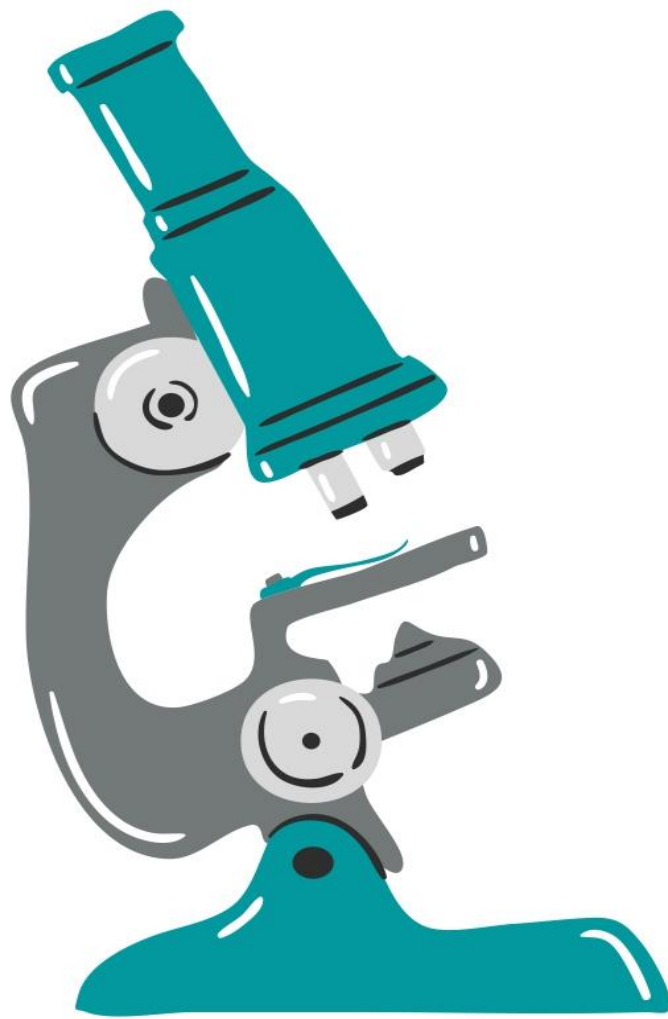


Sheet no. 5



Histology



Writer: Anonymous

Corrector: Yanal Ashour

Doctor: Ghada Abu el Ghanam

Instructions:

Blue → What doctor mentioned in their slides

Black → What doctor said in lecture

Italic → Sheet writers' notes that doctor did **NOT** mention in the lecture

Note: All pictures are taken from doctor's slides

Highlight → What doctor emphasized

Note: Doctor didn't finish epithelium cells section yet, so the first section will continue to talk about stratified cells, then it'll talk about our new topic.

Recall from last sheet, types of epithelia:

- 1) Simple squamous (endothelium, in lung alveoli and mesothelium)
- 2) Simple cuboidal
- 3) Simple columnar
- 4) Pseudostratified columnar
- 5) Stratified squamous (keratinized and non-keratinized)

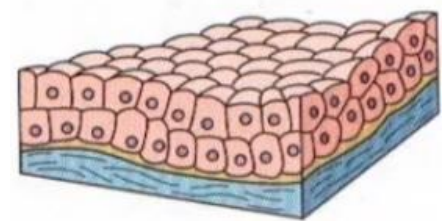
Note: next epithelia are rare types

6) Stratified cuboidal epithelium

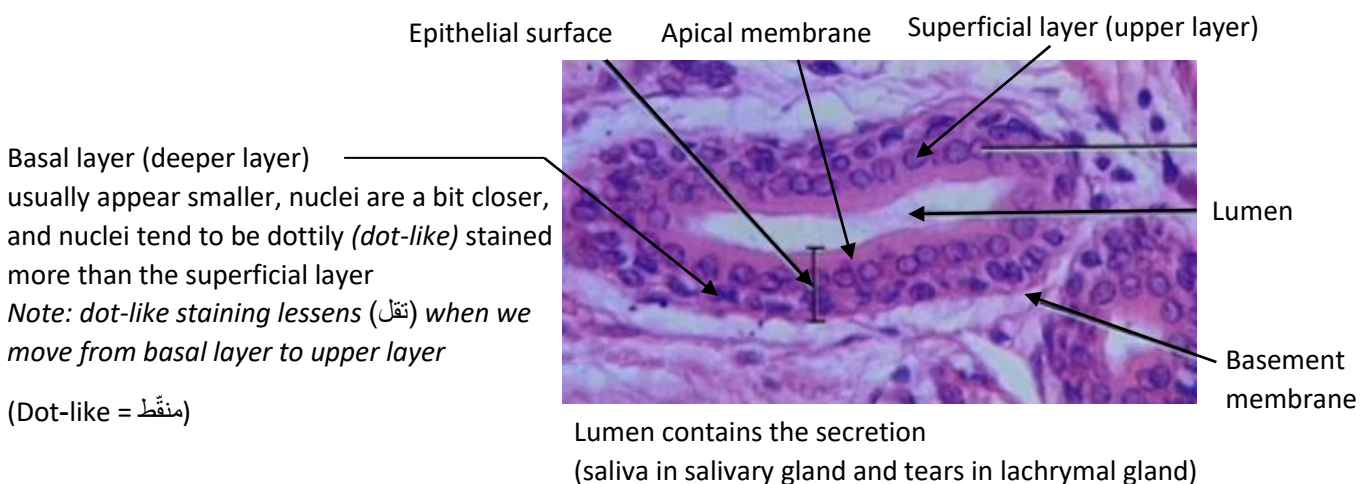
Location: larger ducts of exocrine glands such as salivary glands (excretory ducts)

Note: tiny ducts within the gland itself have simple cuboidal

Example: salivary gland in oral cavity secretes saliva, this saliva is delivered to the oral cavity. Within the gland we have tiny ducts (simple cuboidal), then these tiny become larger and larger until they're larger ducts (stratified cuboidal)



Cuboidal

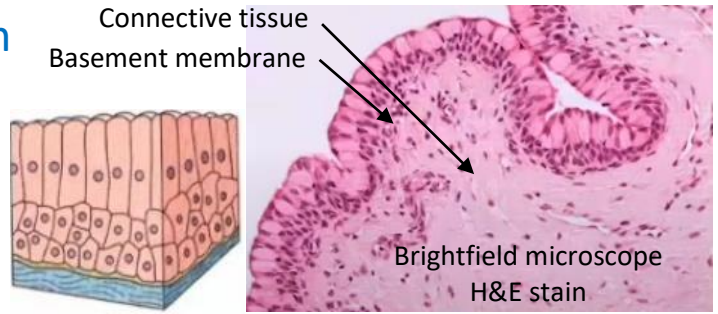


Note: the doctor mentioned here something about paracellular movement, but she didn't finish it (it seemed like she didn't want to talk about it), if someone knows what it is please leave a comment <3

7) Stratified columnar epithelium

Location: conjunctiva, larger ducts

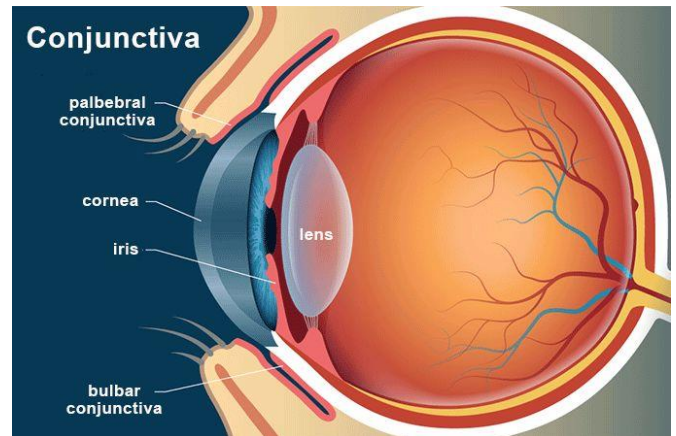
This type is rarer than the previous one



Note: we can notice that the deeper layers aren't columnar, but we ALWAYS look at the most superficial layer

Eye parts:

- Conjunctiva covers the sclera and lines the inner surface of the eyelid
- Conjunctiva cells **usually** secrete mucus



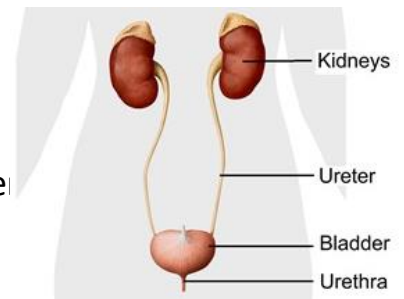
8) Transitional epithelium (urothelium)

Location: urinary tract (urinary bladder & ureters, urethra)

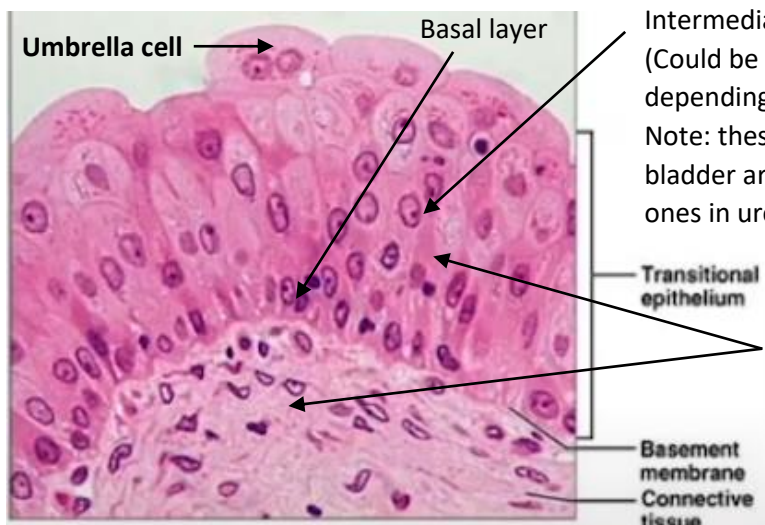
ureter: what carries urine from kidney down to the urinary bladder

urethra: what takes urine outside

Function: allows stretching (changing in size) and protection of inner tissues



I added this picture to help you understand more, doctor didn't use it



Intermediate layers
(Could be more than one layer depending on the region)
Note: these layers in urinary bladder are more than the ones in ureter

We can distinguish two tissues in this picture. In the lower tissue the ECM is much more than the cells (this is because the staining and the distribution of nuclei is different from the upper tissue)

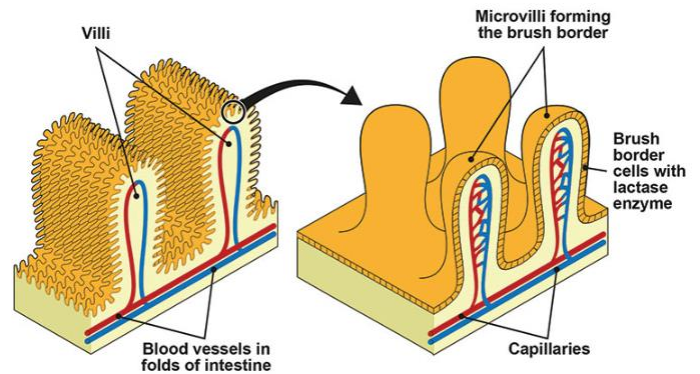
recall: ECM staining looks brighter than nuclei (pink)

Umbrella cells are binucleated cells, and they are rounder than normal cells. They're subjected to urine (urine is rich in urea which is toxic), they prevent urine leakage thus protecting cells, in addition to providing stretchability.

Specialized apical structures

1) Microvilli

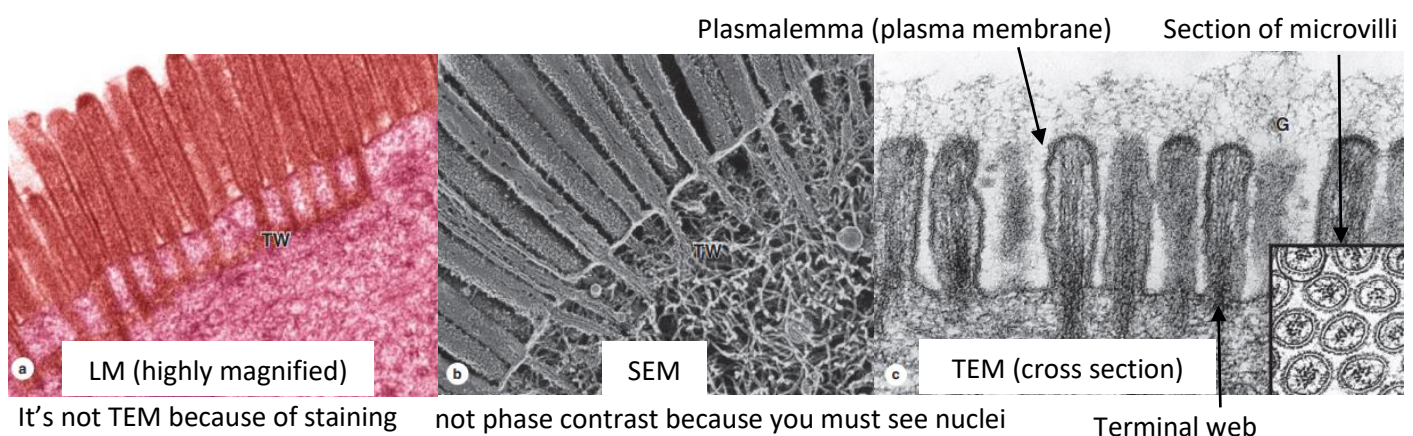
- Finger-like extensions of plasma membrane of apical epithelial cell.
- Present mainly in absorptive cells (columnar/cuboidal).
- Main function is the absorption of nutrients from intestines and glomerular filtrate:
 - Striated border in the intestine
 - Brush border in the kidney (tubules with simple cuboidal with microvilli on)
- Increase the surface area for absorption.



Terminal web: is a filamentous structure found at the apical surface of epithelial cells that possess microvilli. It is composed primarily of **actin** filaments, which also anchors the terminal web to the apical cell membrane. (زي أساسات البيت بتعطي دعامة للبناء)

Note: doctor said "يا محترمين" you were supposed to take terminal web in biology, and you are required to search it up". So, I did it for you 😊

Our Book: Each microvillus contains bundled actin filaments capped and bound to the surrounding plasma membrane by actin-binding proteins (Figure 4–8d). Although microvilli are relatively stable, the microfilament arrays are dynamic and undergo various myosin-based movements, which help maintain optimal conditions for absorption via numerous channels, receptors, and other proteins in the plasmalemma. The actin filaments insert into the terminal web of cortical microfilaments at the base of the microvilli (مؤلف الكتاب نفسه مش فاهم شو هاد بس حظيته احتياط للنيردات)

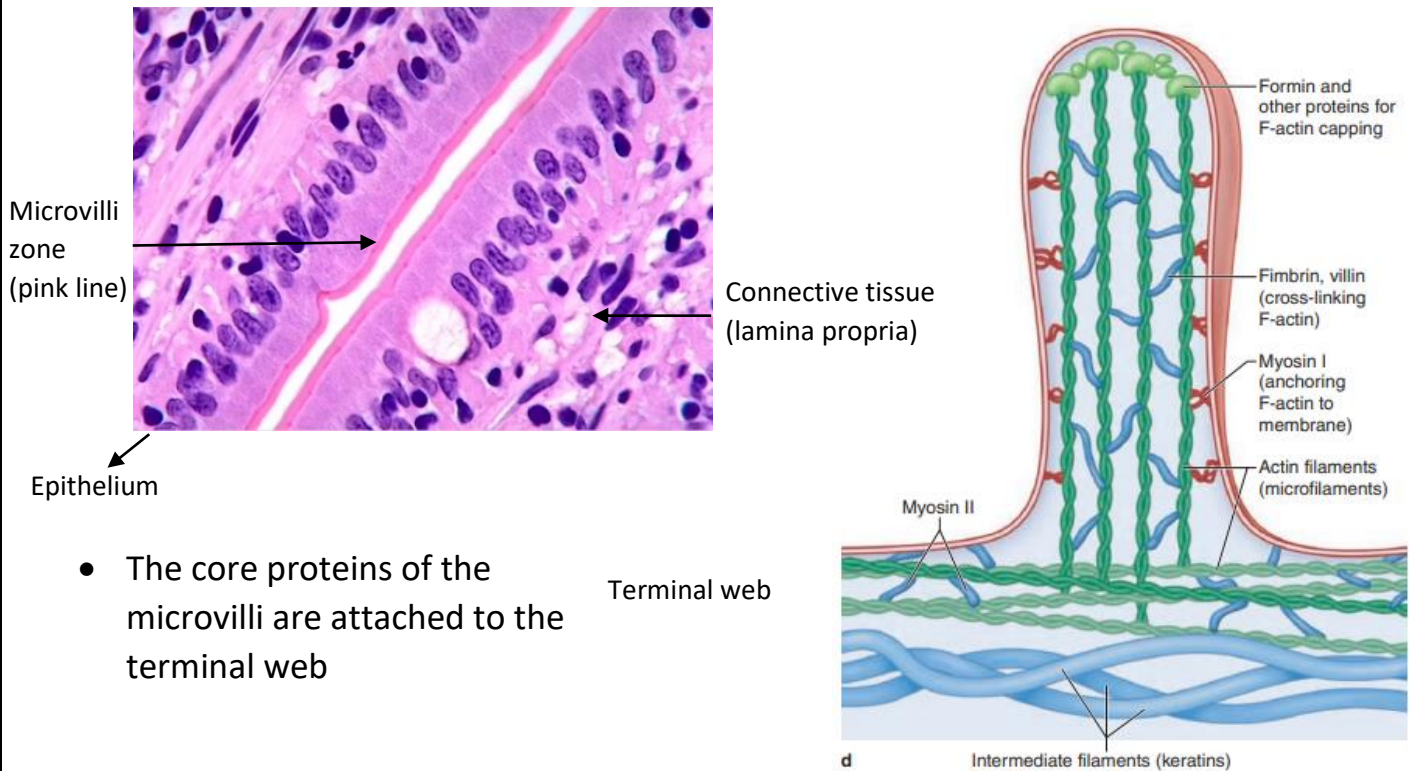


It's not TEM because of staining

not phase contrast because you must see nuclei

Terminal web

Note: the length of microvilli is around $1\ \mu\text{m}$ and the width $0.1\ \mu\text{m}$, and we have hundreds of thousands of microvilli on each cell.



- The core proteins of the microvilli are attached to the terminal web

The mucosa is a membrane that lines various cavities in the body, and covers the surface of internal organs, in short it consists of one or more layers of epithelial cell overlying a layer of loose connective tissue.

Note: it should be in a lining. For example: lining of the GI tract (oral cavity → oral mucosa) (respiratory tract → respiratory mucosa) what is common between those locations is that the epithelium is in contact with something foreign (like food in GI tract and air in respiratory tract)

Note: plasma membrane is fixed to the terminal web by Myosin II

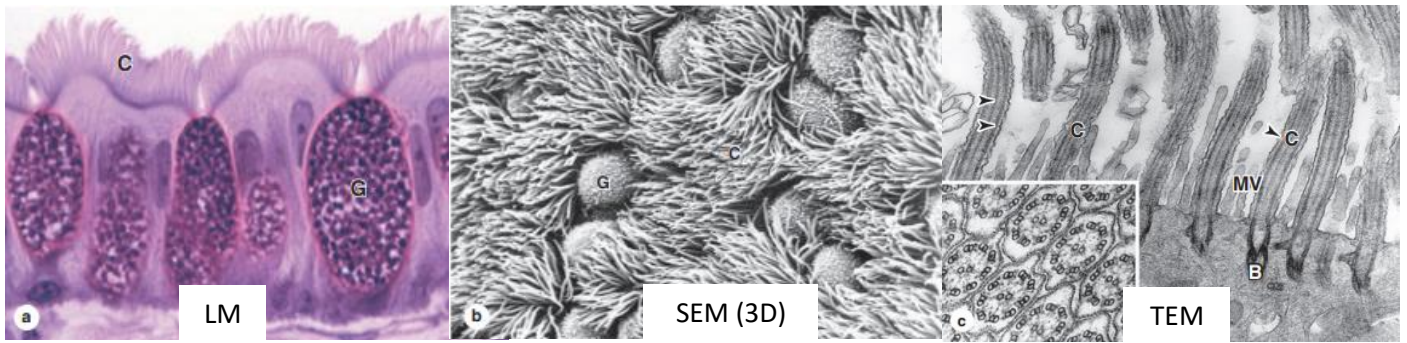
Note: microvilli are immotile (غير متحرك)

Note: don't forget to look at the highlighted parts in pictures (in the whole sheet)

2) Cilia

- Motion detection
- Motile cytoplasmic hair like projections capable of moving fluid and particles along epithelial surfaces.
- Line cells in the respiratory organs, uterine tubes, and efferent ducts in testes.
- They move rhythmically and rapidly in one direction.

Recall: we usually see cilia on pseudostratified epithelium (respiratory tract)

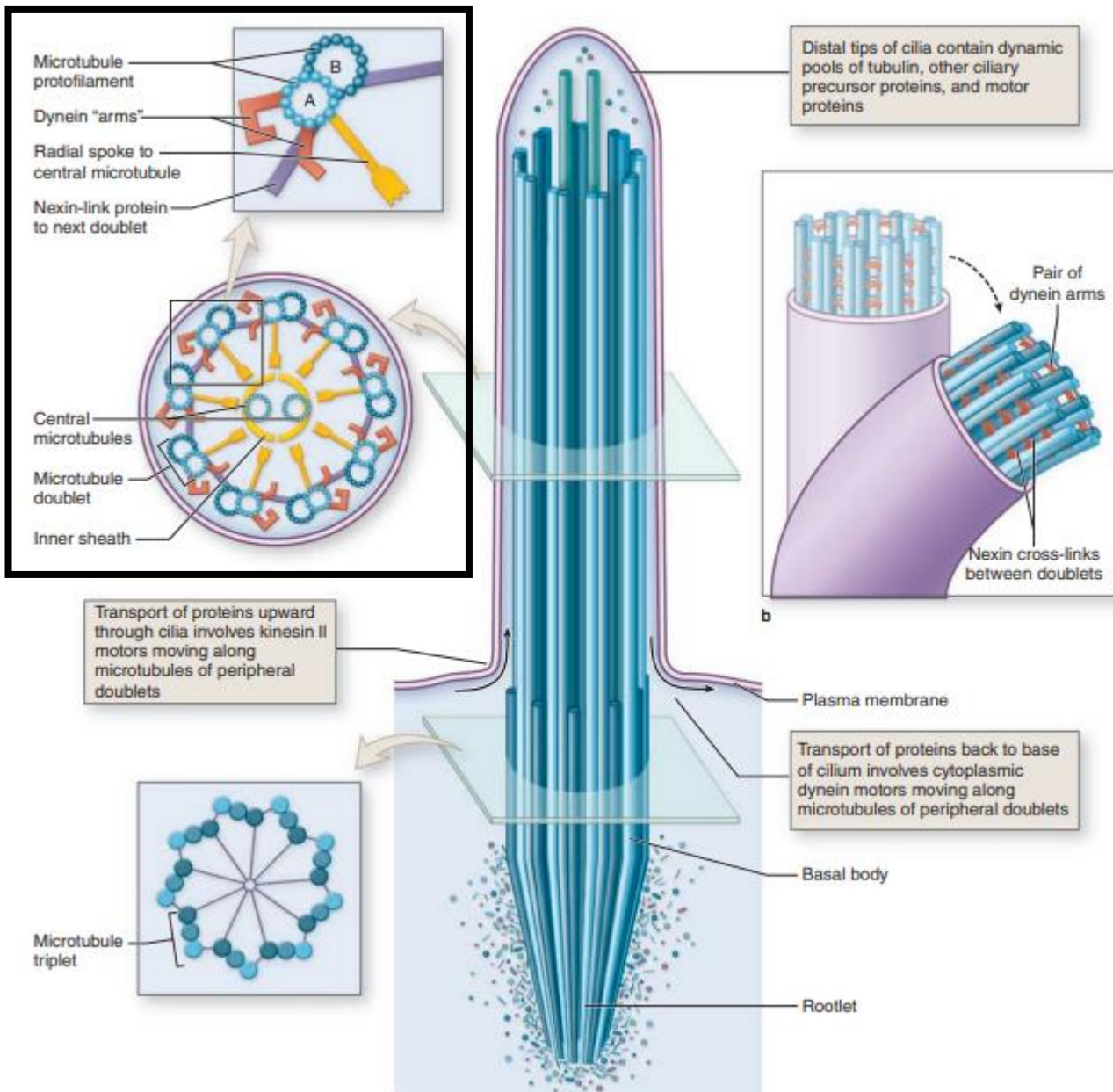


LM
مقطع عرضي

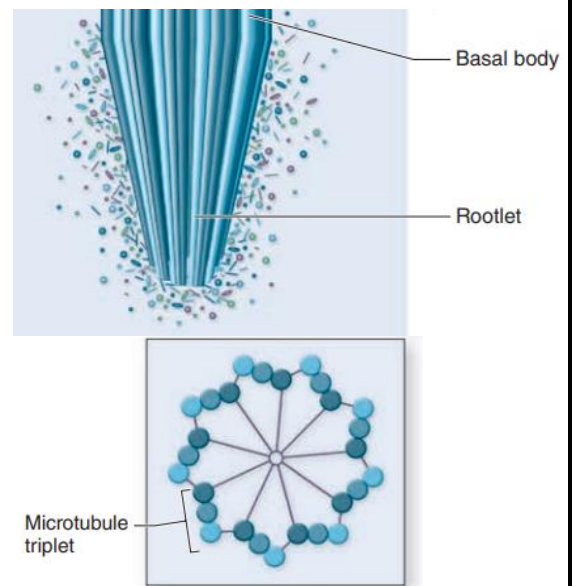
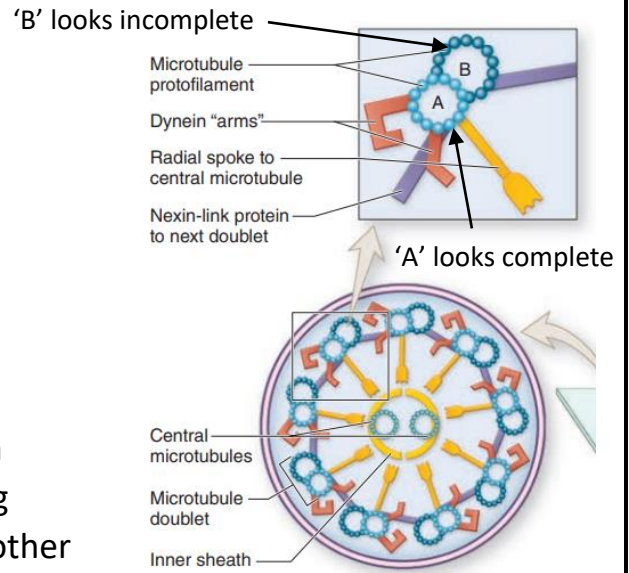
SEM (3D)
Over view (vertical section)

Notes:

- our book uses letters to represent words, *c* for cilia and *g* for goblet cells, *B* for basal body, etc (look at the pictures above)
- goblet cells don't have cilia on them
- cilia look like تبغ السجادة
- cross section won't give you a perfect micrograph because they move in many directions (يعني بتتحرك يمينا ويسارا ولقدام ولورا مشان هيك بتبينش بطولها الكامل)



- We have 9 doublets
 - We have 2 single doublets in the centre
 - Nexin-link protein binds doublets together
 - All doublets move as one unit
 - Dynein "arms" are connected to **microtubule A**
 - dynein arms have motor proteins, which when activated by ATP, briefly bind the neighbouring microtubule and the doublets slide past each other slightly, the sliding motion is restricted by nexin cross-links between doublets
 - Motor proteins distinguish between the cilia and microvilli
 - Doublets are connected to the inner sheath by radial spoke
- The basal body has 9 triplets BUT it doesn't have central microtubules and dynein "arms". so basal bodies don't move, the movement happens only in the core of the cilia



- Usually, cilia move in one direction
- in respiratory tract cilia move upward so they expel mucus
- in uterus, the cilia on the simple columnar move inward, so they move the oval toward the inner cavity of uterus

Note: those pictures are so important!

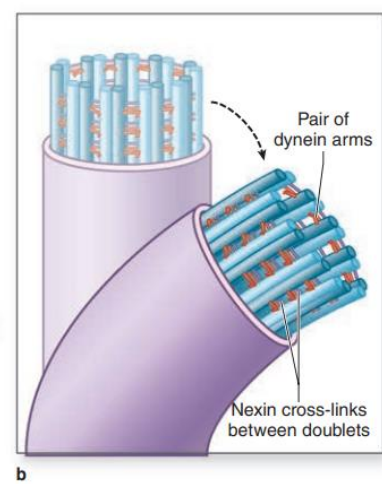
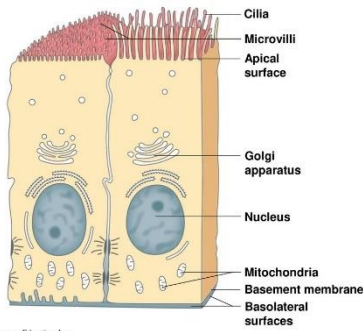


Figure 4-1 The Polarity of Epithelial Cells



Pseudostratified

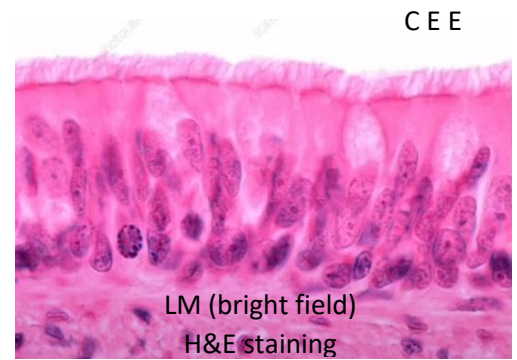
How?

Nuclei don't seem aligned

And we have goblet cells and cilia

So, this sample was taken from respiratory epithelium (ciliated pseudostratified)

Note: it could be male genital tract
but it doesn't have cilia so it's respiratory



3) Stereocilia

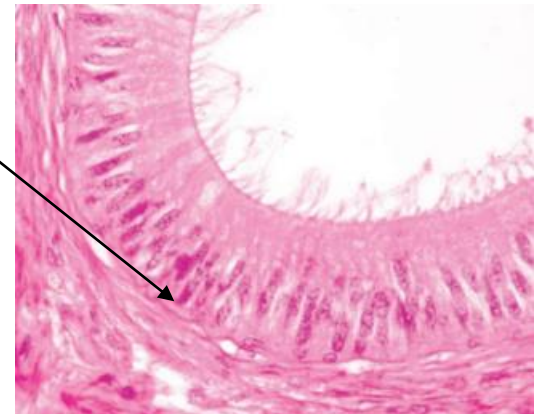
- Increase surface area
- Absorption (same as microvilli)
- Branched and long
- Motion detection

The lining in the inner ear (cochlear) is epithelial with stereocilia, but here stereocilia aren't for absorption (they have sensory nerve endings that can detect motion)

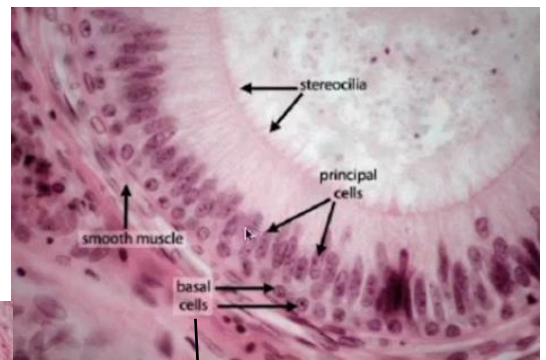
(simply, they convert physical force from sound into an electrical signal)

- Male genital tract and inner ear
- Longer than microvilli
- Immotile (no motor protein)
- Less in number than microvilli
- Branched (because they're long)
- Motor proteins are only available in cilia

Basal cells
(don't reach the surface)



- This sample was taken from epididymis (male genital tract)
- This is pseudostratified epithelium (it's not columnar because the nuclei aren't aligned -on the same level-)



Do not reach the upper surface



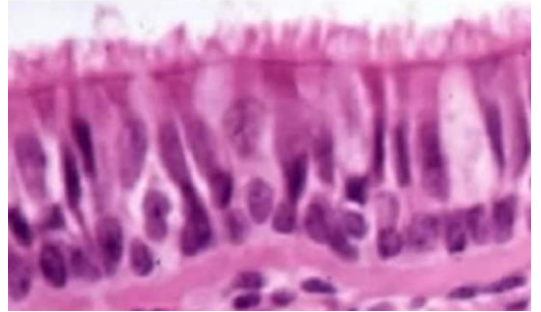
Past paper questions:

1) Which of the following apical structures is seen in the small intestinal epithelium?

- A) cilia b) stereocilia c) microvilli d) c&d

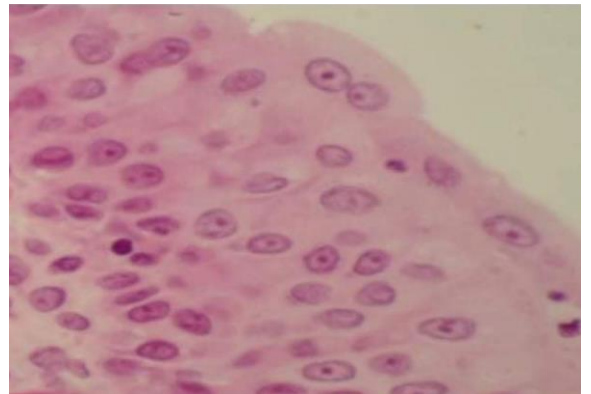
2) identify the type of epithelium in this image:

- a) stratified columnar with goblet cells
b) simple columnar with goblet cells
c) stratified cuboidal with goblet cells
d) ciliated pseudostratified columnar epithelium
e) ciliated pseudostratified columnar with goblet cells



3) Choose the incorrect statement about this tissue:

- a) it lines the urinary bladder
b) it is called urothelium
c) the apical layer is called umbrella cells
d) binucleation is seen in this type
e) it is a stratified cuboidal



You can find the answers on the top right corner of the previous page, so you can't peep 😊

Peep يعني يسترق النظر، غشيتها من جوجل عشان أبين مثقف

تُرِيدِينَ لِقِيَانَ الْمَعَالِي رَخِيصَةً... وَلَا بُدَّ دُونَ الشَّهْدِ مِنْ إِبْرِ النَّحْلِ

(من رام اجتناء الشهد قاسى لسع النحل، ولا يبلغ حلاوة العسل إلا بمقاساة مرارة اللسع)