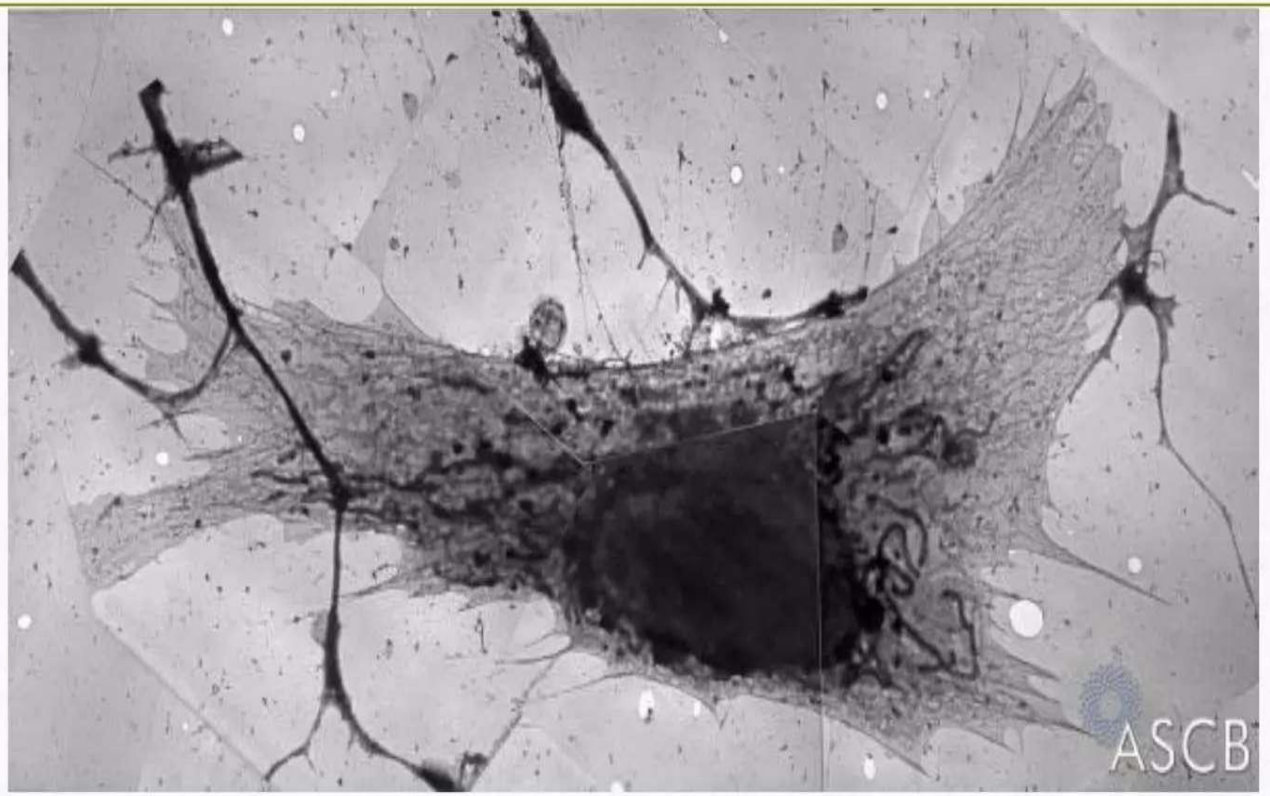
INTRODUCTION

This is a scan of the first electron micrograph taken intact of eukaryotic cell.

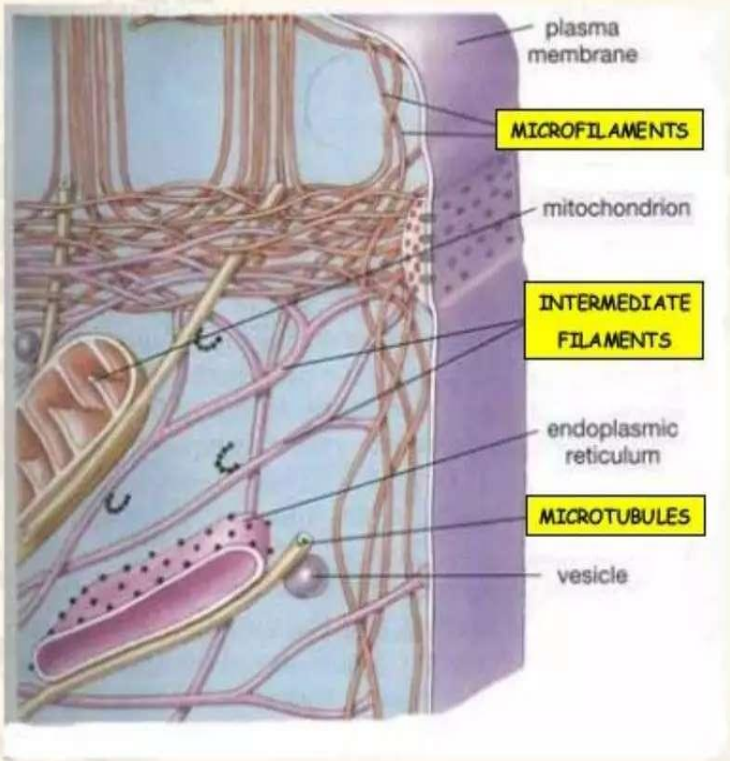


CYTOSKELETON

The cytoskeleton is the structure consisting of fibrous proteins that occur in the cytoplasm and maintain the shape of the cell.

The Cytoskeleton

- The eukaryotic cell is a 3D structure. It has a cytoskeleton anchored to proteins in the plasma membrane
- These proteins both maintain shape and allow movement
- The cytoskeleton is a dynamic structure, as the microfilaments and microtubules can depolymerise and repolymerise very easily



STRUCTURE

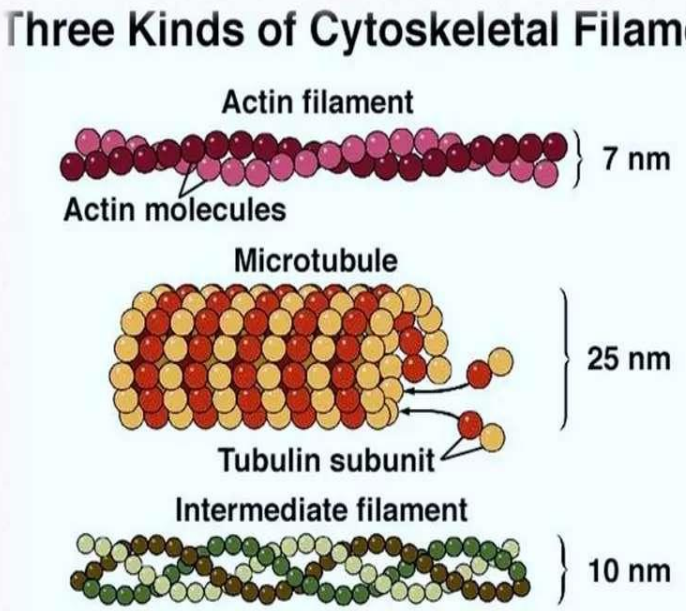
- Network of filamentous proteins
  - filaments formed from a few proteins
  - monomer protein forms polymer filaments
- located in nucleus and cytoplasmic compartments
  - not within organelles
- location based upon cellular function
- named on basis of physical size

FUNCTIONS :

- functions based upon the filaments physical properties
- integral strength
- cell shape
- motility
  1. inside the cell
  2. whole cell
  3. motor proteins associated with 2 filament systems

Cytoskeletal filaments:

1. Microfilaments
2. Microtubules
3. Intermediate filaments



INTERMEDIATE FILAMENTS

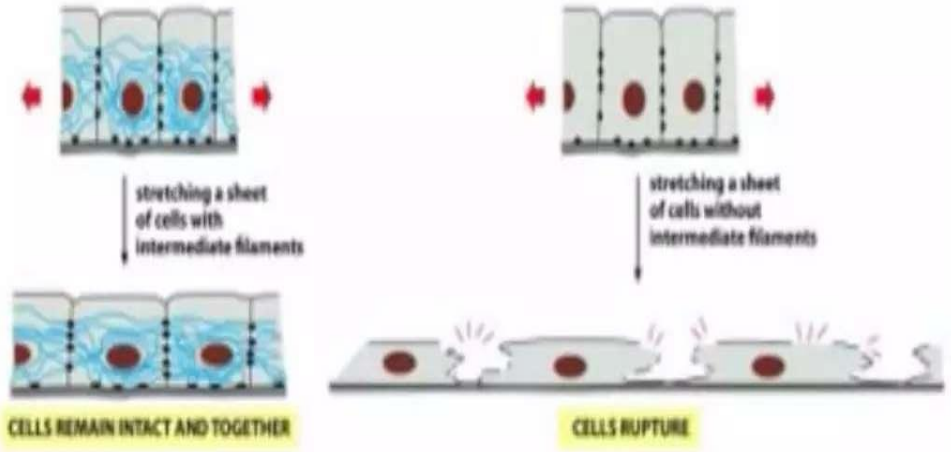
- different cell types, different intermediate filaments
- all eukaryotes nuclear cytoskeleton the same
- resist stresses applied externally to the cell cytoplasm
- 10-nanometer diameter
- cross-linking proteins allow interactions with other cytoskeletal networks

- intermediate filament associated proteins (IFAPs)
  - coordinate interactions between intermediate filaments and other cytoskeletal elements and organelles,
- human disorders
  - mutations weaken structural framework
  - increase the risk of cell rupture

Intermediate Filaments (IFs)

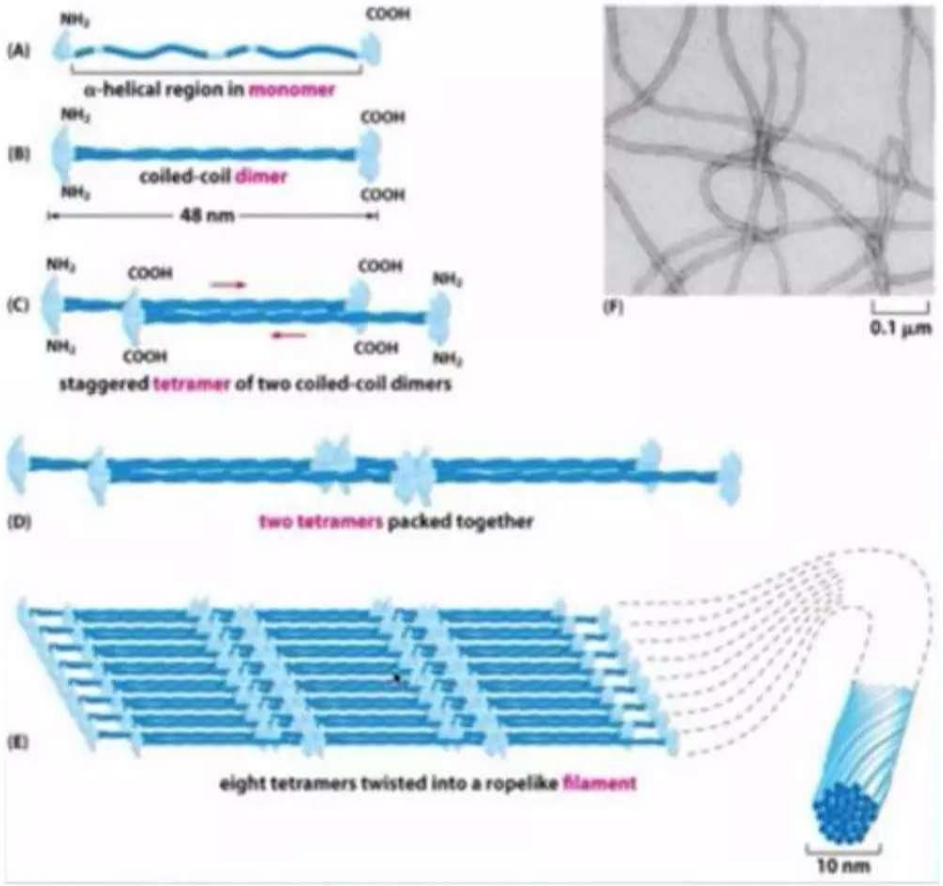
Intermediate filaments

- large tensile strength, main function is to help the cells withstand mechanical stress



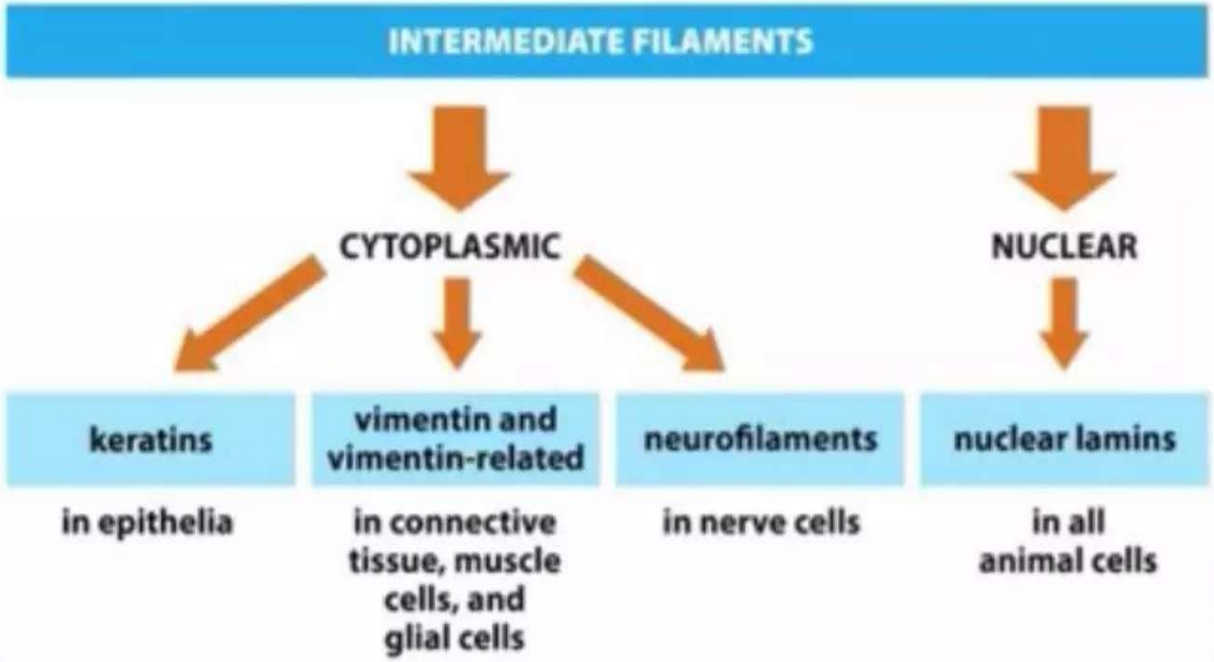
Intermediate Filaments (IFs)

Intermediate filaments form strong rope-like multi-protein assemblies



Intermediate Filaments (IFs)

There are **four classes of intermediate filaments**



Some functions of Intermediate Filaments :

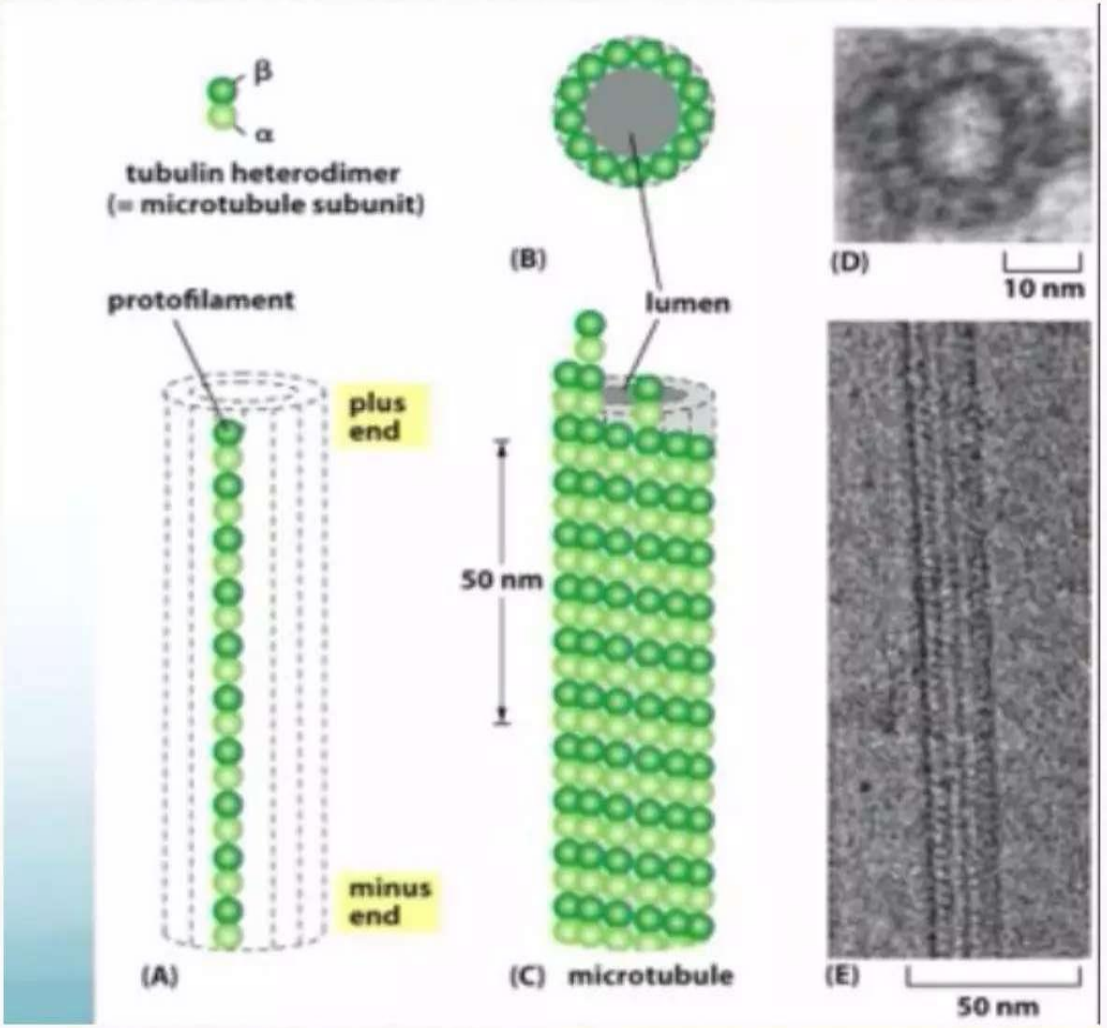
- Intermediate filaments provide mechanical strength and resistance to shear stress.
- There are several types of intermediate filaments, each constructed from one or more proteins characteristic of it.

MICROTUBULES

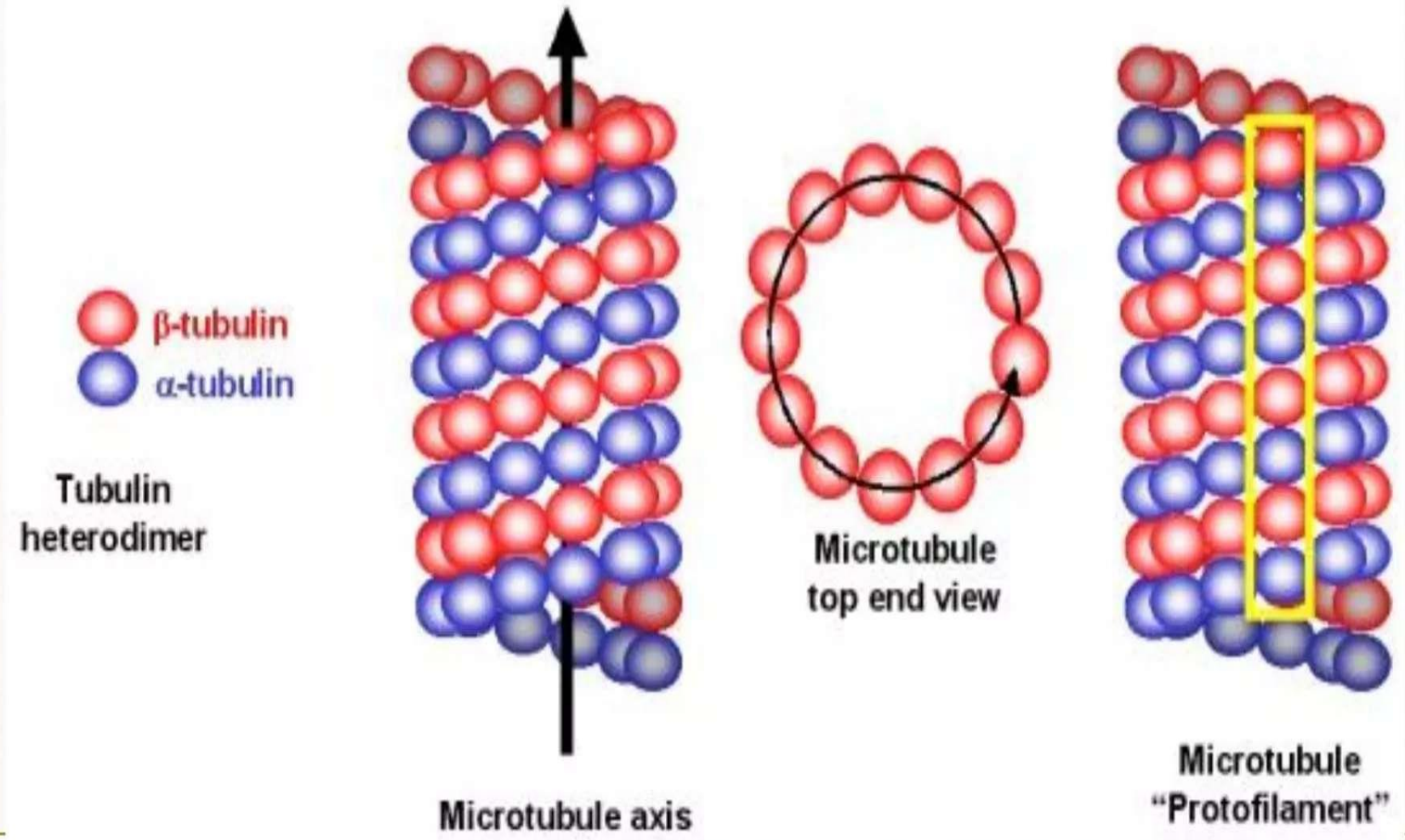
- 25 nm diameter, 14 nm internal channel tubulin cytoplasmic
- All cells contain
- Same core structure
- Same motors Dynein (-) and Kinesin (+)
- Different associated proteins
- Dynamic
- Continuous remodelling

- Movement
- Intracellular > cellular
- Cell division mitotic spindle
- Specialized structures
- centrosome,Spindle pole
- Cell processes - cilia (9+2)

MICROTUBULE STRUCTURE

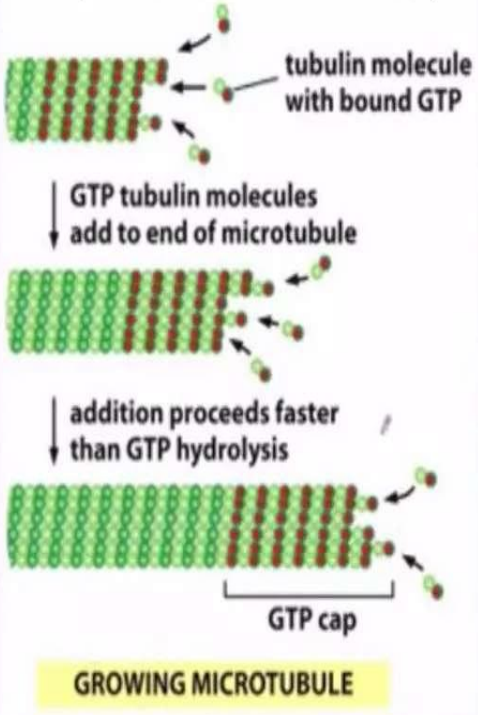


STRUCTURE OF MICROTUBULE

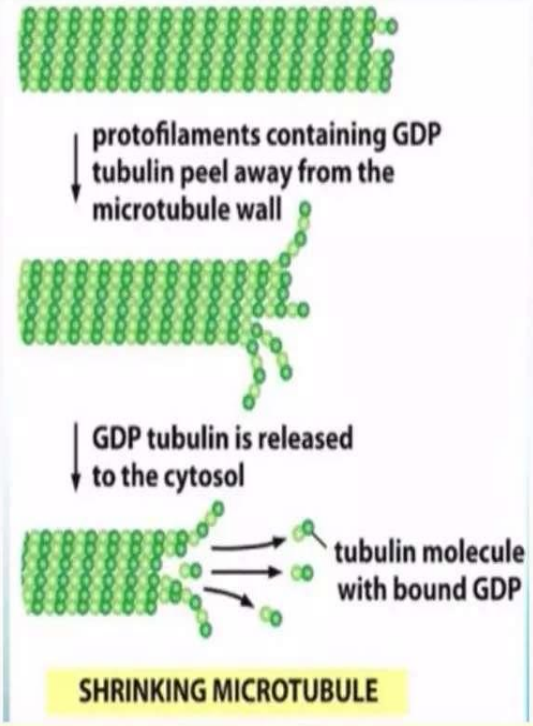


Microtubules (MTs) – Dynamic Instability

If the rate of polymerization is faster than the rate of GTP hydrolysis, **the microtubule will grow** (It contains a GTP cap)



If the rate of GTP hydrolyses is faster then the rate of polymerization , the microtubule will disassemble (GTP cap is lost)



Some functions of Microtubules :

- Microtubules participate in a wide variety of cell activities.
- Most involve motion that is provided by protein "motors" that use ATP.
- They determine the positions of membrane-enclosed organelles and direct intracellular transport.
- The migration of chromosomes during mitosis and meiosis takes place on microtubules that make up the spindle fibers.

Axonemal and cytoplasmic microtubules

- Axonemal and cytoplasmic microtubules are both essential components of the cytoskeleton in eukaryotic cells, but they have distinct roles and structures. Axonemal microtubules are found within the axoneme, the core structure of cilia and flagella, and are crucial for their movement. Cytoplasmic microtubules, on the other hand, are found throughout the cytoplasm and are involved in various cellular processes like intracellular transport and cell division.

Axonemal Microtubules:

- **Location:** Found in the axoneme, the core structure of cilia and flagella.
- **Structure:** Organized in a "9+2" arrangement, with nine pairs of doublet microtubules surrounding a central pair of singlets.
- **Function:** Drive the movement of cilia and flagella, which is essential for cellular motility, the movement of substances across cell surfaces, and sensing the environment.
- **Examples:** Found in respiratory cilia, sperm flagella, and other motile appendages.

Cytoplasmic Microtubules:

- **Location:** Found throughout the cytoplasm of eukaryotic cells.
- **Structure:** Can be single microtubules, doublets, or triplets, depending on the cellular context.
- **Function:** Involved in various cellular processes, including:
  - Intracellular transport of vesicles and organelles.
  - Cell division (mitosis and meiosis).
  - Cell shape and organization.
- **Examples:** Found in nerve cell axons, muscle cells, and other non-motile cells.

Key Differences:

- **Structure:**
- Axonemal microtubules have a specific 9+2 arrangement, while cytoplasmic microtubules have a more diverse range of structures.
- **Location:**
- Axonemal microtubules are confined to the axoneme, while cytoplasmic microtubules are found throughout the cytoplasm.
- **Function:**
- Axonemal microtubules are primarily involved in motility, while cytoplasmic microtubules are involved in a wider range of cellular processes.