

CYTOSKELETON I: MICROTUBULES

12/4/91, rvsd 11/29/93, 11/28/94, 11/27/95, 12/4/96, 1 Dec 99, 29 Nov 00, 6 Dec 02, 29 Nov 04, 30 Nov 05, 19Nov07, 24Nov08
B&D, P. 554, BRP: 644-674, BKH 5th: 742-754, BKH: 6th: 425-450, 7th: 425-437

Shape and movement of cytoplasm due to network of filaments and tubules

cytoskeleton controls distribution: cytoplasm is 20-30% protein, not amorphous

position and move organelles & ribosomes. Enzymes clustered according to function

Acts therefore as "**muscles and skeleton**" of cell

Immunofluorescence microscopy aided understanding tremendously (p 426)

- 1) cells fixed, treated with detergent to make permeable
- 2) treated with primary (anti-tubule or filament Ab) then secondary fluorescein-labeled anti-Ab.

Three major structural elements of cytoskeleton (p 426):

Elements	Structure	Monomer	Function	Stable?
Microtubules	hollow tube	α , β tubulin	cell motility, spindle	yes/ no
Microfilaments	two twined chains	F, G actin	muscle, ameboid movem't, cytokin.	yes/no
Intermediate Filaments	protofilaments	several	support & scaffolding	yes

MICROTUBULES:

FUNCTIONS: Two types:

stable	axonemal microtubules	Motility: cilia, flagella and their basal bodies, p 461
dynamic	cytoplasmic microtubules	movement within cell: maintain shape, mitotic spindles, vesicle movement

STRUCTURE: hollow tubes, polymerize linearly, dimers: alternate α & β tubulin subunits.

Axoneme = central shaft of cilium or flagellum, stable bundle of microtubules

GENETICS: different species have similar, not identical genes

ASSEMBLY: **microtubule-organizing center (MTOC)** initiates proliferation
proliferation, disassembly from **same end.** P 431 and 436
centriole in animal: near nucleus towards Plasma Membrane

Best known MTOC surrounds centrioles, kinetochore and poles of mitotic spindle p. 433

Add & subtract from cap end, prob regulated by **GTP favors growth, GDP disassembly** (catastrophe)

Colchicine:	blocks add'n of tubulin
Vincristine (& Vinblastine):	aggregate tubulin, thus do not assemble
Taxol	binds to, stabilizes microtubules, arrests cells in mitosis

MICROTUBULE ASSOCIATED PROTEINS: (p

MAP required for assembly, = 10-15% total microtubule mass

probably regulatory:	PO ₄ ylated	slowed down,
	without MAP	very slow.

EFFECT ON CELL SHAPE:

govern asymmetry of cells,
configuration of plasma membrane
plane of cell division in plants
change in cell position in embryonic stages.

If microtubules are disrupted (as with colchicine), cells become spherical.

AXONAL TRANSPORT:

microtubule tracks conduct ribosomes, vesicles in nerve cells:

ATP-dependent movement of vesicles to synapses

MOTILITY: 9 pairs of tubes surround central pair in axoneme (p. 458, 460)