



**IDX G10 Biology H
Study Guide Issue 1
By Arianna Edited by Amy**

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Chapter 1: The Science of Biology

1.3 Studying of Life

- **Biology:** study of life
 - **Characteristic of living things**
1. Made up of cell
 - Cell is a collection of living matter enclosed by a barrier. It is complex and highly organized. It is smallest unit of living.
 2. Reproduce
 - Sexual reproduction: 2 parents, unique offspring
 - Asexual reproduction: single parent, happen through binary fission(bacteria), budding(plant)
 3. Universal genetic code
 4. Grow and Develop
 - Life Cycle: particular pattern of growth and change
 - Growth: increase in size
 - Development: cells increase in number and differentiate
 5. Obtain and Use Material/Energy
 - Metabolism: combination of chemical reactions. An organism builds up or break down materials
 - photosynthesis
 - autotroph, heterotroph, decomposers
 6. Respond to Environment
 - stimulus: signal to which organism responds
 7. Maintain a Stable Internal Environment
 - homeostasis: keep internal conditions relatively stable
 8. Change Over Time-->evolution

Chapter 2 : Chemistry of life

2.3 Carbon compound

● Carbon atom

- 4 VE → covalent bond; bond with other elements (HOPSN) or with C to form chains, rings, complex structure

Macromolecules

- giant molecules
- polymer is made of repeating similar building blocks (monomers) → formed by polymerization
- Polymer in living things
 - Dehydration synthesis: condensation
 - Hydrolysis: breakdown
- Macromolecules in living things → Carbohydrates, lipid, nucleic acid, proteins

Carbohydrate

- made of C, H, O in ratio of 1:2:1
- Monosaccharides → single sugar molecule
 - glucose (source of energy); fructose (fruit); galactose (milk and blood)
- Disaccharides is formed by 2 monosaccharides
 - Sucrose: common table sugar = glucose + fructose
 - Lactose: sugar in milk = glucose + galactose
 - Maltose: product of starch digestion = glucose + glucose
- Polysaccharides
 - store excess sugar: glycogen (animal), starch (plant)
 - structural support → cellulose (plant cell wall), chitin (fungi cell wall)

Lipids

- not polymer
- not soluble in water
- made mostly from C and H

- fats, oils, waxes, steroid
- store energy; part of biological membranes, waterproof covering; chemical messenger
- Fats: glycerol molecule +Fatty acids

① saturated fats

- only have single bond (C-C)
- contain max possible number of H atom
- solid at room temperature
- e.g. butter

② unsaturated lipids

- at least one C=C double bond
- liquid at room temperature
- e.g. olive oil

Nucleic acids

- contain C,H,O,N,P
- monomer: nucleotides
- joined by covalent bonds to form polynucleotide
- store & transmit genetic information
- RNA→contain sugar ribose; Adenine, Uracil, Cytosine, Guanine
- DNA→contain sugar deoxyribose; Adenine, Thymine, Cytosine, Guanine

Proteins

- contain N,C,H,O,S
- monomer: amino acids→central carbon, amino group (-NH₂), carboxyl group(-COOH), R group
- over 20 natural amino acids
- Formed by bonding an amino group to a carboxyl group
- ① control rate of reactions & regulate cell processes (enzymes) ② form bones & muscles
③ transport substances/fight diseases (antibody)
- **Four levels of organization→primary, secondary, tertiary, quaternary**
- 1. Primary structure: sequence of amino acids

2. Secondary structure: folding and coiling of polypeptide chain
 - (1) Beta pleated sheet; Alpha helix
 - (2) formed by hydrogen bonds between backbone atoms, broken easily by high temperature / pH change
 - (3) sequence of DNA determine the structure
3. Tertiary Structure: secondary structure itself coiled, precise 3D shape
4. Quaternary Structure: association of different polypeptide chains

2.4 Chemical Reactions and enzymes

- **chemical reaction:** process that changes one set into another set
- **reactants:** element/compound that enter into a reaction
- **product:** element/compounds produced by a reaction
- Involve: ①breaking of bonds in reactant ②formation of bond in product
- Energy released when bond form, absorbed when broken
- Energy releasing reaction occur spontaneously
- Energy absorbing reaction will not occur without energy source

Energy in reactions

- Energy source→autotroph: sunlight; heterotroph: food
- use energy→all life processes, metabolism
- Activation energy: energy needed to get a reaction started
- Enzymes act as biological catalysts→speed up chemical reaction→reduce activation energy

Enzyme naming

- part of name derived from catalyzed reaction
- Ex: lactase, maltase
- most enzyme=protein
- substrates: reactants of enzyme catalyzed reaction
- enzymes provide an active site for substrates to bond together to react.

- Enzymes are specific → catalyze only 1 reaction
 - shape & charge of substrate must be compatible with the active site of enzyme in order for catalyzing to occur

Induced fit

- shape of active site is changed slightly to accommodate the shape of substrates
- Temperature, pH, and regulatory molecules can affect the activity of enzymes
- enzyme work better under optimal conditions
- Inhibitor can bind to enzymes and reduce activity of enzyme
 - Competitive inhibition: block the active site → substrate cannot bind
 - Noncompetitive inhibition: bind to location other than the active site → enzyme shape changed → inactivated

Chapter 7

7.1 Life is cellular

- **Cell:** common structure that make up living things\
- **Microscope**
 - ① light microscope focuses visible light to magnify
 - ② Electron microscope focuses beams of electron
- **Magnification**
 - ① eyepiece lens x objective lens
 - ② size of image / actual size of specimen
 - ③ length of scale bar / length of the scale bar represents
- Light microscope magnification less than 1000 times
- compound light microscope → 2 lenses
- Fluorescent dyes symbol the specimen
- Electron microscope has higher magnification
 - samples dried out
 - vacuum

- Transmission electron microscope: beams of electrons pass through specimen, the denser part of specimen block more electrons, 2D image
- Scanning electron microscope: electron scan back and forth through surface. A detector captures these scattered electrons to create a 3D surface image

The Cell Theory

- Robert Hooke first observed dead cells from a thin slice of cork
- Anton Van Leeuwenhoek first to observe live cells in drop of water
- Matthias Schleidan: All plants made of cells
- Theodor Schwann: All animals made of cell
- Rudolf Virchow: All cell come from existing cell
 1. All living things composed of cell
 2. Cell are basic unit of structure and function
 3. New cells are produced from existing cells

Basic cell parts

- Vary in shape and size
- longest cell in human body: human neuon
- Cell membrane: Thin, flexible barrier around cell
- Cell wall: strong layer around cell membrane, not all cells have; support & protect cell
- nucleus: contain cell's genetic material and control cell activities
- cytoplasm: material inside cell membrane except nucleus

Prokaryotes	Eukaryotes
no nucleus	nucleus
naked DNA	DNA associated with protein
circular chromosome	linear chromosome
70s ribosome	80s ribosome
no internal membrane bound organelle	internal membrane bound organelle
small size	large size

7.2 Cell Structures

Prokaryotic cells

- cell wall : cell membrane, cytoplasm, ribosomes; nucleoid
- some have flagella or pili (Projection for attachment, conjugation)

Eukaryotic Cell

- Organelles: specialized structure to perform cellular functions

1. Nucleus

- Control cell processes & contain hereditary information of DNA
- Chromatin: material of eukaryotic chromosomes
- DNA bound to histone proteins
- Chromosomes: condense during cell division and carry genetic information
- Nucleolus :small dense region in nucleus, where the assembly of ribosomes begins
- Nuclear envelope: double membrane surrounding nucleus, nuclear pores allow material to move→RNA&other molecules

2. Vacuoles

- saclike, membrane enclosed structure to store water, salt, protein, carbohydrate
- plant→large central vacuole, can support heavy structures
- unicellular organisms→contractile vacuole, pump excess water out of cell

3. Vesicles

- smaller vacuoles involve in storing & transporting substances between organelles→nearly all eukaryotes

4. Lysosomes

- small organelles filled with enzymes→break down food materials and dead organelles

5. Cytoskeleton

- network of protein filament
- help cell maintain shape
- facilitate cell movement
- microfilament:long fibers made of actin, movement and support

- microtubules: hallow tubes made of tubulin, maintain cell shape, tracks that organelles are moved along
 - microtubules help separate chromosomes during cell division
 - centrioles→found in pairs; organize microtubules; only in animal cell
- Cilia &flagella: hair like projections formed from cell surface, produce force to help move

6. Ribosome

- small particles made of RNA & protein
- make protein according to instructions from nucleus

7. Endoplasmic Reticulum

- Rough ER: has bound ribosomes on the surface
 - modify proteins made by ribosomes
- Smooth ER: no ribosome on surface
 - synthesis of lipids & detoxification

8. Golgi Apparatus

- stack of membrane to modify, sort, package protein & other materials
- pathway of protein: ribosome → rough ER → vesicle → Golgi Apparatus → vesicle → destination

9. Chloroplast

- plant, algae→use solar energy to make energy rich food molecules by photosynthesis
- 2 envelope membranes
- large stacks of photosynthetic membranes containing chlorophyll

10. Mitochondria

- use energy from food to make high-energy compounds (ATP) in nearly all eukaryotic cell

11. Organelle DNA

- Chloroplast and mitochondria contain DNA
- Mitochondria DNA inherited from cytoplasm of ovum

12. Cell wall

- plants, algae, fungi
- most prokaryotes; not in animal cell
- porous: allow substances pass through

- provide support & protection
- most made from fibers of carbohydrate & protein
- plant cell wall- cellulose
- fungus cell wall- chitin

13. Cell membrane

- boundary of cell
- regulate what enter and leaves the cell
- protection and support
- fluid mosaic model
- phospholipid bilayer
 - fatty acid portion: hydrophobic
 - head(glycerol and phosphate): hydrophilic
 - in water, fatty acid tails cluster together
- membrane proteins
 - integral proteins embedded in membrane. The cytoplasmic side is hydrophilic. The core is hydrophobic
 - peripheral protein: most attached to surface of integral protein
- carbohydrate: attached to some membrane proteins, cell to cell identification
- cholesterol(only in animal cell)
 - locate in hydrophobic region
 - regulate membrane fluidity