Pakistan School
Kingdom of Bahrain

Pakistan School, Kingdom of Bahrain.

Welcome to

Grade 11

Rules of the class

1) Be on time for all your classes.
2) Respect all the participants of the class.
3) Do not create any disturbance.
4) Pay attention to your teacher.
5) Raise hand if you have a question.
6) Enter into the class with your actual name and CPR number.

Chapter 1

Cell Structure and Function

OBJECTIVES:

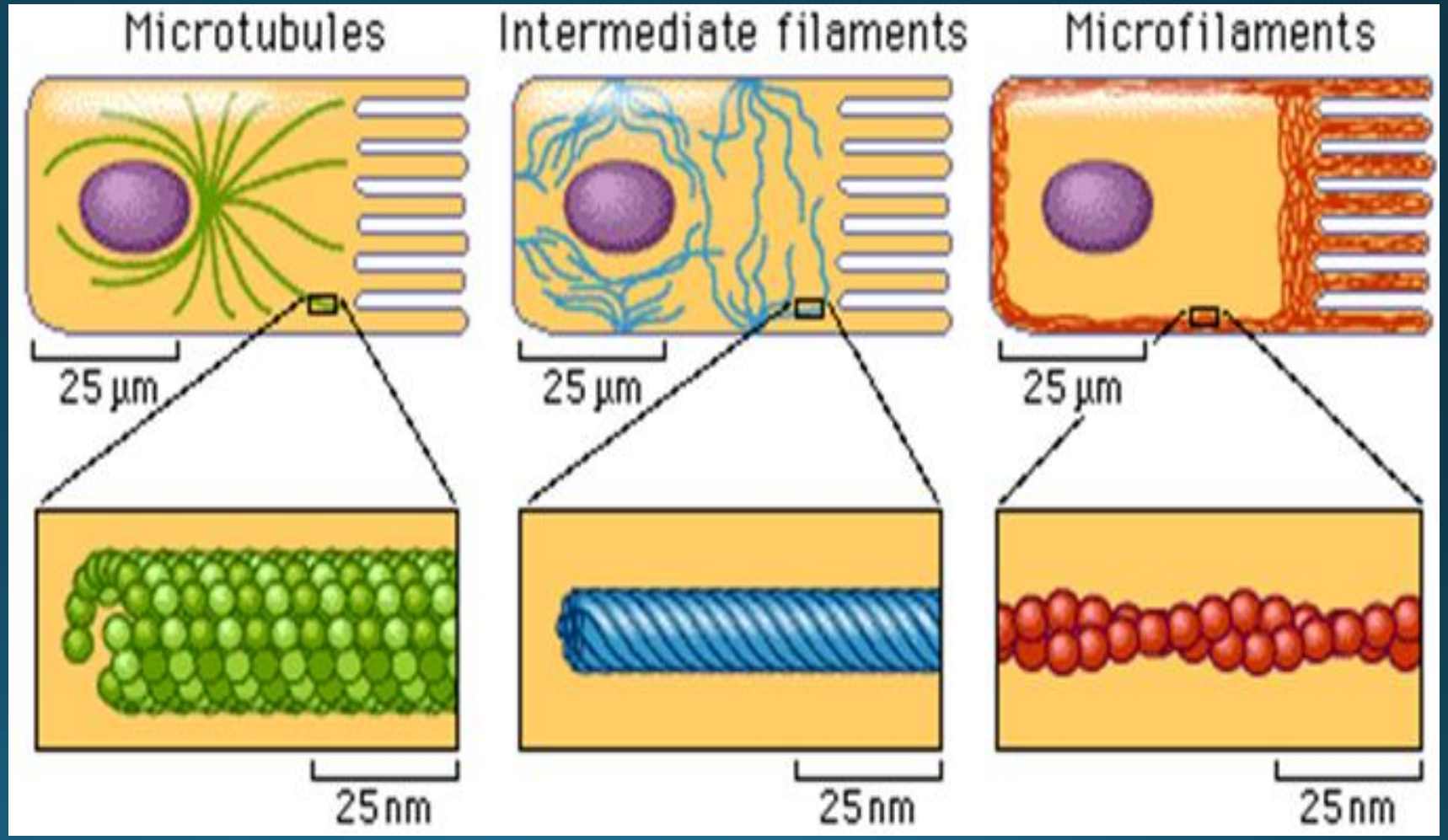
At the end of this lesson students will be able to:

- Analyze the structure of cytoskeleton, cilia and flagella.
- Explain their respective functions.

Cytoskeleton

- Fibrous structures
- Cytoplasm
- 3 types

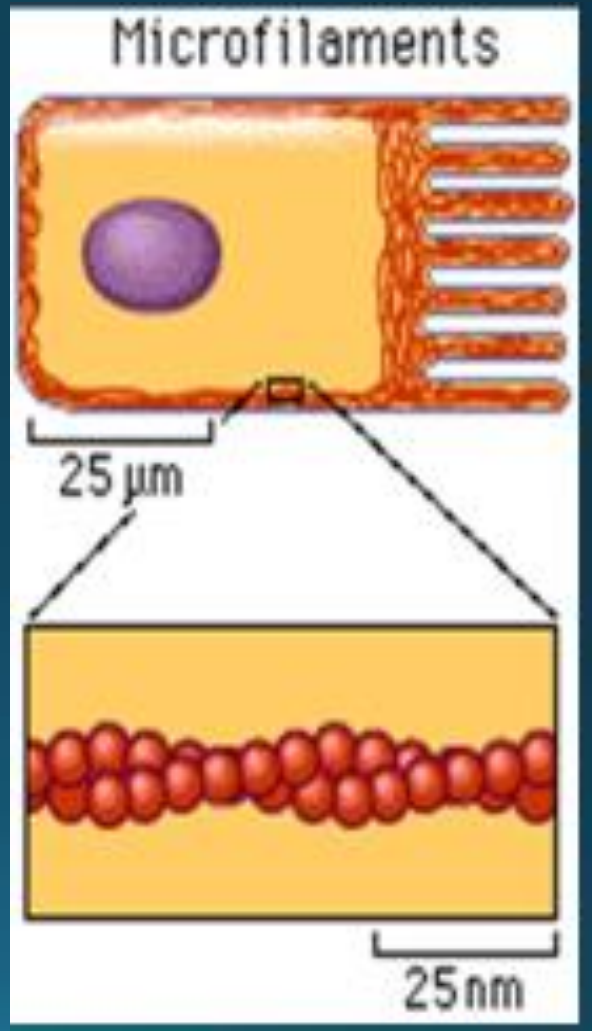
1) Microfilaments
2) Microtubules
3) Intermediate filaments



Microfilament

Actin filaments

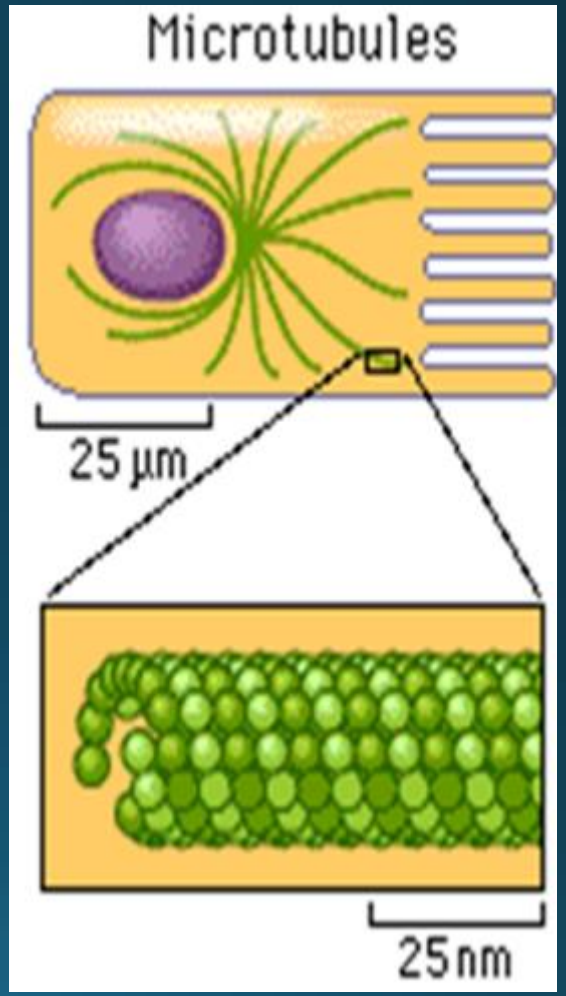
- Thin contractile (7nm)
- Bundle or mesh
- 2 twisted monomer chains → Fibrous or Filamentous actin (F-actin)
- made of Globular actin or G-actin
- 2 chains of tropomyosin twisted on actin filament
- Protein – Troponin → triplets at intervals on filament
- Location : Just under PM + in muscles (as myofibrils)
- Function : Control cyclosis + contraction & relaxation



Microtubules:

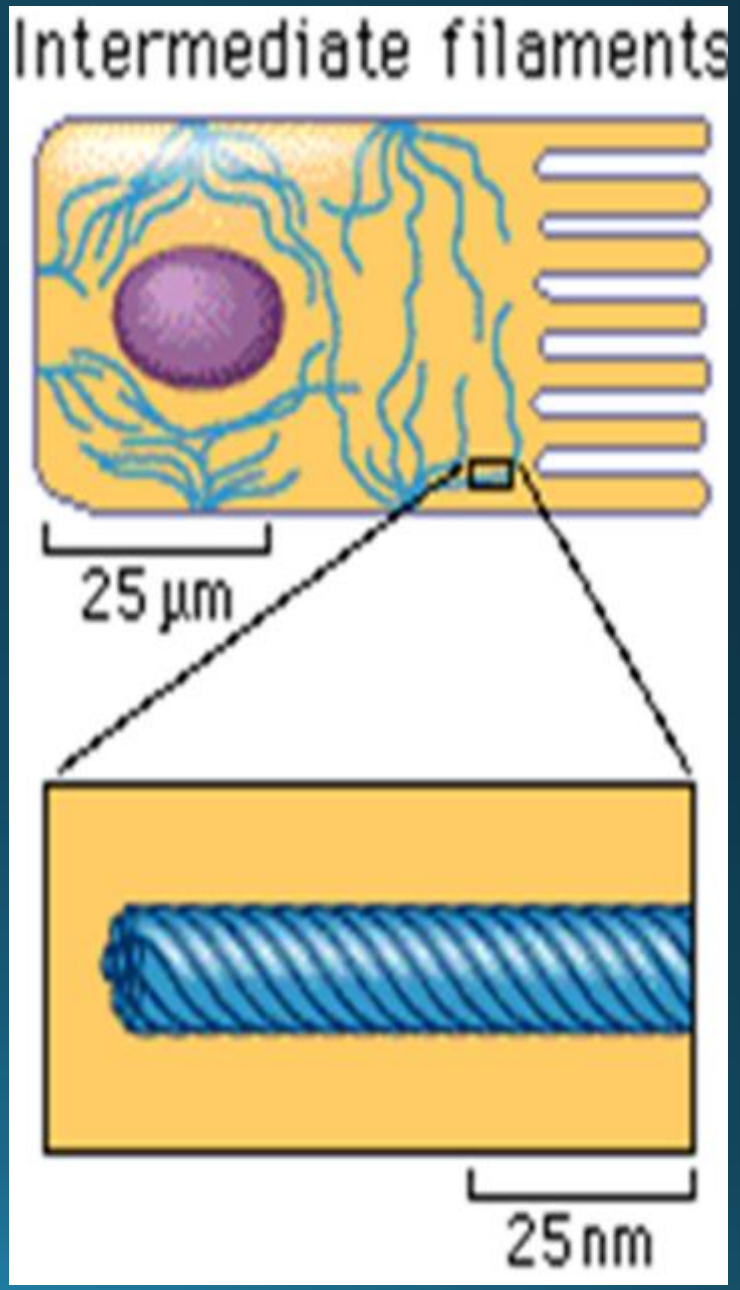
- Small hollow cylinders
- 25 nm diameter , 0.2-25 micrometer length
- Composition : Tubulin (Protein)

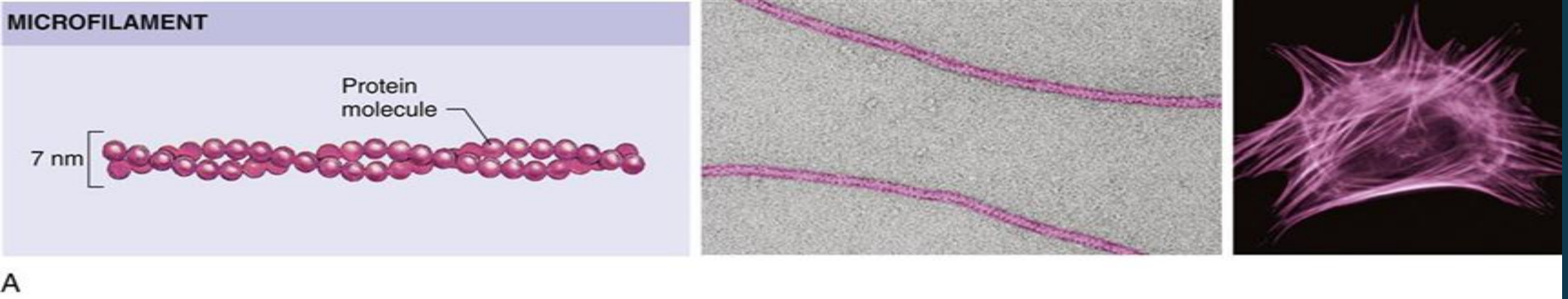
 - dimer (α , β subunits) – linear arrangement → paired filaments
- Paired filaments coiled or twisted → tubular structure = microtubules
- Location : Plants – cytoplasm
- Function : Mitotic apparatus during cell division → Distribution of chromosomes
- Animal cells → formation of cilia, centrioles, flagella, basal body



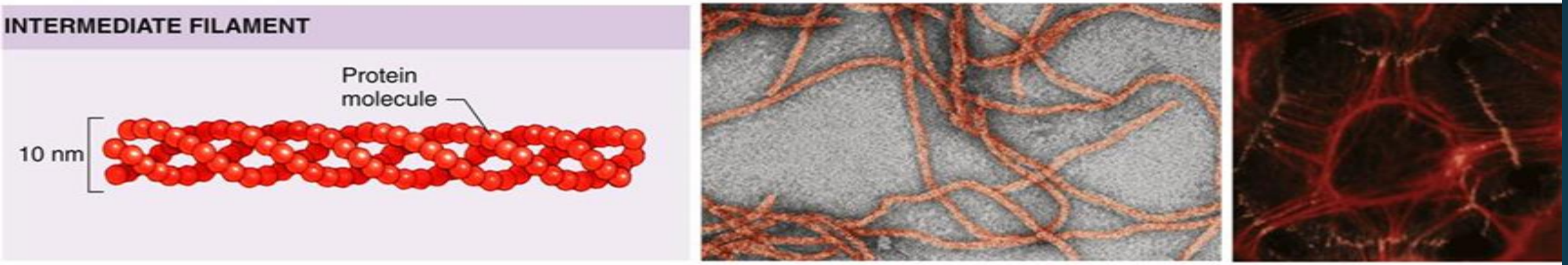
Intermediate filaments

- 8 -10 nm diameter
- Composition : Protein – Vimentin (3 chains twisted with no hollow space)
- Chains or strings of Vimentin subunits
- Function: Mechanical support to nuclear envelope and PM

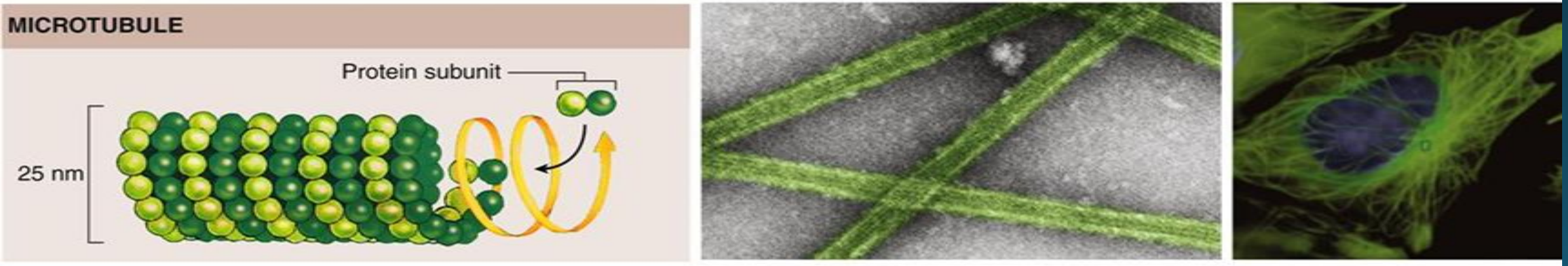



MICROFILAMENT
Protein molecule
7 nm

A


INTERMEDIATE FILAMENT
Protein molecule
10 nm

B


MICROTUBULE
Protein subunit
25 nm

C

Cilia and Flagella

Similarities

- Hair like projection on surface of cells
- Internal structure same

Differences

- Vary in size number and pattern of movement

Flagella: longer, fewer and show undulating movement

Cilia: short, many and show perpendicular beating

a. metachronous → cilia of a row beat one after the other

b. Synchronous → cilia of a row beat simultaneously

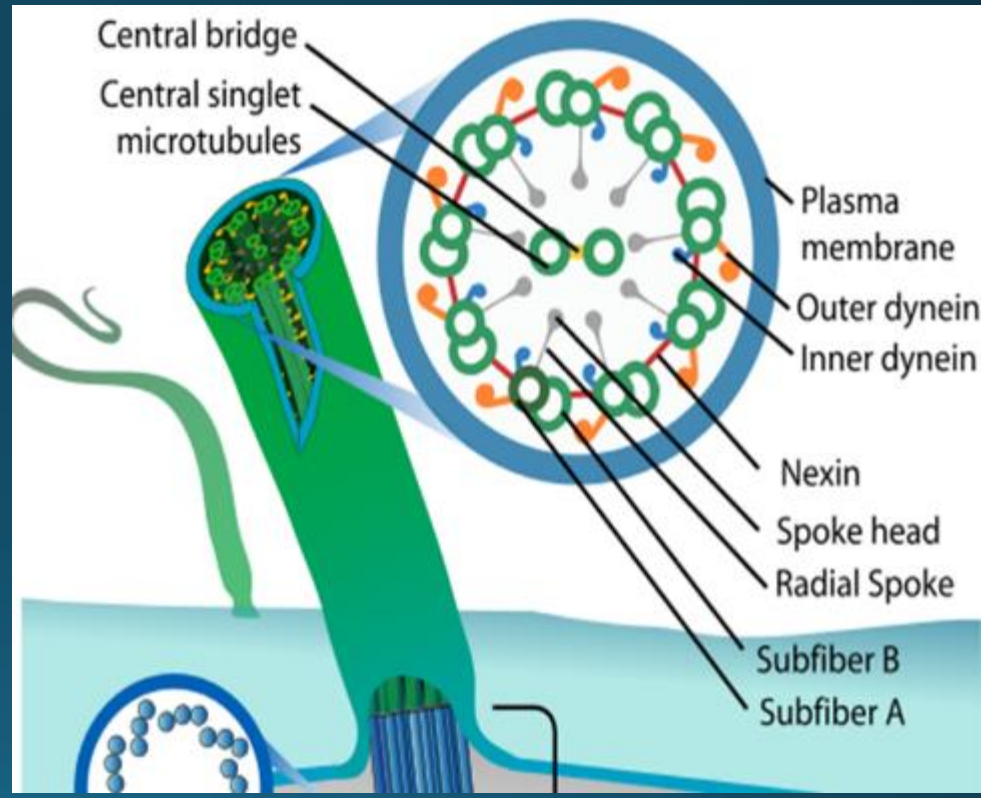
Structure of Cilia and Flagella

- Both share common ultra structure

1. Axoneme
2. Spiral sheath of cytoplasm and plasma membrane

Axoneme (held by bridge , radial spokes and Nexin)

- Eleven longitudinal micro fibrils
- 9 → a. peripheral , arranged in a ring
  b. 2 --subfibers → doublets
  Inner – complete has two arms
  inner dynein arm
  outer dynein arm
  a radial spoke – from A tubule to inner sheath
  outer – C -shaped
- 2 → single in the center enclosed in inner sheath
- A bridge connects the central microtubules



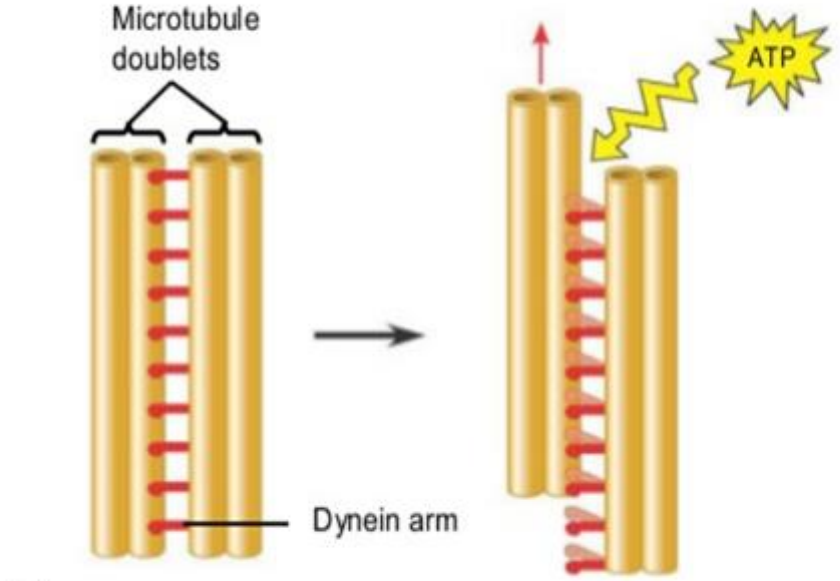
Mechanism of movement of Cilia and Flagella

- Dynein arms of one doublet attach to adjacent doublet and pull
- Doublets slide past over each other in opposite direction
- Arms then release and reattach farther

- https://www.youtube.com/watch?v=9nZYlyFGm50

Protein Dynein:

– Is responsible for the bending movement of cilia and flagella



(a) Powered by ATP, the dynein arms of one microtubule doublet grip the adjacent doublet, push it up, release, and then grip again. If the two microtubule doublets were not attached, they would slide relative to each other.

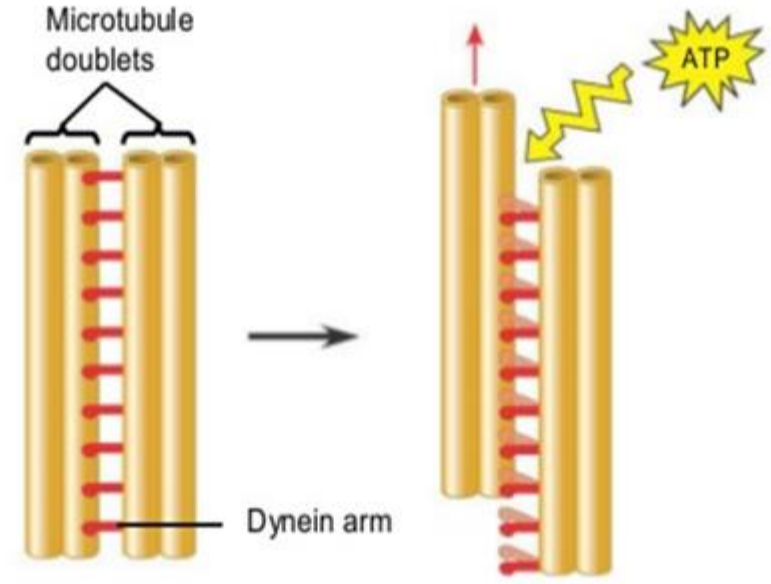
Lateral Movement of a cilium or flagellum

- Dynein makes bridges between adjacent microtubules
- It hydrolyzes ATP to provide energy
- ATP activates motor domain of dynein
- It walks along the adjoining doublet
- It forces the doublet to slide

Over Sliding-over is prevented by bridge , radial spokes and Nexin)

Protein Dynein:

–Is responsible for the bending movement of cilia and flagella



(a) Powered by ATP, the dynein arms of one microtubule doublet grip the adjacent doublet, push it up, release, and then grip again. If the two microtubule doublets were not attached, they would slide relative to each other.

Movement of cilia

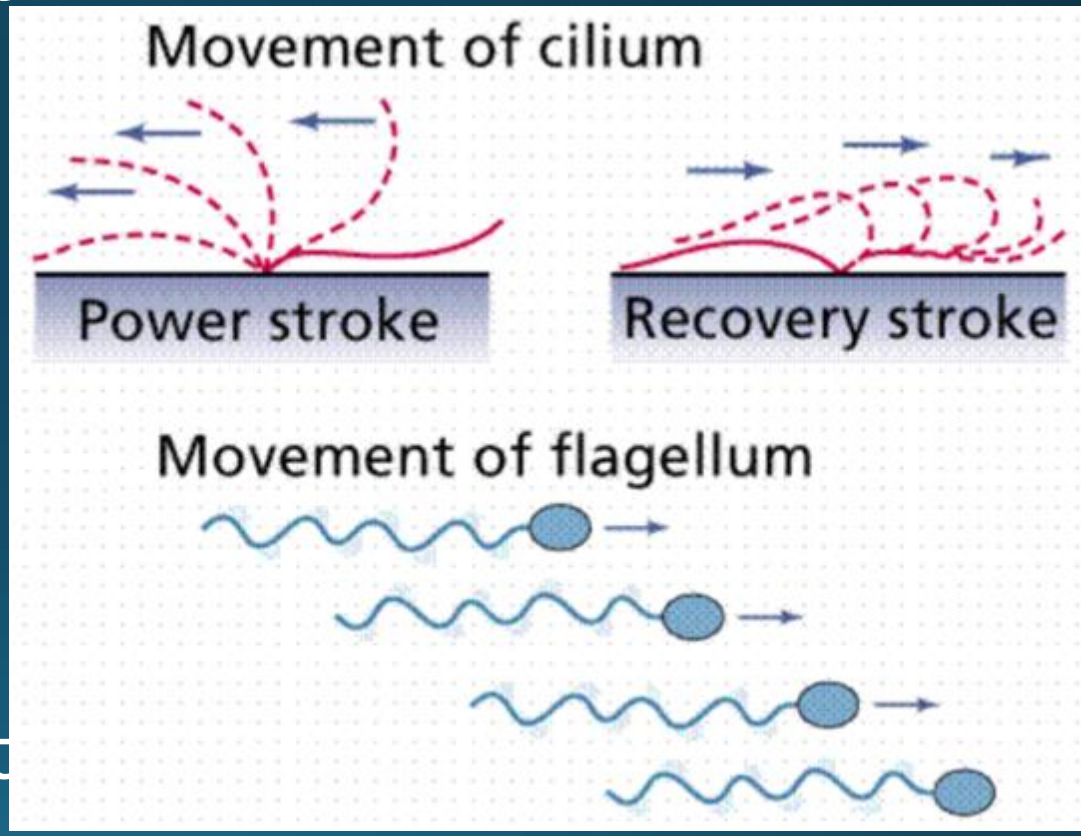
There are two main steps in movement of cilia

1. **Effective stroke / power stroke :**

- Five out of nine doublet fibrils contract simultaneously
- Cilium bends or shortens

2. Recovery stroke

- Four out of nine doublet fibrils contract simultaneously
- Cilium elongates or becomes straight



PLENARY:

1. Name the types of cytoskeleton.
2. What are the proteins that make cytoskeleton?
3. What is axoneme?
4. Differentiate between power stroke and recovery stroke.
5. How are the microtubules arranged in axoneme?


STAY
HOME
STAY SAFE

Allah Hafiz