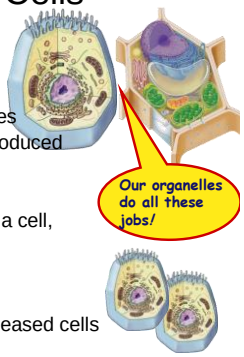
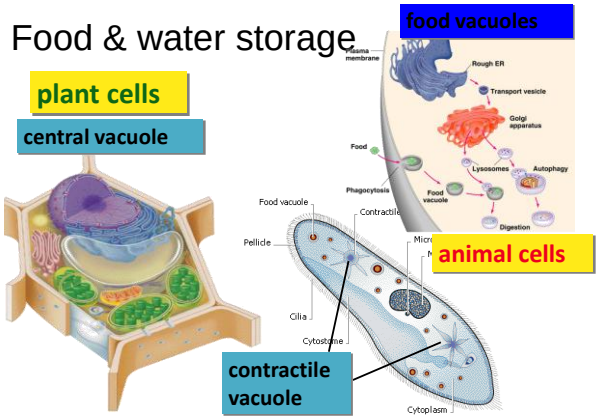
The Jobs of Cells

- Cells have 3 main jobs
  - make energy
    - need energy for all activities
    - need to clean up waste produced while making energy
  - make proteins
    - proteins do all the work in a cell, so we need lots of them
  - make more cells
    - for growth
    - to replace damaged or diseased cells

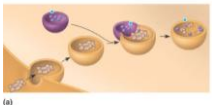


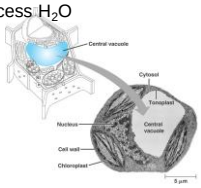
Food & water storage

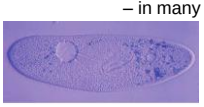


Vacuoles & vesicles

- Function
  - little "transfer ships"
    - Food vacuoles
      - phagocytosis, fuse with lysosomes
    - Contractile vacuoles
      - in freshwater protists, pump excess H_2O out of cell
    - Central vacuoles
      - in many mature plant cells

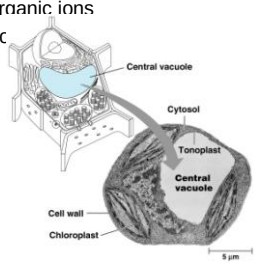






Vacuoles in plants

- Functions
  - storage
    - stockpiling proteins or inorganic ions
    - depositing metabolic byprc
    - storing pigments
    - storing defensive compounds against herbivores
    - selective membrane
      - control what comes in or goes out



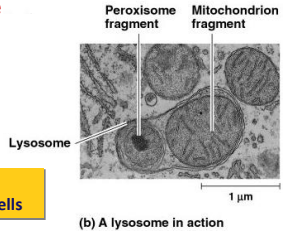
Lysosomes

Where old organelles go to die!

- Function
  - little "stomach" of the cell
    - digests macromolecules
  - "clean up crew" of the
    - cleans up broken down organelles
- Structure
  - vesicles of digestive enzymes

synthesized by rER, transferred to Golgi

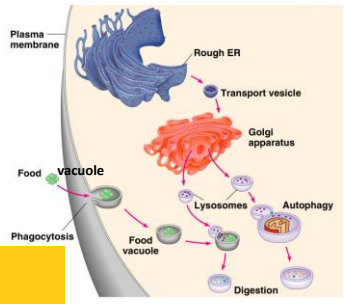
only in animal cells



(b) A lysosome in action

Cellular digestion

- Lysosomes fuse with food vacuoles
  - polymers digested into monomers
    - pass to cytosol to become nutrients of cell



- lyso– = breaking things apart
- –some = body

Lysosomal enzymes

- Lysosomal enzymes work best at pH 5
  - organelle creates custom pH
  - how?
    - proteins in lysosomal membrane pump H^+ ions from the cytosol into lysosome
  - why?
    - enzymes are very sensitive to pH
  - why?
    - enzymes are proteins — pH affects structure
  - why evolve digestive enzymes which function at pH different from cytosol?
    - digestive enzymes won't function well if some leak into cytosol = don't want to digest yourself!

When things go bad…

- Diseases of lysosomes are often fatal
  - digestive enzyme not working in lysosome
  - picks up biomolecules, but can't digest one
    - lysosomes fill up with undigested material
  - grow larger & larger until disrupts cell & organ function
    - lysosomal storage diseases
      - more than 40 known diseases
    - example: Tay-Sachs disease build up undigested fat in brain cells

Lysosomal storage diseases

- Lipids
  - Gaucher's disease
  - Niemann-Pick disease
  - Tay Sachs
- Glycogen & other poylsaccharides
  - Farber disease
  - Krabbe disease
- Proteins
  - Schindler's disease

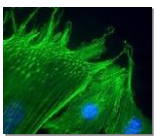
But sometimes cells *need* to die…

- Lysosomes can be used to kill cells when they are supposed to be destroyed
  - some cells have to die for proper development in an organism
    - apoptosis
      - "auto-destruct" process
      - lysosomes break open & kill cell
    - ex: tadpole tail gets re-absorbed when it turns into a frog
    - ex: loss of webbing between your fingers during fetal development

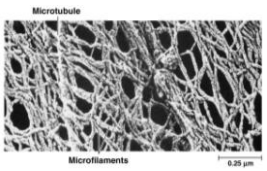
Apoptosis

- programmed destruction of cells in multi-cellular organisms
  - programmed development
  - control of cell growth
    - example:
      if cell grows uncontrollably this self-destruct mechanism is triggered to remove damaged cell
    - cancer must over-ride this to enable tumor growth

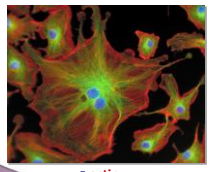
Cytoskeleton



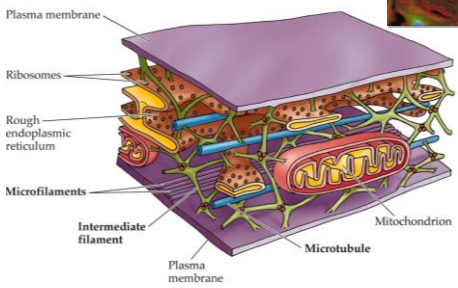
- Function
  - structural support
    - maintains shape of cell
    - provides anchorage for organelles
      - protein fibers
        - » microfilaments, intermediate filaments, microtubules
  - motility
    - cell locomotion
    - cilia, flagella, etc.
  - regulation
    - organizes structures & activities of cell



Cytoskeleton

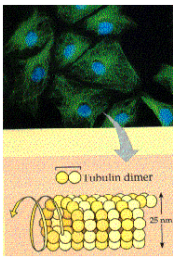


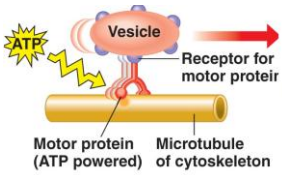
- actin
- microtubule
- nuclei

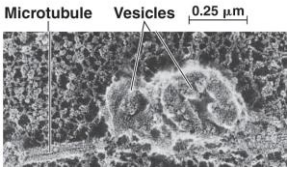


Microtubules

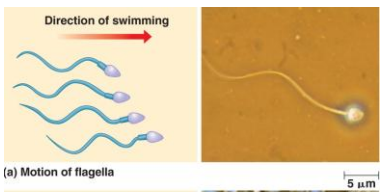
- Hollow tubes made of protein spheres (tubulin)
- Used for cell shape, cilia & flagella
- Used to move organelles (like a monorail) and chromosomes.
- Made in 2 regions called the centrosomes

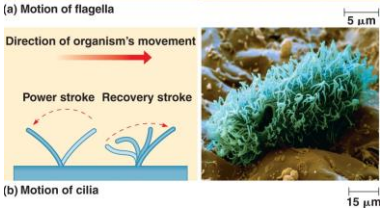






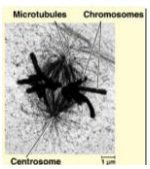
- Cilia and flagella are identical in structure but differ in length, movement and number found on a cell.
- Dynein is the motor protein that bends the flagellum and cilium

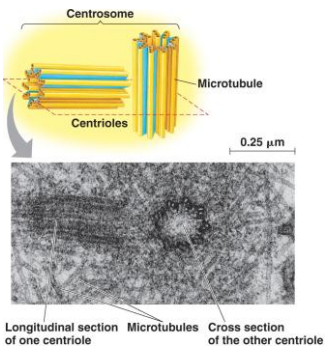




Centrioles

- in animal cells organize microtubules
- guide chromosomes in mitosis
- Made of nine-triplets of microtubules.



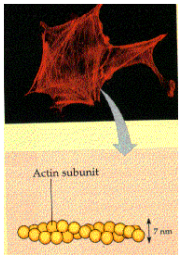


Microfilaments

•2 strands of protein made of actin subunits.

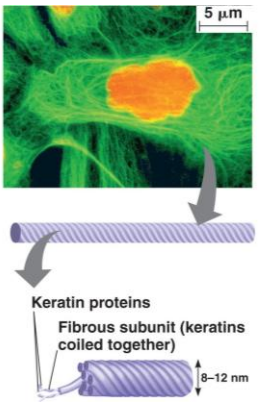
•Used for maintaining and altering cell shape

•Involved in muscle contraction, movement of pseudopods, cytoplasmic streaming and microvilli of the small intestines.



Intermediate Filaments

- Fibrous proteins (keratins) supercoiled into thicker cables
- Maintains cell shape, anchors nucleus and other organelles



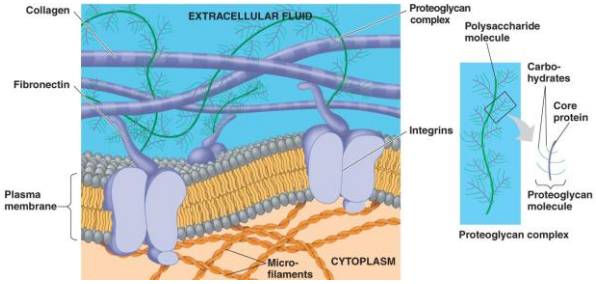
1. Cell walls (prokaryotes, plants, fungi and some protists)

- **Cell walls of plants are made of cellulose, fungi are made of chitin**

2. Extra cellular matrix of animal cells

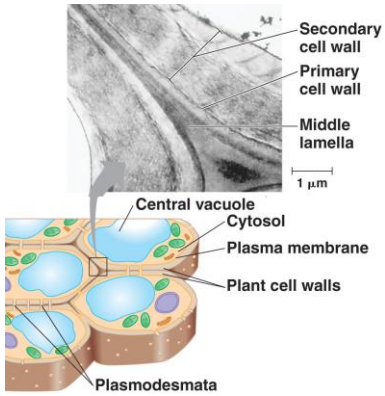
- **(ECM) made of collagen and fibronectins connected to receptor proteins in the cell membrane called integrins. It is used for support, adhesion, movement and support.**

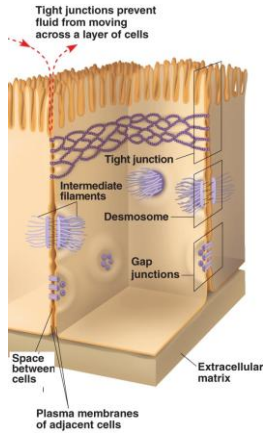
3. Intercellular junctions



Plasmodesmata

Are channels between plant cells that allow direct flow from cytoplasm to cytoplasm in adjacent cells.





There are several types of intercellular junctions in animal cells:

Tight junctions- membranes of neighboring cells are pressed together

Desmosomes- fasten cells together into strong sheets

Gap junctions- provide cytoplasmic channels between adjacent cells like plasmodesmata in plant cells