**General Biology I (101-NYA)**

**Cells Concepts & Learning Outcomes**

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| Topic | Chapter 1, 5 & 6 pages\* | Concept | Learning Outcomes |
| Cell theory | p. 2 | 1. Cell theory:
	1. Every organism is composed of one or more cells.
	2. The cell is the smallest unit having properties of life.
	3. All cells come from preexisting cells.
	4. Continuity of life arises from growth and division of single cells.
 | 1. State the cell theory and describe its implications for biological sciences
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| Cell size |  | 1. Most cells are tiny, with diameters in the range of 1 to 100 μm.
2. Cell size is limited by the surface area-to-volume ratio.
3. Shape influences surface area-to-volume ratios.

  | 1. Explain what is meant by surface area-to-volume ratio and explain the importance of this ratio in determining cell size
2. Explain the relationship between cell size and homeostasis
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| Types of cells |  | 1. There are 2 major categories of cells, based on where, within the cell, most of the genetic material is stored:
	1. Prokaryotic cells: no nucleus or other membrane-bounded compartments; Bacteria & Archaea
	2. Eukaryotic cells: membrane-bounded nucleus and compartments or organelles; Eukarya
 | 1. Compare and contrast prokaryotic and eukaryotic cells
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| Prokaryotic cells | p. 112-115 | 1. The main components of prokaryotic cells include:
2. Plasma membrane (phospholipid bilayer)
3. Cytoplasm: highly concentrated solution of all the molecules that make up the inside of the cell; supercoiled circular chromosome found in the nucleoid region
4. Cell wall: protects cells and gives them shape and structure
 | 1. Provide a rough description of the main structures of prokaryotic cells
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| Eukaryotic cells | p. 116-125 | 1. The larger size of the eukaryotic cell makes it difficult for molecules to diffuse across the entire cell. This is partially solved by membrane-bound organelles**.**
2. The main organelles of eukaryotic cells include:
	1. Nucleus: contains most of the cell’s genetic material (DNA)
	2. Mitochondria and chloroplasts: power plant and industrial park for the storage and conversion of energy
	3. Endoplasmic reticulum and Golgi apparatus: protein packaging and transportation
	4. Lysosomes: cellular digestive systems
	5. Vacuoles: water and/or ion storage (water, ions, other compounds); help the cell maintain its normal volume (turgid pressure); waste storage ; digestive functions; found in plant cells and some fungi and protista
3. Eukaryotic cells contain cytoskeletal proteins: maintain cell shape, support, intracellular movement (trafficking of materials within the cell), and cellular movement.
 | 1. Provide a rough description of the main structures and organelles, and their main functions, of eukaryotic cells
2. Differentiate between plant and animal cells
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| Nucleus | p. 127-129 | 1. It is one of the largest organelle in the cell.
2. It is surrounded by the nuclear envelop (double membrane consisting of 2 lipid bilayers and nuclear pores) as and contains:
	1. Nucleolus: non-membrane-boundedregion; assembly of ribosomes
	2. Chromatin fibers: long thin fibers of DNA bound to proteins
	3. RNA
	4. Nucleoplasm: nuclear matrix
 | 1. Describe the structure and function of the nucleus
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| Vacuoles & peroxisomes | p. 120-121; 123 | 1. Vacuoles are large lysosomes found in plant cells and some fungal and protistan cells.
2. Peroxisomes are small globular organelles where oxidation reactions occur (H2O2 produced as a byproduct of metabolism is converted to H2O and O2 by the enzyme catalase)
 | 1. State the type of cells that contain vacuoles and peroxisomes and describe the structure and function of these organelles
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| Mitochondria | p. 123-124 | 1. Mitochondria are organelles that are involved in converting the potential energy of fuel molecules into a form that the cell can use (ATP).
2. Mitochondria can divide independently of cell division.
3. A typical mitochondrion consists of the following structures:
	1. Outer lipid bilayer
	2. Highly folded inner lipid bilayer (cristae): site of ATP production
	3. Matrix where small amount of DNA and some ribosomes are located
 | 1. Provide a rough description of the structure of mitochondria and describe the role they play in energy conversions
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| Plastids | p. 124 | 1. Plastids are found in plants and algae (protists). Several types exit:
	1. Chloroplasts: convert light energy into chemical energy (photosynthesis); consist of a double membrane, thylakoid network (where chlorophyll and other pigments for photosynthesis are embedded), stroma (intermembrane space) where small amount of DNA and some ribosomes are located
	2. Chromoplasts: pigment storage
	3. Leucoplast: starch and fat storage
2. Chloroplasts can divide independently of cell division.
 | 1. Define plastids and give examples of the different types that exist in some eukaryotic cells
2. Provide a rough description of the structure of chloroplasts and describe the role they play in energy conversions
3. Compare and contrast the structure and function of mitochondria and chloroplasts
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| Cytoskeleton | p. 134-140 | 1. There are 3 major types of cytoskeletal components:
	1. Microfilaments (actin filaments): made up of the protein actin; fiber diameter = 7 nm; function in cell movement, cell support & cell shape
	2. Intermediate filaments: diameter = 8-10 nm; made up of tough protein fibers; function in cell support
	3. Microtubules: diameter = 25 nm; made up of the protein tubulin; function in cell division (movement of chromosomes) & movement of vesicles (role of motor proteins & ATP, and microtubules acting as tracks for vesicular movement)
2. Microtubules are also found in:
	1. Centrosome: consists of 2 centrioles; involved in cell division
	2. Cilia and flagella: locomotary cellular appendages consisting of plasma membrane-covered microtubules
 | 1. Define cytoskeleton and describe the structure and function of the 3 major types of cytoskeletal proteins
2. Compare and contrast cilia and flagella and describe their functions
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| Endomembrane system | p. 129-134 | 1. It is the primary centre for protein and lipid synthesis in the cell. It also acts as a centre for processing and transport of proteins within and outside of the cell.
2. It consists of 3 main parts:
	1. Endoplasmic reticulum (ER)
	2. Golgi apparatus
	3. Lysosomes
3. The endoplasmic reticulum is a nnetwork of interconnecting membranes distributed throughout the cytoplasm and is continuous with the nuclear envelop. It exists under 2 forms:
	1. Rough ER: ribosomes attached on the surface, which actively synthesize proteins
	2. Smooth ER: ribosome-free region; synthesis and hydrolysis of glycogen (animal starch), drug detoxification (including alcohol) & cholesterol and steroid synthesis
4. The Golgi apparatus consists of membrane-bounded compartments known as cisternae (stacked like pancakes; cis, middle, and trans regions); functions in protein processing and sorting via vesicular trafficking (receives products from the rough ER and sends finished products to the cell surface in vesicles)
5. Lysosomes originate from vesicles that bud off from the Golgi apparatus; contain digestive enzymes and are involved in the formation of phagosomes.
6. Materials are delivered to lysosomes via endocytosis (phagocytosis, pinocytosis, receptor-mediated endocytosis, and autophagy)
 | 1. Provide a rough description of the endomembrane system
2. Distinguish between smooth and rough endoplasmic reticulum in terms of structure and function
3. Trace the path of a protein as it is synthesized in the rough ER and processed in the Golgi apparatus
4. Describe the function of lysosomes
5. Define endocytosis
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| Plasma membrane (and other biological membranes): fluid mosaic model | p.99-101 | 1. The fluid mosaic model of the plasma membrane: membrane structure where some proteins are inserted into the lipid bilayer, making the membrane a fluid, dynamic mosaic of phospholipids and proteins.
2. The main components of the plasma membrane:
	1. Lipid portion: phospholipid bilayer and other lipids (eg, cholesterol); selectively permeable barrier for molecules; physical integrity of the membrane
	2. Protein portion: embedded in the lipid bilayer; variety of functions (eg, receptors for cell-cell communication, ion channels, transport of molecules)
	3. Carbohydrate portion: oligosaccharides attached to lipid or protein molecules on the outer surface of the membrane; function in cell identity and cell-cell communication
 | 1. Describe the fluid mosaic model of plasma membrane structure
2. Compare and contrast the function of the different components of the plasma membrane
3. Describe why biological membranes are selectively permeable, and what factors affect their permeability
4. Describe what kinds of molecules are able to diffuse freely through biological membranes, and what molecules can only do so with assistance
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