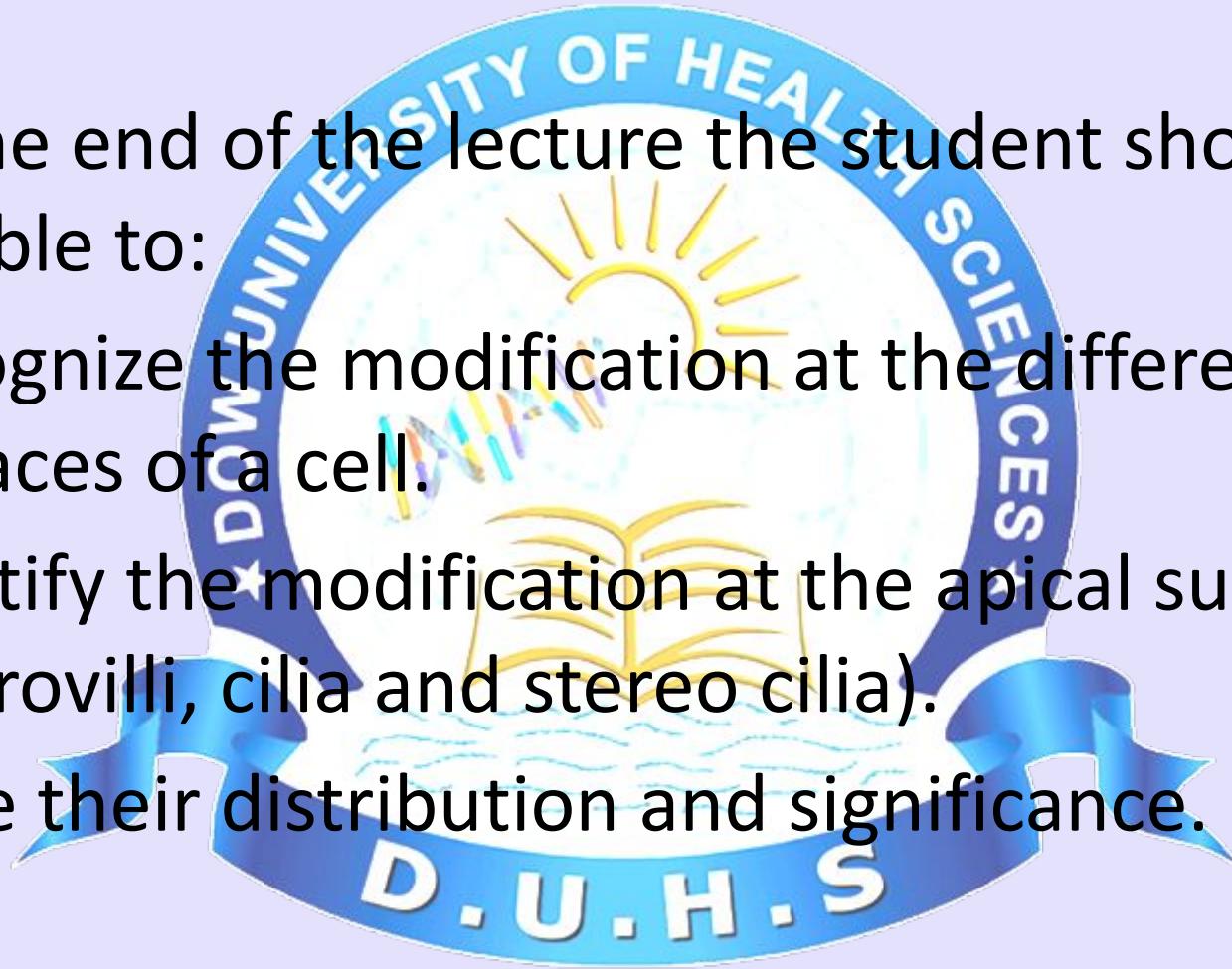


CELL SURFACE **MODIFICATIONS** **(MICROVILLI, CILIA,** **FLAGELLA)**



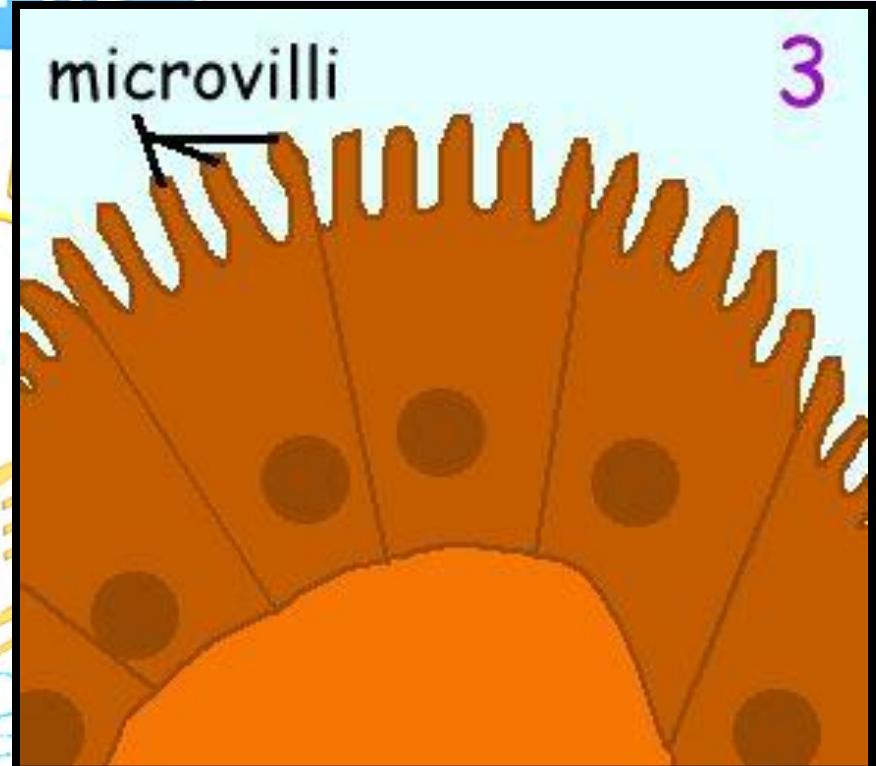
LEARNING OBJECTIVES

- At the end of the lecture the student should be able to:
- Recognize the modification at the different surfaces of a cell.
- Identify the modification at the apical surface (microvilli, cilia and stereo cilia).
- State their distribution and significance.



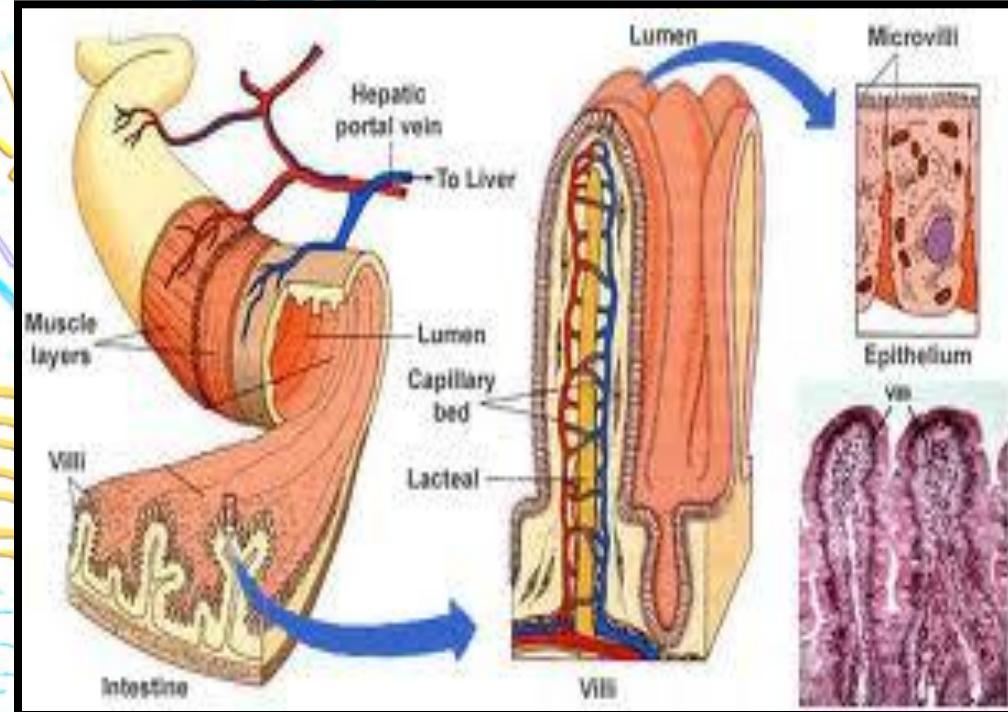
MICROVILLI

- Microvilli (singular: **microvillus**) are microscopic cellular membrane protrusions that increase the surface area of cells



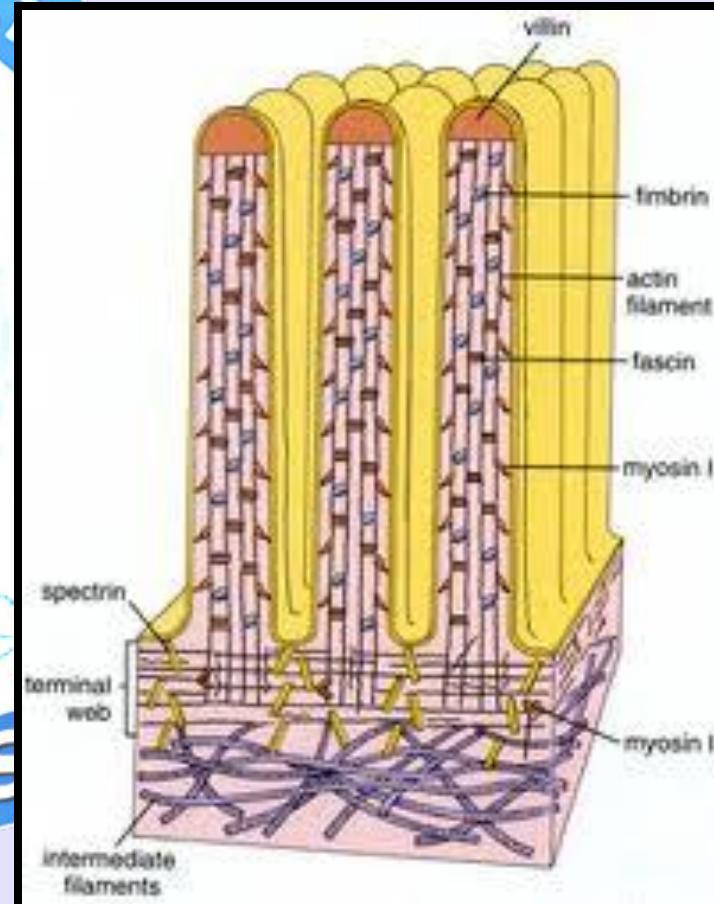
LOCATION OF MICROVILLI

- Thousands of microvilli form a structure called the brush border that is found on the apical surface of some epithelial cells,
 - Example
 - Small intestinal enterocyte
 - Kidney proximal tubule.
- In sensory cells of the inner ear (as stereocilia),
- In the cells of taste buds.
- In olfactory receptor cells.



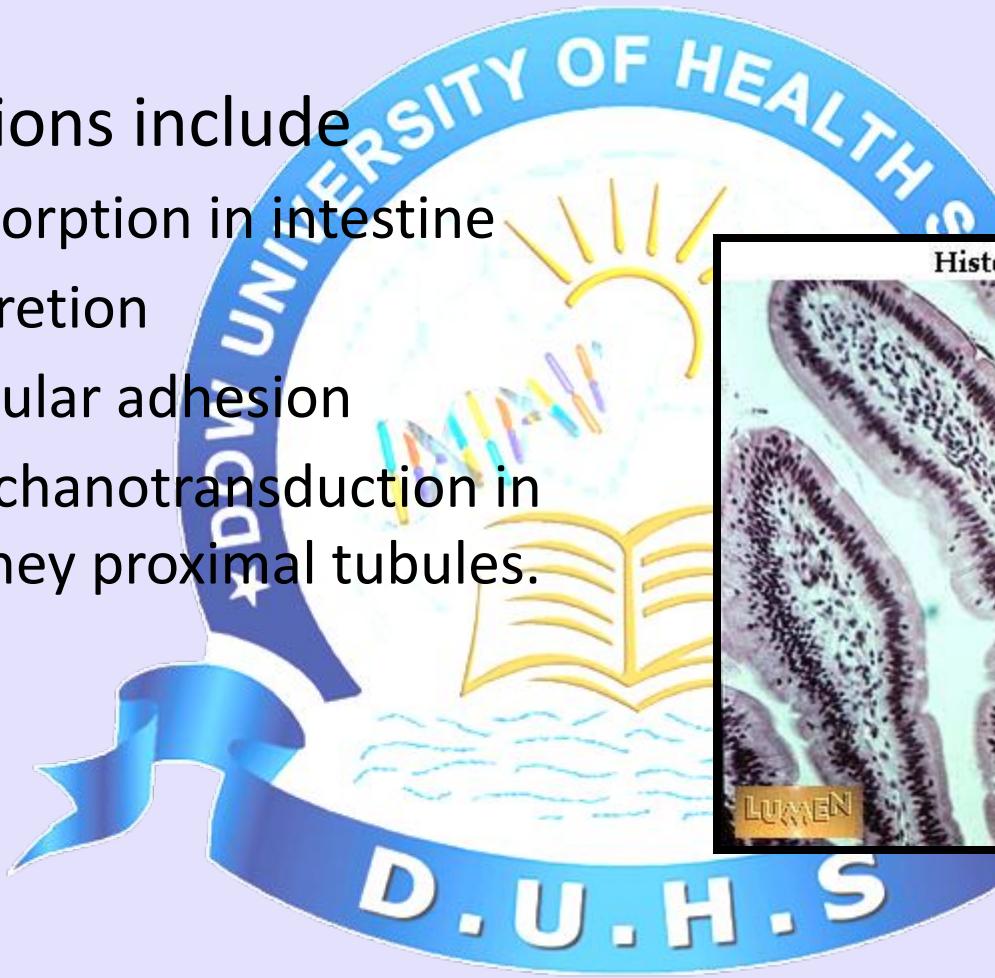
STRUCTURE OF MICROVILLI

- Microvilli are covered in by plasma membrane, which encloses cytoplasm and microfilaments.
- These are cellular extensions, there are little or no cellular organelles present in the microvilli.
- Each microvillus has a dense bundle of cross-linked actin filaments, which serves as its structural core.
- 20 to 30 tightly bundled actin filaments are cross-linked by bundling proteins fimbrin and villin to form the core of the microvilli.



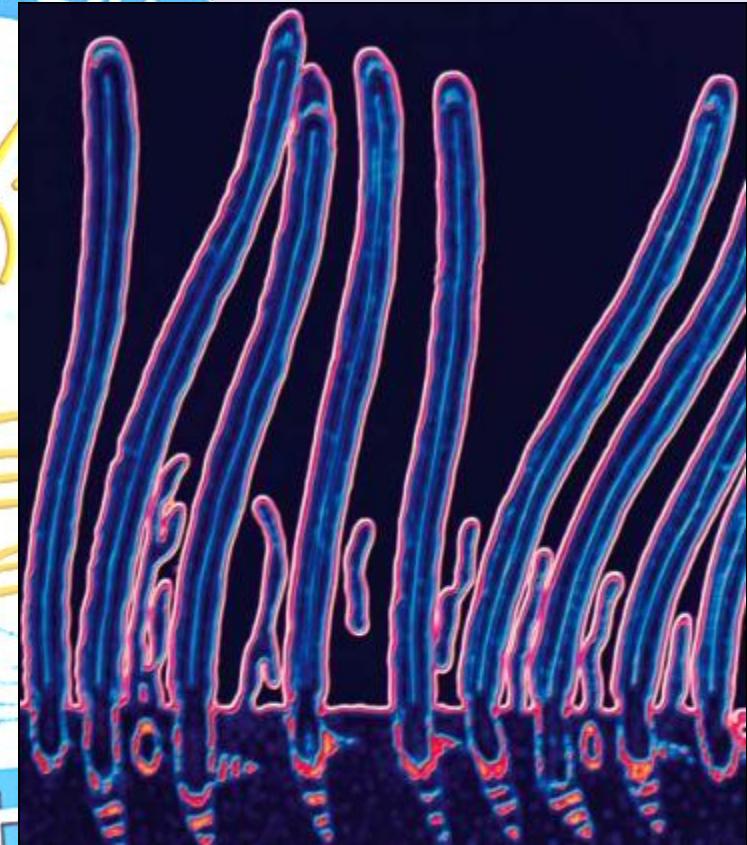
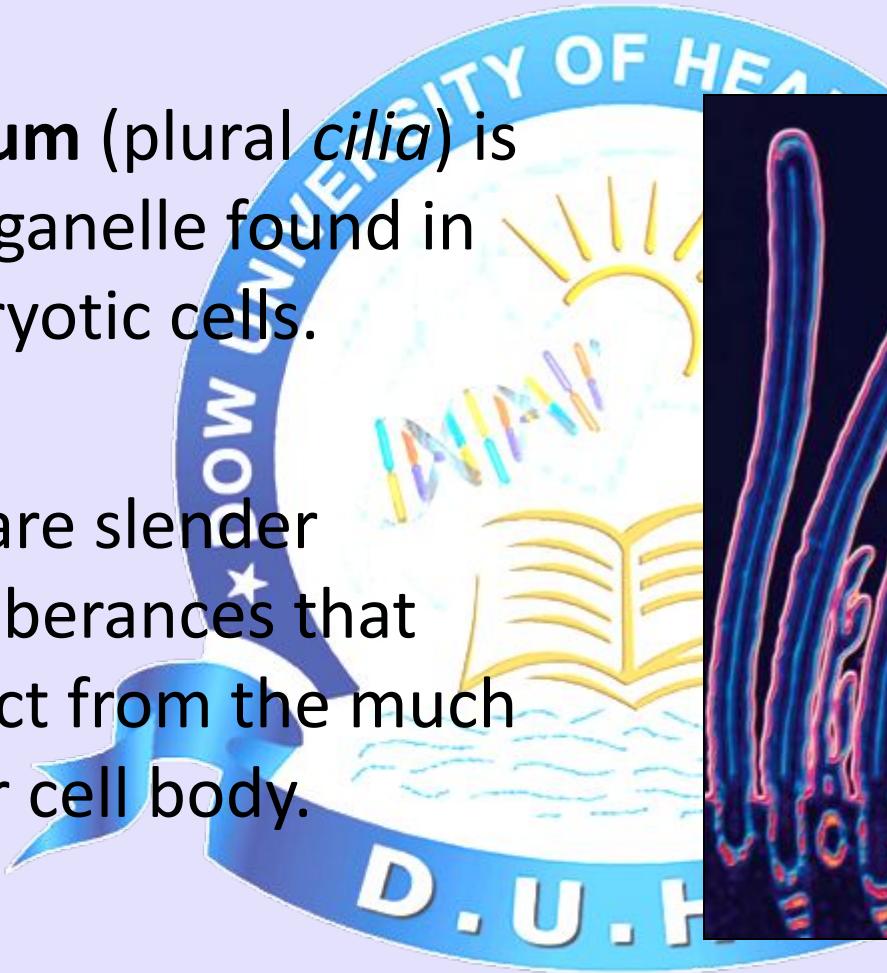
FUNCTIONS OF MICROVILLI

- Functions include
 - Absorption in intestine
 - Secretion
 - Cellular adhesion
 - Mechanotransduction in kidney proximal tubules.



CILIA

- A **cilium** (plural *cilia*) is an organelle found in eukaryotic cells.
- Cilia are slender protuberances that project from the much larger cell body.



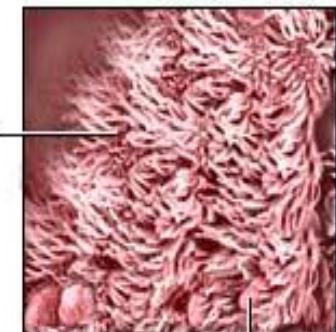
TYPES OF CILIA

MOTILE CILIA:

- Motile cilia are usually present on a cell's surface in large numbers and beat in coordinated waves.
 - For example, motile cilia are found in the lining of the trachea (windpipe), where they sweep mucus and dirt out of the lungs.
 - In female mammals, the beating of cilia in the Fallopian tubes moves the ovum from the ovary to the uterus



Hair-like projections called cilia line the primary bronchus to remove microbes and debris from the interior of the lungs



Cilia

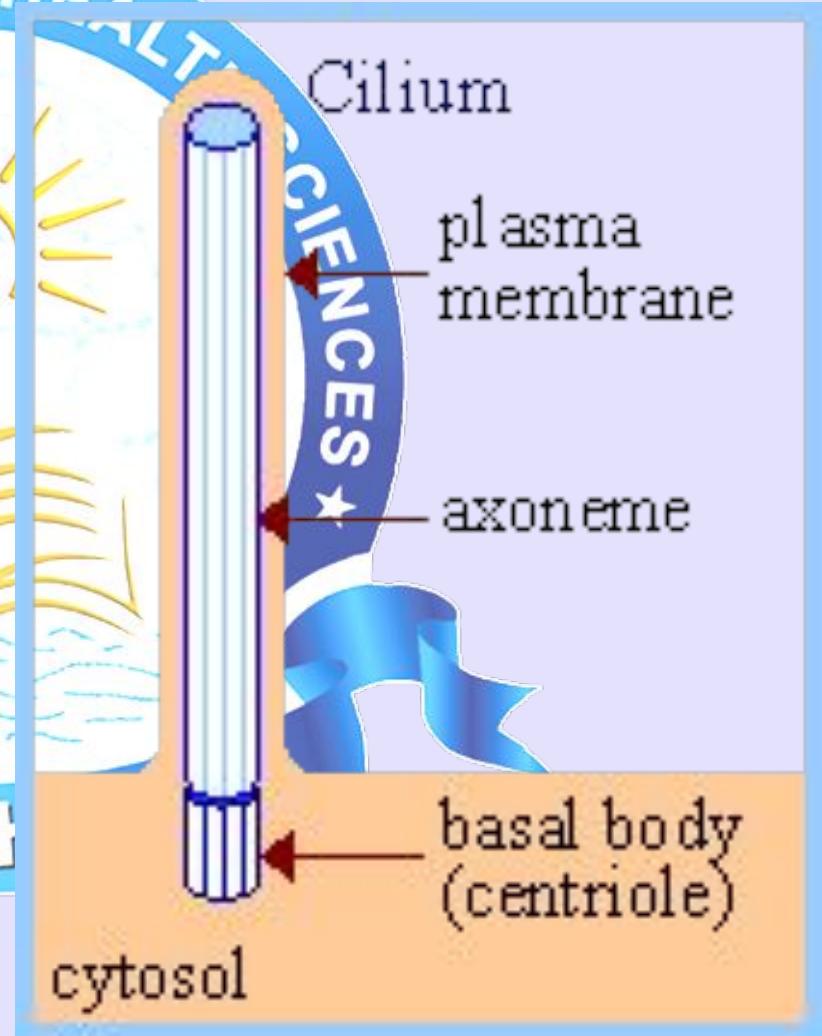
Primary bronchus

Goblet cell

TYPES OF CILIA

Non-motile (Primary cilia) :

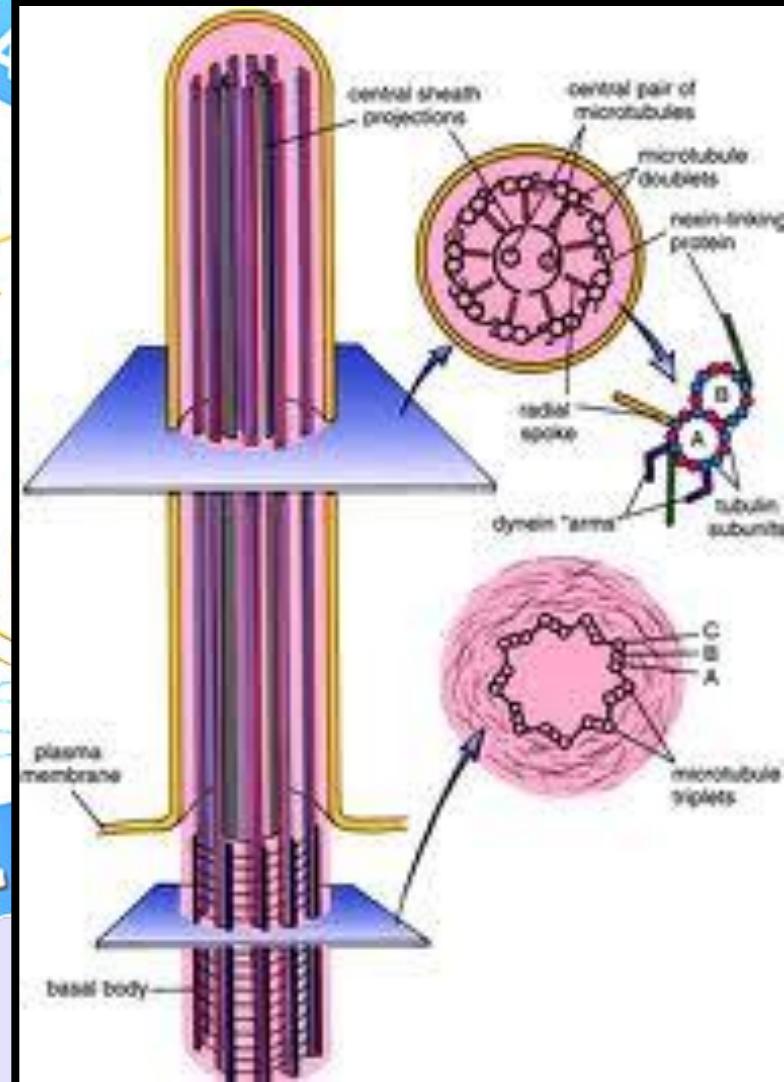
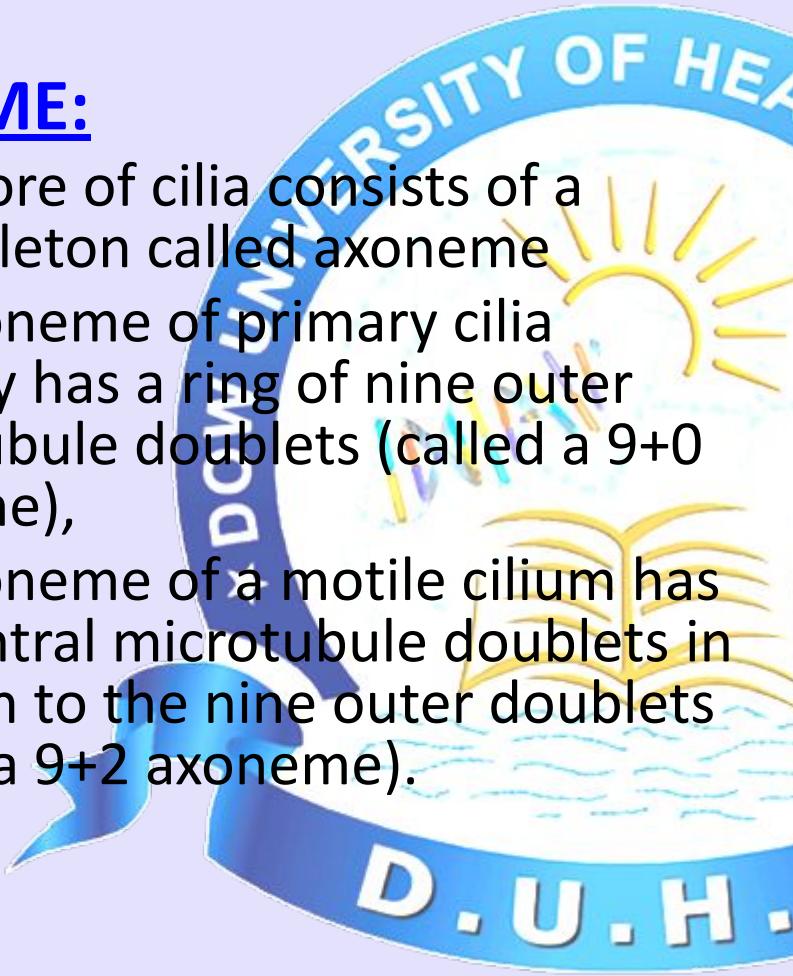
- Usually occur one per cell; all mammalian cells have a single non-motile *primary cilium*.
 - For example, sensory organs like eye and nose



STRUCTURE OF CILIA

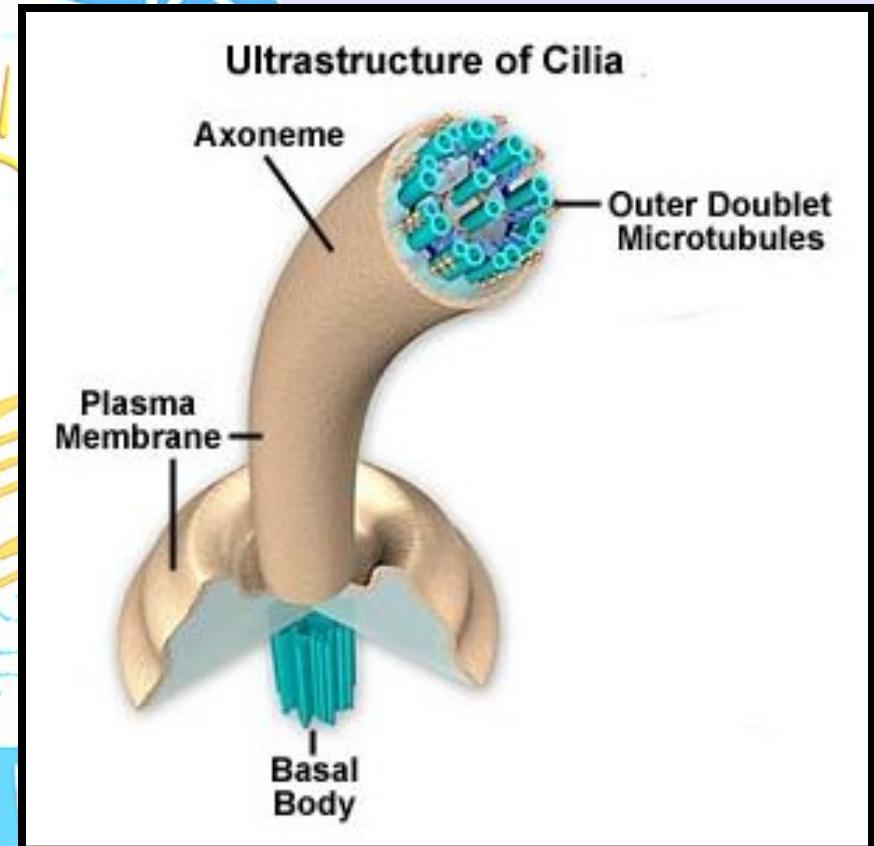
AXONEME:

- Inner core of cilia consists of a cytoskeleton called axoneme
- The axoneme of primary cilia typically has a ring of nine outer microtubule doublets (called a 9+0 axoneme),
- The axoneme of a motile cilium has two central microtubule doublets in addition to the nine outer doublets (called a 9+2 axoneme).



STRUCTURE OF CILIA

- At the base of the cilium where the cilia attaches to the cell body is the microtubule organizing center, the **basal body**. Basal bodies are identical to centrioles and are, in fact, produced by them.



FUNCTIONS OF PRIMARY CILIA

Mechanoreceptors

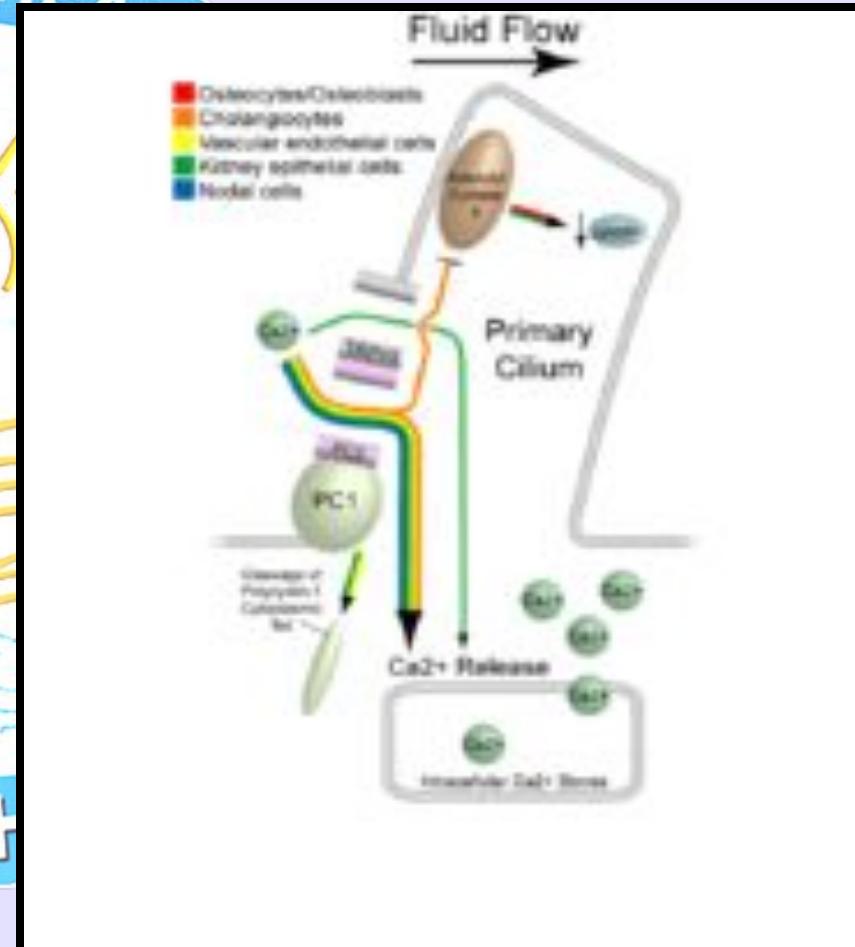
- A primary cilium extends from the apical surface of the epithelial cells lining the kidney tubules and monitors the flow of fluid through the tubules.

Chemoreceptors

- Detect odors by receptors on the primary cilium of olfactory neurons.

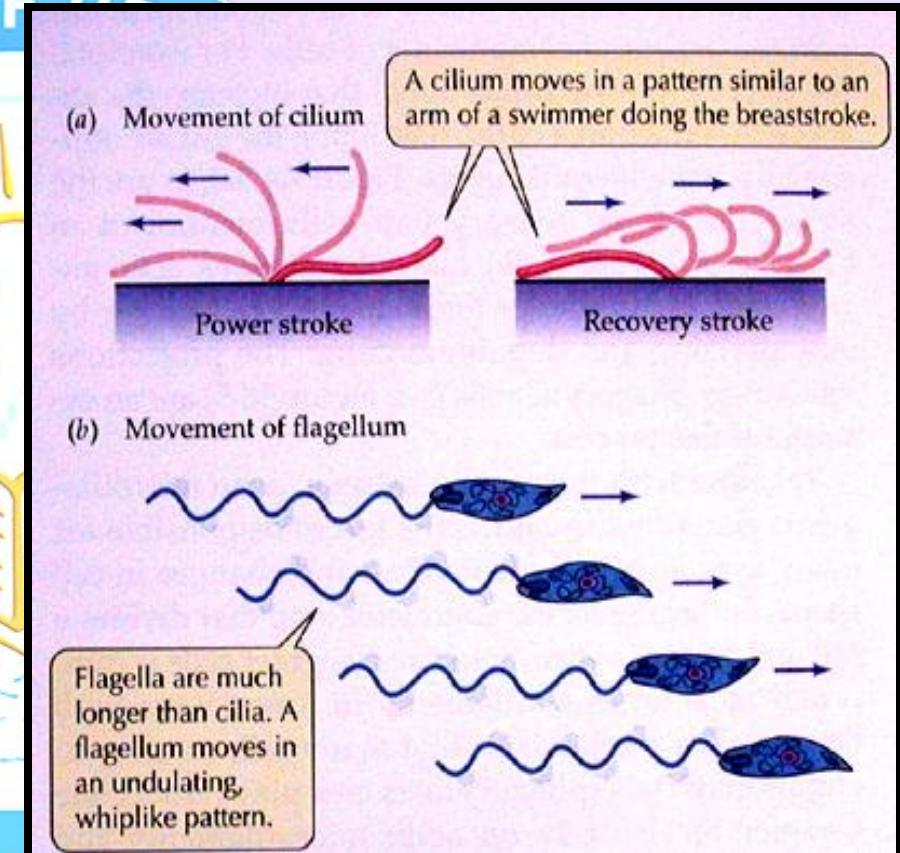
Photoreceptors

- The outer segment of the rods in the vertebrate retina is also derived from a primary cilium.



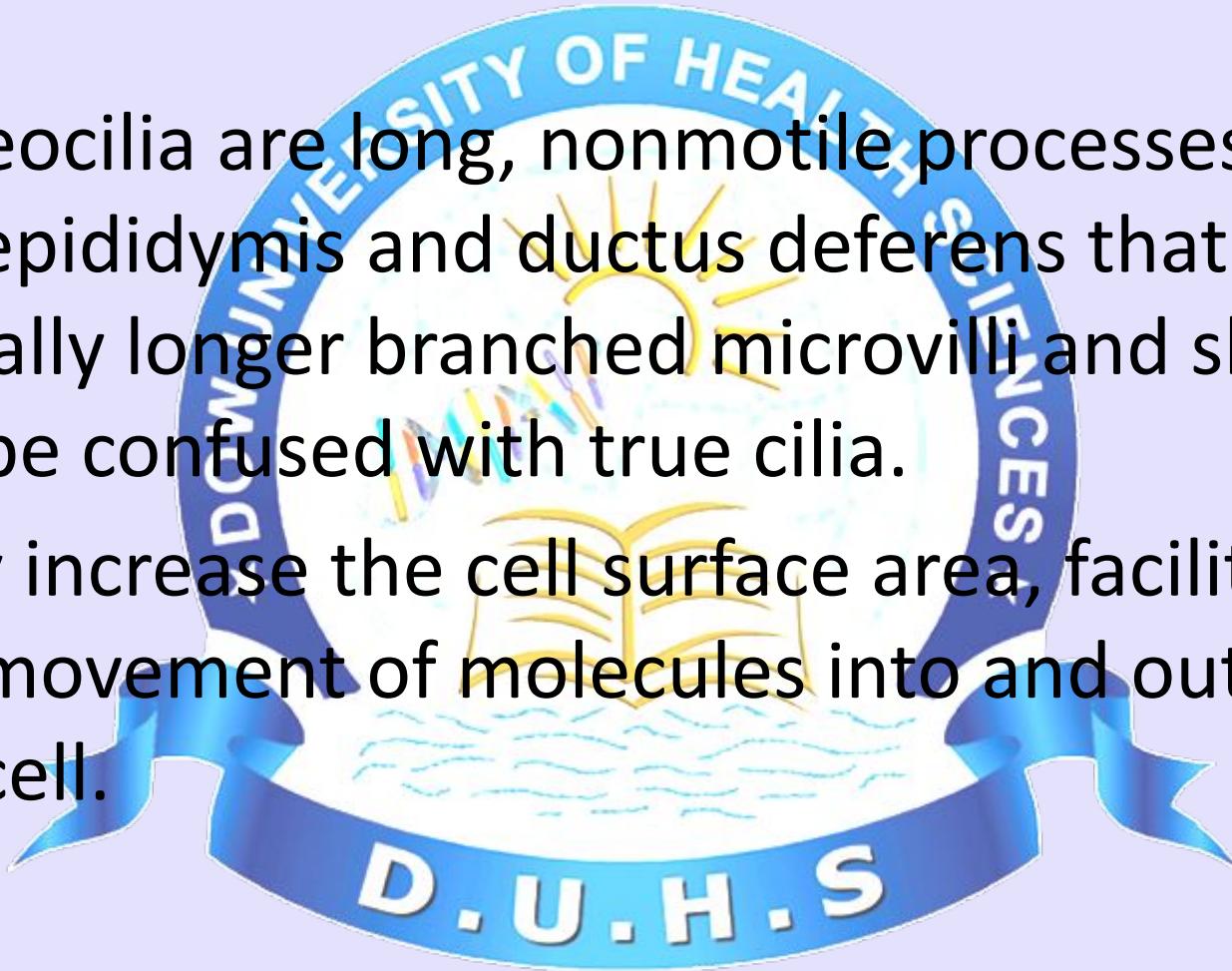
FUNCTIONS OF MOTILE CILIA

- Motile cilia for the transport of fluids (e.g. transport of mucus by stationary ciliated cells in the trachea).
- However, cilia are also used for locomotion (through liquids) in organisms such as *Paramecium*.



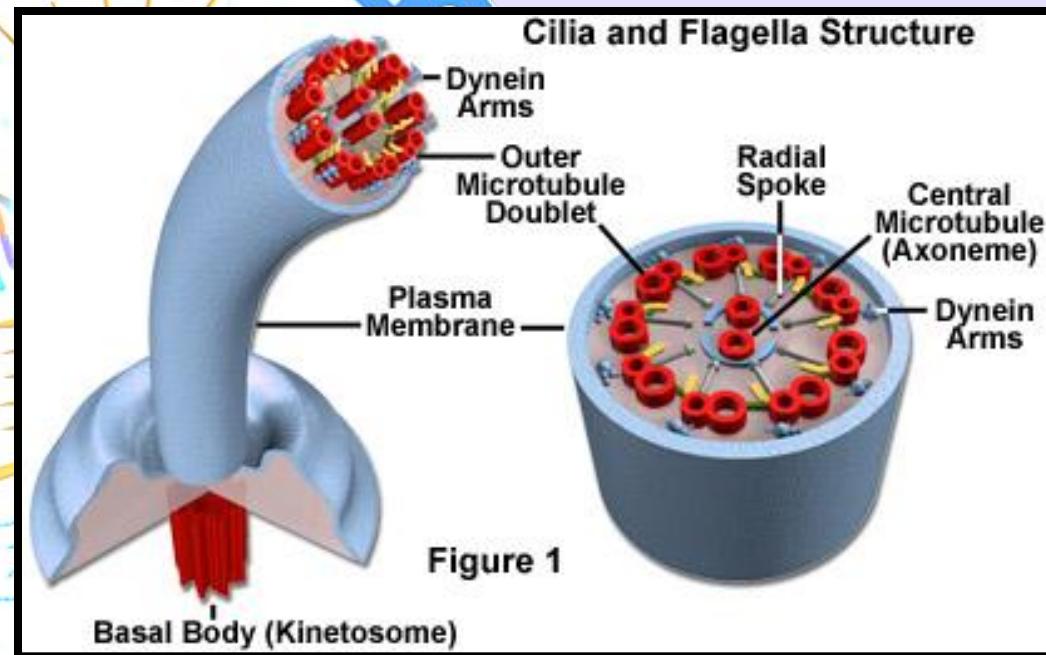
STEREOCILIA

- Stereocilia are long, nonmotile processes of the epididymis and ductus deferens that are actually longer branched microvilli and should not be confused with true cilia.
- They increase the cell surface area, facilitating the movement of molecules into and out of the cell.

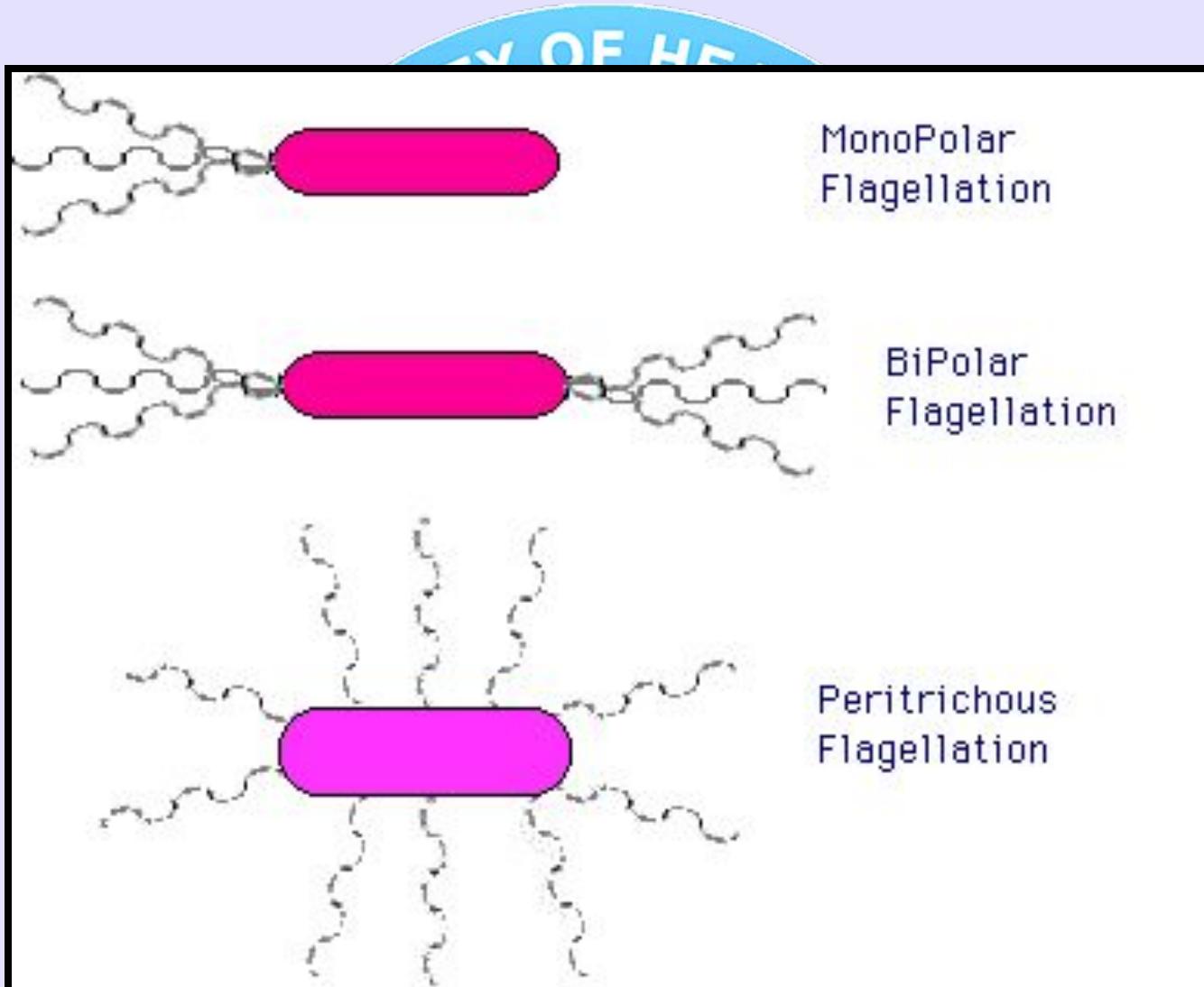


FLAGELLA

- It is a tail-like projection that protrudes from the cell body of certain prokaryotic and eukaryotic cells, and functions in locomotion.

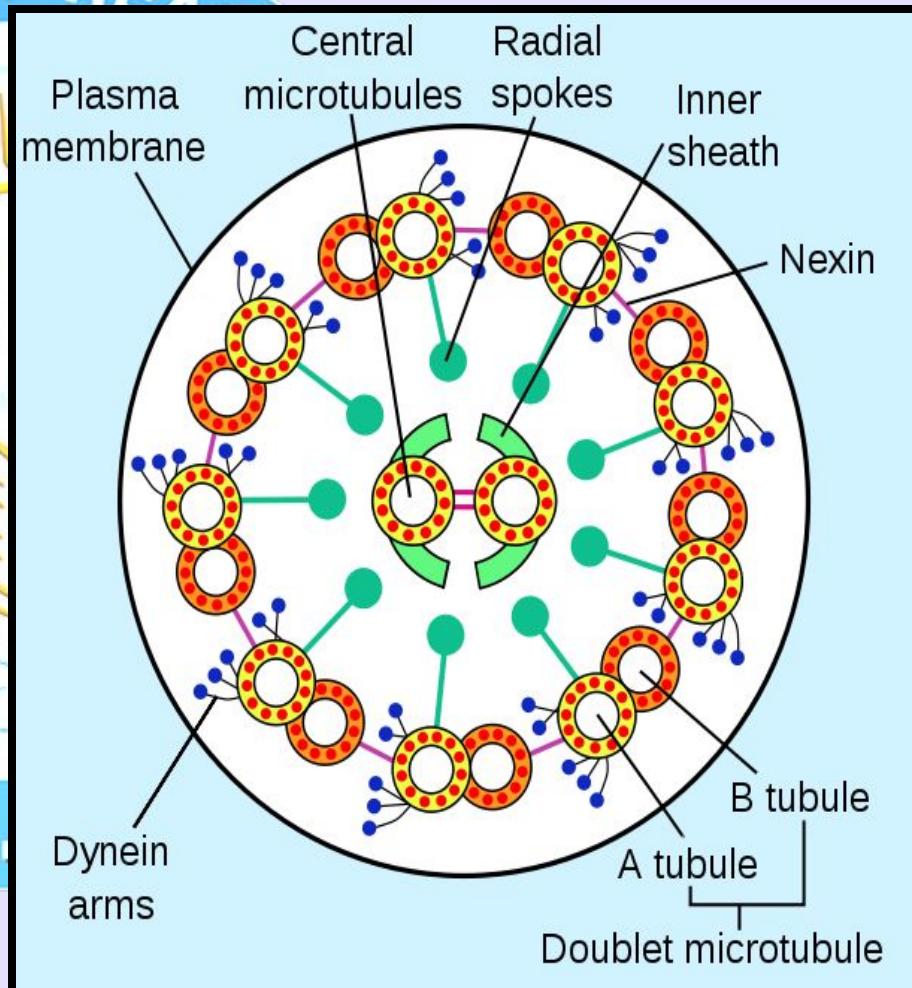


TYPES OF FLAGELLA



STRUCTURE OF FLAGELLUM

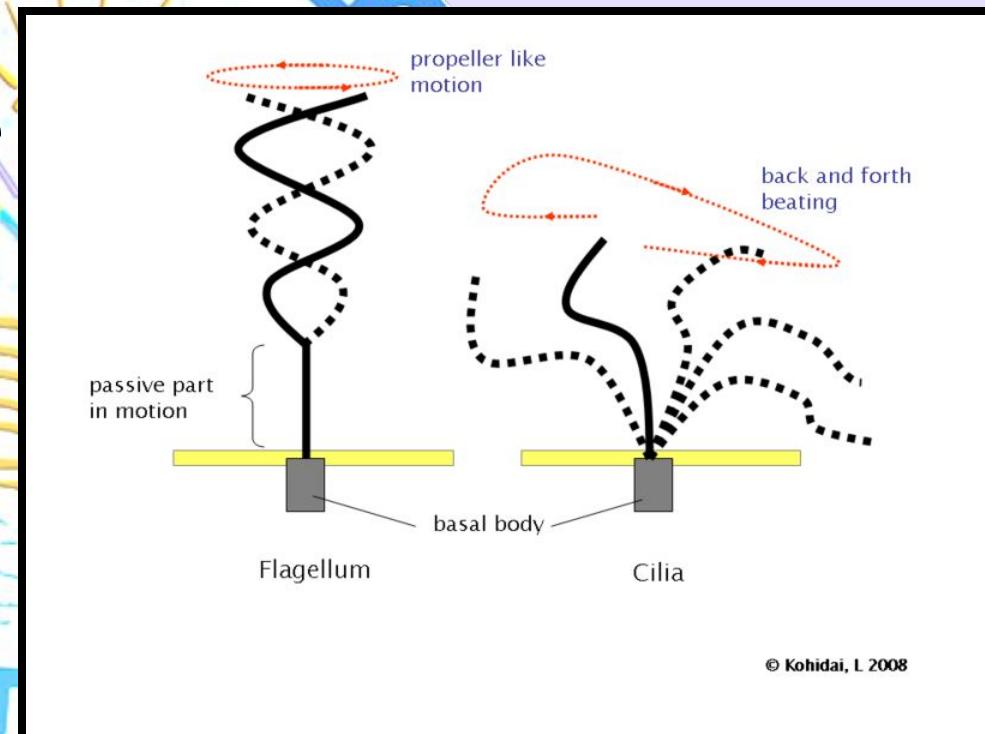
- A eukaryotic flagellum is a bundle of nine fused pairs of microtubule *doublets* surrounding two central single microtubules.
- The so-called "9+2" structure is characteristic of the core of the eukaryotic flagellum called an *axoneme*. At the base of a eukaryotic flagellum is a basal body.
- Basal bodies are structurally identical to centrioles. The flagellum is encased within the cell's plasma membrane, so that the interior of the flagellum is accessible to the cell's cytoplasm.



FLAGELLA V/S CILIA

- Though eukaryotic flagella and motile cilia are ultrastructurally identical, the beating pattern of the two organelles can be different.

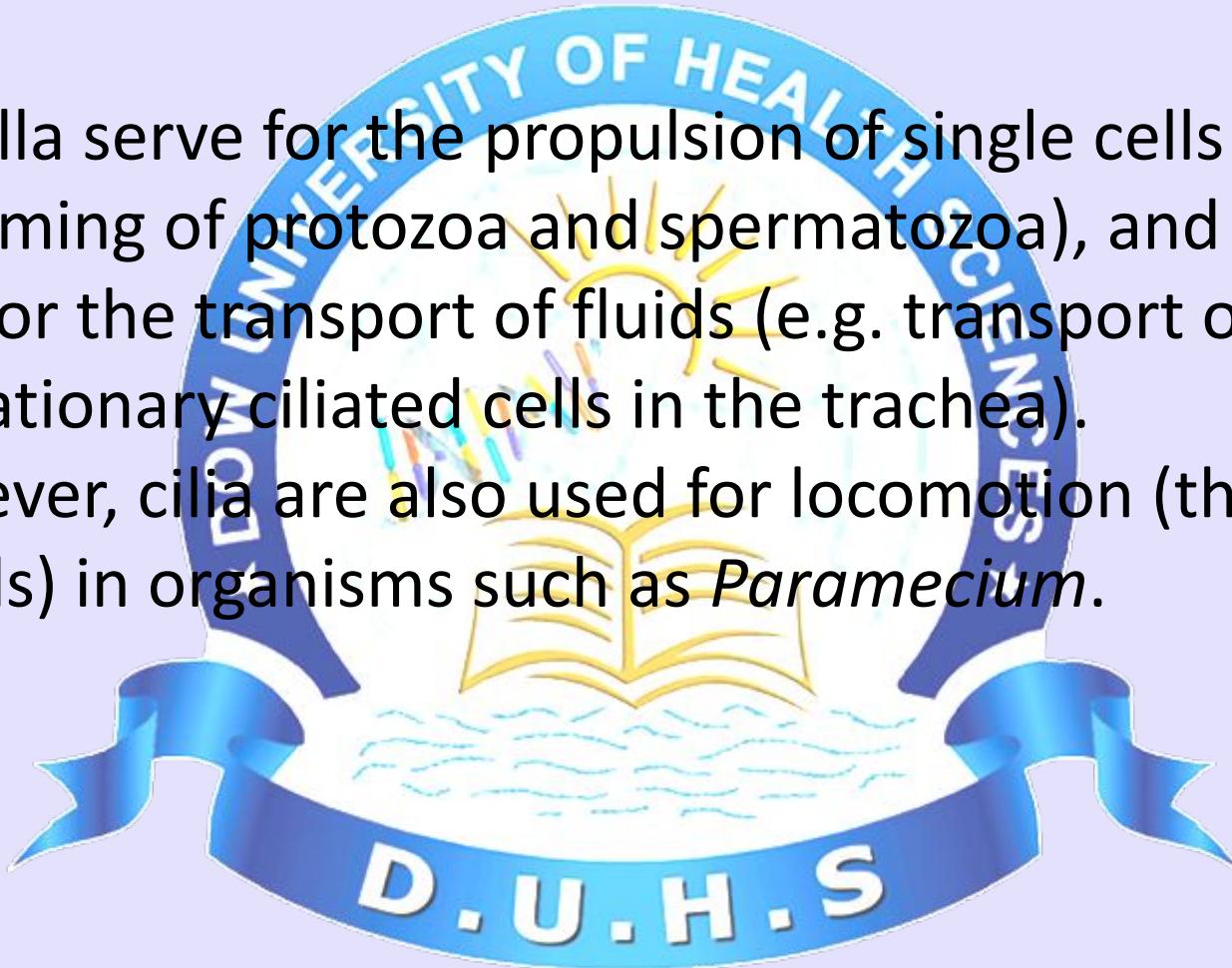
- In the case of flagella (e.g. the tail of a sperm) the motion is propeller-like.
- Beating of motile cilia consists of coordinated back-and-forth cycling of many cilia on the cell surface.



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FUNCTION OF FLAGELLA

- Flagella serve for the propulsion of single cells (e.g. swimming of protozoa and spermatozoa), and motile cilia for the transport of fluids (e.g. transport of mucus by stationary ciliated cells in the trachea).
- However, cilia are also used for locomotion (through liquids) in organisms such as *Paramecium*.



REFERENCES

- ***BASIC HISTOLOGY BY JUNQUEIRA***

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