

**CELL BIOLOGY &
PHYSIOLOGY**

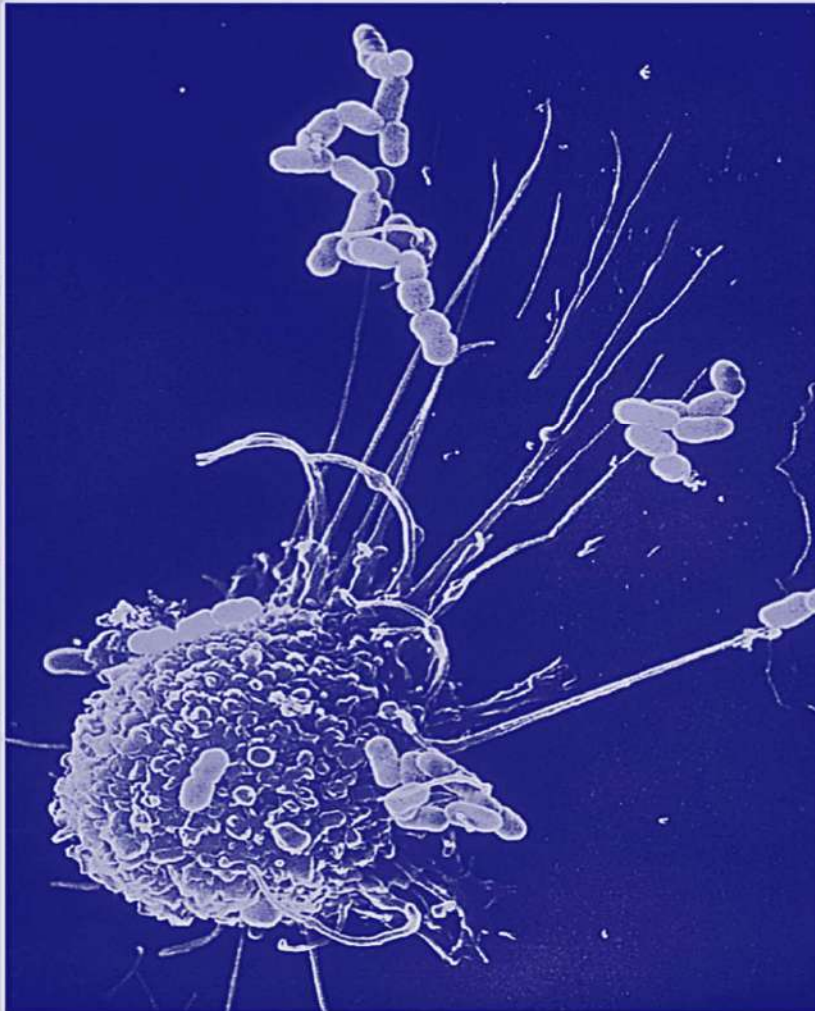
جامعة
الملك سعود
King Saud University



college of sciences
Zoology Department

Cell Biology and Physiology

ZOO (242)





The Cytoskeleton: structure and function.

- ✓ Microtubules
- ✓ Microfilaments
- ✓ Intermediate filaments

Centrosome

Cilia and Flagella

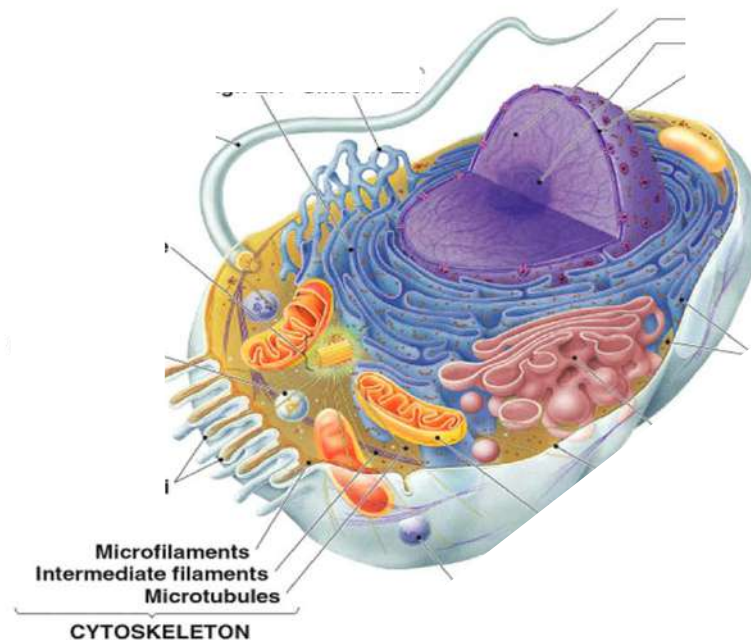
Cell membrane



الهيكـل الخـلوي The Cytoskeleton

Microtubules and filaments

A network of fibres شبكة من الالياف that provides **structural support** تدعيم to the cell. The cytoskeleton also functions in **cell motility** تحرك الخلية and regulation.



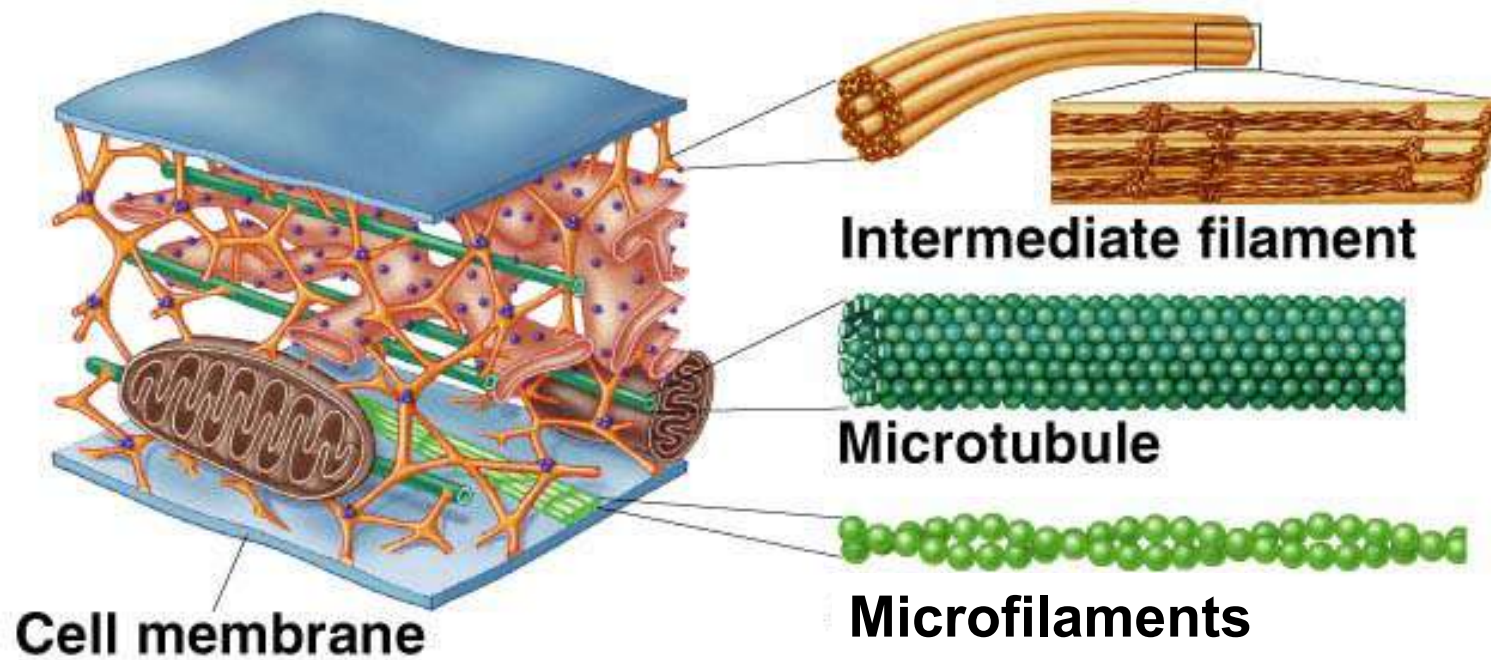
It is made up of 3 types of fibers

1. Microfilaments
2. Microtubules
3. Intermediate filaments

It has 3 main functions:

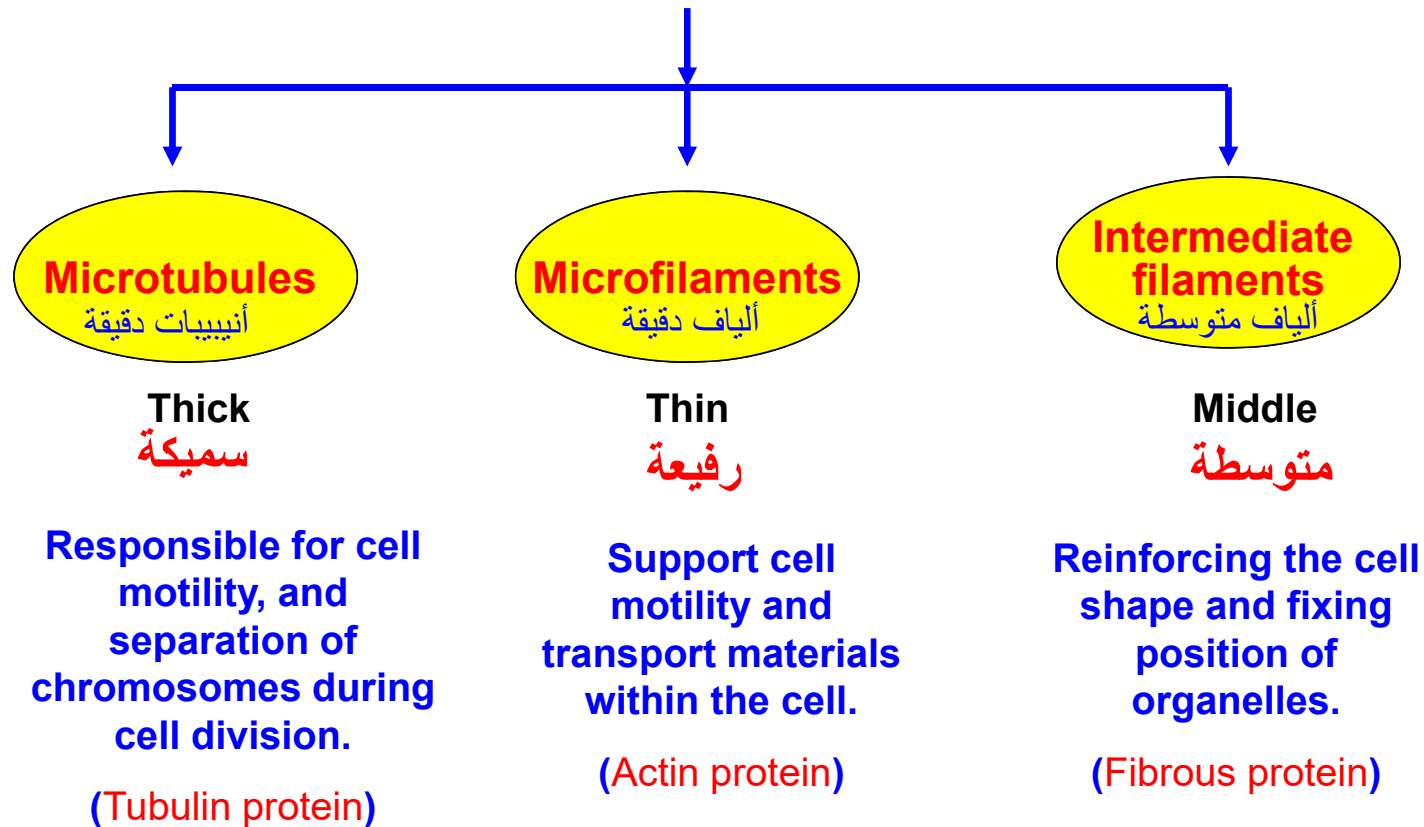
1. Provides mechanical support of the cell and keeps organelles in their fixed locations.
2. Helps moving materials within the cell
3. Plays a major role in cell motility

Cytoskeleton



Cytoskeleton

Cytoskeleton

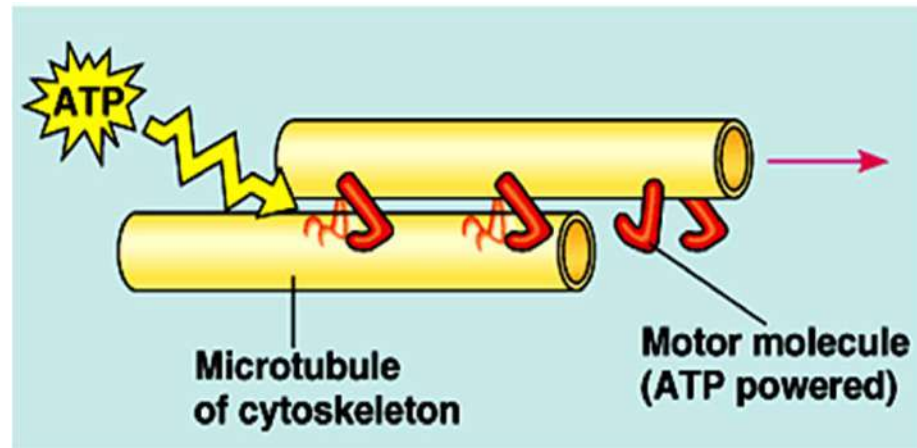


Cytoskeleton

- The cytoskeleton is dynamic, dismantling **يتفكك** in one part and reassembling **يتجمع** in another to change cell shape.
- The cytoskeleton plays a major role in cell motility **حركة الخلية** by interacting with **motor proteins**. **البروتين الحركي**.
- Motor proteins are able to move along the surface of a suitable substrate (powered by **ATP**).
- Motor proteins are the driving force behind most active transport of proteins and vesicles in the cytoplasm.

Cell Movement

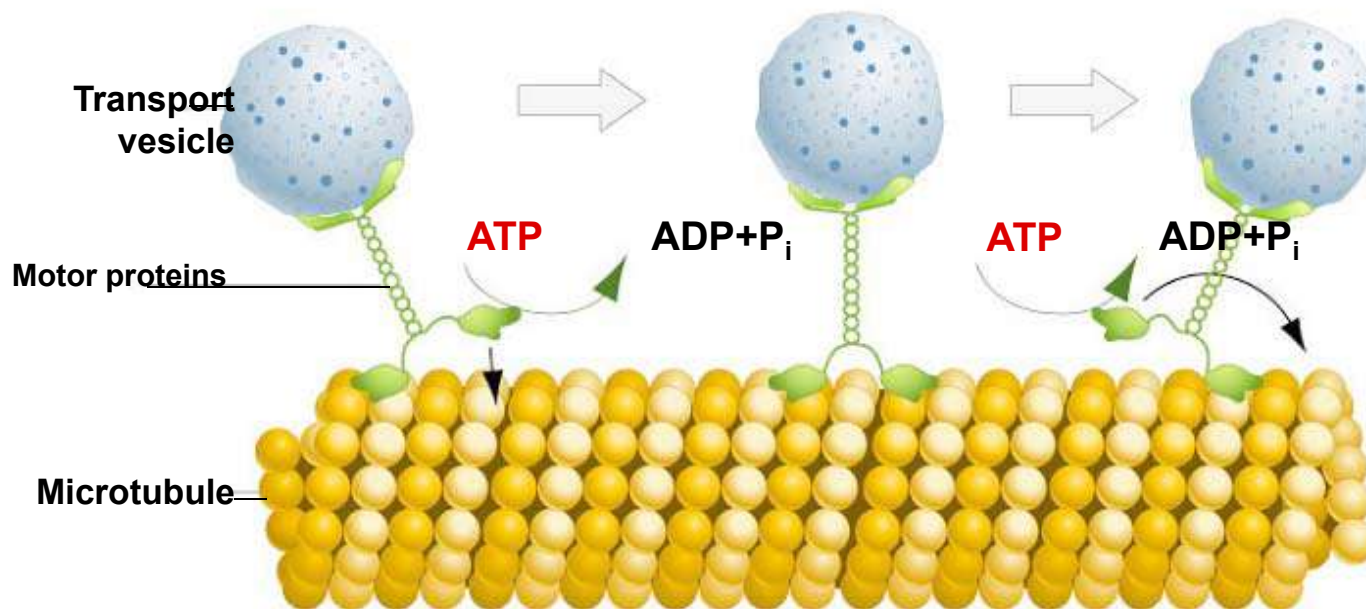
- In **cilia** and **flagella** motor proteins pull components of the cytoskeleton past each other **عكس بعضهم**.
- This is also true in **muscle cells**.



Motor proteins

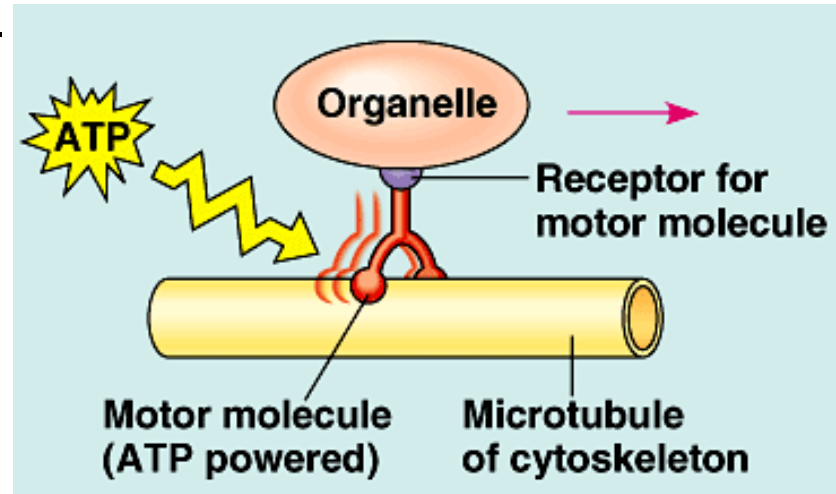
Motor proteins are a class of molecular motors that are able to move along the surface of a suitable substrate. They are powered by the hydrolysis of **ATP** and convert chemical energy into mechanical work.

MOTOR PROTEINS "WALKS" ALONG A MICROTUBULE TRACK

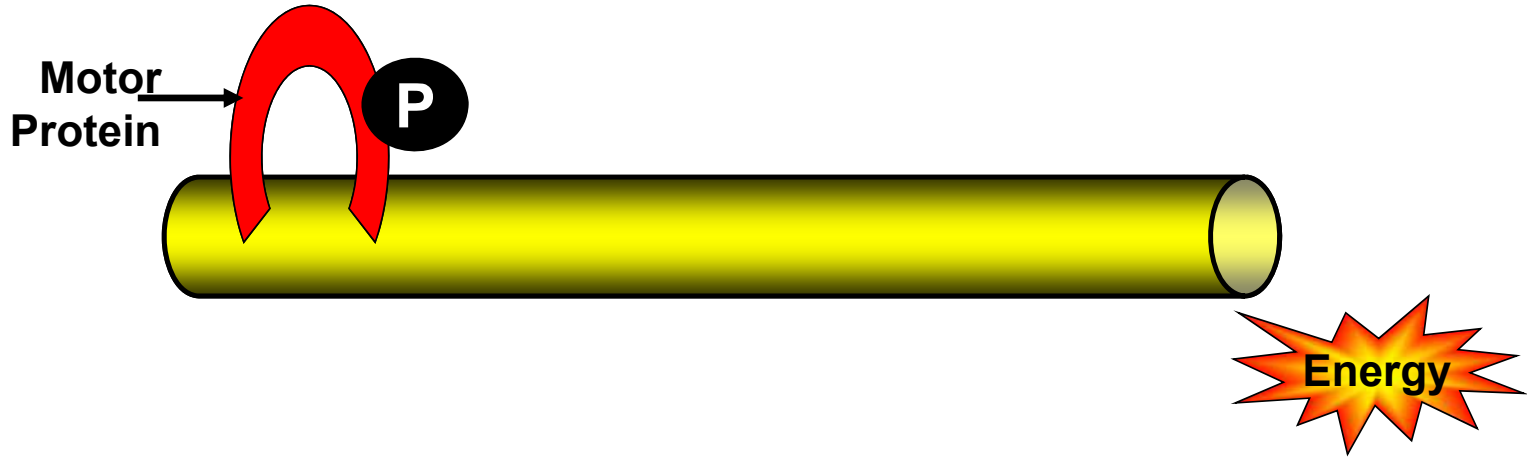


Motor proteins

- Interactions of motor proteins and the cytoskeleton circulates materials within the cell.
- The cytoskeleton may transmit mechanical signals that rearrange the nucleoli and other structures.
- Motor molecules also carry vesicles or organelles to various destinations
إلى أماكن مختلفة provided by the cytoskeleton.



Organelle



Microtubules functions as tracks قضييب that guide motor proteins carrying organelles to their destination المكان المستهدف.

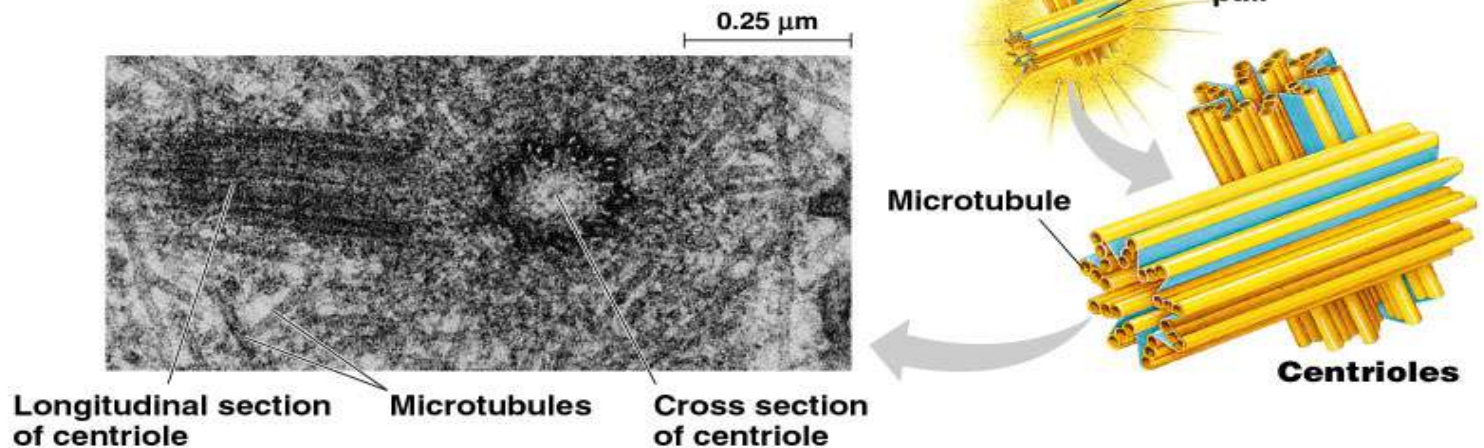
They move chromosomes during cell division

Centrosome

- In many cells, microtubules grow out from a **centrosome** الجسم المركزي near the nucleus.

Centrosome

- In animal cells, the centrosome has a pair of **centrioles**, each with **9 triplets** of microtubules تسعة مجموعات ثلاثية الأنابيبات (9 + 0 pattern) arranged in a ring مُرتبة دائريا.
- During cell division the centrioles replicate تتضاعف.

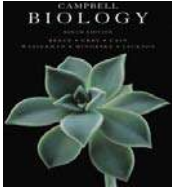


Cilia and Flagella

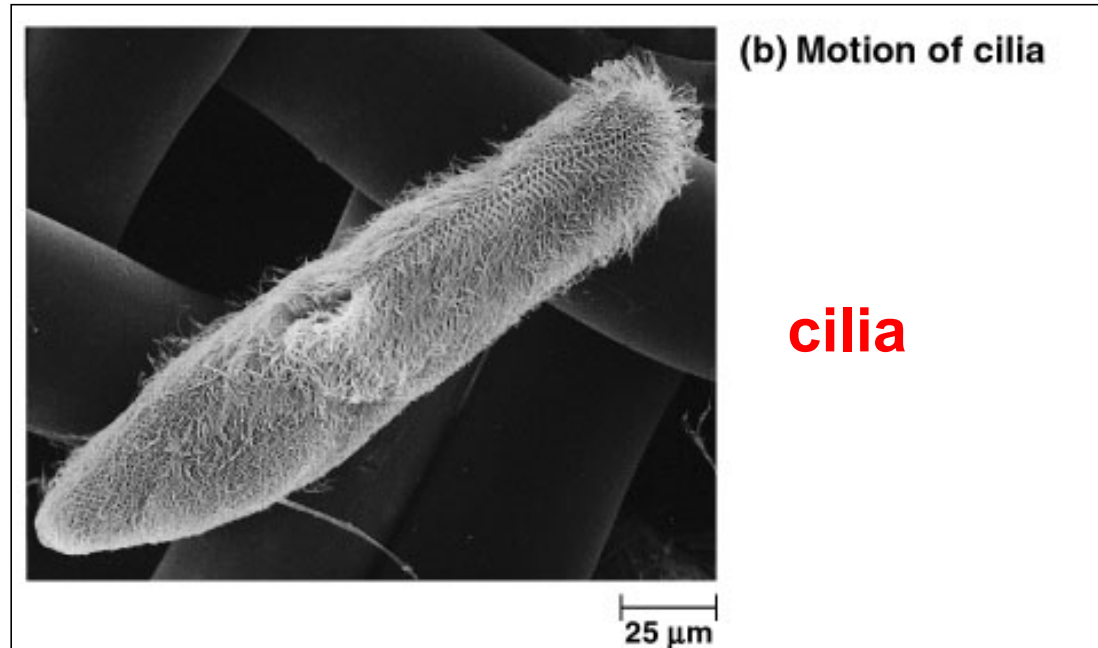
- **Microtubules are the central structural supporting both cilia** الأهداب **and flagella** الأسواط.
 - **Both can move unicellular and small multicellular organisms by propelling** دفع **water outside the organism.**

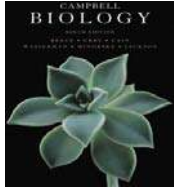
Movement of cilia & flagella

- **Cilia** usually occur in large numbers on the cell surface.
- **Flagella** usually occur in just one or a few per cell.
- **Cilia** move more like oars مجاديف with alternating power and recovery strokes.
- **Flagella** have an undulatory movement حركة تموجية.
- **So, they differ in their beating pattern** أسلوب الحركة.

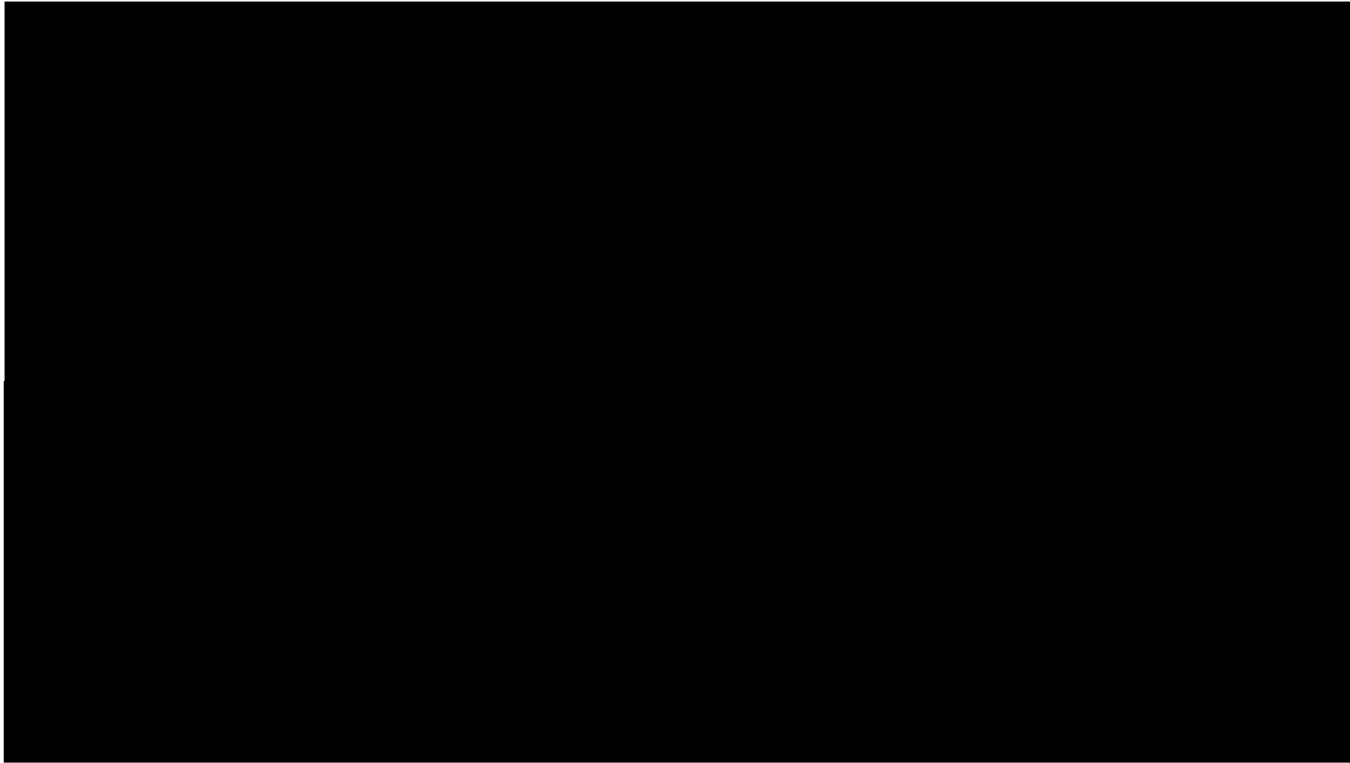


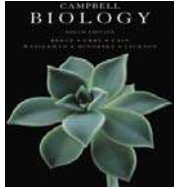
Cilia of *Paramecium*



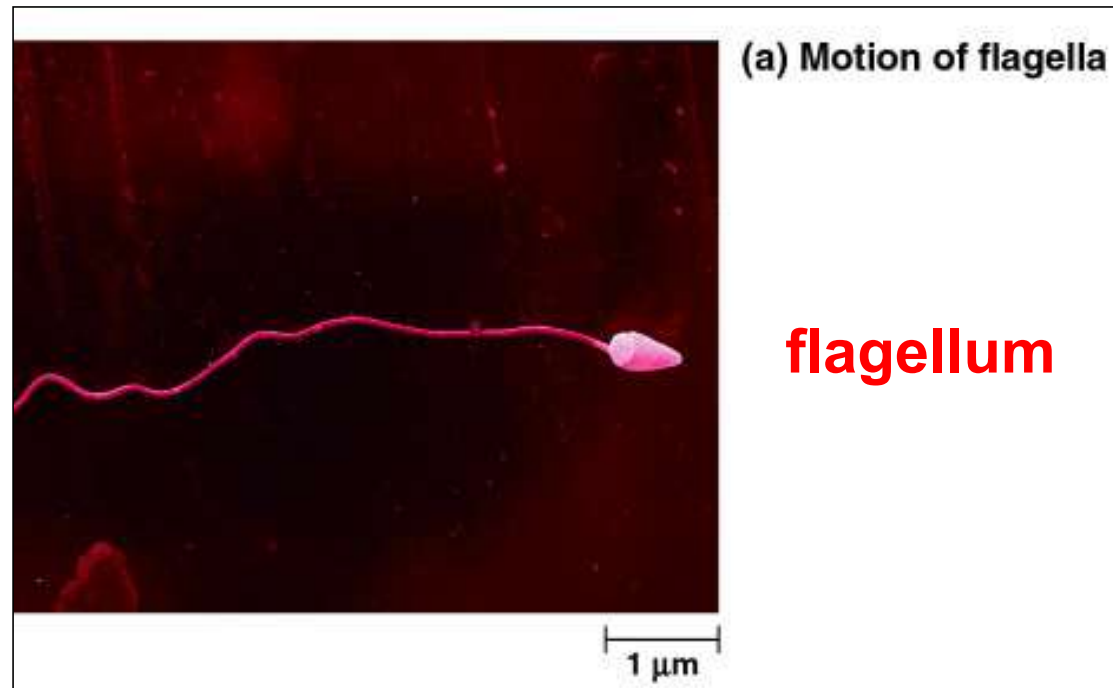


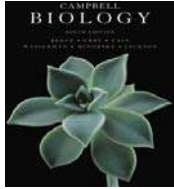
Cilia of *Paramecium*



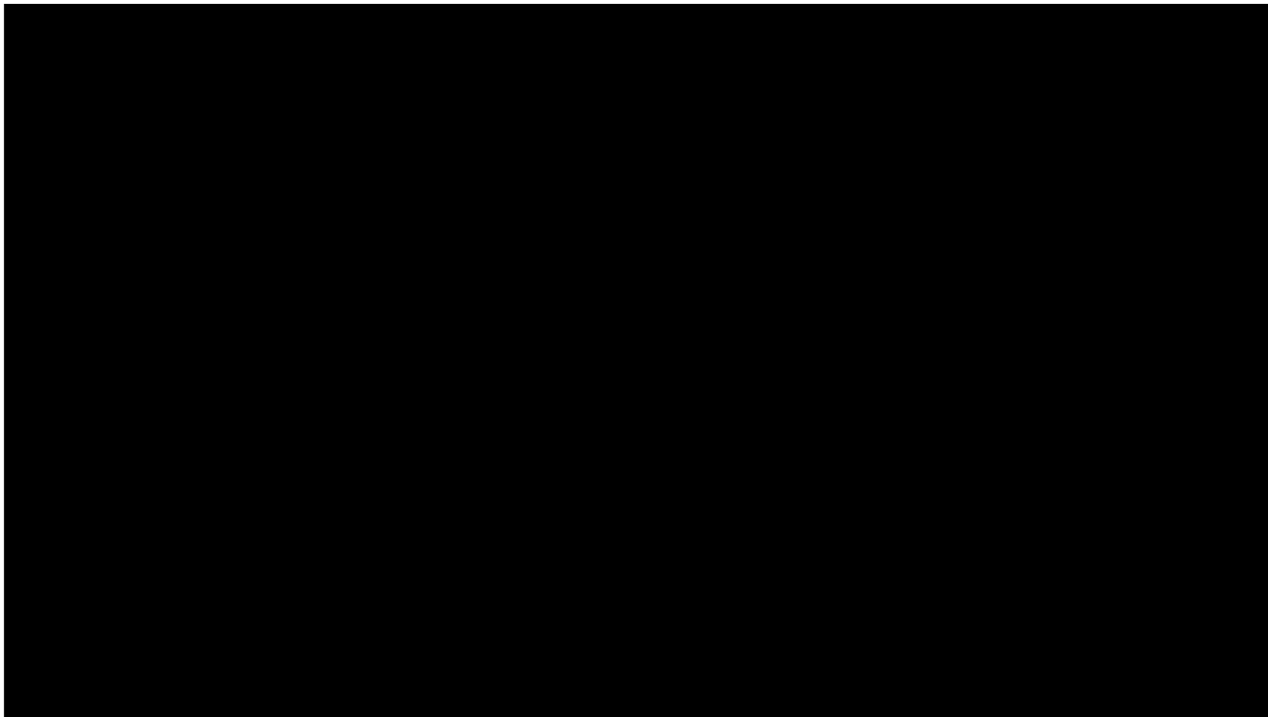


Flagellum of sperm

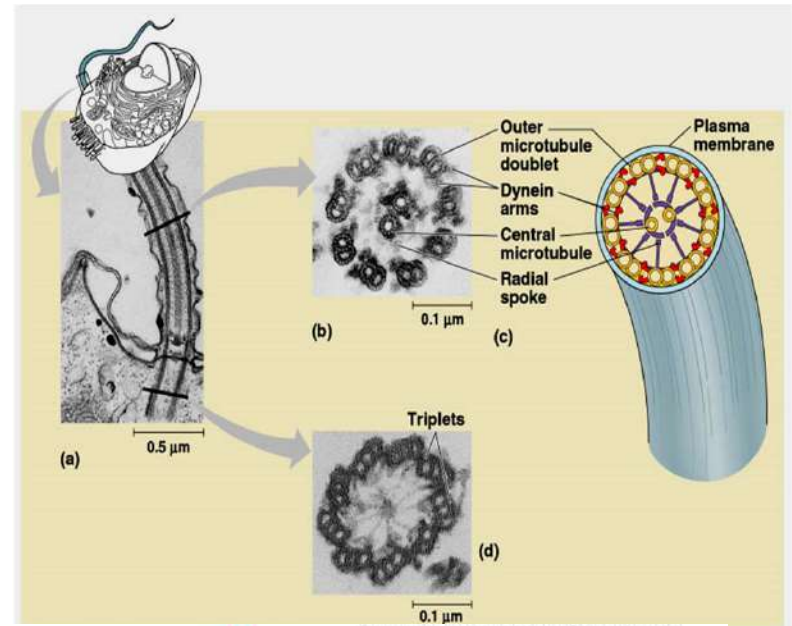




Flagellum of sperm



- ❖ Both **cilia** and **flagella** have the same ultrastructure **التركيب الدقيق**.
- ❖ Both have a core **مركز** of **microtubules** sheathed by the plasma membrane.
- ❖ **9-doublets** (**9 + 2 pattern**) **تسعة مجموعات ثنائية الأنابيبتان** of microtubules arranged around a pair at the center.
- ❖ Flexible “wheels” of proteins connect outer doublets to each other and to the core.
- ❖ The outer doublets are also connected by motor proteins.
- ❖ Thus, the structure of the cilium and flagellum is different from that of the centriole.



Cilia and Flagella Structure

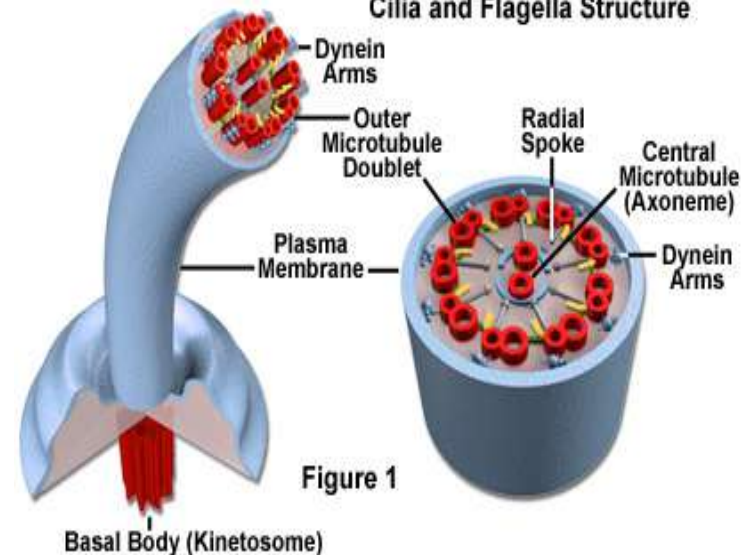
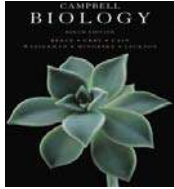


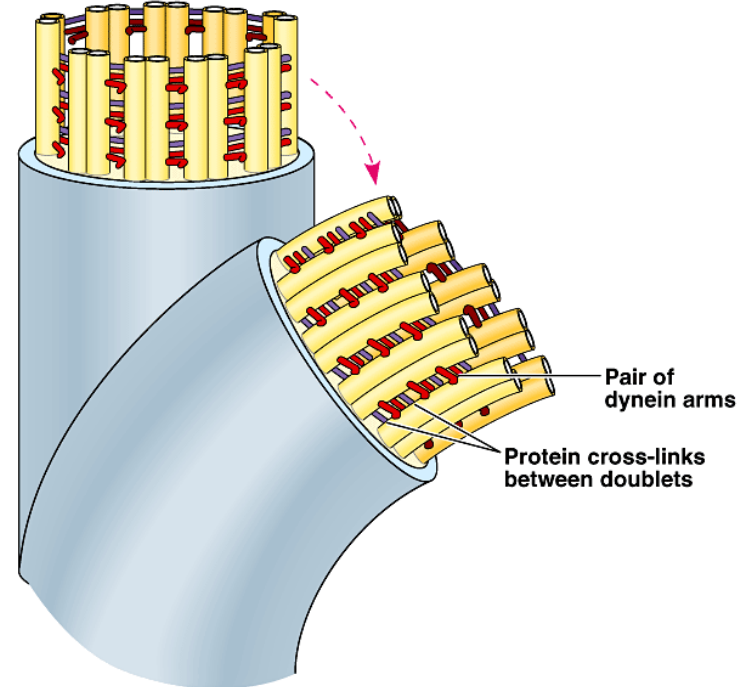
Figure 1



Cilia and Flagella

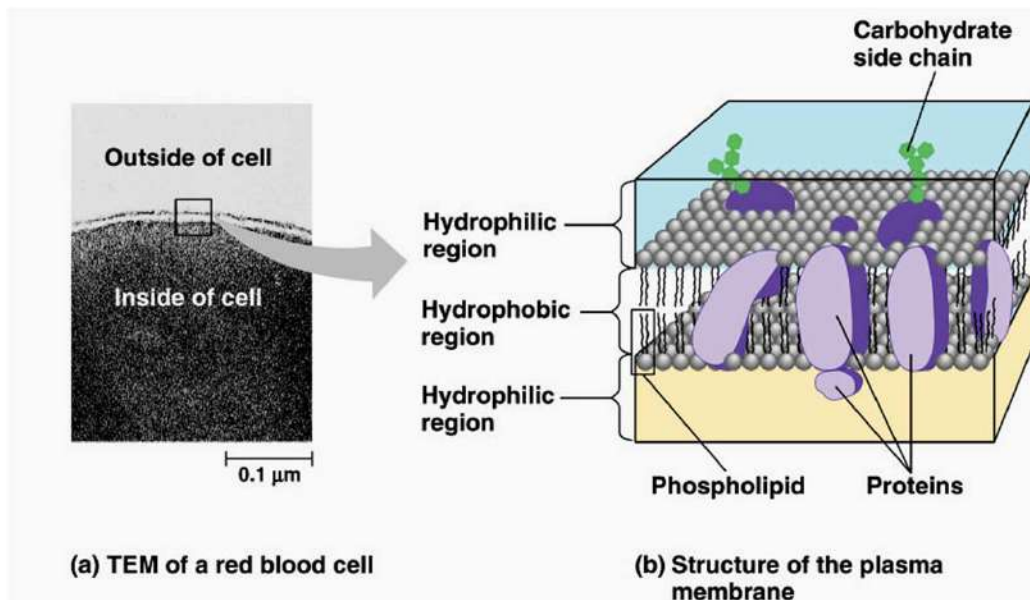
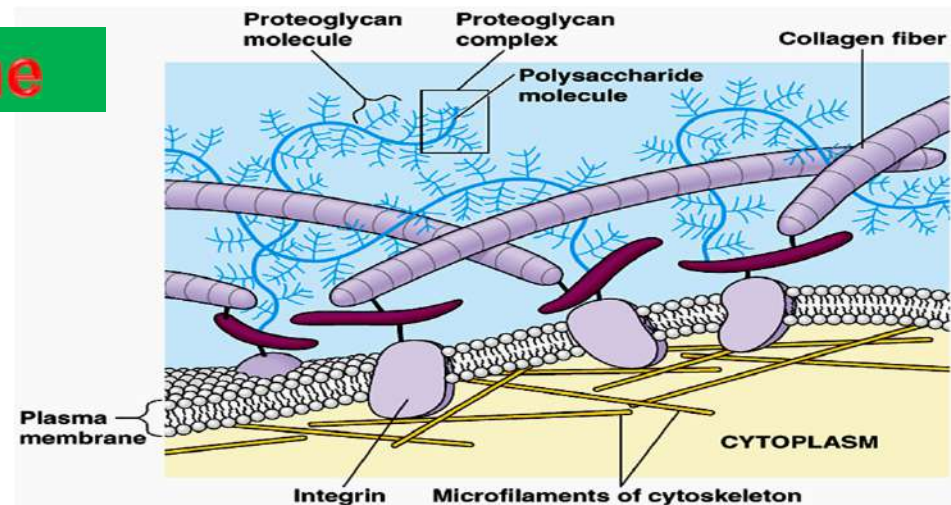


- **Cilia and flagella** are formed of arms of a motor protein (**dynein** بروتين الداينين).
- Dynein arms alternately grab, move, and release the outer microtubules.
- Protein cross-links limit sliding and the force is expressed as bending إلتواء.



7- Cell membrane

The plasma membrane functions as a **selective barrier** that **حاجز اختیاری** allows passage of oxygen, nutrients, and wastes for the whole volume of the cell.



Plasma Membrane Structural Components

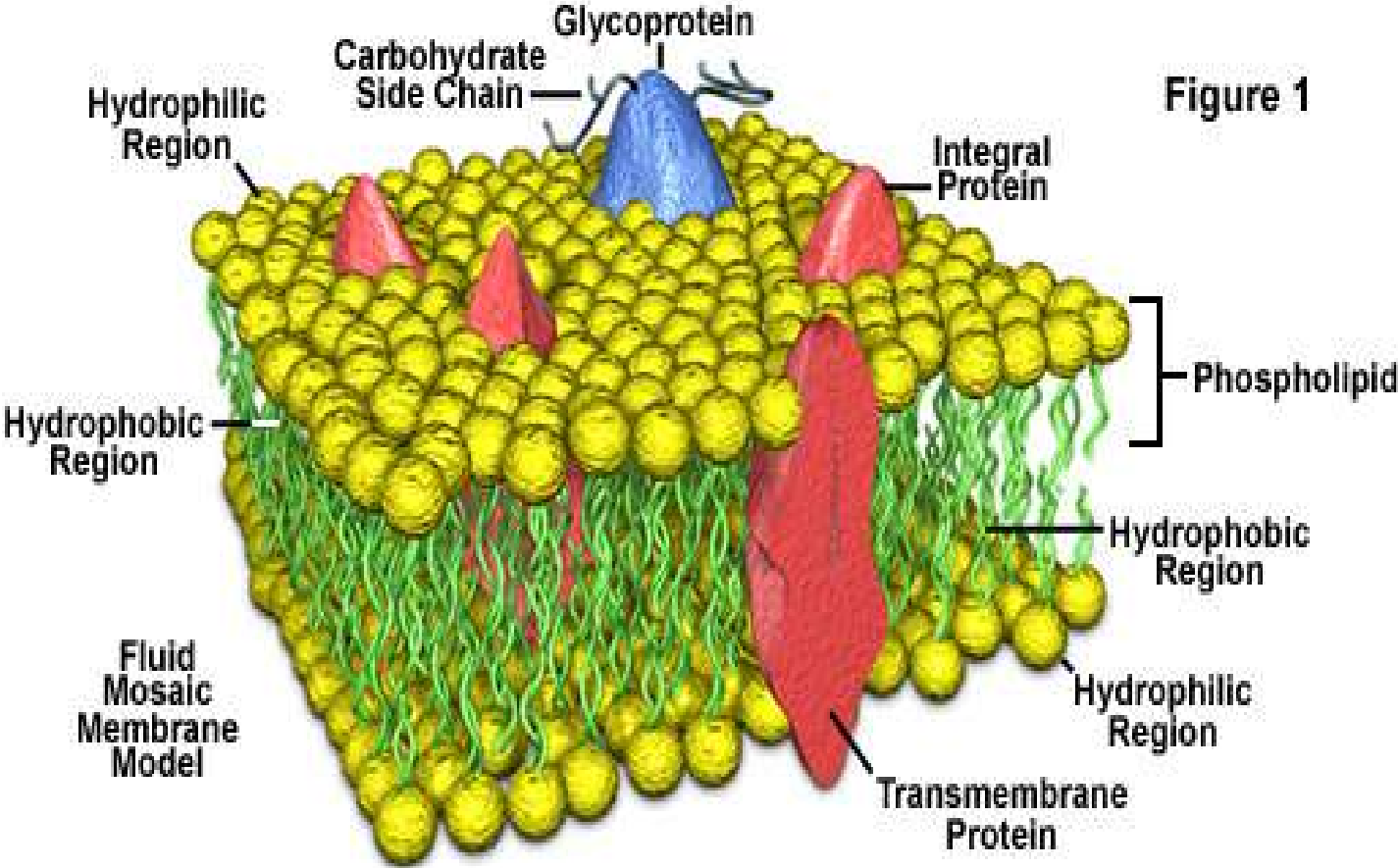
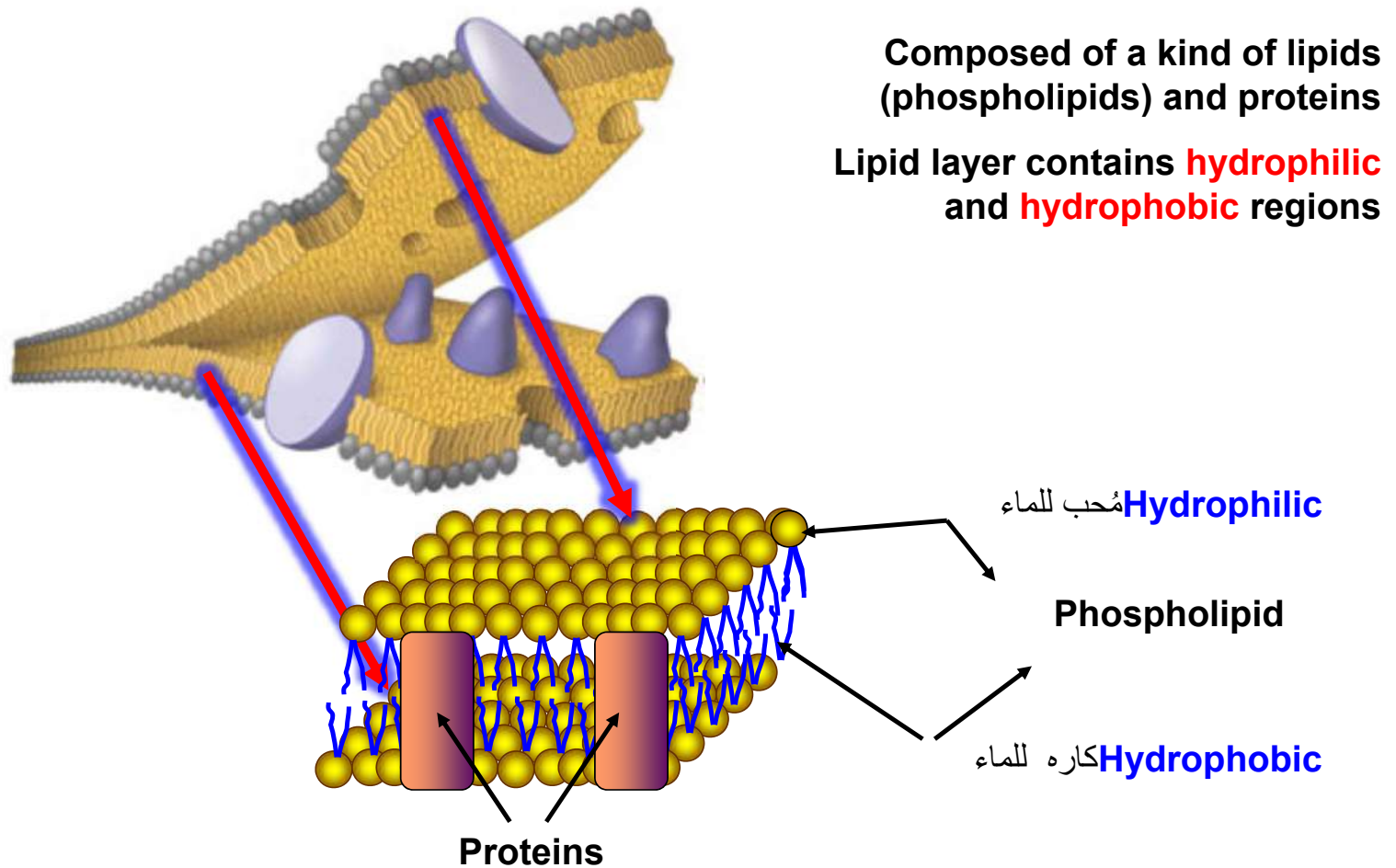


Figure 1

Cell membrane





Summary

- The **cytoskeleton** functions in structural support for the cell and in motility and signal transmission.
- **Microtubules** shape the cell, guide organelle movement, and separate chromosomes in dividing cells.
- **Cilia** and **flagella** are motile appendages containing microtubules. Primary cilia also play sensory and signaling roles.
- **Microfilaments** are thin rods functioning in muscle contraction, amoeboid movement, **cytoplasmic streaming**, and microvillus support. **Intermediate filaments** support cell shape and fix organelles in place.





References

- “The Tour of the cell” chapter 06. Biology by Jane B Reece; Neil A Campbell; et al Boston : Benjamin Cummings / Pearson, ©2011. English : 9th Ed.

