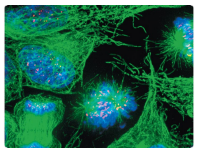
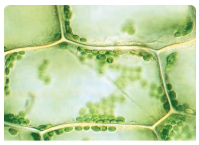
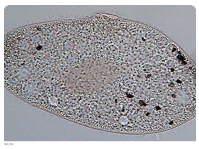
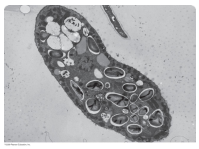




Chapters 4 & 5: The Cell

Honors Biology 2011

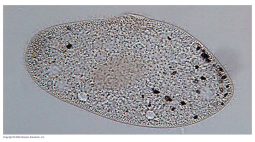
1

The History of the Microscope and Cell Theory

- 1665 - Robert Hooke uses a simple microscope to look at cork.
- 1668 - Anton van Leeuwenhoek observed single celled organisms.
- 1839 - Schleiden and Schwann state that "all living things are composed of cells."
- 1858 - Rudolf Virchow added "all cells come from preexisting cells."
- Cell Theory states "All living things are composed of cells and all cells come from other cells."

2

Types of Microscopes



- Light Microscope
- Electron Microscope (EM) - uses a beam of electrons
  - Scanning Electron Microscope (SEM) - studies cell surface
  - Transmission Electron Microscope (TEM) - studies internal cell structure


3

Cell Size

- Cell size is limited by the ability to carry out cell processes
- Cells need enough surface area to allow nutrients in and wastes out

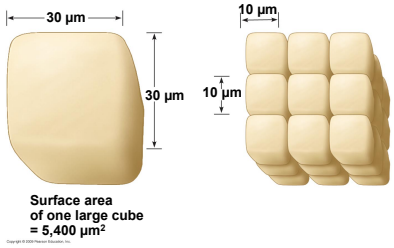
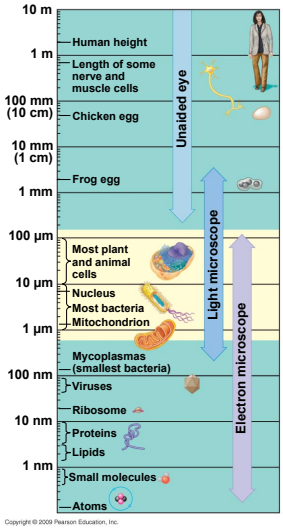


Fig. 4.2



4

All Cells

- Basic shared features:
  - plasma membrane
  - chromosomes
  - ribosomes
  - cytoplasm (area between the nucleus and the plasma membrane)

5

Prokaryotes

- Bacteria and archea
- Smaller than eukaryotic cells
- No nucleus
  - has a nuceoid where the DNA coils
- Often have cell walls, capsules, and pili
- Flagella

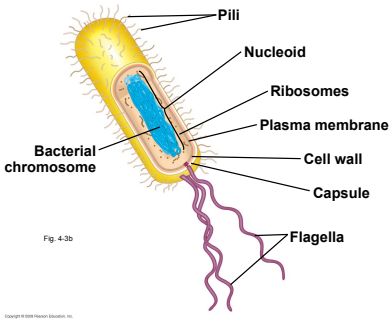
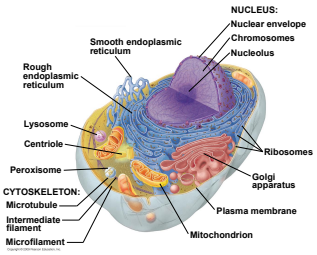


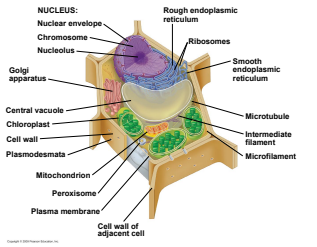
Fig. 4.3

6

Eukaryotic Cells

- eukaryote (Greek: eu=true, karyon=kernal/nucleus)
- animals, plants, protists, fungi
- contains organelles ("little organs") in the cytoplasm
  - Four categories: manufacturing, breakdown, energy processing, and structure/movement/ communication
  - cellular metabolism happens within organelles with complex enzyme interactions

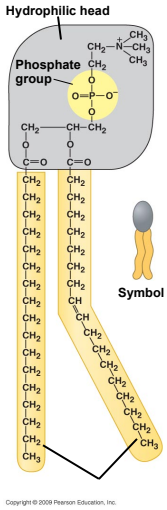




7

Membrane Structure

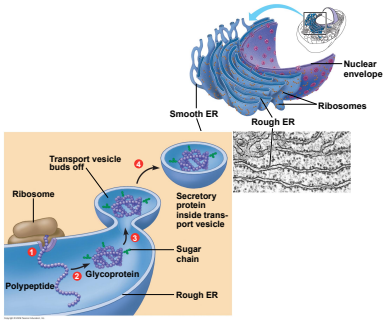
- Membrane forms a barrier between the cell and its surroundings
- Membranes also separate part of the cell from each other
- Phospholipids are the main component
  - Contain: hydrophobic "heads" and hydrophilic "tails"
  - form a bilayer
- Membranes also contain proteins

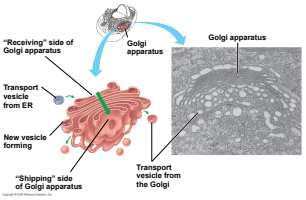


8

Endomembrane System

- Includes: nuclear envelope, endoplasmic reticulum, Golgi apparatus, lysosome, vacuoles, and plasma membrane
- Function in the synthesis, storage, and export of molecules
- Connected to each other or vesicles are used to transfer products

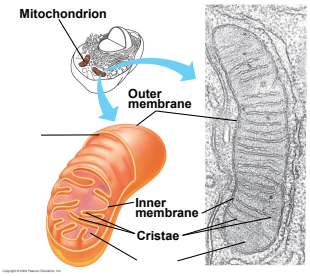




9

Energy Conversion

Fig. 4.14



- Mitochondria - carry out cellular respiration using sugar to make ATP
  - enclosed by two membranes with embedded proteins
- Chloroplasts - convert light energy to form chemical energy
  - enclosed by two membranes with embedded proteins

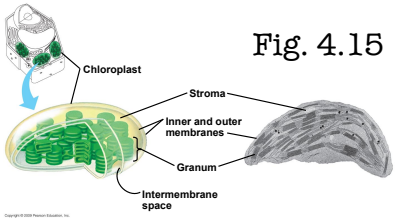


Fig. 4.15

10

Endosymbiosis

- States that mitochondria and chloroplasts were once prokaryotic cells that began living in larger cells
- Evidence: Both mitochondria and chloroplasts contain DNA and ribosomes (the kind found in prokaryotic cells)

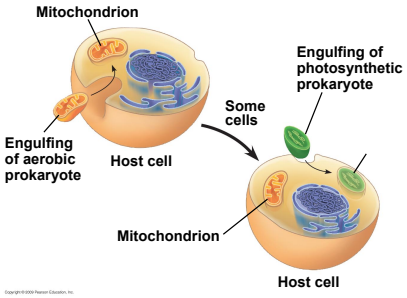


Fig. 4.16

11

Cytoskeleton

- Function in cellular support and motility
- Types:
  - Microfilaments - structure
  - Intermediate filaments - structure
  - Microtubules - structure and movement

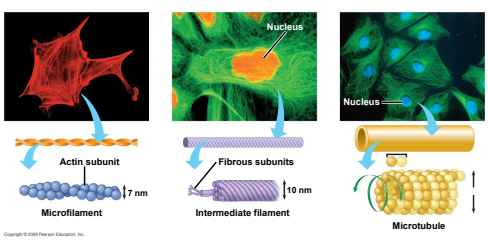
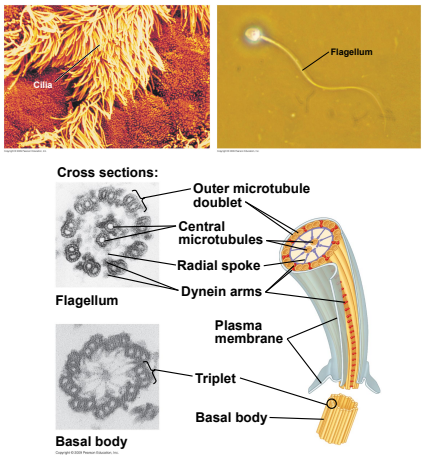


Fig. 4.17

12

Cell Movement

- Cilia and flagella
- Composed of microtubules wrapped in an extension of the plasma membrane
- Microtubules found in a 9 + 2 arrangement



13

Extracellular Matrix

- Helps to hold the cells together in tissues
- Protects and supports the plasma membrane
- Composed of glycoproteins (like collagen)
- Integrins - span the membrane and transmit information between the ECM and the cell

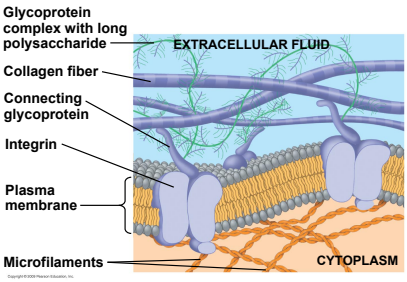
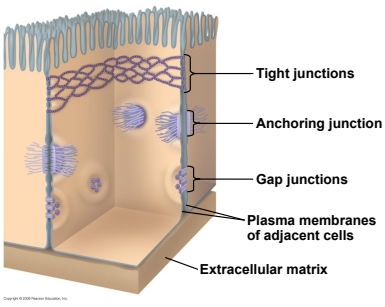


Fig. 4.20

14

Cellular Junctions

- Allow for interactions between cells
- Tight junctions - form seals around cells and prevent leakage of extracelluar material
- Anchoring junctions - fastening cells together
- Gap junctions - allow for molecules to pass through



15

Cell Walls

- Found in plant cells (also some bacteria and protists as well as fungi)
- Provide support
- Made of cellulose
- Contain plasmodesmata
  - channels between cells
  - plasma membrane extends between cells so molecules can easily pass through

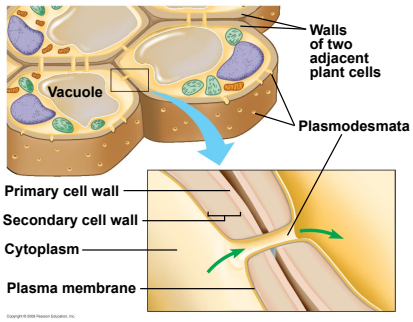
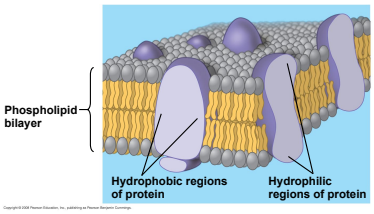


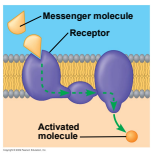
Fig. 4.22

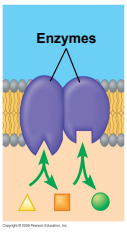
16

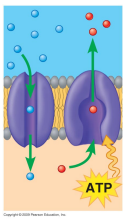
Fluid Mosaic Model

- Membranes are made up of phospholipids and proteins that can drift around amongst each other
- Two types of proteins:
  - Integral - part of the protein is within the membrane (If it goes all the way through, it is called a transmembrane protein.)
  - Peripheral - found only on the outside of the membrane
- Many membrane proteins are enzymes
- Membranes are selectively permeable





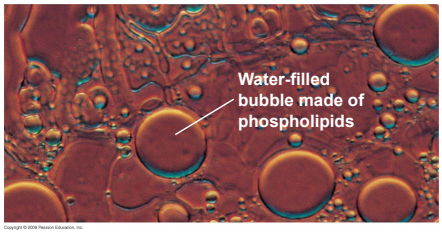


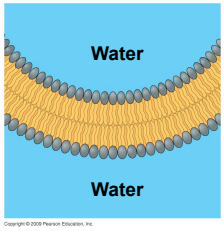


17

Membrane Formation

- Membranes form spontaneously
- When a mixture of phospholipids and water is shaken, it will form water filled “bubbles”





18

Passive Transport

- Requires no energy
- Diffusion - tendency for particles to spread out evenly
  - Diffusion happens down a concentration gradient

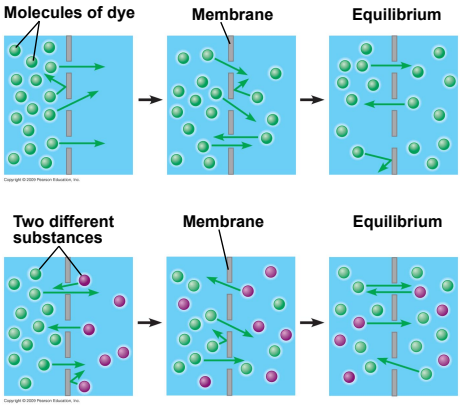
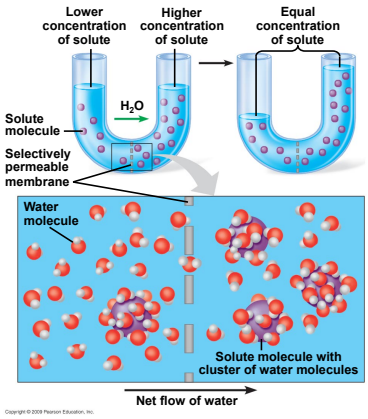


Fig. 5.3

Passive Transport: Osmosis

- Movement of water across a membrane
- Moves in response to solute concentrations



Tonicity

- The ability of a solution to cause a cell to gain or lose water
- Isotonic - concentration same on both sides
- Hypertonic - concentration of solute is higher
- Hypotonic - concentration of solute is lower
- Osmoregulation - maintaining water balance

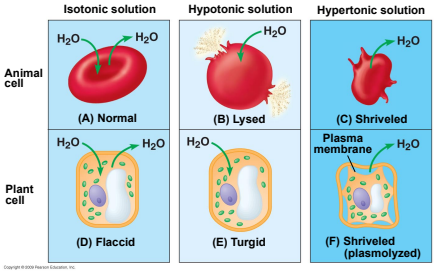
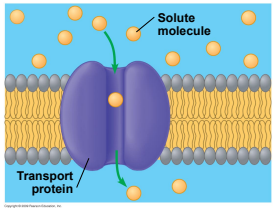


Fig. 5.5

Passive Transport: Facilitated Diffusion

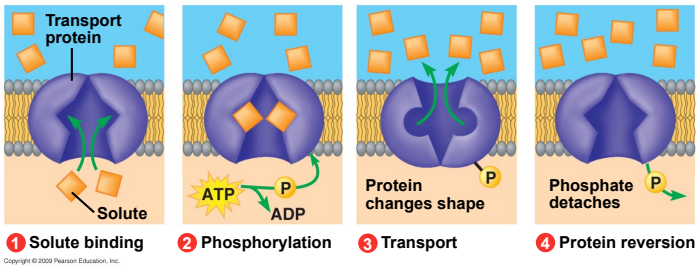
- Using a protein to aid in transport across a membrane
- Ex. aquaporins transport water
- Some proteins function as a hydrophobic tunnel
- Proteins are specific to the substrate



22

Active Transport

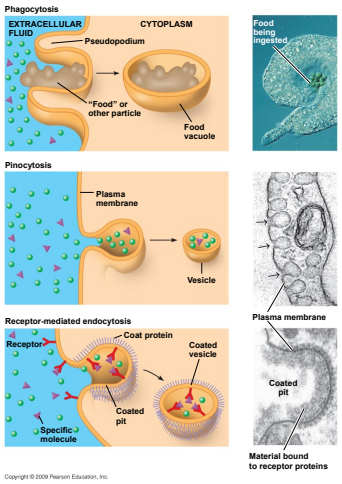
- Moving substances against their concentration gradient
- Require energy (ATP)



23

Bulk Transport

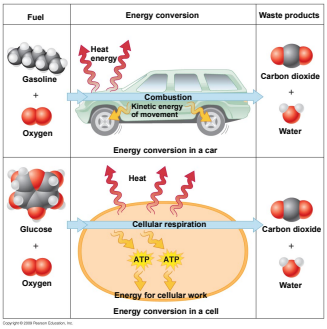
- Movement of large molecules
- Exocytosis - used to EXPORT
- Endocytosis - used to IMPORT
  - Phagocytosis - engulfment by wrapping part of the cell membrane around it
  - Pinocytosis - taking in fluids
  - Receptor-mediated endocytosis - interactions with specific proteins to pull items into the cell



24

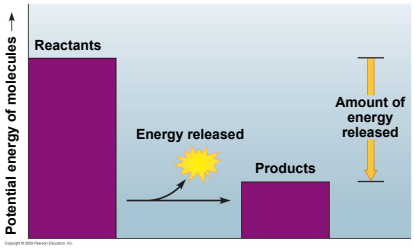
Energy Transformation

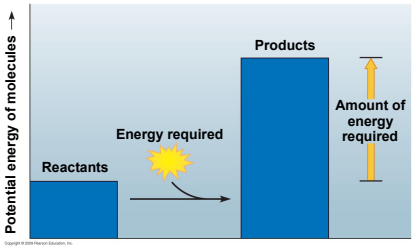
- Cells carry out thousands of chemical reactions
- Energy - capacity to do work
  - Kinetic energy - energy of movement
  - Potential energy - stored energy
    - Chemical energy is potential until teh reaction happens
- First Law of Thermodynamics - energy cannot be created or destroyed, it can only be transferred or transformed
- Second Law of Thermodynamics - energy conversion decease oder of the universe (entropy)



Chemical Reactions

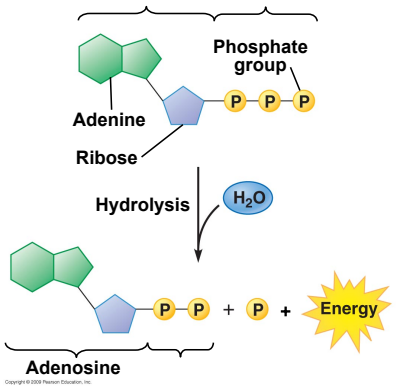
- Exergonic reaction - chemical reaction that releases energy
- Endergonic reaction - chemical reaction that requires energy





ATP

- Adenosine triphosphate
- Source of energy that powers cellular work
- Three parts: adenine (a nitrogenous base), ribose (5-carbon sugar), and three phosphate groups
- Hydrolysis of ATP releases energy by removing a phosphate group



Enzymes: Activation Energy

- Enzymes speed up chemical reactions
- Enzymes do this by lowering the activation energy of a reaction
- Activation Energy (E_A) - the amount of energy needed to start a reaction

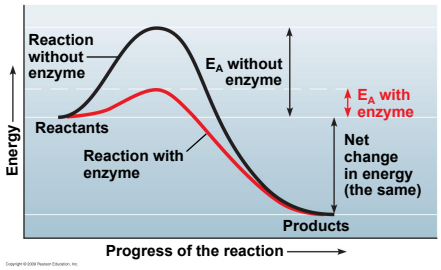


Fig. 5.14

28

Enzyme Catalysis

- Enzymes have unique shapes that determine how they work
- Active site - where the substrate interacts with the enzyme
- Enzymes need certain conditions to work (temp, pH, etc.)

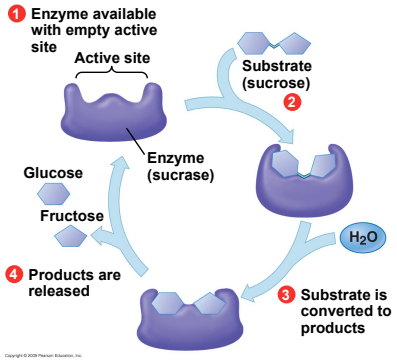


Fig. 5.15

29

Enzyme Inhibition

- Blocking an enzyme from working
- Competitive inhibitors - compete for the active site
- Noncompetitive inhibitors - bind to another site on the enzyme and change the shape of the active site

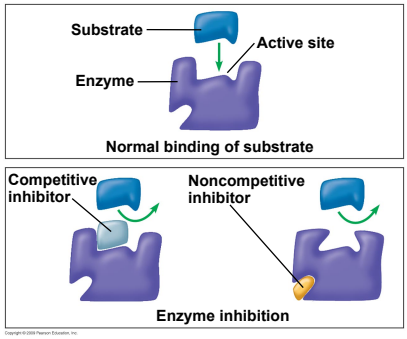


Fig. 5.16

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