Histology

Modified n. 4

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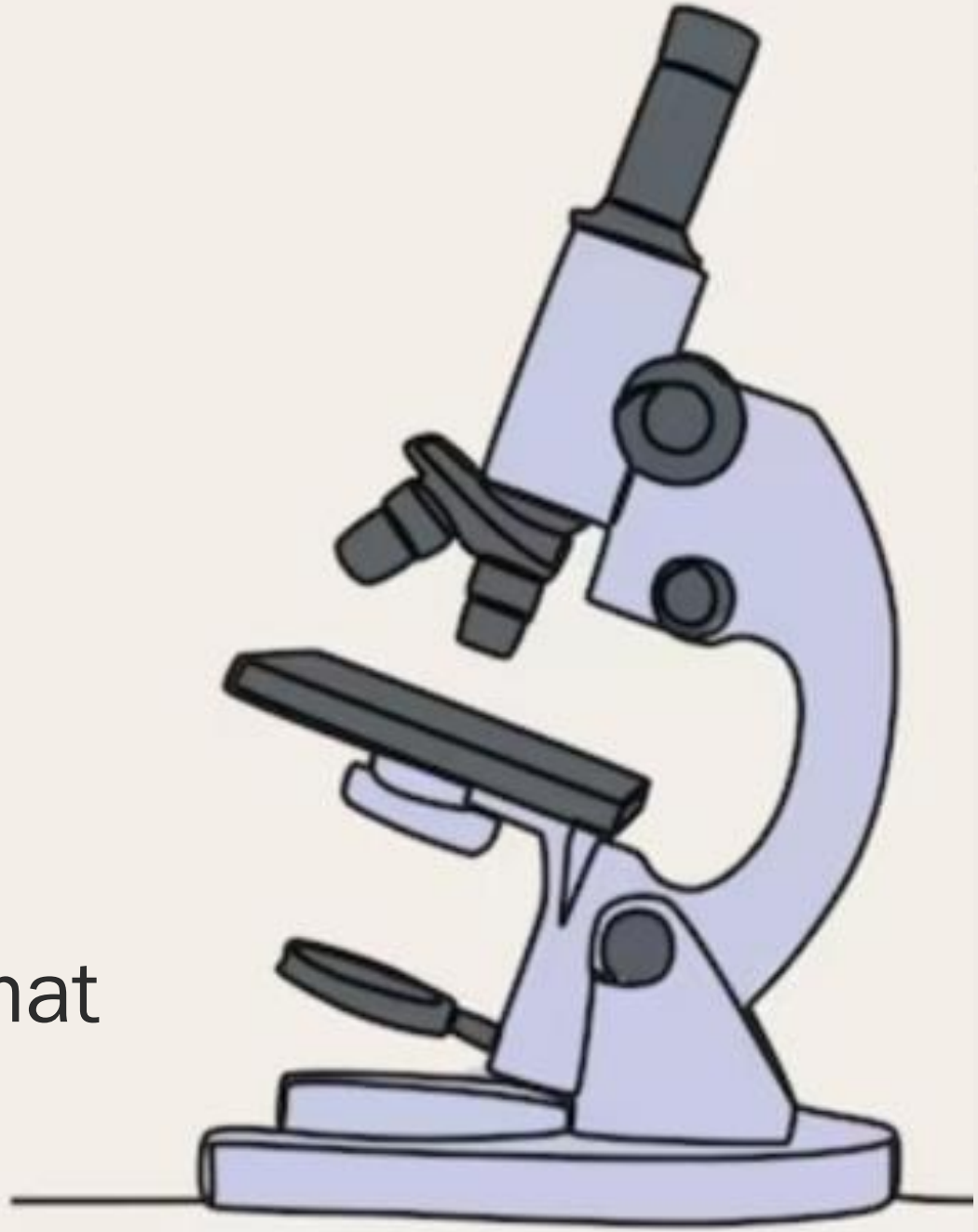
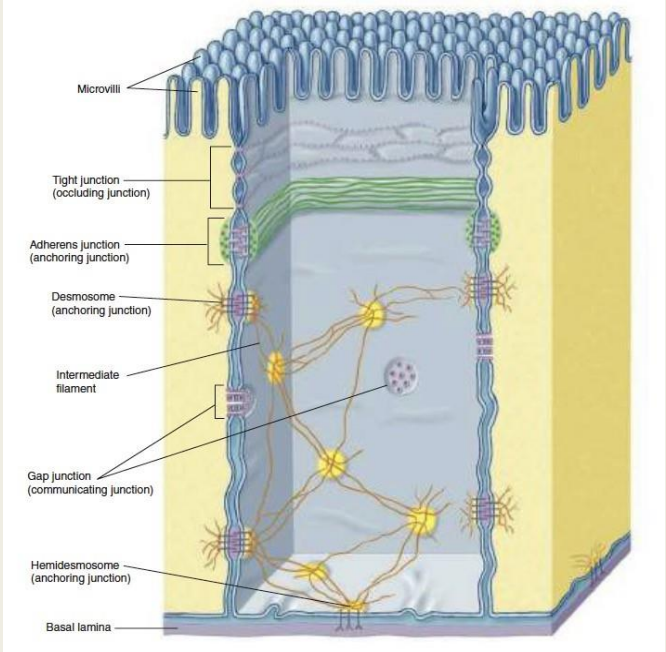


We have various types of junction complexes and that comes from different structure, different location as well.

Junctional Complexes



- Membrane-associated structures provide adhesion and communication between cells
- Epithelial cells adhere strongly to neighboring cells and basal laminae
- Tight or occluding junctions form a seal between adjacent cells.
- Adherent or anchoring junctions are sites of strong cell adhesion.
- Gap junctions are channels for communication between adjacent cells.
- Desmosome or macula adherens are disc-shaped structures at the surface of one cell that are matched with identical structures at an adjacent cell surface.

the junction complexes have also an association with the cytoplasm through the connection with the cytoskeleton, precisely with the actin and the intermediate filaments. each type has a specific connection

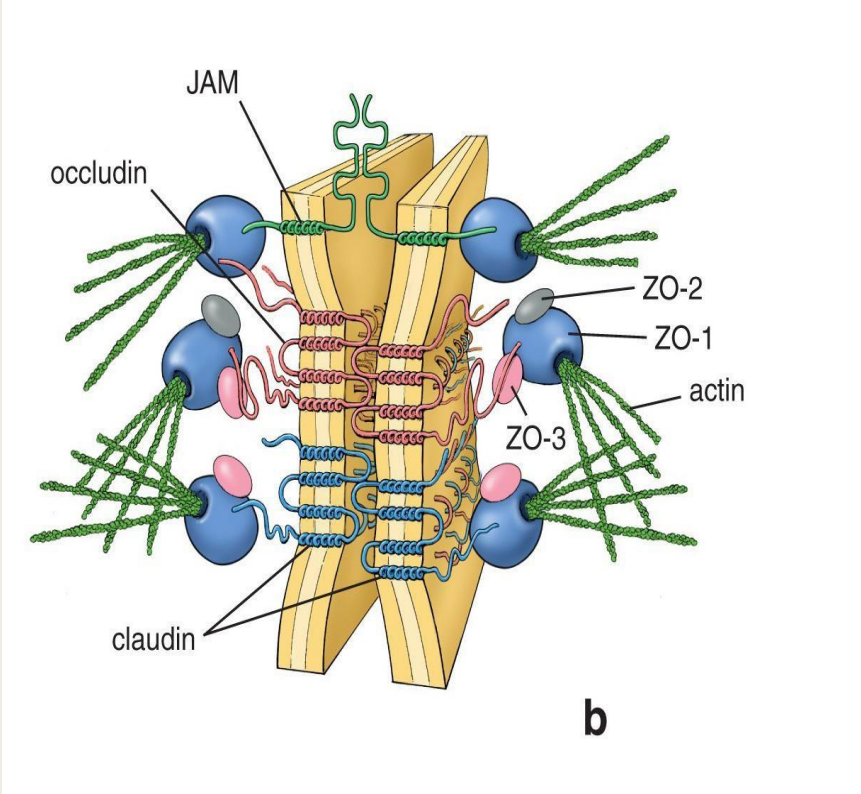
the epithelial cells are bound to the basal lamina and attach and adhere to the basal lamina due to the presence of what we call the hemidesmosomes

Tight Junction

Zonula occludens

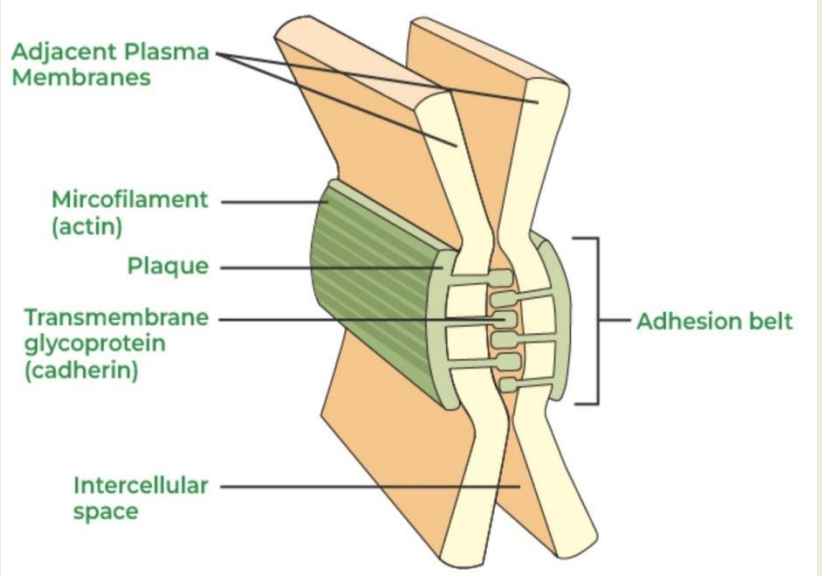
they participate heavily into the prevention of the passage of any molecule or microorganisms that try to gain access to the deeper structures particularly the first one, which is the connective tissue

- Tight or occluding junctions form a seal between adjacent cells.
- They are the most apical
- The seal between the two cell membranes is due to tight interactions between the transmembrane proteins claudin and occluding.
- The intercellular seal of tight junctions ensures that molecules crossing an epithelium in either direction do so through transcellular route not the paracellular one .



Adherent Junctions

Zonula adherens



- Encircle the epithelial cell, usually below the tight junction.
- Firmly anchoes cells to neighboring ones.
- Cell adhesion is mediated by **e-cadherin** (transmembrane glycoproteins) of each cell that bind each other in the presence of Ca^{2+}.

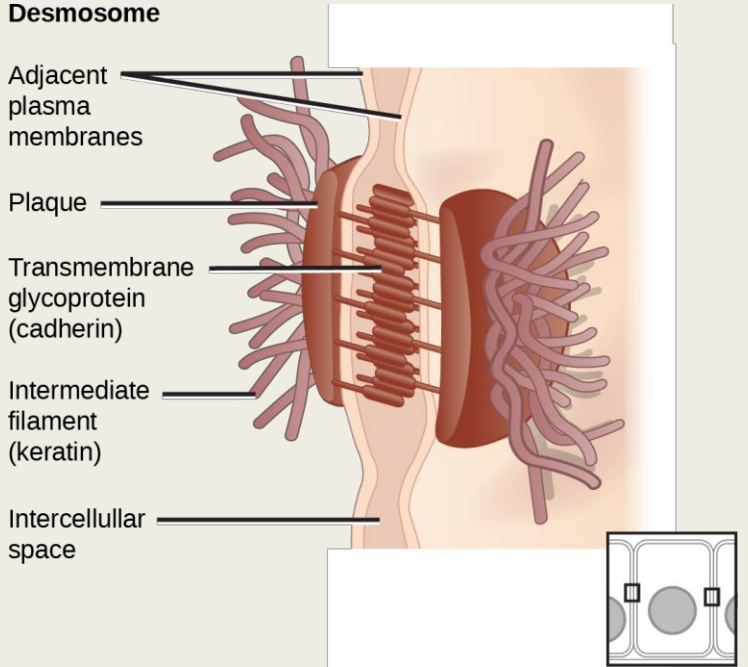
calcium ions that enhance and actually maintain this interaction.

At their cytoplasmic ends, cadherins bind **catenins** that link to actin filaments with actin-binding proteins.
The actin filaments linked to the adherens junctions form part of the "terminal web," a cytoskeletal feature at the apical pole in many epithelial cells.

Desmosomes

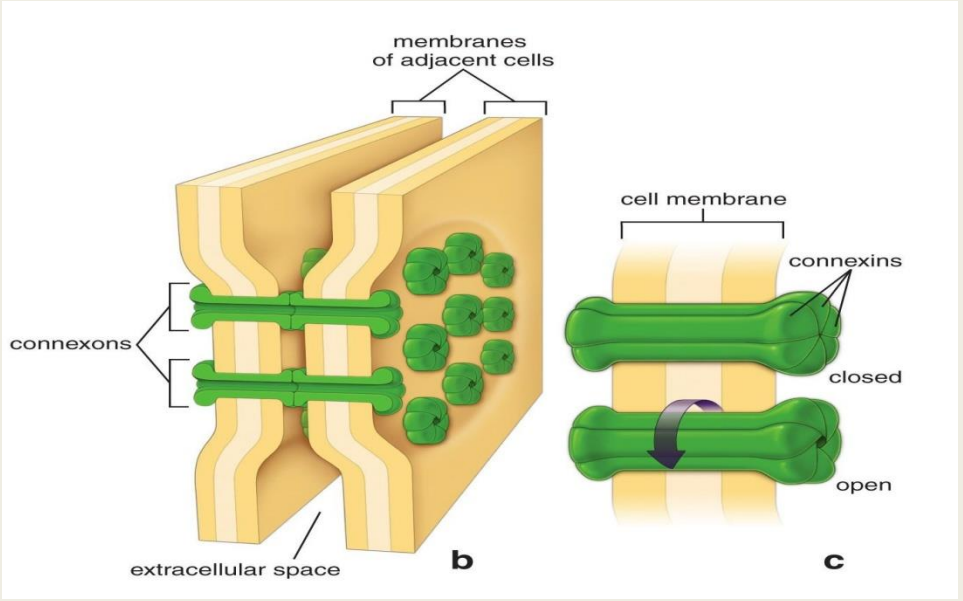
- Disc-shaped structures that are matched with identical structures at an adjacent cell surface
- Desmosomes contain larger members of the cadherin family called desmogleins and desmocollins.
- The cytoplasmic ends of these transmembrane proteins bind a catenin-like protein which bind intermediate filament proteins rather than actins.

the association is quite strong. And that's something that we usually see under the electron microscope as a very dense patch.

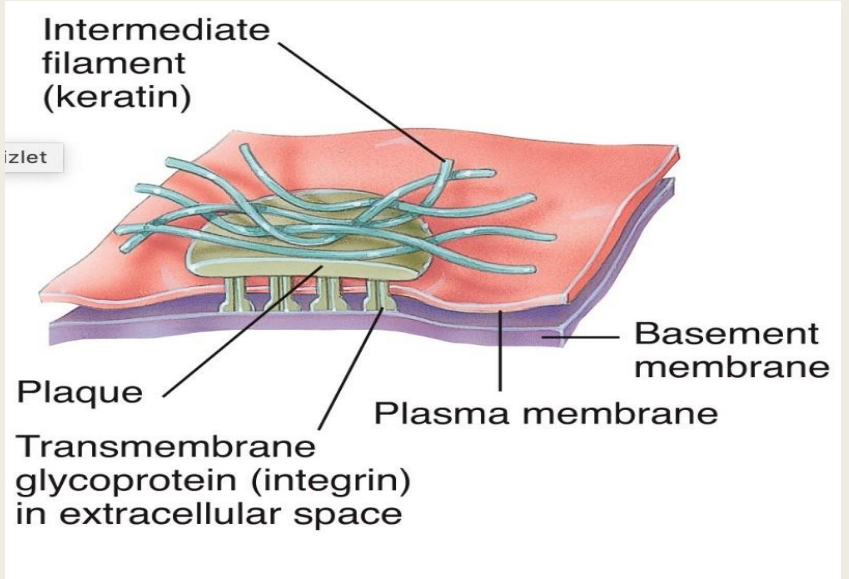


Gap Junctions

- Mediate intercellular communication.
- Present in many other cells.
- Connexins (transmembrane proteins) form hexameric complexes called connexons, each of which has a central hydrophilic pore about 1.5 nm in diameter.
- Permit intercellular exchange of molecules with small molecules < 1.5 nm in diameters.



Hemidesmosomes



- Located on the basal epithelial surface.
- Attach cells to the basal lamina.
- Resemble a half-desmosome ultra structurally, but unlike desmosomes the transmembrane proteins that indirectly link to cytokeratin intermediate filaments are integrins rather than cadherins.
- The integrins of hemidesmosomes bind primarily to laminin molecules in the basal lamina.

Junction	Tight Junction (Zonula Occludens)	Adherent Junction (Zonula Adherens)	Desmosome (Macula Adherens)	Hemidesmosome	Gap Junction (Nexus)
Major transmembrane link proteins	Occludins, claudins, ZO proteins	E-cadherin, catenin complexes	Cadherin family proteins (desmogleins, desmocollin)	Integrins	Connexin
Cytoskeletal components	Actin filaments	Actin filaments	Intermediate filaments (keratins)	Intermediate filaments	None
Major functions	Seals adjacent cells to one another, controlling passage of molecules between them; separates apical and basolateral membrane domains	Provides points linking the cytoskeletons of adjacent cells; strengthens and stabilizes nearby tight junctions	Provides points of strong intermediate filament coupling between adjacent cells, strengthening the tissue	Anchors cytoskeleton to the basal lamina	Allows direct transfer of small molecules and ions from one cell to another
Medical significance	Defects in occludins may compromise the fetal blood-brain barrier, leading to severe neurologic disorders	Loss of E-cadherin in epithelial cell tumors (carcinomas) promotes tumor invasion and the shift to malignancy	Autoimmunity against desmoglein I leads to dyshesive skin disorders characterized by reduced cohesion of epidermal cells	Mutations in the integrin-β4 gene are linked to some types of epidermolysis bullosa, a skin blistering disorder	Mutations in various connexin genes have been linked to certain types of deafness and peripheral neuropathy

we have a clinical condition that's called epidermolysis bullosa. Now this disease is quite nasty. And luckily it's quite rare , those patients, they will suffer from skin blistering because simply the epithelium will not stay on Its in its place because there something wrong with the integrins. So those patients will have blisters on their skin, um, filled with the fluids, and it goes and then another one will appear and so on.

Specialized apical structures

- Microvilli
- Cilia
- Stereocilia

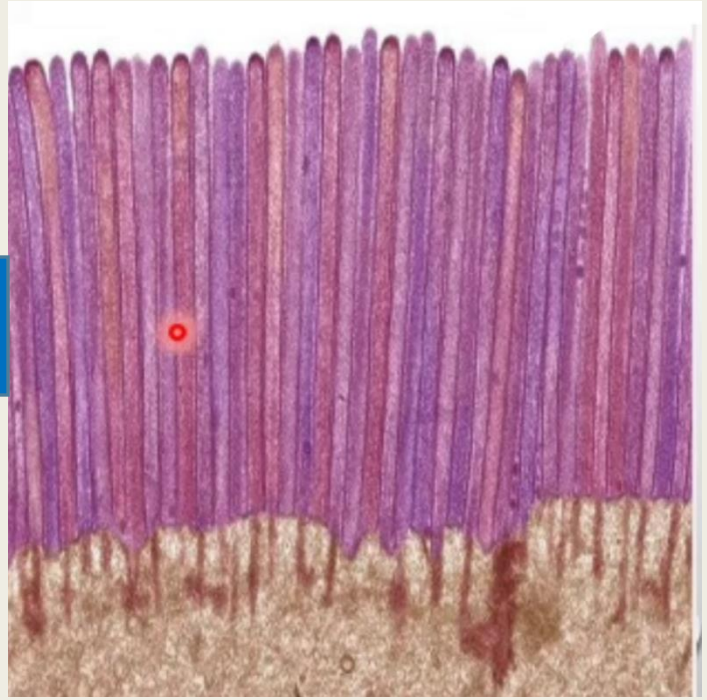
Microvilli

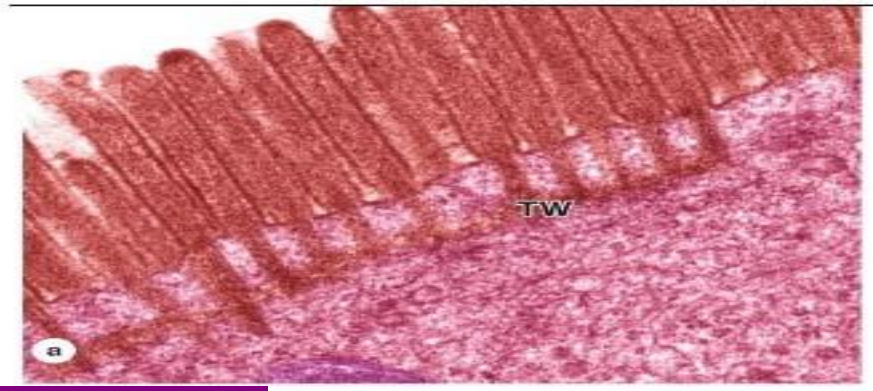
- Finger-like extensions of plasma membrane of apical epithelial cell.
- Present mainly in **absorptive cells (columnar/cuboidal)**.
- Main function is the absorption of nutrients from intestines and glomerular filtrate: Striated border in the intestine. Bruch border in the kidney).
- **Increase the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

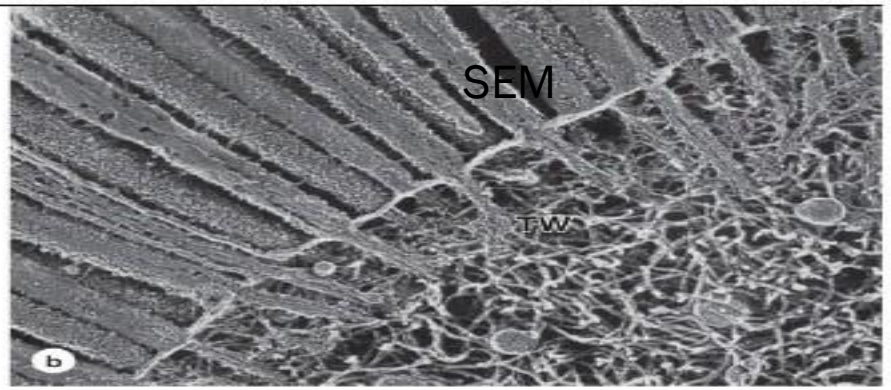
finger like projections are simply one micrometer long and about 0.1 micrometer wide.

same names, but Different function and same structure

It's immotile

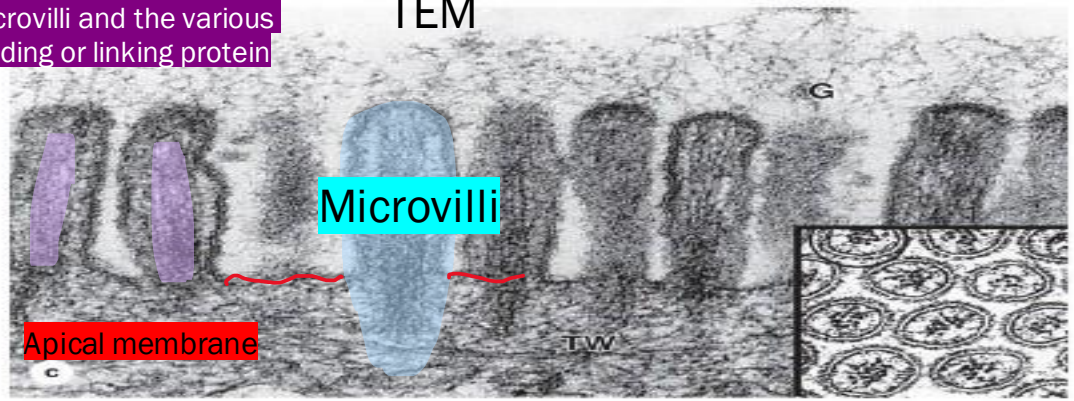


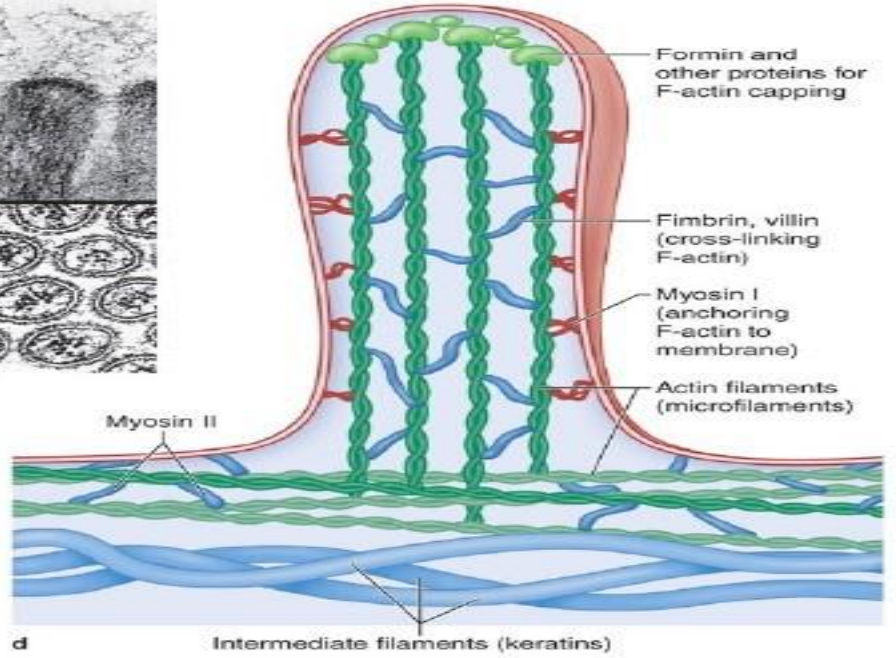




This is their core of the microvilli and the various binding or linking protein

TEM

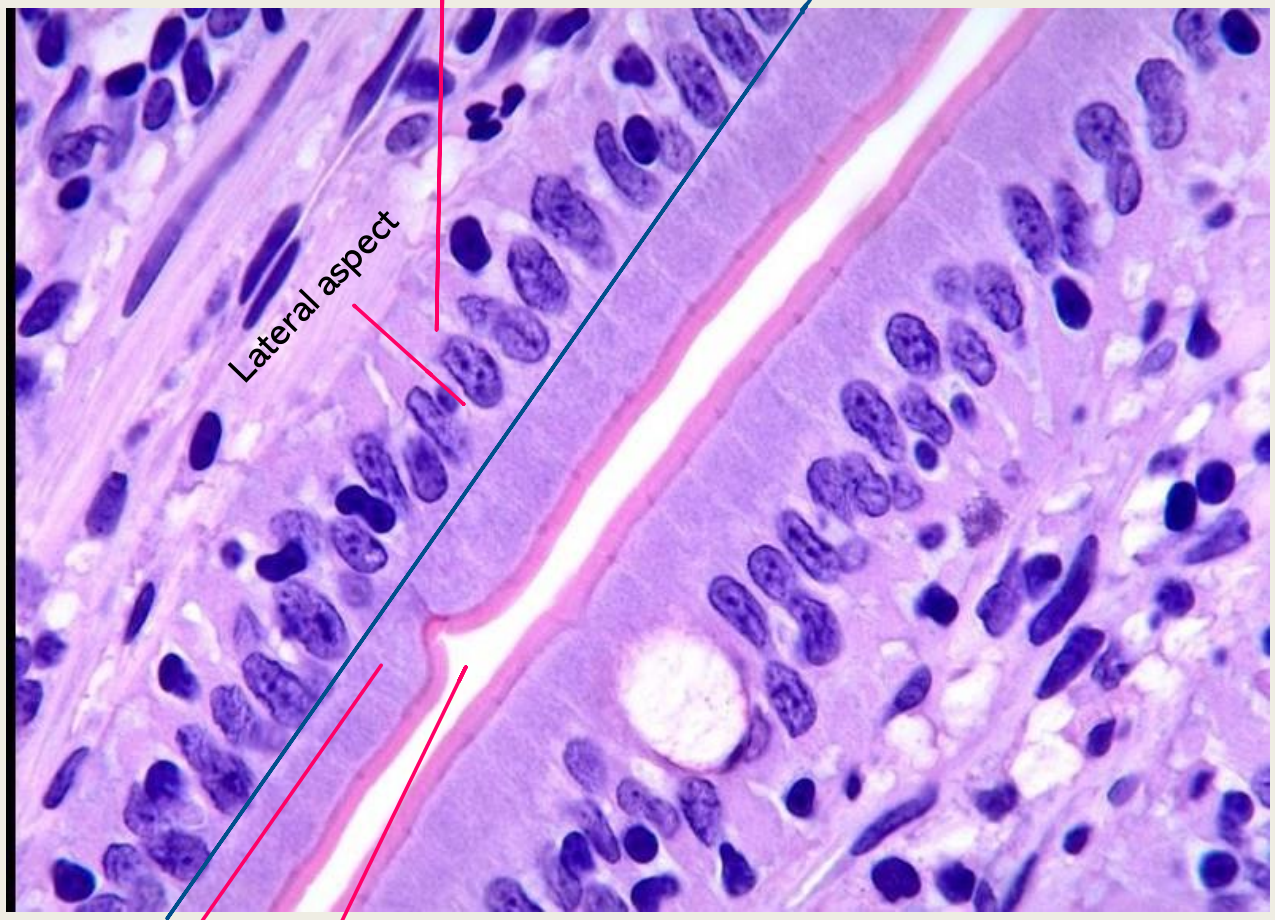




Microvilli

- Increase surface area
- Absorption.

this is a simple epithelium because we have one row of cell



this stain is a hematoxylin and eosin stain. And the image was acquired by a bright field light microscope

so where shall I locate the microvilli? They're usually on the apical surface. And it is actually represented by this dark pink line or area

Microvilli

Cilia

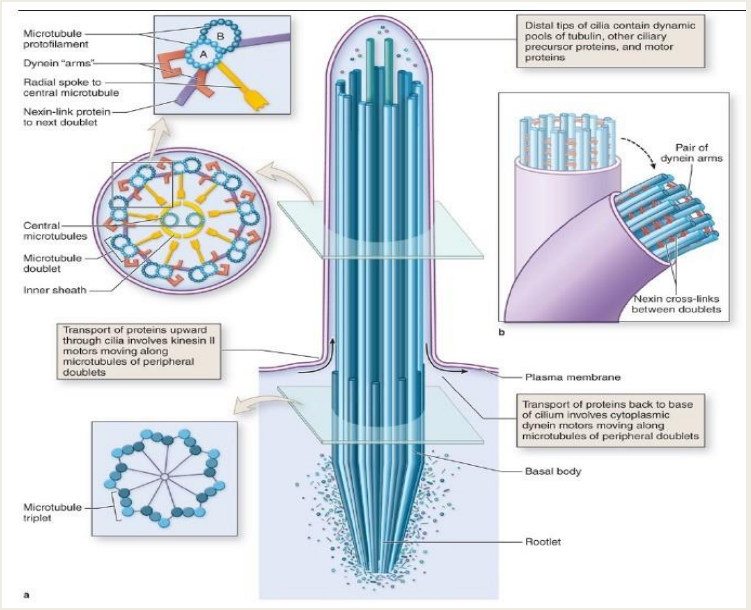
The are significantly longer than the microvilli

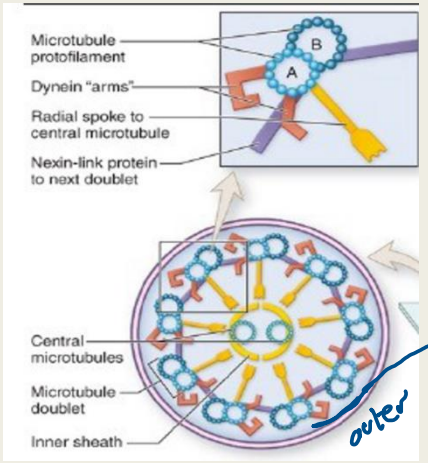
- Motile cytoplasmic hair like projections capable of moving fluid and particles along epithelial surfaces.
- Line cells in the respiratory organs, uterine tubes, and efferent ducts in testes.
- They move rhythmically and rapidly in one direction (motor proteins).
- Abundant on cuboidal or columnar cells
- Each cilium has a core structure consisting of nine peripheral microtubule doublets arrayed around two central microtubules---9 + 2 assembly---is called an axoneme

it is actually equipped with motor proteins that actually helps in its motility.

cilli are loaded on the apical surface of the respiratory epithelium, the respiratory epithelium means we have mucus. usually this mucus is there for a reason. And once it gets old loaded with the molecules that are unneeded, we need to flush that mucus out. So the movement of the cilia helps the body to remove the old one and a new coming mucus from the cells will replace it, another the movement of example for it's importance is the ova is usually facilitated by the movement of the cilia. So they help push the ovum toward the uterus

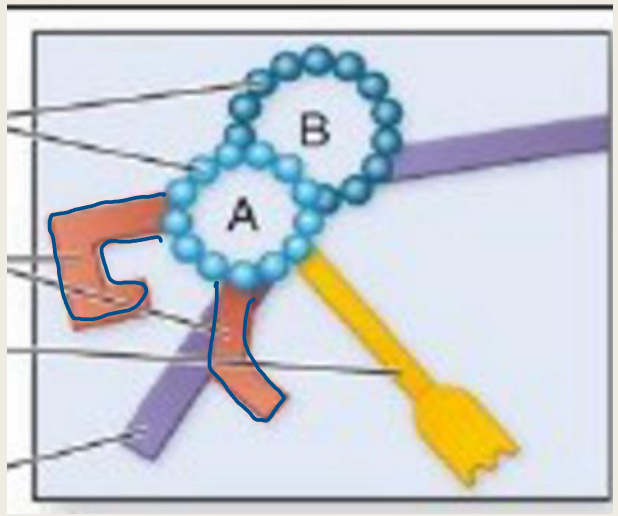
- **A microtubule** of the doublet is composed of **13** tubulin dimers arranged in a side-by-side configuration.
- **B microtubule** is composed of **10** tubulin dimers and shares the remaining dimers with those of the A microtubule.
- The **dynein arms** extend from the A microtubule and make temporary cross-bridges with the B microtubule of the adjacent doublet.
- The basal body is anchored by the striated rootlet within the cell cytoplasm.
- A cross section of the basal body shows the arrangement of nine microtubule triplets.



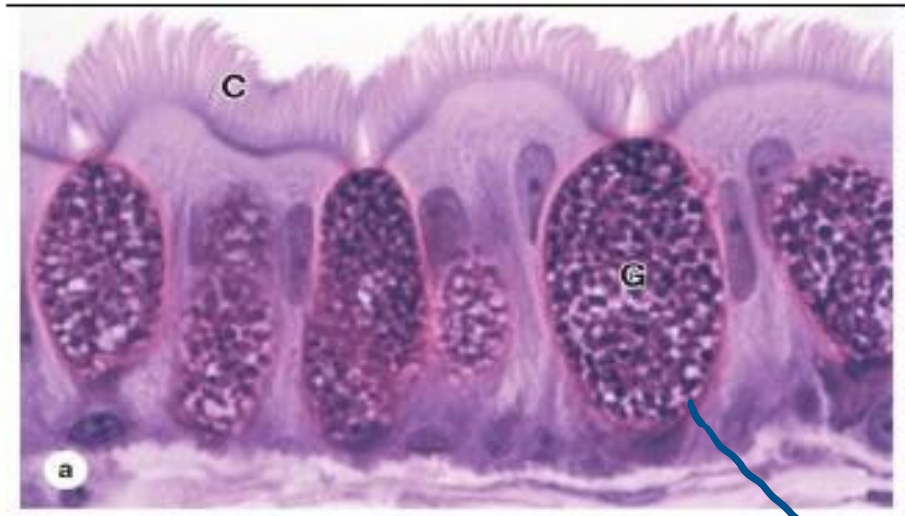


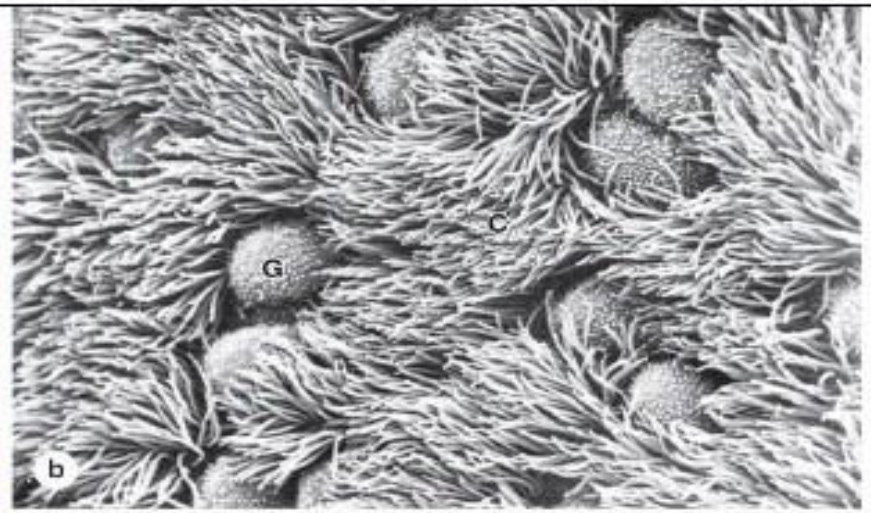
the external aspects, we have the central aspect of the cilia. the outer aspect is simply composed of microtubules. And they come in pairs. So nine doublets, whereas we have two single ones and the center, the doublets are formed of microtubule A and microtubule B. These two are bound together and radiating from them precisely from a microtubule are the dynein arms. Those are the ones that actually initiate the movement, because those are the ones where the ATP will be utilized and energy is produced to move the cilium.

the dynein that radiates from microtubule A will attach microtubule B on the neighboring doublets. And then its attachment will change according to the motion that is required. But usually cilia move in one direction So in case of the respiratory tract, the cilia will move upward. That will maintain the flushing of the old mucus upward. Whereas in the female genital tract the movement of the cilli will be toward the uterus So that will guarantee that the ovum will be sliding and reaching its final destination, which is the uterus.

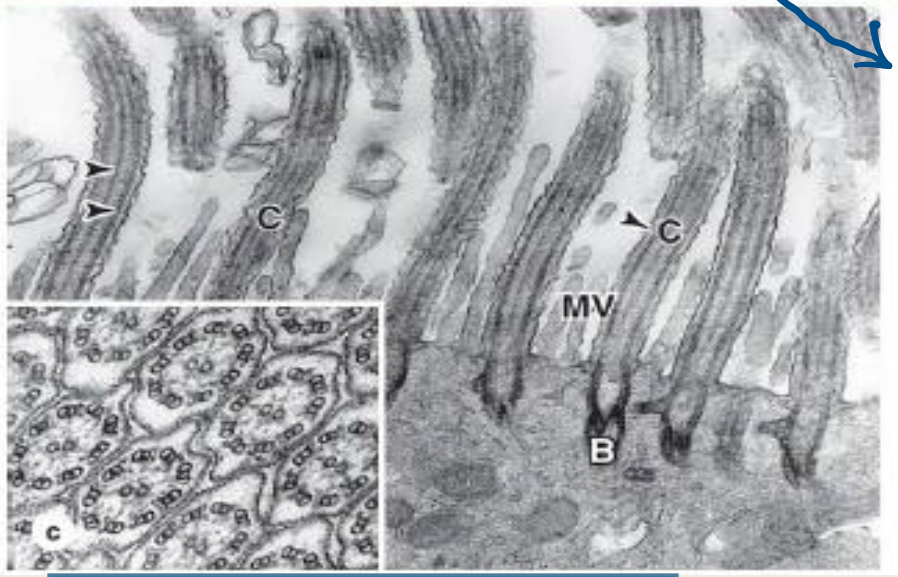


SEM (3D)





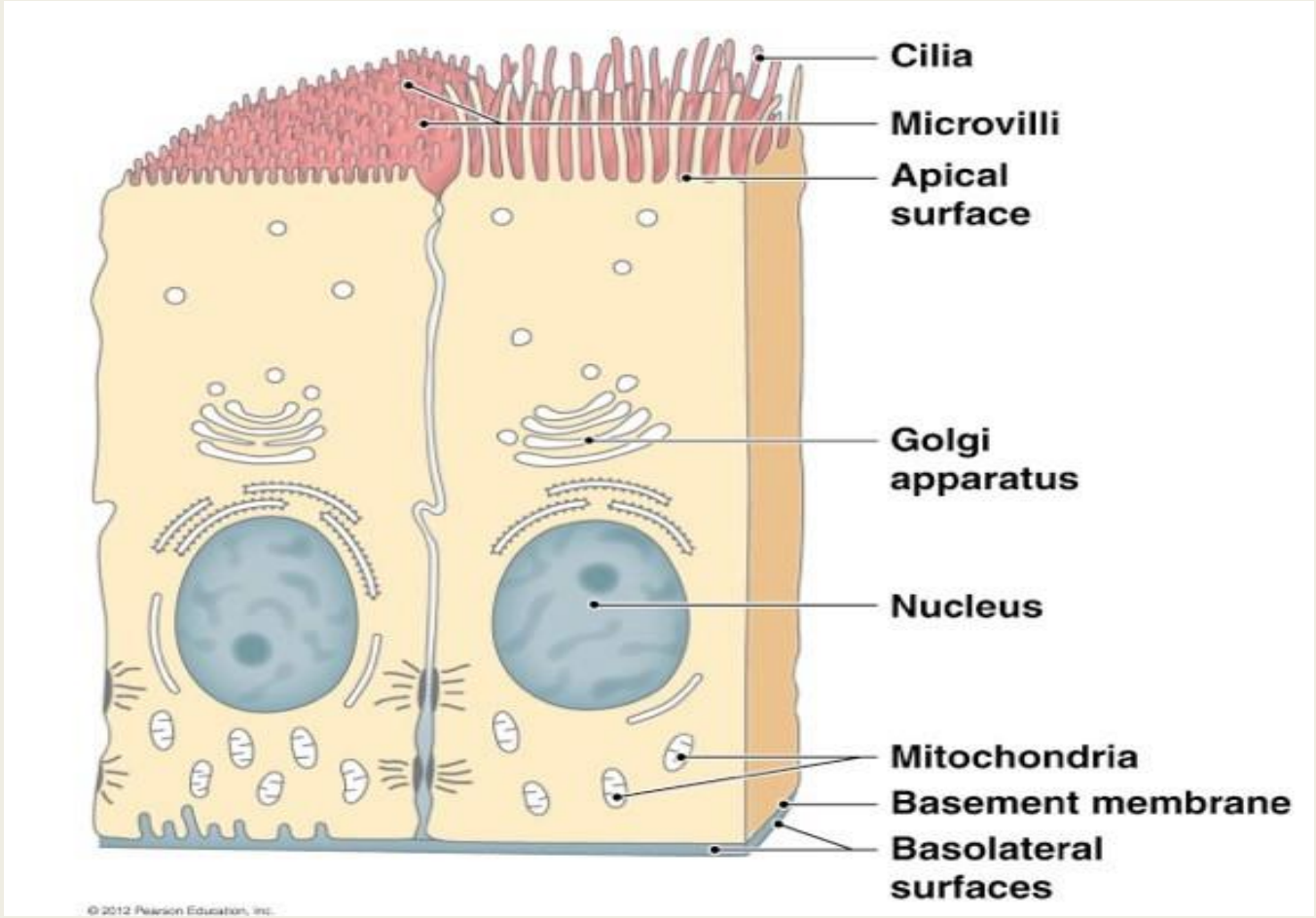
it’s a goblet cell, That's the cell that produces the mucus that will be secreted and will cover the upper surface of the epithelium.



Cilia

it shows us the nine doublets plus two which is the central two single microtubules

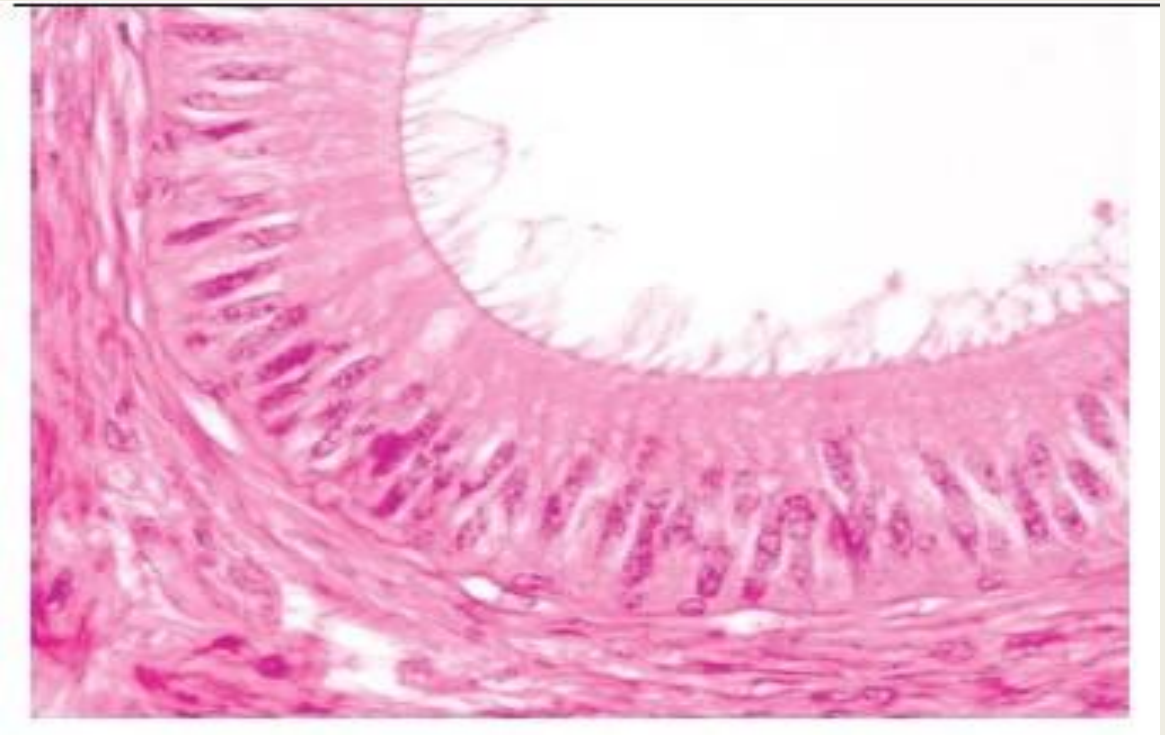
Cilia And Microvilli



Stereocilia

Least common type

- They are similar to microvilli BUT longer.
- Branched.
- Found in epididymis and ductus deferens (males)
- They have an absorptive function.
- In the internal ear they have a sensory function— detection of motion.



in the in the internal ear.it's different because they are present in what we call the hair cells. And their role is quite integral and important in a translation of the mechanical stimulation further into electrical. And then we do experience that we have heard something and the equilibrium as well that will be detected in the internal. This is all, important because of the presence of these structures in the internal ear.

Stereocilia