9th Class Biology Notes
Federal Board (FBISE)
Full Book Notes

Complete chapter-wise study notes with original practice questions for Class 9 Biology, Federal Board of Intermediate and Secondary Education (FBISE), Islamabad.

About these notes

These notes follow the chapters of the National Book Foundation (NBF) Biology book for Class 9, Federal Board. The ten chapters covered, in order, are:

1. The Science of Biology
2. Biodiversity
3. Cell
4. Cell Cycle
5. Tissues, Organs, and Organ Systems
6. Molecular Biology
7. Metabolism
8. Plant Physiology
9. Plant Reproduction
10. Evolution

About the paper: The FBISE Class 9 Biology paper is SLO-based (student learning outcomes) as per the Federal Board. Students should check the current model paper on the official FBISE website, fbise.edu.pk, before their examination, because the board may revise the paper pattern.

Published by Zahid Notes (zahidenotes.com) as free study material for students. The practice questions in this book are original questions written for revision; they are not taken from any past paper.

Contents

1. Chapter 1 — The Science of Biology
2. Chapter 2 — Biodiversity
3. Chapter 3 — Cell
4. Chapter 4 — Cell Cycle
5. Chapter 5 — Tissues, Organs, and Organ Systems
6. Chapter 6 — Molecular Biology
7. Chapter 7 — Metabolism
8. Chapter 8 — Plant Physiology
9. Chapter 9 — Plant Reproduction
10. Chapter 10 — Evolution
11. MCQ Answer Key (all chapters)

How to Use These Notes

Read one chapter at a time. First read the study notes and learn the key definitions and key terms. Then close the notes and try the multiple-choice questions, short questions, and long questions for that chapter from memory. Check your MCQ answers against the answer key at the end of the book. For short and long questions, write full answers in your own words in a notebook, then compare them with the notes.

Revise regularly: read the key definitions of each chapter again after a few days, and attempt the questions a second time before your tests and examinations.

> **A note on accuracy:** Where a figure or value has not been verified from an official source, it has been left out of these notes rather than guessed. For the official paper pattern, always consult the current model paper on fbise.edu.pk.

CHAPTER 1

The Science of Biology

What is Biology?

Biology is the scientific study of life and living organisms. It explores how living things are structured, how they function, how they grow, how they reproduce, and how they interact with one another and with their environment. The word biology comes from two Greek words: *bios*, meaning life, and *logos*, meaning study or knowledge.

Levels of Organisation

Life is organised in a hierarchy. Atoms join to form molecules, molecules form organelles, organelles work together inside cells, cells form tissues, tissues form organs, organs form organ systems, and organ systems form an organism. Beyond the organism, organisms of the same kind form a population, populations of different kinds form a community, communities together with their environment form an ecosystem, and all ecosystems together form the biosphere.

Characteristics of Living Things

Living things share several features. They are made of cells, they grow and develop, they reproduce, they respond to stimuli, they need energy and carry out metabolism, they maintain a stable internal environment (homeostasis), and they adapt to their environment over generations through evolution.

CHAPTER 1 (CONTINUED)

The Science of Biology

Branches of Biology

Biology has many branches. Botany is the study of plants, zoology is the study of animals, microbiology is the study of microscopic organisms, genetics is the study of heredity, ecology is the study of interactions between organisms and their environment, and anatomy and physiology study the structure and functions of the body.

The Scientific Method

Biologists work through the scientific method. They observe a phenomenon, ask a question, form a hypothesis (a testable explanation), design a controlled experiment, collect and record data, analyse the results, and draw a conclusion. A conclusion may support or reject the hypothesis, and the work is repeated to check reliability.

Biological Tools and Safety

The microscope is the most important tool in biology; it magnifies tiny structures such as cells. Other common tools include slides, test tubes, petri dishes, and measuring instruments. In the laboratory, students must follow safety rules: wear protective equipment when required, handle glassware carefully, never taste chemicals, and wash hands after work.

Key Definitions

- **Biology:** The scientific study of life and living organisms.
- **Cell:** The smallest unit of life; all living things are made of one or more cells.
- **Homeostasis:** The maintenance of a stable internal environment inside a living thing.
- **Hypothesis:** A testable explanation proposed to answer a scientific question.
- **Biosphere:** The part of the Earth where life exists, including land, water, and air.

Key Terms to Remember

Biology, Cell, Tissue, Organ, Organ system, Population, Community, Ecosystem, Biosphere, Homeostasis, Metabolism, Hypothesis, Observation, Experiment, Microscope.

Practice Questions: The Science of Biology

Multiple-Choice Questions

1. The scientific study of life is called
   (a) Biology (b) Physics (c) Chemistry (d) Geology
2. The smallest unit of life is the
   (a) Tissue (b) Cell (c) Organ (d) Organ system
3. A group of organisms of the same kind living in one area forms a
   (a) Community (b) Ecosystem (c) Population (d) Biosphere
4. The maintenance of a stable internal environment is called
   (a) Metabolism (b) Homeostasis (c) Evolution (d) Reproduction
5. The study of plants is known as
   (a) Zoology (b) Botany (c) Microbiology (d) Genetics
6. A testable explanation for a scientific question is a
   (a) Law (b) Theory (c) Hypothesis (d) Conclusion
7. Which of these is a characteristic of living things?
   (a) Growth (b) Reproduction (c) Response to stimuli (d) All of these
8. Cells, tissues, organs and organ systems together form a/an
   (a) Population (b) Organism (c) Community (d) Ecosystem
9. The study of heredity is called
   (a) Ecology (b) Genetics (c) Anatomy (d) Physiology
10. The first step of the scientific method is usually
    (a) Experiment (b) Observation (c) Conclusion (d) Hypothesis

Practice Questions: The Science of Biology

Short Questions

1. Define biology and name its two Greek root words.
2. List any four characteristics of living things.
3. What is the difference between a population and a community?
4. Why is the microscope important in biology?
5. Write any two laboratory safety rules.

Long Questions

1. Describe the levels of biological organisation from atom to biosphere with one example at each level.
2. Explain the steps of the scientific method and show how a biologist would use them to study a question about plant growth.

CHAPTER 2

Biodiversity

What is Biodiversity?

Biodiversity means the variety of life on Earth. It includes the variety of species, the variety of genes within a species, and the variety of ecosystems. A region with many different kinds of plants, animals, and microorganisms has high biodiversity; a region with few kinds has low biodiversity.

Levels of Biodiversity

Genetic diversity is the variety of genes within one species, which is why individuals of the same species differ from one another. Species diversity is the variety of different species in an area. Ecosystem diversity is the variety of habitats and ecosystems, such as forests, deserts, rivers, and seas.

Classification

Classification is the grouping of organisms on the basis of shared features. It helps scientists identify organisms, study their relationships, and organise knowledge about millions of species. Organisms are grouped into ranks, from the largest group to the smallest: kingdom, phylum, class, order, family, genus, and species.

Biodiversity

Five Kingdoms

Living things are commonly placed in five kingdoms. Monera includes bacteria. Protista includes single-celled organisms such as amoeba. Fungi includes mushrooms and yeasts. Plantae includes all plants. Animalia includes all animals.

Binomial Nomenclature

Every species is given a scientific name made of two parts: the genus name and the species name. The genus name begins with a capital letter and the species name begins with a small letter; both are written in italics in print. This system gives each species one unique name understood by scientists everywhere.

Importance and Conservation

Biodiversity gives us food, medicines, timber, and clean air and water, and it keeps ecosystems stable. Human activities such as deforestation, pollution, and overhunting reduce biodiversity. Conservation means protecting species and their habitats, for example through national parks, wildlife sanctuaries, and laws against hunting.

Key Definitions

- **Biodiversity:** The variety of life on Earth, including genetic, species, and ecosystem diversity.
- **Classification:** The grouping of organisms on the basis of shared features.
- **Species:** A group of organisms that can interbreed and produce fertile offspring.
- **Genus:** A group of closely related species.
- **Conservation:** The protection and careful management of living things and their habitats.

Key Terms to Remember

Biodiversity, Genetic diversity, Species diversity, Ecosystem diversity, Classification, Kingdom, Phylum, Class, Order, Family, Genus, Species, Binomial nomenclature, Monera, Protista, Fungi, Plantae, Animalia, Conservation, Endangered species.

Practice Questions: Biodiversity

Multiple-Choice Questions

1. The variety of life on Earth is called
   (a) Ecology (b) Biodiversity (c) Evolution (d) Classification
2. The variety of genes within one species is
   (a) Species diversity (b) Ecosystem diversity (c) Genetic diversity (d) Kingdom diversity
3. The smallest unit of classification is the
   (a) Genus (b) Family (c) Species (d) Order
4. Bacteria belong to the kingdom
   (a) Protista (b) Fungi (c) Monera (d) Plantae
5. In binomial nomenclature, a scientific name has
   (a) One part (b) Two parts (c) Three parts (d) Four parts
6. Mushrooms belong to the kingdom
   (a) Fungi (b) Plantae (c) Animalia (d) Protista
7. The largest rank in classification is the
   (a) Species (b) Genus (c) Kingdom (d) Family
8. Which of these protects biodiversity?
   (a) Deforestation (b) Pollution (c) National parks (d) Overhunting
9. Amoeba belongs to the kingdom
   (a) Monera (b) Protista (c) Fungi (d) Animalia
10. The genus name in a scientific name begins with a
    (a) Small letter (b) Capital letter (c) Number (d) Symbol

Practice Questions: Biodiversity

Short Questions

1. Define biodiversity and name its three levels.
2. What is classification? Why is it useful?
3. Name the five kingdoms of living things.
4. What is binomial nomenclature? Give one example of how a scientific name is written.
5. Give two reasons why biodiversity is important for humans.

Long Questions

1. Describe the three levels of biodiversity with examples, and explain why each level matters.
2. Explain the five-kingdom classification system, giving the main features and one example of each kingdom.

CHAPTER 3

Cell

Cell Theory

The cell theory states that all living things are made of cells, the cell is the basic unit of life, and all cells come from pre-existing cells. Some organisms, such as bacteria and amoeba, are unicellular, made of a single cell. Others, such as plants and animals, are multicellular, made of many cells working together.

Prokaryotic and Eukaryotic Cells

Prokaryotic cells, found in bacteria, have no true nucleus and no membrane-bound organelles; their genetic material lies free in the cytoplasm. Eukaryotic cells, found in plants, animals, fungi, and protists, have a true nucleus and membrane-bound organelles.

Cell Membrane and Cell Wall

The cell membrane is a thin boundary around the cell that controls what enters and leaves it. Plant cells also have a cell wall outside the membrane, made of cellulose, which gives the cell shape and protection. Animal cells have no cell wall.

Nucleus

The nucleus is the control centre of the cell. It contains the genetic material, DNA, which carries instructions for the cell's activities, including growth, division, and making proteins. The nucleus is surrounded by a nuclear membrane with tiny pores.

Cell

Cytoplasm and Organelles

The cytoplasm is the jelly-like substance in which organelles are suspended. Mitochondria release energy from food during respiration. Ribosomes make proteins. The endoplasmic reticulum transports materials within the cell. The Golgi apparatus packages and distributes substances. Lysosomes digest waste material. Vacuoles store water and other substances; plant cells usually have one large vacuole.

Plastids and Chloroplasts

Plastids are found only in plant cells. Chloroplasts contain chlorophyll, the green pigment that traps sunlight for photosynthesis. Other plastids store food or pigments. Centrioles are found in animal cells and help in cell division.

Movement Across the Membrane

Substances move in and out of cells by diffusion, osmosis, and active transport. Diffusion is the movement of molecules from an area of higher concentration to an area of lower concentration. Osmosis is the movement of water across a partially permeable membrane. Active transport uses energy to move substances against their concentration gradient.

Key Definitions

- **Cell theory:** All living things are made of cells; the cell is the basic unit of life; all cells arise from pre-existing cells.
- **Prokaryotic cell:** A cell without a true nucleus or membrane-bound organelles.
- **Eukaryotic cell:** A cell with a true nucleus and membrane-bound organelles.
- **Diffusion:** Movement of molecules from higher to lower concentration.
- **Osmosis:** Movement of water across a partially permeable membrane from a dilute to a more concentrated solution.

Key Terms to Remember

Cell theory, Unicellular, Multicellular, Prokaryotic, Eukaryotic, Cell membrane, Cell wall, Nucleus, Cytoplasm, Mitochondrion, Ribosome, Endoplasmic reticulum, Golgi apparatus, Lysosome, Vacuole, Chloroplast, Chlorophyll, Diffusion, Osmosis, Active transport.

Practice Questions: Cell

Multiple-Choice Questions

1. The basic unit of life is the
   (a) Tissue (b) Organ (c) Cell (d) Organ system
2. Which cell has no true nucleus?
   (a) Plant cell (b) Animal cell (c) Prokaryotic cell (d) Fungal cell
3. The control centre of the cell is the
   (a) Mitochondrion (b) Nucleus (c) Ribosome (d) Vacuole
4. The cell wall of a plant cell is made of
   (a) Chitin (b) Cellulose (c) Protein (d) Lipid
5. Which organelle releases energy during respiration?
   (a) Ribosome (b) Golgi apparatus (c) Mitochondrion (d) Lysosome
6. Photosynthesis takes place in the
   (a) Mitochondrion (b) Chloroplast (c) Nucleus (d) Vacuole
7. Proteins are made by the
   (a) Ribosome (b) Lysosome (c) Vacuole (d) Cell wall
8. Movement of water across a partially permeable membrane is
   (a) Diffusion (b) Osmosis (c) Active transport (d) Respiration
9. Animal cells do NOT have a
   (a) Cell membrane (b) Nucleus (c) Cell wall (d) Mitochondrion
10. The jelly-like substance inside the cell is the
    (a) Cytoplasm (b) Nucleoplasm (c) Cell sap (d) Chlorophyll

Practice Questions: Cell

Short Questions

1. State the three points of the cell theory.
2. Write two differences between prokaryotic and eukaryotic cells.
3. What is the function of the nucleus in a cell?
4. Name the organelle that makes proteins and the organelle that releases energy.
5. Define osmosis and give one example of it in a plant cell.

Long Questions

1. Draw a labelled diagram of a plant cell and describe the functions of its main parts.
2. Compare a plant cell and an animal cell, listing the structures found in both and the structures found in only one of them, with their functions.

CHAPTER 4

Cell Cycle

What is the Cell Cycle?

The cell cycle is the series of events that a cell goes through as it grows and divides into two daughter cells. It has two main phases: interphase, during which the cell grows and copies its genetic material, and the mitotic phase, during which the cell divides.

Interphase

Interphase is the longest part of the cell cycle. During it the cell grows, carries out its normal functions, and duplicates its DNA so that each daughter cell receives a complete copy. By the end of interphase the cell is ready to divide.

Mitosis

Mitosis is the division of the nucleus, producing two daughter nuclei that are genetically identical to the parent nucleus. Its stages are prophase, metaphase, anaphase, and telophase. In prophase the chromosomes become visible and the nuclear membrane breaks down. In metaphase the chromosomes line up in the middle of the cell. In anaphase the sister chromatids are pulled apart to opposite ends. In telophase two new nuclei form and the cell divides into two daughter cells.

Cell Cycle

Importance of Mitosis

Mitosis is needed for the growth of multicellular organisms, for the replacement of damaged or worn-out cells, and for repair of tissues. In some organisms it is also a method of asexual reproduction.

Meiosis

Meiosis is a special type of cell division that produces gametes, the sex cells. It involves two divisions, and the resulting cells have half the genetic material of the parent cell, so that when two gametes fuse at fertilisation the full amount is restored. Meiosis also produces variation because genetic material is exchanged between chromosomes and is shuffled into new combinations.

Cell Cycle Control and Errors

The cell cycle is controlled by checkpoints that check whether the cell is ready to move to the next stage. If these controls fail, cells may divide in an uncontrolled way, which can lead to tumours and cancer. Apoptosis is programmed cell death, a controlled process that removes old or damaged cells.

Key Definitions

- **Cell cycle:** The series of events through which a cell grows and divides into two daughter cells.
- **Interphase:** The phase of the cell cycle in which the cell grows and copies its DNA.
- **Mitosis:** Nuclear division producing two genetically identical daughter cells.
- **Meiosis:** Cell division producing gametes with half the genetic material of the parent cell.
- **Apoptosis:** Programmed cell death that removes old or damaged cells.

Key Terms to Remember

Cell cycle, Interphase, Mitosis, Prophase, Metaphase, Anaphase, Telophase, Cytokinesis, Meiosis, Gamete, Chromosome, Chromatid, DNA, Daughter cell, Checkpoint, Apoptosis, Cancer, Fertilisation, Variation, Asexual reproduction.

Practice Questions: Cell Cycle

Multiple-Choice Questions

1. The cell cycle consists of interphase and the
   (a) Resting phase (b) Mitotic phase (c) Growing phase (d) Sleeping phase
2. During interphase, the cell
   (a) Divides its nucleus (b) Copies its DNA (c) Forms gametes (d) Stops growing
3. Mitosis produces daughter cells that are
   (a) Genetically identical to the parent (b) Genetically different from the parent (c) Gametes (d) Dead cells
4. In metaphase, chromosomes line up in the
   (a) Middle of the cell (b) Nucleus (c) Cytoplasm (d) Cell wall
5. Sister chromatids are pulled apart during
   (a) Prophase (b) Metaphase (c) Anaphase (d) Telophase
6. Meiosis produces
   (a) Two identical cells (b) Four gametes with half the genetic material (c) Two gametes (d) One identical cell
7. Mitosis is important for
   (a) Growth (b) Repair of tissues (c) Replacement of worn-out cells (d) All of these
8. Programmed cell death is called
   (a) Mitosis (b) Meiosis (c) Apoptosis (d) Cytokinesis
9. Uncontrolled cell division can lead to
   (a) Growth (b) Cancer (c) Repair (d) Variation
10. In telophase, new nuclei
    (a) Break down (b) Form around the chromosomes (c) Disappear (d) Fuse together

Practice Questions: Cell Cycle

Short Questions

1. Define the cell cycle and name its two main phases.
2. What happens during interphase?
3. List the four stages of mitosis in order.
4. What is the difference between mitosis and meiosis?
5. Why is mitosis important for a multicellular organism?

Long Questions

1. Describe the stages of mitosis in order, explaining what happens to the chromosomes at each stage.
2. Explain meiosis: where it occurs, what it produces, and why it is important for sexual reproduction and variation.

CHAPTER 5

Tissues, Organs, and Organ Systems

What is a Tissue?

A tissue is a group of similar cells that work together to carry out a particular function. In multicellular organisms, cells are organised into tissues, tissues into organs, organs into organ systems, and organ systems into the organism.

Plant Tissues

Plant tissues are of two main kinds. Meristematic tissues are made of young, dividing cells found at the tips of roots and shoots; they cause growth. Permanent tissues are made of mature cells that no longer divide. They include simple tissues such as parenchyma, collenchyma, and sclerenchyma, and complex tissues such as xylem and phloem. Xylem transports water and mineral salts from the roots to the leaves. Phloem transports food made in the leaves to all parts of the plant.

Animal Tissues

Animal tissues include epithelial tissue, which covers body surfaces and lines organs; connective tissue, which supports and joins body parts and includes blood, bone, and cartilage; muscular tissue, which contracts to cause movement; and nervous tissue, which carries messages in the form of nerve impulses.

Tissues, Organs, and Organ Systems

Organs and Organ Systems

An organ is a structure made of different tissues working together for a function, such as the heart, leaf, or stomach. An organ system is a group of organs working together, such as the digestive system, the circulatory system, the respiratory system, and the nervous system.

Human Organ Systems

The digestive system breaks down food and absorbs nutrients. The circulatory system transports blood, nutrients, gases, and wastes. The respiratory system takes in oxygen and gives out carbon dioxide. The excretory system removes wastes. The nervous system controls and coordinates body activities. The skeletal system supports the body and protects internal organs, and the muscular system brings about movement.

Tissue Damage and Repair

When tissues are injured, the body repairs them by producing new cells through cell division. Healing is faster in tissues with a good blood supply. Some tissues, such as nervous tissue, repair very slowly or not at all.

Key Definitions

- **Tissue:** A group of similar cells working together to carry out a particular function.
- **Organ:** A structure made of different tissues working together for a function.
- **Organ system:** A group of organs working together to carry out a major function.
- **Xylem:** Plant tissue that transports water and mineral salts from roots to leaves.
- **Phloem:** Plant tissue that transports food from leaves to all parts of the plant.

Key Terms to Remember

Tissue, Meristematic tissue, Permanent tissue, Parenchyma, Collenchyma, Sclerenchyma, Xylem, Phloem, Epithelial tissue, Connective tissue, Muscular tissue, Nervous tissue, Organ, Organ system, Digestive system, Circulatory system, Respiratory system, Nervous system, Skeletal system, Excretory system.

Practice Questions: Tissues, Organs, and Organ Systems

Multiple-Choice Questions

1. A group of similar cells working together is a
   (a) Organ (b) Tissue (c) Organ system (d) Organism
2. Xylem transports
   (a) Food from leaves (b) Water and mineral salts from roots (c) Nerve impulses (d) Blood
3. Phloem transports
   (a) Water from roots (b) Food made in the leaves (c) Oxygen (d) Wastes
4. Meristematic tissue is found at the
   (a) Tips of roots and shoots (b) Middle of the stem (c) Old leaves (d) Bark
5. Blood is an example of
   (a) Epithelial tissue (b) Connective tissue (c) Muscular tissue (d) Nervous tissue
6. The tissue that carries nerve impulses is
   (a) Muscular tissue (b) Nervous tissue (c) Epithelial tissue (d) Connective tissue
7. The heart is an example of a/an
   (a) Tissue (b) Cell (c) Organ (d) Organ system
8. The system that takes in oxygen is the
   (a) Digestive system (b) Respiratory system (c) Circulatory system (d) Excretory system
9. Which tissue gives strength to plant parts?
   (a) Parenchyma (b) Sclerenchyma (c) Meristematic tissue (d) Phloem
10. A group of organs working together forms a/an
    (a) Tissue (b) Cell (c) Organ system (d) Organism

Practice Questions: Tissues, Organs, and Organ Systems

Short Questions

1. Define a tissue and give one example from plants and one from animals.
2. What is the function of xylem and phloem?
3. Name the four main types of animal tissue and give one function of each.
4. What is the difference between an organ and an organ system?
5. Name any four human organ systems and state one function of each.

Long Questions

1. Describe the main plant tissues, including meristematic tissue, simple permanent tissues, and complex tissues, with their functions.
2. Explain how cells, tissues, organs, and organ systems are organised in the human body, using the digestive system as an example.

CHAPTER 6

Molecular Biology

Molecules of Life

All living things are made of chemical substances called biomolecules. The main groups are carbohydrates, proteins, lipids, and nucleic acids. Water and mineral salts are also essential for life.

Carbohydrates

Carbohydrates are made of carbon, hydrogen, and oxygen. They are the main source of energy for the body. Simple sugars such as glucose are the basic units; many glucose units join to form starch in plants and glycogen in animals, which store energy. Cellulose, found in plant cell walls, is also a carbohydrate.

Proteins

Proteins are made of amino acids joined together. They build and repair body tissues, make enzymes and hormones, and form parts of the cell such as the cell membrane. Meat, eggs, milk, beans, and lentils are rich sources of protein.

Lipids

Lipids include fats and oils. They store more energy than carbohydrates, form part of cell membranes, and protect body organs. A diet very high in fats can harm health, so fats should be eaten in moderate amounts.

Molecular Biology

Nucleic Acids

Nucleic acids are DNA and RNA. DNA (deoxyribonucleic acid) is found in the nucleus and carries the hereditary instructions of the cell. Its structure is a double helix, like a twisted ladder, made of two strands joined by pairs of bases. RNA (ribonucleic acid) helps in making proteins.

DNA Structure and Bases

DNA is made of repeating units called nucleotides. Each nucleotide has a sugar, a phosphate group, and a nitrogenous base. There are four bases: adenine, thymine, guanine, and cytosine. Adenine always pairs with thymine, and guanine always pairs with cytosine. The order of the bases is the genetic code that directs the making of proteins.

Enzymes

Enzymes are biological catalysts made of protein. They speed up chemical reactions in the body without being used up themselves. Each enzyme works on a particular substance, called its substrate. Enzymes are affected by changes in their surroundings, and very harsh conditions can change their shape and stop them working, which is called denaturation.

Key Definitions

- **Biomolecule:** A chemical substance found in living things, such as a carbohydrate, protein, lipid, or nucleic acid.
- **Carbohydrate:** A biomolecule made of carbon, hydrogen, and oxygen that is the main source of energy.
- **Protein:** A biomolecule made of amino acids that builds tissues and makes enzymes and hormones.
- **DNA:** Deoxyribonucleic acid; the molecule that carries hereditary instructions in the cell.
- **Enzyme:** A protein that speeds up a chemical reaction in a living thing without being used up.

Key Terms to Remember

Biomolecule, Carbohydrate, Glucose, Starch, Glycogen, Cellulose, Protein, Amino acid, Lipid, Nucleic acid, DNA, RNA, Double helix, Nucleotide, Adenine, Thymine, Guanine, Cytosine, Enzyme, Substrate, Denaturation.

Practice Questions: Molecular Biology

Multiple-Choice Questions

1. The main source of energy for the body is
   (a) Proteins (b) Lipids (c) Carbohydrates (d) Nucleic acids
2. Proteins are made of
   (a) Glucose units (b) Amino acids (c) Fatty acids (d) Nucleotides
3. Starch is stored in
   (a) Animals (b) Plants (c) Fungi only (d) Bacteria only
4. DNA is found mainly in the
   (a) Cytoplasm (b) Nucleus (c) Mitochondrion (d) Ribosome
5. The shape of DNA is a
   (a) Single strand (b) Double helix (c) Triple helix (d) Flat sheet
6. Adenine always pairs with
   (a) Guanine (b) Cytosine (c) Thymine (d) Adenine
7. Guanine pairs with
   (a) Thymine (b) Adenine (c) Cytosine (d) Uracil
8. Enzymes are made of
   (a) Carbohydrate (b) Protein (c) Lipid (d) Nucleic acid
9. The substance an enzyme acts on is its
   (a) Product (b) Substrate (c) Catalyst (d) Inhibitor
10. Cellulose is found in the
    (a) Animal cell membrane (b) Plant cell wall (c) Nucleus (d) Ribosome

Practice Questions: Molecular Biology

Short Questions

1. Name the four main groups of biomolecules.
2. Why are carbohydrates called the main source of energy?
3. What are amino acids? Which biomolecule are they the units of?
4. Describe the double helix structure of DNA in your own words.
5. What is an enzyme? What happens when an enzyme is denatured?

Long Questions

1. Describe carbohydrates, proteins, and lipids: their building units, their functions in the body, and one food source of each.
2. Explain the structure of DNA, including nucleotides and base pairing, and describe how DNA carries hereditary information.

CHAPTER 7

Metabolism

What is Metabolism?

Metabolism is the sum of all chemical reactions that take place inside a living thing. It has two parts: anabolism, the building up of complex substances from simpler ones, which needs energy; and catabolism, the breaking down of complex substances into simpler ones, which releases energy.

Photosynthesis

Photosynthesis is the process by which green plants make their own food. Using sunlight, chlorophyll in the leaves traps light energy and the plant combines water and carbon dioxide to make glucose and release oxygen. Photosynthesis takes place mainly in the leaves, inside chloroplasts. It is the basis of nearly all food chains, because plants make the food that other living things depend on.

Factors Affecting Photosynthesis

Photosynthesis is affected by light intensity, the amount of carbon dioxide available, the supply of water, and the temperature. When light is very low, photosynthesis is slow; as light increases, the rate increases up to a point and then levels off. A shortage of water or carbon dioxide also slows the process.

Metabolism

Respiration

Respiration is the process by which living things release energy from food. In aerobic respiration, glucose is broken down using oxygen, releasing energy, carbon dioxide, and water. Anaerobic respiration takes place without oxygen and releases less energy; in yeast it produces alcohol and carbon dioxide, and in muscle cells during hard exercise it produces lactic acid.

Photosynthesis and Respiration Compared

Photosynthesis stores energy in food and takes in carbon dioxide while releasing oxygen; respiration releases energy from food and takes in oxygen while releasing carbon dioxide. The two processes are linked in nature: the oxygen released by photosynthesis is used in respiration, and the carbon dioxide released by respiration is used in photosynthesis.

Energy in Living Things

Energy from respiration is used for all life activities: growth, movement, transport of substances, and keeping the body warm in warm-blooded animals. The energy is stored and transferred in the cell by a carrier molecule called ATP, which is made during respiration and used up when energy is needed.

Key Definitions

- **Metabolism:** The sum of all chemical reactions in a living thing.
- **Anabolism:** Building-up reactions that make complex substances from simpler ones.
- **Catabolism:** Breaking-down reactions that release energy.
- **Photosynthesis:** The process by which green plants make food using sunlight, water, and carbon dioxide.
- **Respiration:** The process by which living things release energy from food.

Key Terms to Remember

Metabolism, Anabolism, Catabolism, Photosynthesis, Chlorophyll, Chloroplast, Stomata, Glucose, Respiration, Aerobic respiration, Anaerobic respiration, Lactic acid, ATP, Light intensity, Carbon dioxide, Oxygen, Food chain, Energy, Denaturation, Enzyme.

Practice Questions: Metabolism

Multiple-Choice Questions

1. The sum of all chemical reactions in a living thing is
   (a) Photosynthesis (b) Metabolism (c) Respiration (d) Digestion
2. Building-up reactions are called
   (a) Catabolism (b) Anabolism (c) Respiration (d) Fermentation
3. Photosynthesis takes place mainly in the
   (a) Roots (b) Stem (c) Leaves (d) Flowers
4. The green pigment that traps sunlight is
   (a) Carotene (b) Chlorophyll (c) Haemoglobin (d) Melanin
5. Photosynthesis releases
   (a) Carbon dioxide (b) Nitrogen (c) Oxygen (d) Hydrogen
6. Aerobic respiration needs
   (a) Carbon dioxide (b) Nitrogen (c) Oxygen (d) Sunlight
7. Anaerobic respiration in yeast produces
   (a) Lactic acid only (b) Alcohol and carbon dioxide (c) Oxygen and water (d) Glucose
8. The energy carrier made during respiration is
   (a) DNA (b) RNA (c) ATP (d) Glucose
9. Which factor affects the rate of photosynthesis?
   (a) Light intensity (b) Carbon dioxide (c) Water supply (d) All of these
10. Respiration releases energy from
    (a) Water (b) Food (c) Sunlight (d) Minerals

Practice Questions: Metabolism

Short Questions

1. Define metabolism and name its two parts.
2. Write the word equation for photosynthesis.
3. Where does photosynthesis take place, and which pigment traps sunlight?
4. What is the difference between aerobic and anaerobic respiration?
5. Name three factors that affect the rate of photosynthesis.

Long Questions

1. Describe photosynthesis in detail: where it happens, what it needs, what it produces, and why it is important for life on Earth.
2. Compare aerobic and anaerobic respiration, and explain how the energy released is used by living things.

CHAPTER 8

Plant Physiology

What is Plant Physiology?

Plant physiology is the study of how plants function. It covers how plants take in water and mineral salts, how they transport substances, how they make food, and how they remove wastes. A plant's structure is closely related to its functions.

Absorption of Water and Salts

Roots absorb water and mineral salts from the soil. Root hairs greatly increase the surface area of the root for absorption. Water enters the root hair cells by osmosis, moving from the soil into the cells, while mineral salts enter by diffusion and active transport.

Transpiration

Transpiration is the loss of water vapour from the aerial parts of a plant, mainly through the stomata of leaves. It helps to pull water up from the roots and cools the plant. The rate of transpiration is affected by light, wind, humidity, and temperature: it is faster in bright light, in wind, and in dry air, and slower in humid air.

Transport in Plants

Water and mineral salts are carried upward in the xylem vessels, from the roots to the leaves. Food made in the leaves is carried to all parts of the plant in the phloem. This movement of food is called translocation.

Plant Physiology

Stomata and Gaseous Exchange

Stomata are tiny pores on the surface of leaves, each surrounded by two guard cells. They open and close to control the exchange of gases: carbon dioxide enters for photosynthesis and oxygen leaves, while water vapour also escapes. The guard cells open the pore when they take in water and become firm, and close it when they lose water.

Movement in Plants

Plants respond to stimuli by growth movements called tropisms. Phototropism is growth towards light, geotropism is growth in response to gravity (roots grow down, shoots grow up), and thigmotropism is a response to touch. These movements help the plant reach light and water.

Excretion in Plants

Plants remove wastes by storing them in bark, in old leaves that fall off, in fruits, or as resins and gums. Because plants make little waste compared with animals, they have no special excretory system.

Key Definitions

- **Transpiration:** The loss of water vapour from the aerial parts of a plant, mainly through the stomata.
- **Translocation:** The movement of food in the phloem from the leaves to all parts of the plant.
- **Stomata:** Tiny pores on leaves that control gaseous exchange and water loss.
- **Phototropism:** Growth of a plant part towards light.
- **Root hair:** A thin extension of a root cell that increases the surface area for absorption.

Key Terms to Remember

Plant physiology, Root hair, Osmosis, Transpiration, Stomata, Guard cell, Xylem, Phloem, Translocation, Phototropism, Geotropism, Thigmotropism, Gaseous exchange, Mineral salts, Resin, Gum, Bark, Leaf, Stem, Root.

Practice Questions: Plant Physiology

Multiple-Choice Questions

1. Water is absorbed from the soil mainly by the
   (a) Leaves (b) Stem (c) Roots (d) Flowers
2. Root hairs increase the
   (a) Length of the stem (b) Surface area for absorption (c) Number of leaves (d) Size of flowers
3. Transpiration is the loss of
   (a) Liquid water from roots (b) Water vapour from leaves (c) Food from the stem (d) Mineral salts
4. Water and mineral salts are carried upward in the
   (a) Phloem (b) Xylem (c) Epidermis (d) Cortex
5. Food made in the leaves is transported in the
   (a) Xylem (b) Phloem (c) Root hairs (d) Stomata
6. Stomata are surrounded by
   (a) Epidermal cells (b) Guard cells (c) Xylem vessels (d) Root hairs
7. Growth of a shoot towards light is called
   (a) Geotropism (b) Phototropism (c) Thigmotropism (d) Chemotropism
8. Roots growing downward in response to gravity is
   (a) Phototropism (b) Geotropism (c) Thigmotropism (d) Transpiration
9. Transpiration is faster in
   (a) Humid air (b) Still air (c) Windy and dry air (d) Darkness
10. Plants store some wastes in
    (a) Old leaves that fall off (b) The heart (c) The kidneys (d) The lungs

Practice Questions: Plant Physiology

Short Questions

1. Define transpiration and name the part of the leaf through which it mainly occurs.
2. How do root hairs help a plant absorb water?
3. What is the function of xylem and phloem in transport?
4. Explain how guard cells open and close a stoma.
5. Define phototropism and geotropism with one example of each.

Long Questions

1. Describe how water and mineral salts are absorbed by roots and transported to the leaves, and explain the role of transpiration in this movement.
2. Explain the structure and function of stomata, and describe the factors that affect the rate of transpiration.

CHAPTER 9

Plant Reproduction

Reproduction in Plants

Reproduction is the process by which living things produce new individuals of their own kind. Plants reproduce in two ways: asexually, without the fusion of gametes, and sexually, by the fusion of male and female gametes.

Asexual Reproduction

In asexual reproduction a new plant grows from a part of the parent plant, so the offspring are identical to the parent. Natural methods include runners, bulbs, tubers, and rhizomes. Artificial methods used by farmers and gardeners include cuttings, grafting, and layering.

Structure of a Flower

The flower is the reproductive part of a flowering plant. Its main parts are the sepals, which protect the bud; the petals, which attract pollinators; the stamens, the male parts, each made of an anther that produces pollen and a filament; and the carpel, the female part, made of the stigma, style, and ovary, which contains ovules.

Pollination

Pollination is the transfer of pollen grains from the anther to the stigma. In self-pollination the pollen goes to a flower of the same plant; in cross-pollination it goes to a flower of another plant of the same kind. Pollination is carried out by wind, water, insects, birds, and other animals.

Plant Reproduction

Fertilisation and Seed Formation

After pollination, a pollen grain grows a pollen tube down the style to the ovule. The male gamete fuses with the female gamete inside the ovule; this is fertilisation. The fertilised ovule becomes a seed, and the ovary becomes a fruit. The seed contains an embryo and stored food, protected by a seed coat.

Seed Dispersal and Germination

Seeds are dispersed, or scattered, by wind, water, and animals, so that new plants grow away from the parent and do not compete with it. Germination is the growth of a seed into a new plant. A seed needs water, oxygen, and a suitable temperature to germinate; light is not needed by most seeds.

Alternation of Generations

In the life cycle of a plant, a spore-producing generation and a gamete-producing generation alternate with each other. The sporophyte produces spores, and the gametophyte produces gametes. In flowering plants the sporophyte is the large, familiar plant, and the gametophyte is small and short-lived.

Key Definitions

- **Pollination:** The transfer of pollen grains from the anther to the stigma.
- **Fertilisation:** The fusion of male and female gametes.
- **Germination:** The growth of a seed into a new plant.
- **Seed dispersal:** The scattering of seeds away from the parent plant.
- **Asexual reproduction:** Reproduction without the fusion of gametes, producing offspring identical to the parent.

Key Terms to Remember

Reproduction, Asexual reproduction, Sexual reproduction, Runner, Bulb, Tuber, Rhizome, Cutting, Grafting, Flower, Sepal, Petal, Stamen, Anther, Pollen, Carpel, Stigma, Style, Ovary, Ovule, Pollination, Fertilisation, Seed, Fruit, Germination, Seed dispersal, Sporophyte, Gametophyte.

Practice Questions: Plant Reproduction

Multiple-Choice Questions

1. The reproductive part of a flowering plant is the
   (a) Leaf (b) Flower (c) Root (d) Stem
2. Pollen is produced in the
   (a) Ovary (b) Stigma (c) Anther (d) Style
3. The female part of a flower is the
   (a) Stamen (b) Carpel (c) Petal (d) Sepal
4. Pollination is the transfer of pollen to the
   (a) Ovary (b) Stigma (c) Style (d) Ovule
5. Fertilisation is the fusion of
   (a) Two seeds (b) Male and female gametes (c) Pollen and petal (d) Ovary and anther
6. After fertilisation, the ovule becomes a
   (a) Fruit (b) Flower (c) Seed (d) Leaf
7. After fertilisation, the ovary becomes a
   (a) Seed (b) Fruit (c) Flower (d) Root
8. A seed needs water, oxygen, and a suitable temperature to
   (a) Disperse (b) Germinate (c) Flower (d) Pollinate
9. Growing a new plant from a stem cutting is
   (a) Sexual reproduction (b) Asexual reproduction (c) Pollination (d) Fertilisation
10. Cross-pollination means pollen goes to a flower of
    (a) The same plant (b) Another plant of the same kind (c) A different kind of plant (d) A dead plant

Practice Questions: Plant Reproduction

Short Questions

1. Define reproduction and name its two types in plants.
2. Name the four main parts of a flower and give one function of each.
3. What is the difference between self-pollination and cross-pollination?
4. What does the ovule become after fertilisation? What does the ovary become?
5. Name three conditions a seed needs to germinate.

Long Questions

1. Describe the structure of a flower with a labelled diagram, and explain the functions of its male and female parts.
2. Explain pollination, fertilisation, seed formation, dispersal, and germination in a flowering plant.

CHAPTER 10

Evolution

What is Evolution?

Evolution is the change in the characteristics of living things over many generations. It explains how the great variety of life on Earth arose from earlier forms, and why living things are adapted to their environments.

Evidence from Fossils

Fossils are the remains or traces of organisms that lived long ago, preserved in rocks. They show that many kinds of organisms that lived in the past are now extinct, and that the organisms found in older rocks are different from those in younger rocks. Fossils provide a record of how life has changed over time.

Evidence from Comparative Anatomy

The bodies of different animals show similar structures built on the same basic plan, called homologous structures. For example, the forelimbs of humans, bats, whales, and other mammals have the same set of bones arranged in the same way, even though they are used for different purposes. This suggests that these animals share a common ancestor.

Evidence from Embryology and Biochemistry

The early embryos of different vertebrates look very similar, which suggests a common ancestry. Biochemistry gives further evidence: the molecules of life, such as DNA and proteins, are similar in different organisms, and closely related organisms have more similar DNA than distantly related ones.

Evolution

Natural Selection

Charles Darwin proposed the theory of evolution by natural selection. It works in this way: individuals of a species vary from one another; more offspring are produced than can survive; those with features that suit their environment are more likely to survive and reproduce; and they pass those useful features to their offspring. Over many generations, the features that help survival become more common in the population.

Adaptation and Speciation

An adaptation is a feature that helps an organism survive and reproduce in its environment, such as the thick fur of animals in cold regions or the long neck of a giraffe for reaching leaves. When populations of one species become separated and change in different ways over a long time, they may become so different that they can no longer interbreed; they have become separate species. This is speciation.

Lamarck and Darwin

Before Darwin, Jean-Baptiste Lamarck suggested that organisms change because they use or do not use body parts, and that these changes are passed to offspring. This idea was not supported by evidence. Darwin's theory of natural selection, supported by much evidence, is the accepted explanation of evolution today.

Key Definitions

- **Evolution:** Change in the characteristics of living things over many generations.
- **Fossil:** The remains or traces of an organism that lived long ago, preserved in rock.
- **Homologous structures:** Structures in different organisms built on the same basic plan, suggesting a common ancestor.
- **Natural selection:** The process by which organisms better suited to their environment survive and reproduce more successfully.
- **Adaptation:** A feature that helps an organism survive and reproduce in its environment.

Key Terms to Remember

Evolution, Fossil, Extinct, Homologous structures, Analogous structures, Embryology, Natural selection, Variation, Adaptation, Speciation, Common ancestor, Darwin, Lamarck, Survival of the fittest, Population, Environment, Heredity, Species, Geological time, Extinction.

Practice Questions: Evolution

Multiple-Choice Questions

1. Evolution is change over many
   (a) Days (b) Generations (c) Hours (d) Minutes
2. Fossils are found preserved in
   (a) Water (b) Air (c) Rocks (d) Soil only
3. Homologous structures suggest a
   (a) Common ancestor (b) Different ancestor (c) No ancestor (d) Recent origin
4. The theory of evolution by natural selection was proposed by
   (a) Lamarck (b) Mendel (c) Darwin (d) Linnaeus
5. Natural selection favours organisms that are
   (a) Largest (b) Best suited to their environment (c) Oldest (d) Fastest always
6. A feature that helps an organism survive is an
   (a) Adaptation (b) Mutation only (c) Fossil (d) Embryo
7. The formation of a new species is called
   (a) Fossilisation (b) Speciation (c) Adaptation (d) Variation
8. Early embryos of different vertebrates look
   (a) Very different (b) Very similar (c) Identical to adults (d) Unrelated
9. Lamarck suggested that acquired characters are
   (a) Passed to offspring (b) Never passed on (c) Lost at birth (d) Only in plants
10. Organisms that lived in the past and no longer exist are called
    (a) Living (b) Extinct (c) Fossilised only (d) Adapted

Practice Questions: Evolution

Short Questions

1. Define evolution in your own words.
2. What are fossils? What do they tell us about the history of life?
3. What are homologous structures? Give one example.
4. State the main points of Darwin's theory of natural selection.
5. What is an adaptation? Give one example.

Long Questions

1. Describe the main lines of evidence for evolution: fossils, comparative anatomy, embryology, and biochemistry.
2. Explain natural selection step by step, and show how it can lead to adaptation and the formation of new species.

MCQ Answer Key

Answers to all multiple-choice questions, chapter by chapter. The letters refer to the options (a), (b), (c), and (d) given with each question.

Chapter 1 — The Science of Biology

1. A 2. B 3. C 4. B 5. B 6. C 7. D 8. B 9. B 10. B

Chapter 2 — Biodiversity

1. B 2. C 3. C 4. C 5. B 6. A 7. C 8. C 9. B 10. B

Chapter 3 — Cell

1. C 2. C 3. B 4. B 5. C 6. B 7. A 8. B 9. C 10. A

Chapter 4 — Cell Cycle

1. B 2. B 3. A 4. A 5. C 6. B 7. D 8. C 9. B 10. B

Chapter 5 — Tissues, Organs, and Organ Systems

1. B 2. B 3. B 4. A 5. B 6. B 7. C 8. B 9. B 10. C

MCQ Answer Key (continued)

Chapter 6 — Molecular Biology

1. C 2. B 3. B 4. B 5. B 6. C 7. C 8. B 9. B 10. B

Chapter 7 — Metabolism

1. B 2. B 3. C 4. B 5. C 6. C 7. B 8. C 9. D 10. B

Chapter 8 — Plant Physiology

1. C 2. B 3. B 4. B 5. B 6. B 7. B 8. B 9. C 10. A

Chapter 9 — Plant Reproduction

1. B 2. C 3. B 4. B 5. B 6. C 7. B 8. B 9. B 10. B

Chapter 10 — Evolution

1. B 2. C 3. A 4. C 5. B 6. A 7. B 8. B 9. A 10. B

End of book. Good luck with your studies.