Cells are the basic unit of life.
The cell theory grew out of the work of many scientists

- Galileo (1610) – made the first microscope
- Hooke (1665) – made up the term “cell” after viewing cork under a microscope
- Leeuwenhoek (1675) – viewed pond water under a microscope and discovered little creatures he called “animalcules”
- Schleiden and Schwann (1838) – determined all organisms are made of one or more cells and that cells are the basic unit of life
- Virchow (1858) – determined all cells arise from pre-existing cells
The Cell Theory has three principles:

- All organisms are made of cells.
- All existing cells are produced by other living cells.
- The cell is the most basic unit of life.

There are two types of cells:

- *Prokaryotic cells* – small, simple cells that lack a nucleus and organelles
- *Eukaryotic cells* – more complicated cells that contain a nucleus and membrane-bound organelles

Bacterium
(colored SEM; magnification 8800x)
All cells share certain characteristics:

- All cells have:
  - A cell membrane (plasma membrane) that is selectively permeable
  - Cytoplasm = jellylike material in cell
  - Ribosomes to make proteins
  - Cytoskeleton = protein filaments that provide support, shape and help with movement and cell division
3.1 Cell Theory

Parts of a microscope

- eyepiece
- neck
- revolving nosepiece
- low-power objective
- high-power objective
- stage clip
- stage
- diaphragm
- mirror (light source)
- base
- coarse adjustment
- fine adjustment
- arm
Eukaryotic Cells have a membrane-bound nucleus and organelles

- The nucleus stores genetic information
- Nuclear membrane (envelope) = surrounds nucleus
- Nucleolus = located inside nucleus, where ribosomes are made
Ribosomes

- Link amino acids to form proteins.
- “Protein Factory”
**Endoplasmic Reticulum (ER)**

- System of interconnected membranes that process and move proteins (from rough ER) or lipids (from smooth ER).
- “Transport System”
Two types of ER

- **Rough ER**
  - Covered with ribosomes
  - Processes and transports proteins
  - Completed protein is packaged into a *vesicle* that pinches off of rough ER

- **Smooth ER**
  - Does not have ribosomes
  - Makes lipids and breaks down toxic substances
7.2 Cell Organelles

**Vesicles**

- Membrane-bound sacs that hold materials.
- “Packages to be delivered”
Golgi apparatus

- Modifies, sorts, and packages materials for export out of the cell
- “Post Office”
Making Proteins

- DNA
- RNA
- Ribosomes
- Endoplasmic Reticulum
- Vesicles
- Golgi Apparatus
- Protein

Protein on its way!
Mitochondria

- Supply energy to the cell.
- “Power house”
Lysosomes

- Contain enzymes to digest material
- “Garbage Dump”
Vacuole

- Fluid-filled sac used for storage of water and food
- “Storage Tank”
- Animals have many small vacuoles.
- Plants have a single large central vacuole.
Centrioles

- Tubes found in the centrosomes
- Help in cell division
- Form cilia and flagella
- Only found in animal cells
Cell Wall

- Provides rigid structural support
- Made of cellulose
- Only found in plant cells
Chloroplast

- Convert solar energy to chemical energy through photosynthesis.
- Only found in plant cells
Animal cell vs. Plant cell

animal cells

plant cells
The cell membrane is a barrier that separates a cell from the external environment.

- The cell membrane has two major functions:
  - forms a boundary between inside and outside of the cell
  - controls passage of materials
### Fluid Mosaic Model

- The cell membrane is made of a phospholipid bilayer.
- Proteins are embedded in the membrane.
3.3 Cell Membrane

- Phospholipids
  - Consist of a phosphate head and 2 lipid tails
  - Phosphate is *hydrophilic* (water-liking)
  - Lipid is *hydrophobic* (water-disliking)

**Structure of a phospholipid bilayer:**

- Phospholipids
  - Consist of a phosphate head and 2 lipid tails
  - Phosphate is *hydrophilic* (water-liking)
  - Lipid is *hydrophobic* (water-disliking)
The cell membrane is selectively permeable.

- Some molecules can cross the membrane while others cannot.
Materials move across membranes because of concentration differences.

(ex: more $\rightarrow$ less or less $\rightarrow$ more)

- Two types of cell transport:
  1) Passive Transport
  2) Active Transport
Passive transport

- Does not require energy input
- Moves materials from high concentration to low concentration (more → less)
- Three types of passive transport:
  1) simple diffusion
  2) osmosis
  3) facilitated diffusion
Simple Diffusion

- Molecules diffuse down a concentration gradient. (high → low)

Which way will fat move?
Osmosis

- Osmosis is the diffusion of water molecules across a semipermeable membrane.
- When solutes are dissolved in water,
  - more water means less solutes
  - less water means more solutes
- Water can move freely across cell membranes from high [water] to low [water] (or low [solute] to high [solute])
Movement of water across the cell membrane depends on the relative concentration of water molecules in the cell compared to the fluid outside the cell.

1) **Isotonic** – solution and cell have same conc. of water and solutes; no net water movement

2) **Hypertonic** – fluid outside of cell has more solutes (less water) than cell; water moves out of cell

3) **Hypotonic** – fluid outside of cell has fewer solutes (more water) than cell; water moves into cell
Facilitated Diffusion

- Some molecules cannot easily diffuse across the cell membrane.
- Facilitated diffusion is diffusion through transport proteins.

Which way will sugar move?
Active transport

- Requires energy input (in the form of ATP)
- Moves materials from low concentration to high concentration (less → more)
- Occurs through transport protein pumps.
- Examples:
  - endocytosis
  - exocytosis
  - Na/K pump
Endocytosis and Exocytosis – allow a cell to import and export large materials or large amounts of material

- **Endocytosis**
  - process of taking material into the cell
  - ex: phagocytosis (engulfing solid particle; “cell-eating”); pinocytosis (engulfing liquid particle; “cell-drinking”)
• **Exocytosis**
  - process of expelling material from the cell
  - ex: removing wastes
3.3 Cell Membrane

Cell Transport Summary

- Simple diffusion
- Facilitated diffusion
- Active transport

ATP