Cells

- Cells are the basic living structural, functional unit of the body
- Cytology is the branch of science that studies cells
- The human body has 100 trillion cells, 200 different cell types with a variety of shapes, sizes and functions.

Cell Diversity

- Sizes (diameter)
  - Ovum – 140 µm
  - RBC – 8 µm
  - µm = 1/10,000 of a cm
- Shapes
  - Flat
  - Oval
  - Cubed
  - Star shaped
  - Elongated
  - Concave
- Structures
  - Flagella
  - Cilia
  - Microvilli

Generalized Cell

- Major parts of a cell
  - Plasma membrane
  - Cytoplasm
  - Organelles
  - Inclusions

Fluid mosaic model of the plasma membrane

- Phospholipids – 75%
  - Lipid bilayer
- Glycolipids – 5%
  - Self recognition
- Cholesterol – 20%
  - Maintains integrity
  - Maintains fluidity

Membrane Lipids
Membrane Proteins

- Integral proteins
  - Extend across the phospholipid bilayer
  - Channels
  - Pores
  - Receptors
  - Transporters
  - Enzymes
- Peripheral proteins
  - Loosely attached to inner or outer surface
  - Enzymes
  - Cytoskeletal anchors

Functions of the Cell Membrane

- Communication (receptors)
- Shape & protection
- Maintains the electrochemical gradient
  - Electrical separation of charge
  - Chemical (concentration gradient)
- Selective permeability (barrier)
  - Some substances easily travel across the membrane and others do not

Membrane Transport

- **Passive transport** (kinetic energy not ATP)
  - **Simple (Net) diffusion**
    - Movement of molecules from [high] to [low]
  - **Facilitated diffusion**
    - Movement of molecules from [high] to [low]
    - Transport molecule involved
  - **Osmosis**
    - Movement of solvent from [high] to [low]
  - **Filtration**
    - Mechanical/hydrostatic pressure

Figure 2.3a. Membrane transport mechanisms.

Figure 2.3b. Membrane transport mechanisms.

Figure 2.3c. Membrane transport mechanisms.

Figure 2.3d. Membrane transport mechanisms.

Figure 2.3e. Membrane transport mechanisms.
Membrane Transport

- Active transport (uses ATP)
  - Primary active transport
    - Molecule mover hydrolyzes ATP
  - Secondary active transport
    - Molecule mover does not hydrolyze ATP
    - Uses [gradient] created by primary active transport
- Vesicular transport
  - Endocytosis
    - Phagocytosis
    - Pinocytosis
    - Receptor-mediated endocytosis
  - Exocytosis

Figure 2.3d  Membrane transport mechanisms.

Extracellular fluid
Lipid bilayer
Cytoplasm
Solute
ATP
Active transport
Some transport proteins use ATP as an energy source to actively pump substances across the plasma membrane against their concentration gradient.

Figure 2.4a  The three types of endocytosis.

(a) Phagocytosis
The cell engulfs a large particle by forming projecting pseudopods (“false feet”) around it and enclosing it within a membrane sac called a phagosome. The phagosome then combines with a lysosome, and its contents are digested. Vesicle may or may not be protein-coated but has receptors capable of binding to microorganisms or solid particles.

Figure 2.4b  The three types of endocytosis.

(b) Pinocytosis
Infolding of the plasma membrane carries a drop of extracellular fluid containing solutes into the cell in a tiny membrane-bound vesicle. No receptors are used, so the process is nonspecific.

Figure 2.4c  The three types of endocytosis.

(c) Receptor-mediated endocytosis
Extracellular substances bind to specific receptor proteins in regions of protein-coated pits, enabling the cell to ingest and concentrate specific substances in protein-coated vesicles. The ingested substance may simply be released inside the cell or combined with a lysosome to digest contents. Receptors are recycled to the plasma membrane in vesicles.

Figure 2.4e  The three types of endocytosis.

(d) Exocytosis
Photomicrograph of a secretory vesicle releasing its contents by exocytosis (110,000 x)
Cytoplasm

- Made up of:
  - Cytosol – aqueous part
  - Organelles (except the nucleus)
  - Inclusions

Nucleus

- Largest organelle
- Contains DNA
- Nuclear envelope
- Double membrane
- Nuclear pores
- Nucleolus
**Ribosomes**
- Synthesized in the nucleolus
- Ribosomal RNA
- Proteins
- Protein synthesis
- Free ribosomes
  - Cellular proteins
- ER bound ribosomes
  - Membrane or secreted proteins

**Endoplasmic Reticulum**
- Network of membranes
- Extends from nuclear envelope
- Provides a surface for chemical reactions
- Smooth ER
  - Synthesis of lipids
- Rough ER
  - Synthesis of membrane or secreted proteins

**Golgi Apparatus**
- First described by Camillo Golgi
- Packaging and transport of protein & lipids from the ER
- Creates secretory vesicles
- Creates lysosomes

**Lysosomes**
- Created by golgi
- Contain digestive (hydrolytic enzymes)
- High acid (low pH inside)
- H⁺ pumps in the membrane

**Mitochondria**
- Powerhouse of the cell
- Double membrane with enzymes on the inner membrane
- Cellular respiration
- Self-replicating
- Have their own DNA
- Similar to prokaryotic cells
- Get them from your mother
Anatomy Chapter 2 - Cells

Cytoskeleton

- Microfilaments
  - Actin
  - Movement eg. muscles
  - Mechanical support eg. microvilli
- Intermediate filaments
  - Anchor organelles
  - Anchor cells to each other
- Microtubules
  - Tubulin
  - Cell division
  - Movement of cilia and flagella

Centrosome w/ Centrioles

Organizing center for the growth of mitotic spindles in dividing cells & microtubules in non-dividing cells

Cell Division

- 2 types of nuclear division
  - Mitosis (somatic cell division)
    - 2 identical daughter cells
    - Diploid (2N)
    - 23 pairs of homologous chromosomes
  - Meiosis (reproductive cell division)
    - 4 genetically different cells
    - Haploid (1N)
    - Sperm & Egg
- Cytokinesis
  - Division of the cytoplasm

Somatic Cell Cycle

Mitosis

Major Study Objectives

- Cell diversity
- Cell membrane components and their functions
- Mechanisms of passive and active transport
- Cellular organelles and their functions
- Cell division and chromosomes