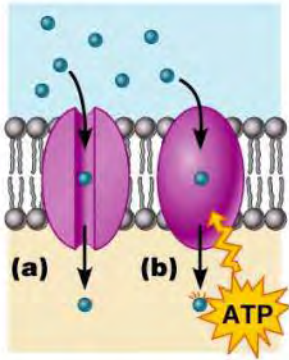


How do cells maintain
structure, connections &
organize activities?

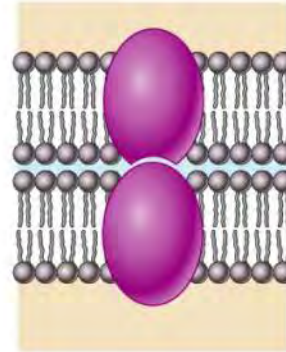
Proteins!

- Ultimately responsible for each of these activities.
- Proteins provide structure, allow movement & mediate interactions

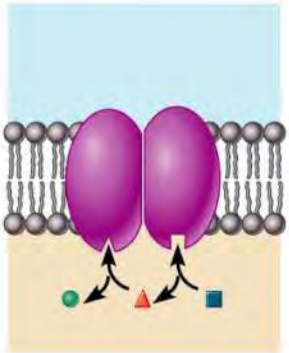
Some plasma membrane proteins



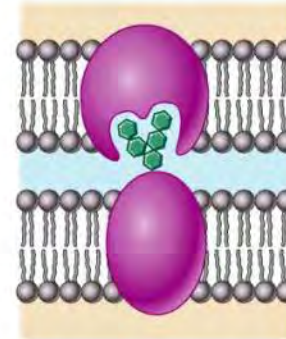
Transport
a) Passive
b) Active



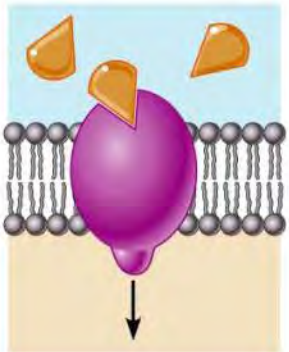
Intercellular
junctions



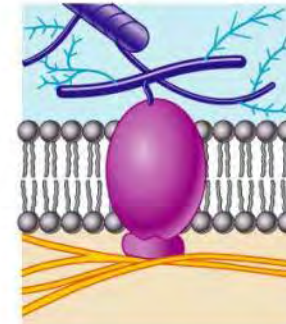
Enzymes



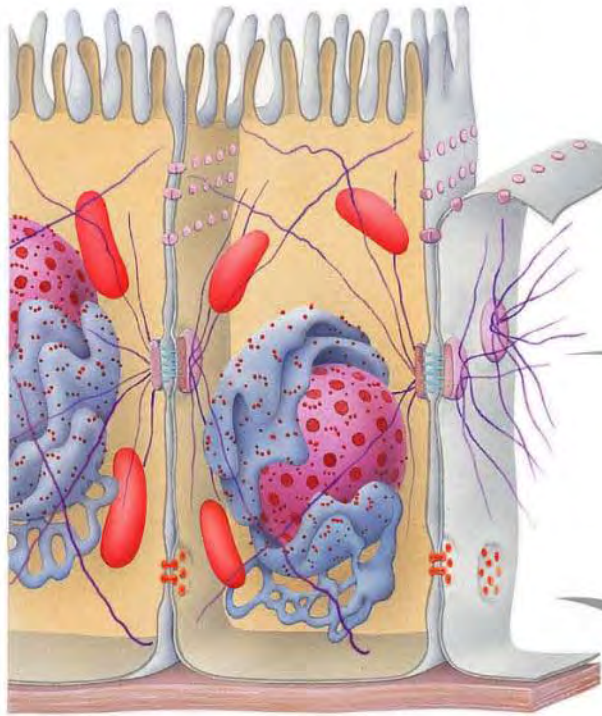
Cell-cell
recognition



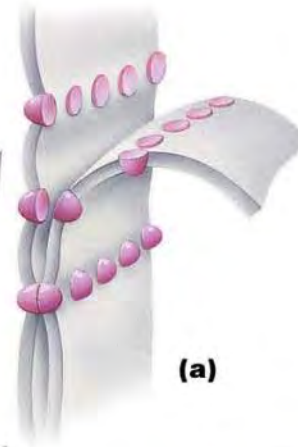
Initiating
enzyme
cascades



Attach to
cytoskeleton;
Motor proteins

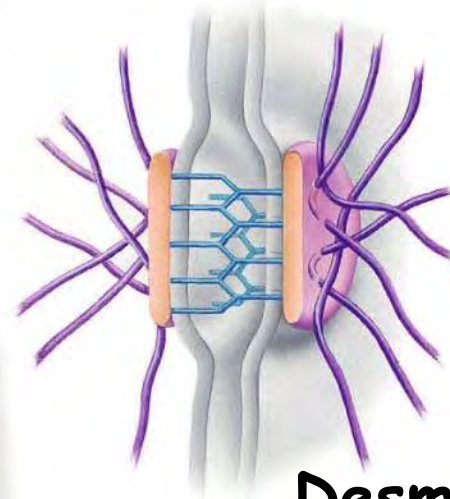


Tight junctions
staple
neighboring cells
exposed to
chemical stress



(a)

Gap junctions allow
rapid communication
& sharing between
neighbors



(b)

Desmosomes bind
neighboring cells
exposed to
mechanical stress



(c)

Extracellular environment

- Space between cells
- **Extracellular matrix:** sticky fluid derived from plasma
 - **nutrients** for cells - glycoprotein, salts, amino acids, etc.
 - Cellular wastes - CO_2 , lactic acid, etc.
- Cells must exchange nutrients & wastes with the environment.

Cell membranes are selectively permeable

- Some compounds pass uninhibited through membrane (**passive diffusion**), some require assistance from membrane proteins (**facilitated diffusion**), and some require assistance AND energy expenditure (**active transport**)

1. Diffusion

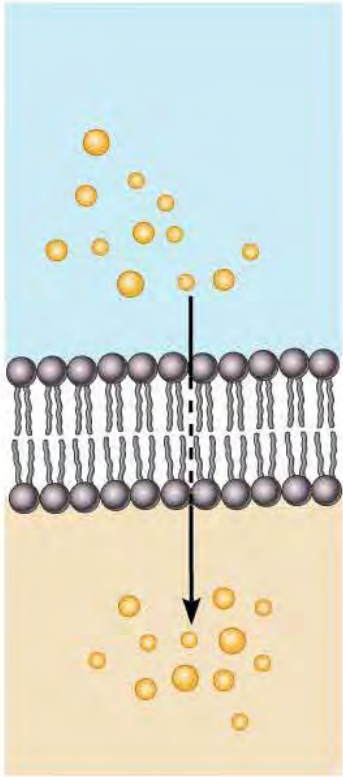
- Passive diffusion
- Carrier or channel-mediated (facilitated) diffusion

2. Active Transport

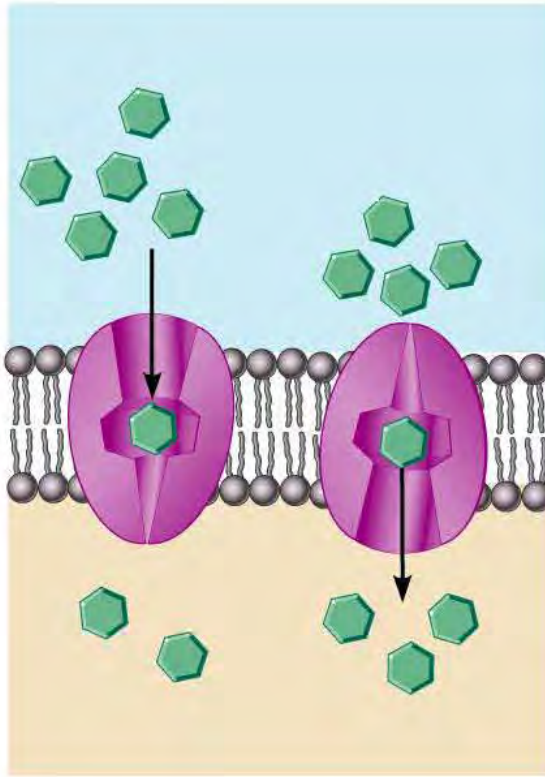
- Pumps, bulk transport

PM + proteins mediate transport

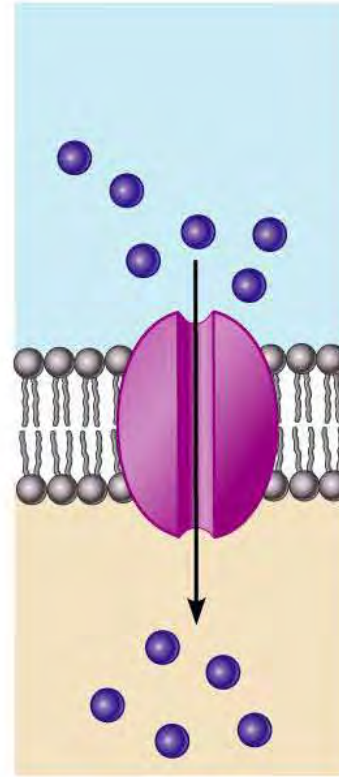
Passive (Diffusion & Osmosis) or Active



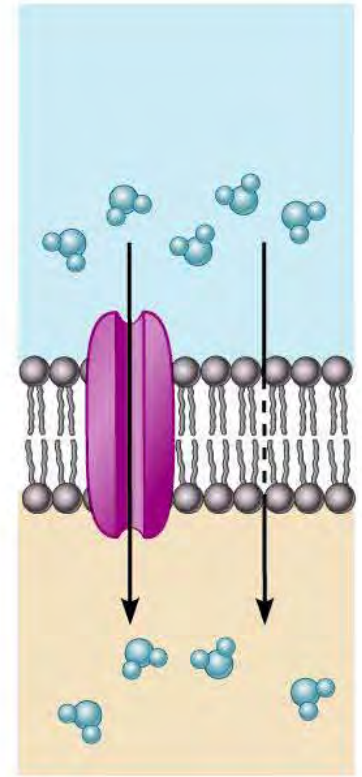
(a) Simple diffusion; P



(b) Carrier-mediated; A



(c) Channel-mediated; P



(d) Osmosis; P

What determines whether transport is passive or active?

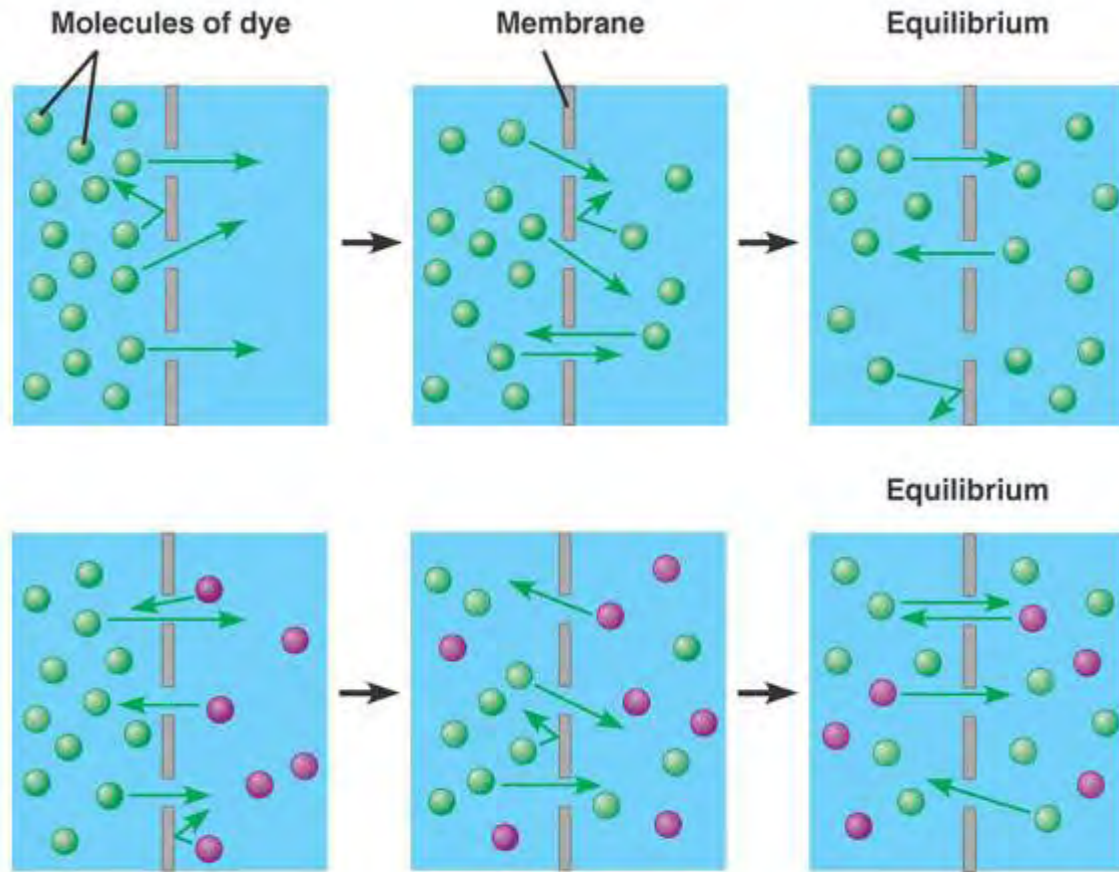
What determines rate of transport?

First, terminology

- **Solvent**: The predominant liquid or gas in a solution
- **Solute**: The stuff that is dissolved in a solution
- **Diffusion**: The net movement of solute from a higher to a lower concentration (**Concentration gradient**), until equilibrium is achieved. Uses intrinsic Kinetic Energy (KE).

Passive diffusion

- Kinetic energy causes particles to move
- Diffusion occurs due to *random* collisions between these energized particles

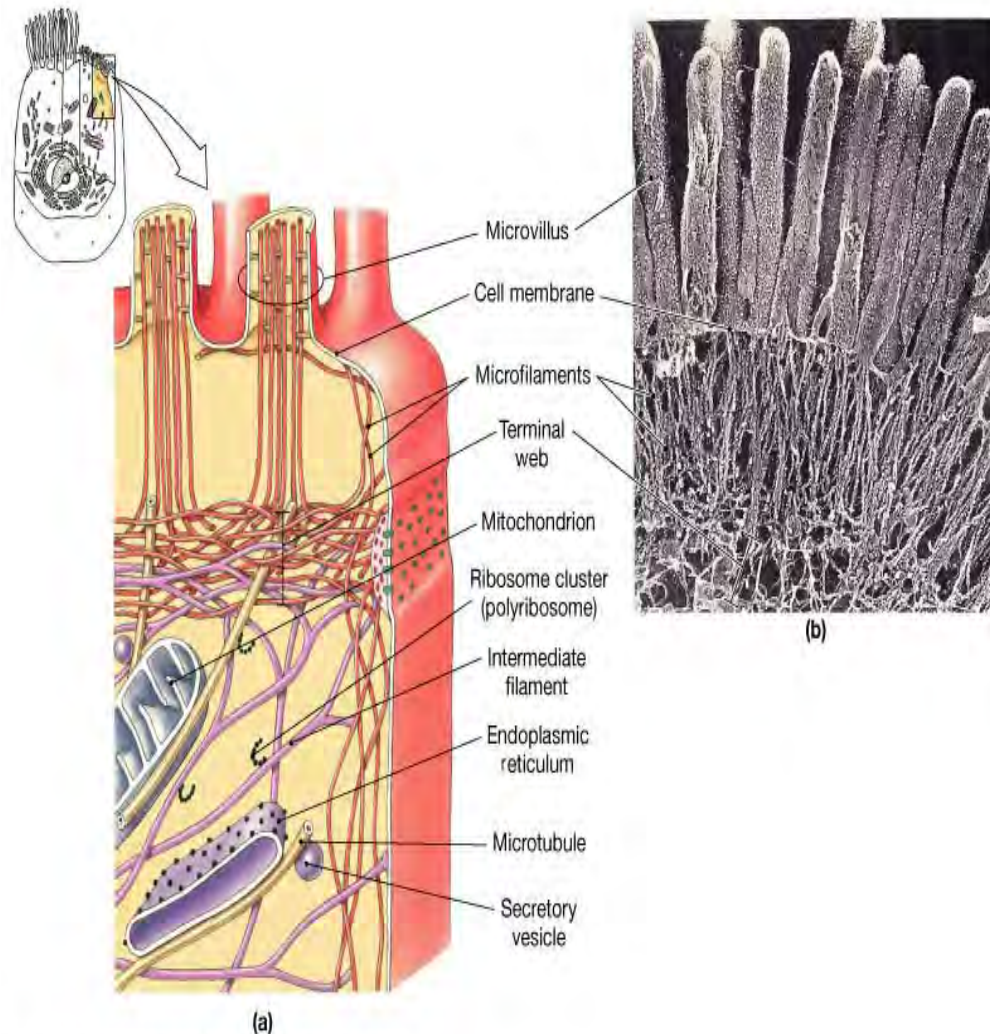


Osmosis + Diffusion

- Both are happening *all the time* across cell membranes
- Osmosis (H_2O) occurs RAPIDLY, diffusion (solutes) occurs SLOWLY
- H_2O moves **into** cells with high solute concentration and **out** of cells with low solute concentration

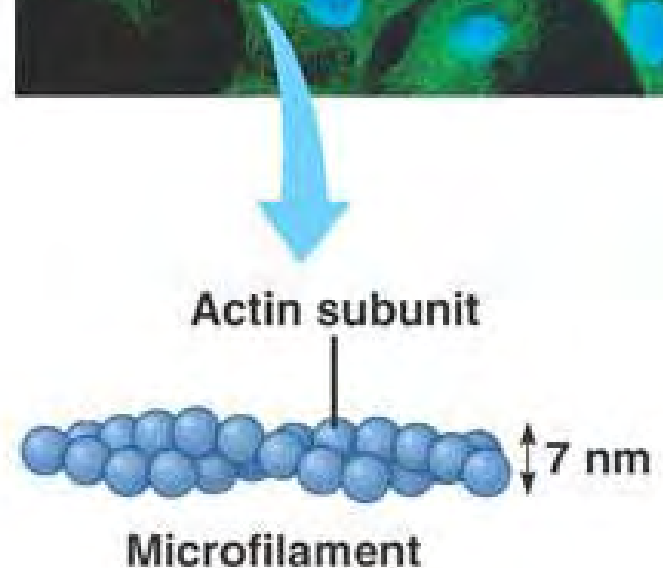
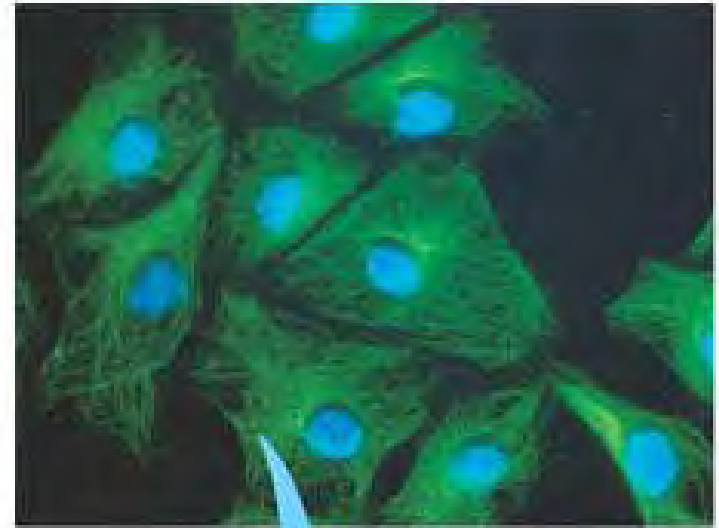
Cytoskeleton

- *Cytoskeleton* = cell skeleton
- All cells contain structural filaments:
 - Microfilaments
 - Intermediate filaments
 - Microtubules
 - Thick filaments (*muscle cells*)
- Made of **proteins**



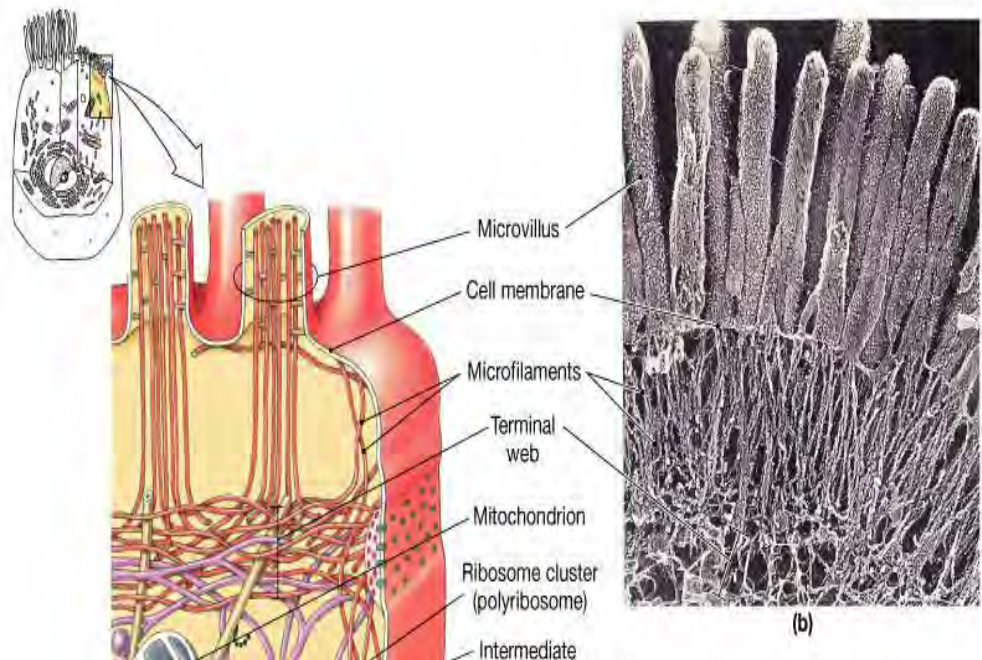
Microfilaments

- **Actin strands**
- Primarily in periphery of cell
- Functions:
 - Anchor cytoskeleton to **integral** proteins of cell membrane
 - Interact with **myosin** to promote cell shortening (Ex: muscle cells)



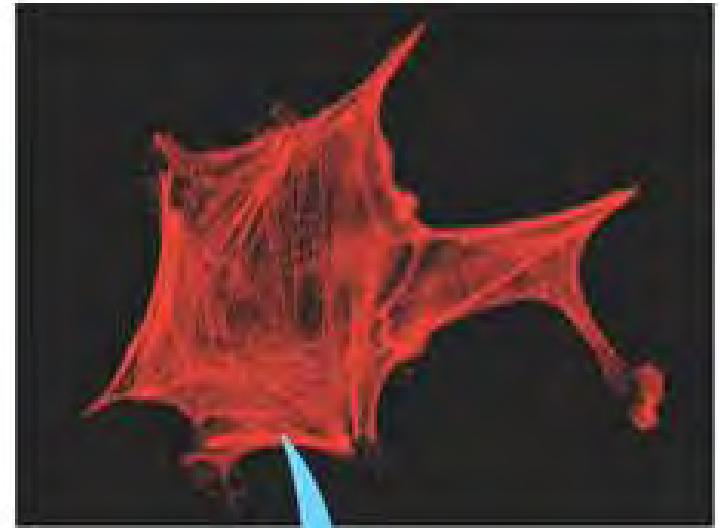
Microvilli

- Microfilaments (actin)
- Increase **SA** of cell
 - maximizes absorptive surface (Ex: intestinal walls)
- No movement



Intermediate filaments

- (7-11nm)
- Most durable cytoskeletal fiber
- Located throughout cell; *High # in superficial layers of skin*
- Functions
 - Provides shape to cell
 - Stabilize (encase) organelles

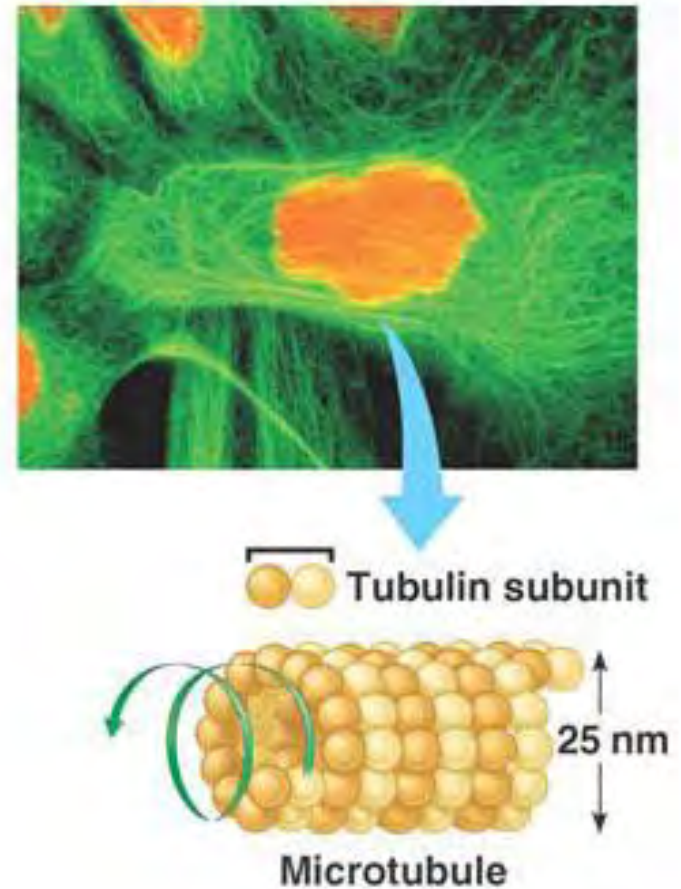


Thick filaments

- Only found in muscle cells, interact with actin to form a contraction

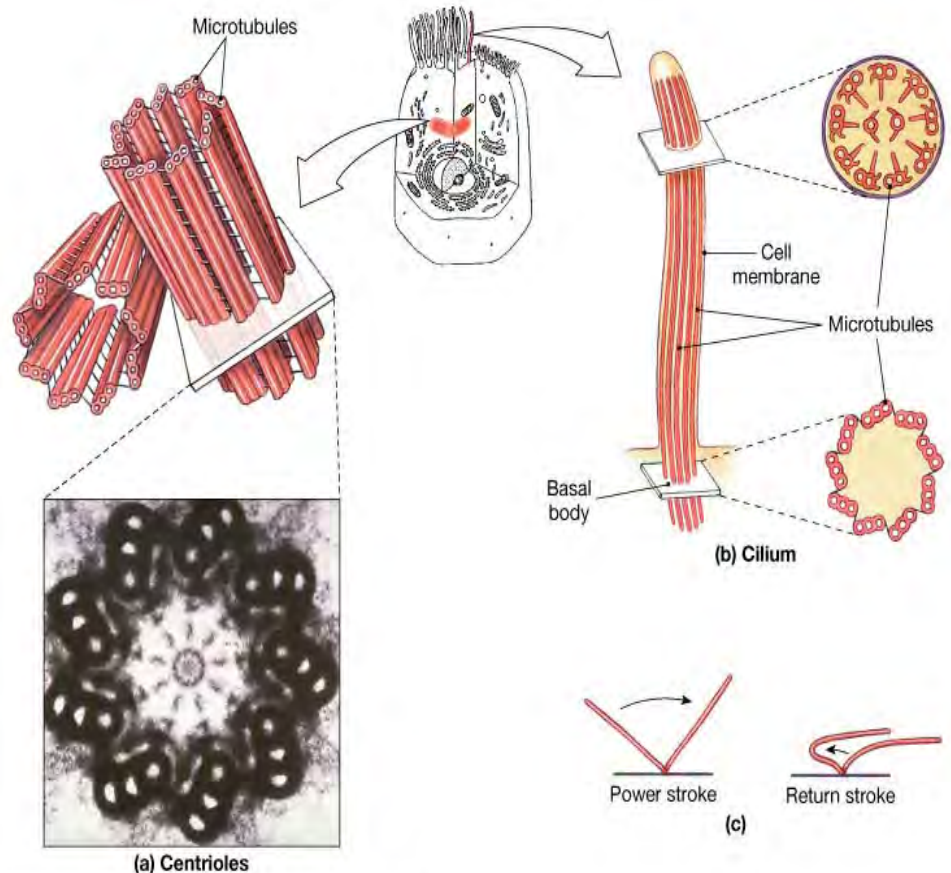
Microtubules

- tubulin protein subunits; **ALL cells contain these**
- Microtubular array centered near the nucleus (@ **centrosome**)
- Functions
 - Cell shape & rigidity
 - Anchor organelles; RR tracks for organelle movement
 - Forms **spindle apparatus**
 - Forms **centrioles, basal bodies, parts of flagella**



Centrioles & Basal bodies

- Centrioles
 - Form *anchors* of spindle apparatus
 - Anchor is *independent* of spindle apparatus
- Basal bodies
 - Anchors flagella & cilia to a cell
 - Anchor is an *extension* of flagella & cilia



Cilia & Flagella

- Cilia

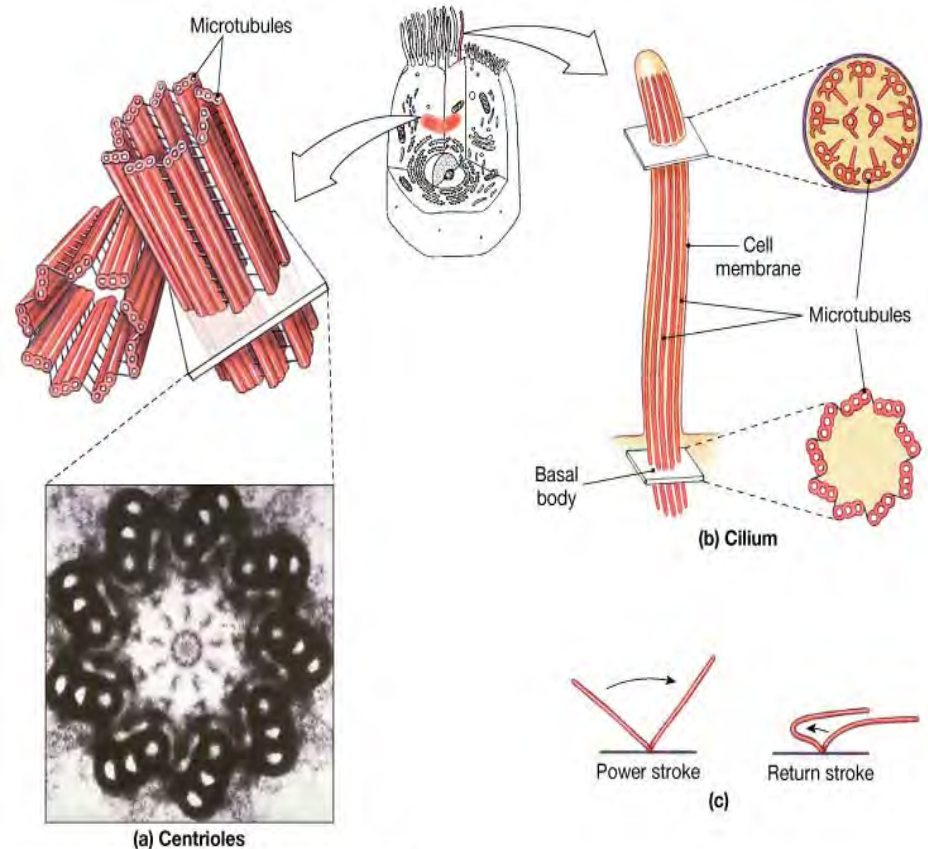
- Rhythmic beating (rowing team) moves fluids & particles across cell surface

- Where might you find these?

- Flagella

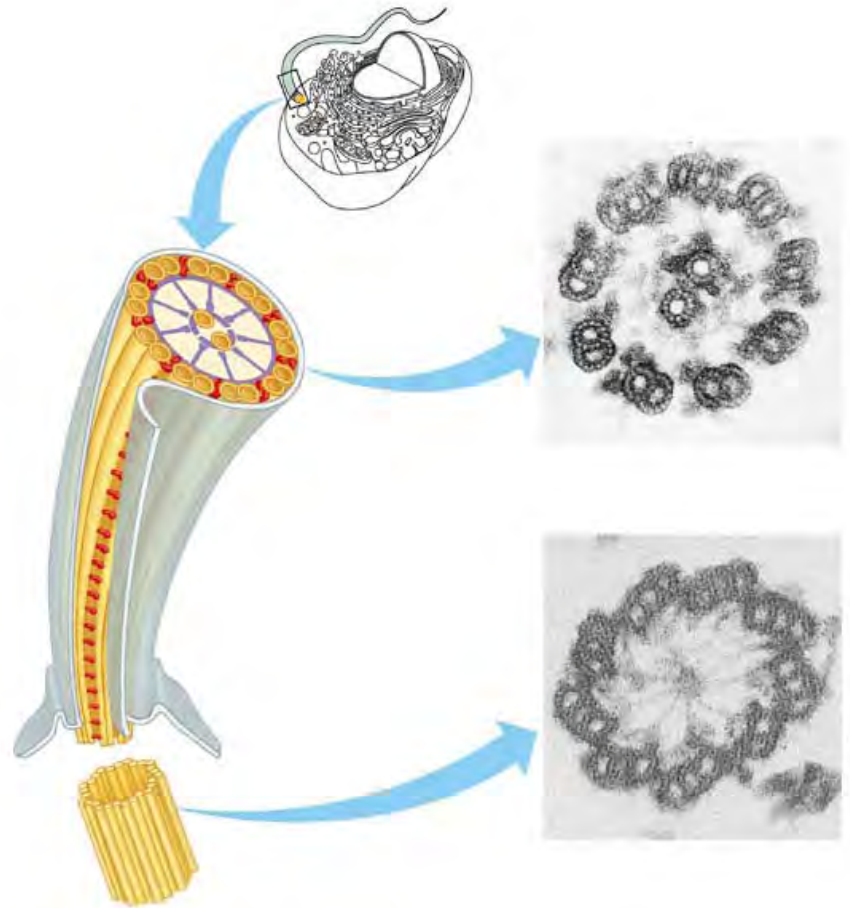
- Whip-like motion moves cell

- Where do you find them?



Movement

- **Dynein arms (red)** anchored to microtubule
- Grab adjacent microtubule and "walk" along
- Produces bending
- Show "flagella & cilia"



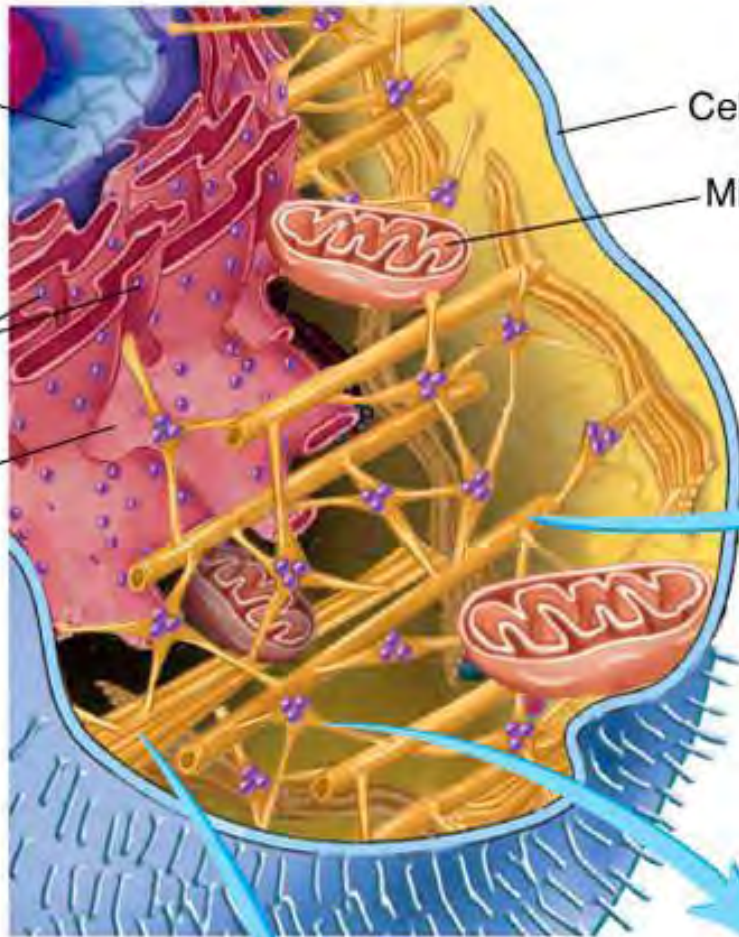
Nucleus

Cell membrane

Mitochondrion

Ribosomes

Endoplasmic reticulum



Protein subunits

5 nm



25 nm

Microtubules are composed of tubulin protein subunits. Microtubules are 25 nm diameter tubes with 5 nm thick walls.

Protein subunits



10 nm

Intermediate filaments are protein fibers 10 nm in diameter.

Protein subunits



8 nm

Actin filaments (microfilaments) are composed of actin subunits and are about 8 nm in diameter.

(a)