SILAPATHAR COLLEGE

CYTOSKELETON

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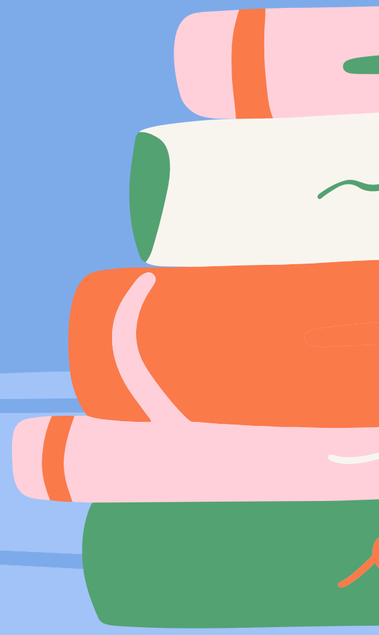
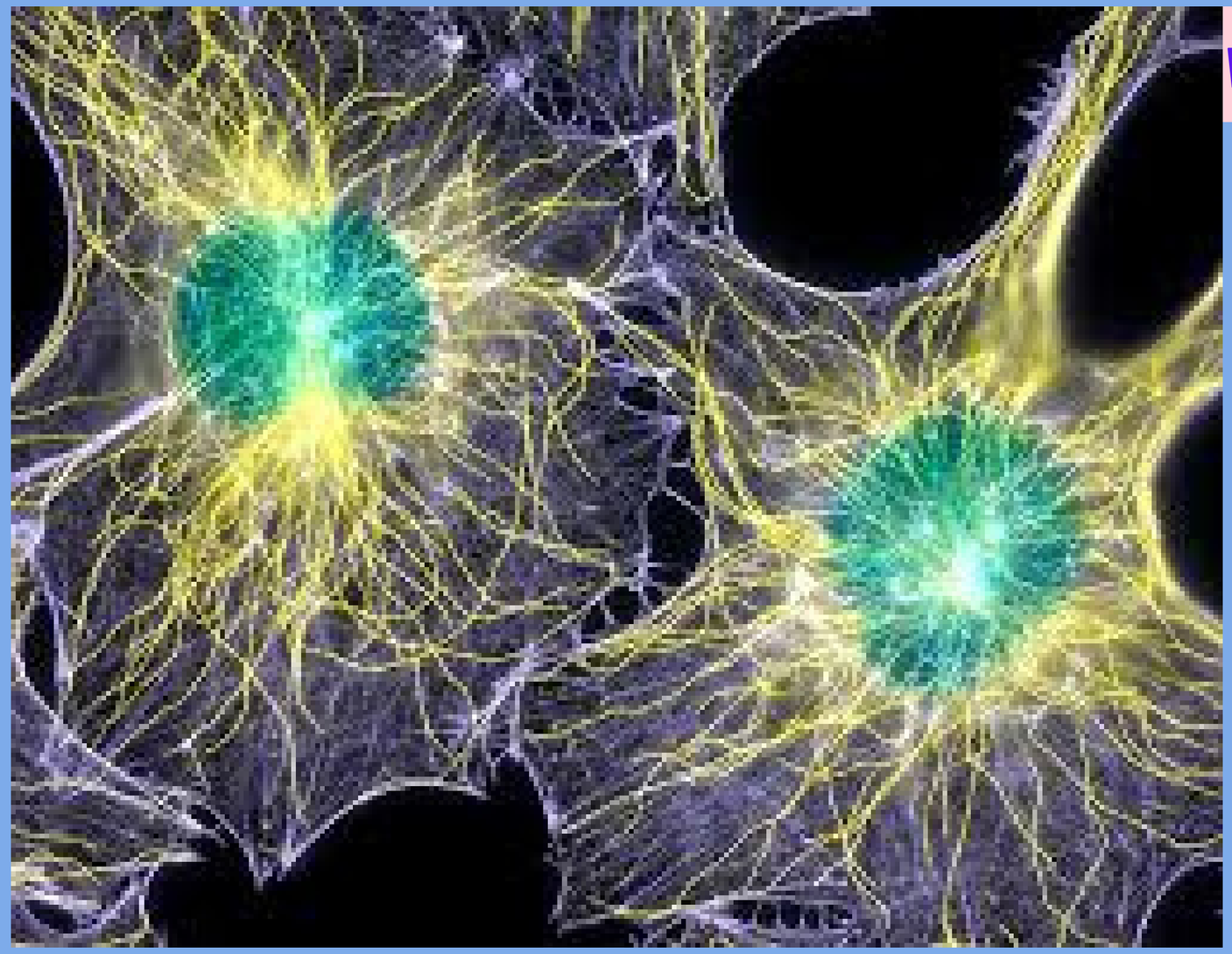




What are the things that cell need to do?

- change their shape
- Move to other place
- Rearrange their internal component
- adapt to changing environment

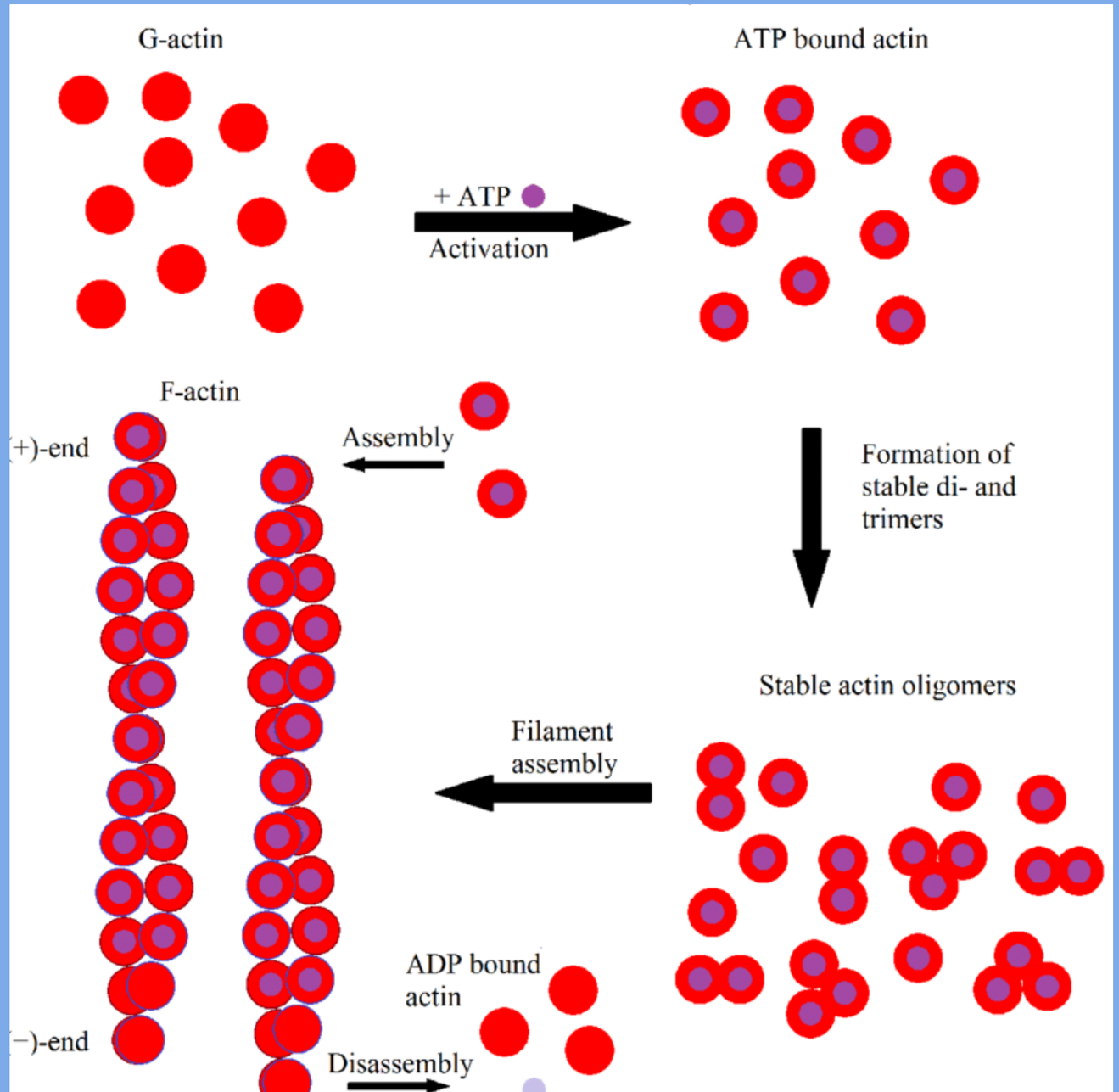
WHAT ARE CYTOSKELETON?

- The cytoskeleton is a network of filaments and tubules that extends throughout a cell, through the cytoplasm.
- It is found in all cells, though the proteins that it is made of vary between organisms.
- The cytoskeleton supports the cell, gives it shape, organizes and tethers the organelles, and has roles in molecule transport, cell division, and cell signaling.
- The cytoskeleton organizes other constituents of the cell, maintains the cell’s shape, and is responsible for the locomotion of the cell itself and the movement of the various organelles within it.

ACTIN FILAMENT OR MICROFILAMENT

- Actin filaments occur in a cell in the form of meshworks or bundles of parallel fibers; they help determine the shape of the cell and also help it adhere to the substrate.
- Actin is a family of globular multi-functional proteins that form microfilaments in the cytoskeleton, and the thin filaments in muscle fibrils.
- The constantly changing arrays of actin filaments help move the cell and mediate specific activities within it, such as cell cleavage during mitosis.
- It can be present as either a free monomer called G-actin (globular) or as part of a linear polymer microfilament called F-actin (filamentous)

ACTIN FILAMENT ASSEMBLY

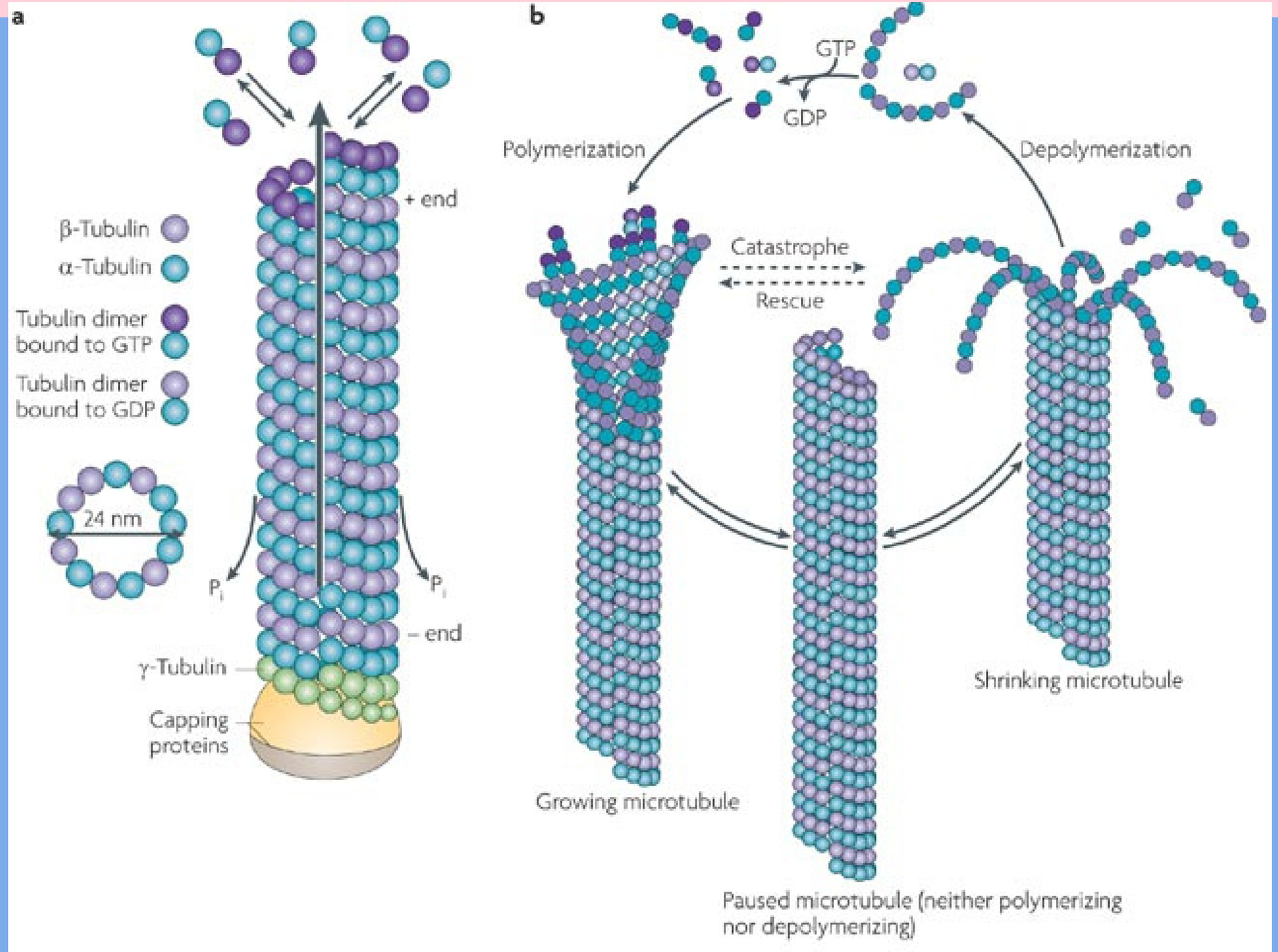


MICROTUBULES

Microtubules: the basics

Microtubules are major components of the cytoskeleton. They are found in all eukaryotic cells, and they are involved in mitosis, cell motility, intracellular transport, and maintenance of cell shape. Microtubules are composed of alpha- and beta-tubulin subunits assembled into linear protofilaments. A single microtubule contains 10 to 15 protofilaments (13 in mammalian cells) that wind together to form a 24 nm wide hollow cylinder. Microtubules are structures that can rapidly grow (via polymerization) or shrink (via depolymerization) in size, depending on how many tubulin molecules they contain.

MICROTUBULES

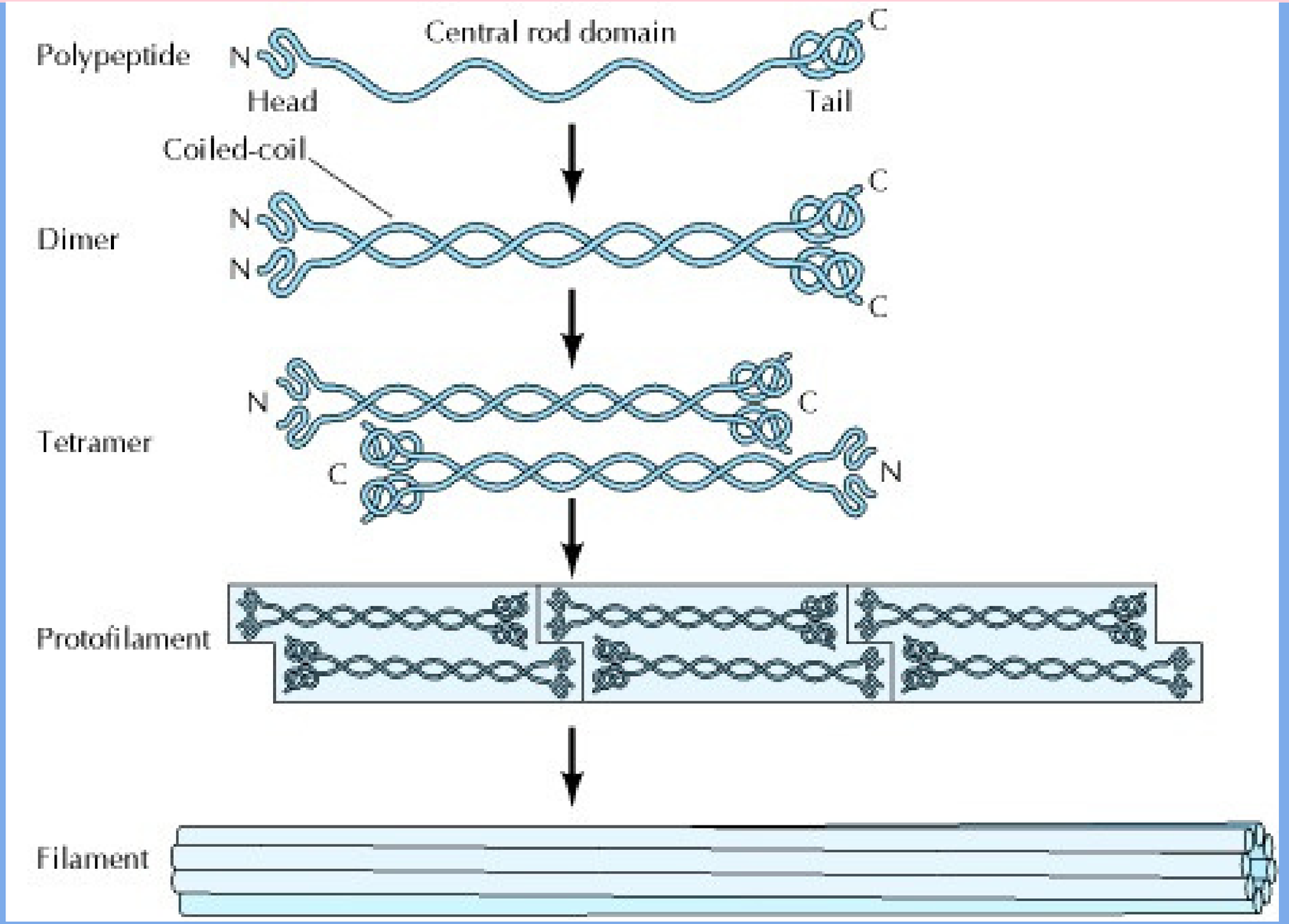


Intermediate filament

- Intermediate filaments have a diameter of about 10 nm, which is intermediate between the diameters of the two other principal elements of the cytoskeleton, actin filaments (about 7 nm) and microtubules (about 25 nm).
- In contrast to actin filaments and microtubules, the intermediate filaments are not directly involved in cell movements. Instead, they appear to play basically a structural role by providing mechanical strength to cells and tissues.

- The central rod domains of two polypeptides wind around each other in a coiled-coil structure to form dimers. Dimers then associate in a staggered antiparallel fashion to form tetramers. Tetramers associate end to end to form protofilaments and laterally to form filaments. Each filament contains approximately eight protofilaments wound around each other in a ropelike structure.

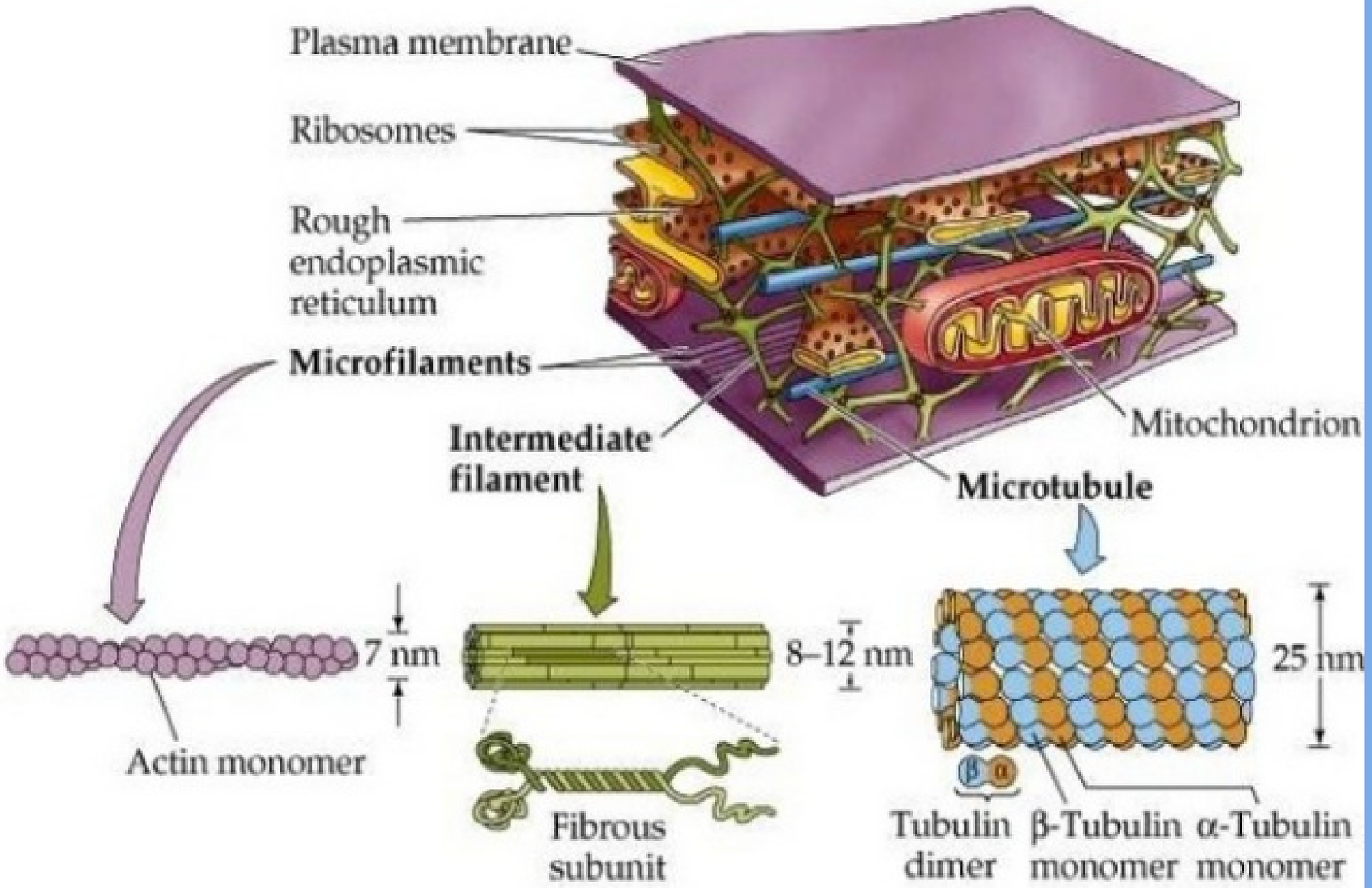
Intermediate filament

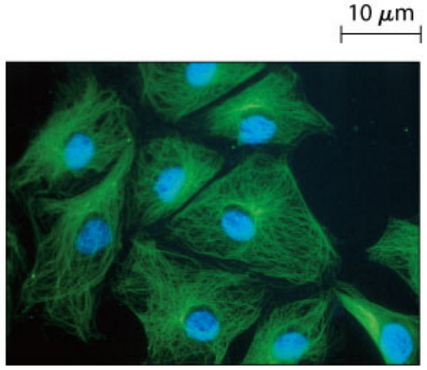
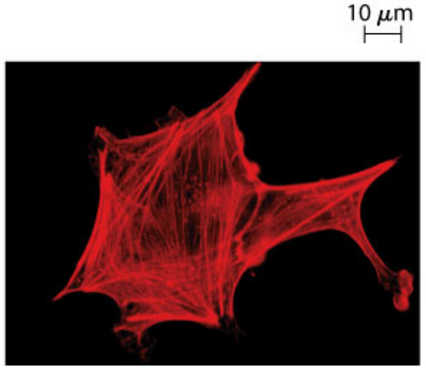
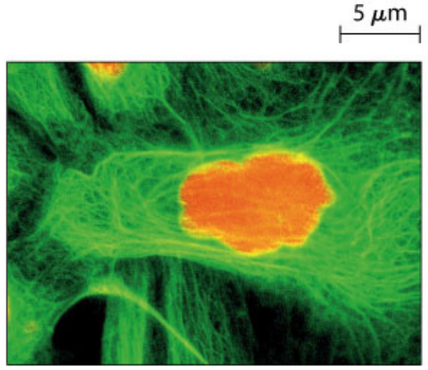
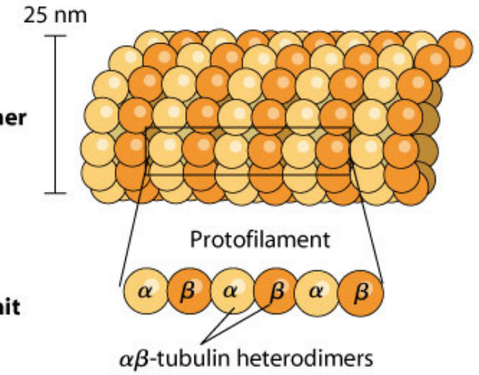
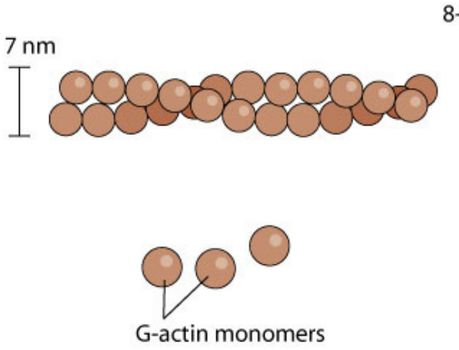
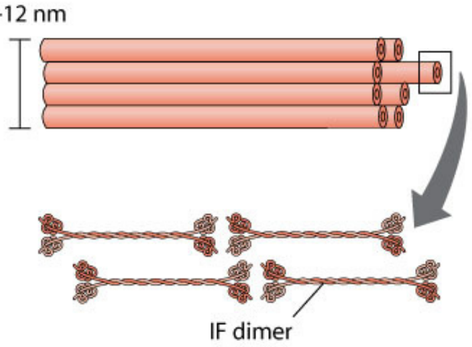


Intermediate filament protein types

Class	IF protein	Cell type	Molecular weight (Kd)
I	Type I, acidic keratins	Epithelia	52.5–68
II	Type II, basic keratins	Epithelia	40.0–64
III	Vimentin	Mesenchyma	54
	Desmin	Muscle	52
	GFAP	Glial cells; Astrocytes	53
	Peripherin	Peripheral nervous system	57
	Plasticin	Retinal ganglion cells	52.6
IV	Neurofilament proteins -L, -M, -H,	Central nervous system	68, 145, 200
	α-internexin	CNS neuronal cells	66
V	Lamins A, B, C	Nuclear membrane	60, 67, 70
VI	Nestin	Neuroepithelial cells	200

How Cytoskeleton are found



	Microtubules	Microfilaments	Intermediate Filaments
			
			
Structure	Hollow tube with a wall consisting of 13 protofilaments	Two intertwined chains of F-actin	Eight protofilaments joined end to end with staggered overlaps
Diameter	Outer: 25 nm Inner: 15 nm	7 nm	8–12 nm
Monomers	α-tubulin β-tubulin	G-actin	Several proteins; see Table 15-4
Polarity	(+), (−) ends	(+), (−) ends	No known polarity
Functions	Cytoplasmic: Organization and maintenance of animal cell shape and polarity Chromosome movements Intracellular transport/ trafficking, and movement of organelles Axonemal: Cell motility	Muscle contraction Cell locomotion Cytoplasmic streaming Cytokinesis Maintenance of animal cell shape Intracellular transport/trafficking	Structural support Maintenance of animal cell shape Formation of nuclear lamina and scaffolding Strengthening of nerve cell axons (neurofilament protein) Keeping muscle fibers in register (desmin)