

Chapter 3

Cell Structure and Genetic Control

- I. Plasma Membrane and Associated Structures
 - A. Structure of the Plasma Membrane
 - B. Phagocytosis
 - C. Endocytosis
 - D. Exocytosis
- II. Cytoplasm and Its Organelles
 - A. Cytoplasm
 - B. Organelles
 - C. Cytosol
- III. Cell Nucleus
- IV. Protein Synthesis and Secretion
 - A. Transcription
 - B. Translation
 - C. Protein Production

Cell

- Is the basic unit of structure and function in body
- Is a highly organized molecular factory
- Great diversity of function.
 - Organ physiology derived from complex functions of the cell.
- Has 3 main components: plasma membrane, cytoplasm and organelles

Fig 3.1

Plasma Membrane

- Surrounds and gives cell form
- Is selectively permeable
- Formed by a double layer of phospholipids
 - Hydrophilic heads and hydrophobic tails
 - Restrict passage of H₂O and H₂O soluble ions.
 - Which restricts passage of polar compounds
- Phospholipids form a two-layered membrane, the phospholipid bilayer

Handout from *Essential Biology* text

- Structure described as a

fluid – mosaic model



proteins move



proteins scattered and varied

It's like - “protein icebergs floating in a phospholipid sea”.

- Proteins span or partially span the membrane.
 - Provide structural support, transport molecules, serve as receptors.
- Negatively charged carbohydrates attach to the outer surface.
 - Involved with regulatory molecules.

Fig 3.2

- **Cholesterol** is important in stabilizing membrane
- Protein types and quantity **vary** among different cell types
- Proteins have **multiple functions** (see Fig 4.8 on Handout)
- Some functions of membrane proteins

Handout from *Essential Biology* text (Fig 5.11)

Fig 5.11 -Primary Functions of Membrane Proteins

- a - attachment to cytoskeleton & extracellular matrix
- b - cell signaling
- c - enzymatic activity
- d - transport
- e - intercellular joining
- f - cell-cell recognition

Cytoplasm, Organelles, Nucleus

- Cytoplasm:
 - Aqueous content of the cell.
- Organelles:
 - Sub-cellular structures within the cytoplasm.
- Nucleus:
 - Is a large spheroid body.
 - Largest of the organelles.
 - Contains the genetic material (DNA).
 - Nucleoli: (Singular = nucleolus)
 - Centers for production of ribosomes.

Fig 3.1

Bulk Transport

- Endocytosis
 - Phagocytosis:
 - Phagocytic cells use pseudopods to surround and engulf particles.
 - Pseudopods join, fuse, and surround ingested particle (food vacuole).
 - Lysosomes digest food vacuole.
 - Protects from invading organisms.
 - Removes debris.

- http://www.youtube.com/watch?v=CC4CvYEhx_8&feature=related

Fig 3.3

- Pinocytosis:
 - Nonspecific process.
 - Plasma membrane invaginates, fuses, vesicle containing ECF pinches off, and vesicle enters cell.
 - <http://www.youtube.com/watch?v=v8XaY-vVtcA&feature=related>

Fig 3.4

- Receptor-mediated endocytosis:
 - Interaction of molecules in ECF with specific membrane receptor proteins.
 - Membrane invaginates, fuses, pinches off and forms vesicle.
 - Vesicle enters cell.
- Exocytosis:
 - Process by which cellular products are secreted into extracellular environment.
 - Proteins and other molecules to be secreted are packaged in vesicles by Golgi complex.
 - Vesicles fuse with plasma membrane and release contents into extracellular environment.
 - <http://www.youtube.com/watch?v=K7yku3sa4Y8>

Cilia, Flagella, Microvilli

Read page 56 – 57

Cytoplasm

- Cytoplasm:
 - Jelly-like matrix within the cell.
 - Includes organelles and cytosol.
 - Organelles are small “organs”; solid part of cytoplasm

- Cytosol is liquid part of cytoplasm
- Highly organized structure with microtubules and microfilaments that function as cytoskeleton.

Cytoskeleton

- Cytoskeleton:
 - Actin and myosin (microfilaments).
 - Spindle apparatus (microtubules).

Fig 3.8

Organelles

I will cover a few of the organelles in lecture, but you are still responsible for all the organelles on pages 57 – 61.

Mitochondria

- Sites for energy production of all cells, but mature RBCs.
- Contain own DNA, can reproduce themselves.
- Structure:
 - Outer membrane: smooth.
 - Inner membrane: cristae.
 - Cristae and matrix compartmentalize mitochondrion space.

Fig 3.9b

Ribosomes

- Protein factories:
 - Proteins produced according to genetic information contained in mRNA.
 - Located in cytoplasm and on the surface of endoplasmic reticulum.
 - Composed of rRNA and proteins.
 - rRNA molecules serve as enzymes (ribozymes) required for protein synthesis.

Fig 3.10

Cell Nucleus

- Contains cell's DNA
- Enclosed by a double membrane nuclear envelope
 - Outer membrane is continuous with ER
- Most cells have a single nucleus.

Fig 3.13

- Nucleoli:
 - Found in the nucleus.
 - DNA contains the genes that code for the production of rRNA (ribosomal RNA).

Chromatin

- DNA within nucleus combines with protein (histones) to form chromatin.
 - Thread-like material that makes up the chromosomes.
 - Histone proteins are positively charged and form spools around which the negatively charged DNA strands wrap.
- DNA (the genetic code) determines what you look like and what proteins your cells make (your phenotype).
- Each chromosome contains hundreds to thousands of genes
- Each gene is composed of hundreds to thousands of DNA molecules.
- DNA is too large to leave the nucleus

Fig 3.15

Genetic Transcription

- Process by which messenger RNA (mRNA) is made from DNA
- Transfers genetic information from DNA to mRNA
- mRNA small enough to leave nucleus
- Transcription occurs in nucleus

Fig 3.16

Genetic Translation

- Process by which mRNA directs the amino acid (a.a.) sequence to produce a polypeptide or protein
- Occurs in cytoplasm
- Needs mRNA, rRNA, tRNA, and ATP

Protein Production

- If proteins will be used outside the cell, they will be made in ribosomes of the Rough Endoplasmic Reticulum (RER)
- From the RER, protein goes to the Golgi Complex where it's packaged before leaving the cell by exocytosis
- If proteins are needed in the cell, they'll be made from ribosomes that are free-floating in the cytoplasm

Hypertrophy

- Increase in the size of cells
 - Example: an increase in skeletal muscle size

Hyperplasia

- Increase in the number of cells
- Most growth is due to hyperplasia
 - Example: a callus on the palm of your hand