# 9th Class Biology Notes Khyber Pakhtunkhwa (KPK) Full Book Notes

Complete chapter-wise study notes with original practice questions for Class 9 Biology, Khyber Pakhtunkhwa Textbook Board (KPTBB), Peshawar.

**About these notes**

These notes follow the chapters of the Khyber Pakhtunkhwa Textbook Board Biology book for Class 9. The nine chapters covered, in order, are:

1. Introduction to Biology
2. Solving a Biological Problem
3. Biodiversity
4. Cells and Tissues
5. Cell Cycle
6. Enzymes
7. Bio-Energetics
8. Nutrition
9. Transport

**Boards served:** this book serves all KPK boards — Peshawar, Mardan, Swat, Abbottabad, Bannu, Kohat, Malakand and D. I. Khan — because all of them use the Khyber Pakhtunkhwa Textbook Board book.

**About the paper:** the KPK Class 9 Biology theory paper is of 65 marks — Section A: 12 multiple-choice questions (12 marks); Section B: any 8 of 11 short questions (32 marks); Section C: any 3 of 4 long questions (21 marks). The practical examination carries 10 marks, so the subject total is 75 marks. These figures are reproduced from board papers and board date sheets; students should check the current model paper on their own board's official website before the examination, because the board may revise the 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.

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10. 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.

> **Exam tip:** in the KPK paper, Section B short questions carry 4 marks each, so learn definitions with one or two supporting points. Section C long questions carry 7 marks each, so practise writing full, well-organised answers with examples.

CHAPTER 1

# Introduction to Biology

## What is Biology?

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

All living things show certain common characteristics. They are made of cells, they grow and develop, they need energy, they respond to changes around them, they reproduce, and they pass their characters to the next generation. Non-living things do not show all of these characteristics together.

- Botany: the study of plants.
- Zoology: the study of animals.
- Microbiology: the study of microorganisms such as bacteria and viruses.
- Ecology: the study of the relations of organisms with one another and their environment.
- Genetics: the study of heredity and variation.
- Physiology: the study of the functions of living things.
- Anatomy: the study of the internal structure of organisms.
- Biotechnology: the use of living organisms to make useful products.

## Levels of Biological Organisation

Living things are organised in levels, from the smallest to the largest. Atoms join to form molecules; molecules form organelles; organelles work together in cells; similar cells form tissues; tissues form organs; organs form organ systems; and organ systems form an organism. Organisms of the same kind form a population, populations of different kinds form a community, and communities with their non-living environment form an ecosystem.

The cell is the basic unit of life. Some organisms, such as bacteria and Amoeba, are unicellular, made of a single cell. Others, such as humans and mango trees, are multicellular, made of many cells that work together.

## Biology and Other Sciences

Biology is linked with many other sciences. Biophysics uses physics to explain life processes, biochemistry studies the chemistry of living things, and biogeography studies where organisms live on Earth. Mathematics helps biologists count populations and analyse data, and geography helps them understand climate and habitats.

Many Muslim scientists contributed to biology. Jabir bin Hayyan worked in chemistry, Al-Razi described diseases such as smallpox and measles, Ibn Sina wrote the Canon of Medicine, and Al-Biruni studied plants and animals. Their work laid foundations for modern science.

## Careers in Biology

Studying biology opens many careers: medicine, dentistry, pharmacy, veterinary science, agriculture, forestry, fisheries, food science, nursing, laboratory technology, teaching and research. Biologists also work in wildlife conservation, public health and the pharmaceutical industry.

# Chapter 1 — Introduction to Biology: Questions

## Short Questions

**Q1.** Define biology.

**Answer:** Biology is the scientific study of life and living organisms — their structure, functions, growth, reproduction and relations with the environment.

**Q2.** Name the three major divisions of biology.

**Answer:** The three major divisions are botany (study of plants), zoology (study of animals) and microbiology (study of microorganisms).

**Q3.** What is a cell?

**Answer:** A cell is the smallest structural and functional unit of life. All living organisms are made of one or more cells.

**Q4.** List four characteristics of living things.

**Answer:** Living things are made of cells, grow and develop, need energy, respond to stimuli, reproduce, and pass characters to offspring.

**Q5.** What is ecology?

**Answer:** Ecology is the branch of biology that studies the relations of organisms with one another and with their non-living environment.

## Long Questions

**Q1.** Describe the levels of biological organisation from atoms to ecosystem.

**Answer:** The levels are: atoms join to form molecules; molecules form organelles; organelles form cells, the basic unit of life; similar cells form tissues; tissues form organs; organs form organ systems; organ systems form an organism; organisms of one kind form a population; populations of different kinds form a community; and a community with its non-living environment forms an ecosystem. Each level is built from the level below it, and new properties appear at each higher level.

**Q2.** Explain how biology is related to other sciences and name some Muslim scientists who contributed to biology.

**Answer:** Biology is linked with physics (biophysics), chemistry (biochemistry), geography (biogeography) and mathematics (population studies and data analysis). Muslim scientists made early contributions: Al-Razi described smallpox and measles, Ibn Sina wrote the Canon of Medicine, Jabir bin Hayyan advanced chemistry, and Al-Biruni studied plants and animals. Their observations and writings helped later scientists build modern biology.

## Multiple-Choice Questions

**Q1.** The scientific study of life is called:

a. Botany
b. Biology
c. Geology
d. Chemistry

**Q2.** The study of fungi is known as:

a. Mycology
b. Virology

c. Entomology
d. Parasitology

**Q3.** The basic unit of life is the:

a. Tissue
b. Organ
c. Cell
d. Organelle

**Q4.** Which of these is a unicellular organism?

a. Human
b. Mango tree
c. Amoeba
d. Fish

**Q5.** The study of the relations of organisms with their environment is:

a. Genetics
b. Ecology
c. Physiology
d. Anatomy

**Q6.** Botany is the study of:

a. Animals
b. Plants
c. Microorganisms
d. Fossils

**Q7.** A group of organisms of the same kind living in one area is a:

a. Community
b. Ecosystem
c. Population
d. Biosphere

**Q8.** Which Muslim scientist wrote the Canon of Medicine?

a. Al-Razi
b. Ibn Sina
c. Jabir bin Hayyan
d. Al-Biruni

**Q9.** The study of heredity is called:

a. Ecology
b. Genetics
c. Taxonomy
d. Embryology

**Q10.** Which level comes just above tissue in organisation?

a. Cell
b. Organ
c. Organelle

d. Molecule

CHAPTER 2

# Solving a Biological Problem

## The Scientific Method

A biological problem is solved by the scientific method, a step-by-step way of finding answers. The steps are: recognise the problem, make observations, form a hypothesis, make a deduction, design and perform an experiment, collect and analyse data, and draw a conclusion. A hypothesis is a proposed explanation that can be tested. A good hypothesis must be testable and based on observations.

Observations can be qualitative (describing qualities, such as colour or smell) or quantitative (measured with numbers, such as length or temperature). A theory is a well-tested explanation supported by much evidence, while a scientific law describes a pattern that is always observed under the same conditions.

## Malaria: A Case Study

Malaria is a disease that shows how the biological method works. In the past, people thought malaria came from bad air in marshy places. In 1878, Laveran observed the malaria parasite in the blood of patients. In 1897, Ronald Ross showed that the female Anopheles mosquito carries the parasite from one person to another.

The biological method was applied to malaria like this: the problem was the cause of malaria; observations showed that malaria was common near marshes and that mosquitoes were common there; the hypothesis was that mosquitoes spread malaria; the experiment compared people protected from mosquitoes with people who were not; the results supported the hypothesis; and the conclusion was that the female Anopheles mosquito transmits malaria. Today malaria is controlled by mosquito nets, spraying, draining standing water and medicines.

## Variables and Controls

In an experiment, the independent variable is the factor the scientist changes, the dependent variable is the result that is measured, and the controlled variables are the factors kept the same. A control group is kept unchanged so that the effect of the changed factor can be judged. Repeating an experiment and using a large sample make the results more reliable.

# Chapter 2 — Solving a Biological Problem: Questions

## Short Questions

**Q1.** Define hypothesis.

**Answer:** A hypothesis is a proposed explanation for a problem that can be tested by experiments and observations.

**Q2.** What is the difference between qualitative and quantitative observation?

**Answer:** Qualitative observation describes qualities such as colour or smell, while quantitative observation gives measured numbers such as length, mass or temperature.

**Q3.** Who discovered the malaria parasite?

**Answer:** Laveran discovered the malaria parasite (Plasmodium) in the blood of malaria patients in 1878.

**Q4.** What is a control group in an experiment?

**Answer:** A control group is the group in an experiment that is kept unchanged, so the effect of the tested factor can be compared against it.

**Q5.** Define theory.

**Answer:** A theory is an explanation that has been tested many times and is supported by a large amount of evidence.

## Long Questions

**Q1.** Describe the steps of the scientific method using malaria as an example.

**Answer:** The steps are: (1) recognise the problem — what causes malaria; (2) observe — malaria was common near marshes where mosquitoes were many; (3) form a hypothesis — mosquitoes spread malaria; (4) deduce — if mosquitoes are kept away, people will not get malaria; (5) experiment — compare people protected by nets with people who are not; (6) collect and analyse data — protected people fell ill less often; (7) conclude — the female Anopheles mosquito transmits malaria. Laveran found the parasite in blood and Ronald Ross proved the mosquito's role.

**Q2.** Explain independent, dependent and controlled variables with an example.

**Answer:** The independent variable is the factor changed by the scientist, the dependent variable is the result measured, and controlled variables are kept the same. For example, to test the effect of light on plant growth: light is the independent variable, plant height is the dependent variable, and water, soil and temperature are controlled variables. A control group kept in normal light lets the scientist judge whether the change in light caused the change in growth.

## Multiple-Choice Questions

**Q1.** A testable proposed explanation is called a:

a. Theory
b. Law
c. Hypothesis
d. Observation

**Q2.** The malaria parasite was discovered by:

a. Ronald Ross
b. Laveran

c. Ibn Sina
d. Pasteur

**Q3.** The mosquito that transmits malaria is the female:

a. Culex
b. Aedes
c. Anopheles
d. Housefly

**Q4.** Ronald Ross showed in 1897 that malaria is spread by:

a. Bad air
b. Dirty water
c. Mosquitoes
d. Contaminated food

**Q5.** Which observation is quantitative?

a. The leaf is green
b. The plant is 25 cm tall
c. The flower smells sweet
d. The fruit is soft

**Q6.** The factor a scientist changes in an experiment is the:

a. Dependent variable
b. Independent variable
c. Controlled variable
d. Control group

**Q7.** The first step of the scientific method is to:

a. Form a hypothesis
b. Recognise the problem
c. Draw a conclusion
d. Perform an experiment

**Q8.** The malaria parasite is called:

a. Amoeba
b. Plasmodium
c. Paramecium
d. Euglena

**Q9.** A well-tested explanation supported by much evidence is a:

a. Hypothesis
b. Theory
c. Guess
d. Deduction

**Q10.** In an experiment, the result that is measured is the:

a. Independent variable
b. Dependent variable
c. Controlled variable

d. Hypothesis

CHAPTER 3

# Biodiversity

## What is Biodiversity?

Biodiversity means the variety of life on Earth — the variety of genes, species and ecosystems. It includes the differences within a species, the number of different species, and the variety of habitats. Biodiversity is important because it keeps ecosystems stable, provides food, medicine, timber and clean air and water, and gives raw material for breeding better crops and animals.

Pakistan has rich biodiversity, from the high mountains of the north to the deserts of the south and the coast of the Arabian Sea. Markhor, snow leopard, Indus dolphin and juniper forests are examples of Pakistan's wildlife and habitats.

## Classification and the Five Kingdoms

Classification is the grouping of organisms on the basis of similarities and differences. The five-kingdom system divides living things into Monera (bacteria), Protista (Amoeba, Paramecium, Euglena), Fungi (mushrooms, yeast), Plantae (plants) and Animalia (animals). Viruses are not placed in any kingdom because they are acellular, having no cell of their own.

Bacteria are prokaryotes: their cells have no true nucleus. Protists are mostly unicellular eukaryotes. Fungi absorb food from dead or living matter. Plants make their own food by photosynthesis. Animals eat other organisms for food.

## Binomial Nomenclature

Each species is given a scientific name of two parts — the genus name and the species name — written in Latin or Latinised form, for example Homo sapiens for humans and Mangifera indica for mango. The genus name begins with a capital letter and the species name with a small letter; the whole name is written in italics or underlined. This system, given by Carolus Linnaeus, avoids confusion because common names differ from place to place.

## Threats to Biodiversity and Conservation

Biodiversity is threatened by deforestation, hunting, pollution, overgrazing, habitat loss and climate change. Conservation means protecting species and their habitats. In Pakistan, national parks such as Margalla Hills and Chitral Gol protect wildlife, and laws control hunting and the cutting of forests. Planting trees, protecting wetlands and breeding endangered animals in zoos also help conserve biodiversity.

# Chapter 3 — Biodiversity: Questions

## Short Questions

**Q1.** Define biodiversity.

**Answer:** Biodiversity is the variety of life on Earth, including the variety of genes, species and ecosystems.

**Q2.** Name the five kingdoms of living things.

**Answer:** The five kingdoms are Monera, Protista, Fungi, Plantae and Animalia.

**Q3.** Why are viruses not placed in any kingdom?

**Answer:** Viruses are acellular; they have no cell of their own and can only reproduce inside a living host cell, so they do not fit any kingdom.

**Q4.** Write the scientific name of humans.

**Answer:** The scientific name of humans is Homo sapiens.

**Q5.** What is deforestation?

**Answer:** Deforestation is the large-scale cutting down of forests, which destroys habitats and reduces biodiversity.

## Long Questions

**Q1.** Describe the five kingdoms of classification with one example of each.

**Answer:** The five kingdoms are: (1) Monera — prokaryotic unicellular organisms, e.g. bacteria; (2) Protista — mostly unicellular eukaryotes, e.g. Amoeba and Paramecium; (3) Fungi — organisms that absorb food from dead or living matter, e.g. mushroom and yeast; (4) Plantae — multicellular organisms that make food by photosynthesis, e.g. mango tree; (5) Animalia — multicellular organisms that eat other organisms, e.g. humans and fish. Viruses are not included because they are acellular.

**Q2.** Explain the causes of loss of biodiversity and how it can be conserved in Pakistan.

**Answer:** Biodiversity is lost through deforestation, hunting, overgrazing, pollution, habitat destruction and climate change. It can be conserved by creating national parks and wildlife sanctuaries, enforcing laws against hunting and tree cutting, planting trees, protecting wetlands, controlling pollution, and breeding endangered species in zoos. In Pakistan, parks such as Margalla Hills and Chitral Gol protect animals like the markhor and snow leopard.

## Multiple-Choice Questions

**Q1.** The variety of life on Earth is called:

a. Ecology
b. Biodiversity
c. Taxonomy
d. Evolution

**Q2.** Bacteria belong to the kingdom:

a. Protista
b. Fungi
c. Monera
d. Plantae

**Q3.** The scientific name of mango is:

a. Homo sapiens
b. Mangifera indica
c. Rosa indica
d. Canis familiaris

**Q4.** Which kingdom includes mushrooms?

a. Plantae
b. Fungi
c. Protista
d. Animalia

**Q5.** Amoeba belongs to the kingdom:

a. Monera
b. Protista
c. Fungi
d. Animalia

**Q6.** Binomial nomenclature was given by:

a. Darwin
b. Linnaeus
c. Mendel
d. Pasteur

**Q7.** In a scientific name, the genus begins with a:

a. Small letter
b. Capital letter
c. Number
d. Symbol

**Q8.** Which of these is a prokaryote?

a. Paramecium
b. Yeast
c. Bacterium
d. Euglena

**Q9.** The national animal of Pakistan is the:

a. Snow leopard
b. Markhor
c. Indus dolphin
d. Chinkara

**Q10.** The main cause of habitat loss is:

a. Deforestation
b. Rainfall
c. Photosynthesis
d. Migration

CHAPTER 4

# Cells and Tissues

## The Cell and Cell Theory

The cell is the basic structural and functional unit of life. The cell theory states that all living things are made of cells, the cell is the basic unit of life, and new cells come from pre-existing cells. Cells were first seen by Robert Hooke in 1665, when he looked at cork under a microscope and called the small compartments cells.

There are two main types of cells. Prokaryotic cells, such as bacteria, have no true nucleus and no membrane-bound organelles. Eukaryotic cells, such as plant and animal cells, have a true nucleus and membrane-bound organelles.

## Cell Organelles

Each organelle has a job. The nucleus controls the cell and holds the genetic material. Mitochondria release energy by respiration and are called the powerhouse of the cell. Ribosomes make proteins. The endoplasmic reticulum transports materials; the rough type has ribosomes and the smooth type makes lipids. The Golgi apparatus packs and sends out proteins. Lysosomes digest waste. Vacuoles store water and food; plant cells have one large vacuole. Plastids, including chloroplasts, are found in plant cells; chloroplasts trap sunlight for photosynthesis. The cell membrane controls what enters and leaves the cell, and the cell wall, found in plant cells, gives support and protection.

## Plant Cell and Animal Cell

Plant cells and animal cells are both eukaryotic, but they differ. Plant cells have a cell wall, chloroplasts and a large central vacuole, while animal cells do not. Animal cells have centrioles, which plant cells usually lack. Both have a nucleus, cytoplasm, mitochondria, ribosomes, endoplasmic reticulum and Golgi apparatus.

## Tissues

A tissue is a group of similar cells that work together for one function. In plants, meristematic tissue grows and divides, while permanent tissues such as parenchyma, collenchyma and sclerenchyma give support and store food. Xylem carries water and phloem carries food in plants. In animals, epithelial tissue covers surfaces, connective tissue joins parts, muscular tissue moves the body, and nervous tissue carries messages.

## Movement of Materials

Materials pass into and out of cells by diffusion, osmosis and active transport. Diffusion is the movement of molecules from high to low concentration. Osmosis is the movement of water through a partially permeable membrane from a dilute to a concentrated solution. Active transport uses energy to move substances against their concentration gradient.

# Chapter 4 — Cells and Tissues: Questions

## Short Questions

**Q1.** State the cell theory.

**Answer:** All living things are made of cells, the cell is the basic unit of life, and new cells arise from pre-existing cells.

**Q2.** Who first observed cells?

**Answer:** Robert Hooke first observed cells in cork in 1665.

**Q3.** What is the powerhouse of the cell?

**Answer:** The mitochondria are called the powerhouse of the cell because they release energy by respiration.

**Q4.** Define tissue.

**Answer:** A tissue is a group of similar cells that work together to perform a particular function.

**Q5.** What is osmosis?

**Answer:** Osmosis is the movement of water through a partially permeable membrane from a dilute solution to a concentrated solution.

## Long Questions

**Q1.** Describe the structure and functions of the main organelles of a eukaryotic cell.

**Answer:** The nucleus controls the cell and contains genetic material. Mitochondria release energy through respiration. Ribosomes synthesise proteins. The endoplasmic reticulum transports materials within the cell. The Golgi apparatus modifies, packs and secretes proteins. Lysosomes digest waste and old parts. Vacuoles store water and food. In plant cells, chloroplasts carry out photosynthesis and the cell wall gives support. The cell membrane controls the entry and exit of substances. Each organelle works with the others to keep the cell alive.

**Q2.** Compare a plant cell with an animal cell.

**Answer:** Both plant and animal cells are eukaryotic and contain a nucleus, cytoplasm, mitochondria, ribosomes, endoplasmic reticulum and Golgi apparatus. A plant cell has a cell wall, chloroplasts for photosynthesis and one large central vacuole, while an animal cell has none of these. An animal cell has centrioles, which are usually absent in plant cells. Plant cells are usually regular in shape because of the cell wall, while animal cells vary in shape.

## Multiple-Choice Questions

**Q1.** The cell theory was given by:

a. Hooke
b. Schleiden and Schwann
c. Darwin
d. Mendel

**Q2.** The powerhouse of the cell is the:

a. Nucleus
b. Ribosome
c. Mitochondrion
d. Golgi apparatus

**Q3.** Protein synthesis takes place in the:

a. Lysosome
b. Ribosome
c. Vacuole
d. Chloroplast

**Q4.** Which organelle is found only in plant cells?

a. Mitochondrion
b. Chloroplast
c. Nucleus
d. Ribosome

**Q5.** The cell wall is made of:

a. Chitin
b. Cellulose
c. Protein
d. Lipid

**Q6.** Osmosis is the movement of:

a. Salts
b. Water
c. Proteins
d. Glucose only

**Q7.** Xylem in plants carries:

a. Food
b. Water
c. Oxygen
d. Hormones

**Q8.** Nervous tissue is made of:

a. Neurons
b. Muscle fibres
c. Blood cells
d. Bone cells

**Q9.** The control centre of the cell is the:

a. Cytoplasm
b. Nucleus
c. Vacuole
d. Cell membrane

**Q10.** Which tissue covers the body surface in animals?

a. Muscular
b. Connective
c. Epithelial
d. Nervous

CHAPTER 5

# Cell Cycle

## The Cell Cycle

The cell cycle is the series of events by which a cell grows, copies its DNA and divides into two daughter cells. It has two main phases: interphase, when the cell grows and copies its DNA, and the mitotic phase, when the cell divides. Interphase has three sub-phases: G1 (growth), S (DNA synthesis) and G2 (preparation for division).

## Mitosis

Mitosis is the division of the nucleus that produces two genetically identical daughter cells. It has four stages. In prophase, chromosomes condense and the nuclear membrane disappears. In metaphase, chromosomes line up at the centre of the cell. In anaphase, sister chromatids separate and move to opposite poles. In telophase, new nuclear membranes form around the two sets of chromosomes. Then the cytoplasm divides (cytokinesis). Mitosis is needed for growth, repair and asexual reproduction.

## Meiosis

Meiosis is the division that produces four genetically different cells with half the number of chromosomes. It has two divisions, meiosis I and meiosis II. Meiosis produces gametes (sperm and egg) in animals and spores in plants. Crossing over during meiosis I exchanges parts between chromosomes and creates variation. A human body cell has 46 chromosomes, while a gamete has 23.

## Errors in the Cell Cycle

If the cell cycle is not controlled, cells may divide without stopping and form a tumour. Uncontrolled division is cancer. Some errors in meiosis produce gametes with the wrong number of chromosomes; for example, Down syndrome is caused by an extra chromosome 21. Apoptosis is programmed cell death, a controlled process that removes old or damaged cells.

# Chapter 5 — Cell Cycle: Questions

## Short Questions

**Q1.** Define the cell cycle.

**Answer:** The cell cycle is the series of events by which a cell grows, copies its DNA and divides into two daughter cells.

**Q2.** Name the three sub-phases of interphase.

**Answer:** The sub-phases of interphase are G1 (growth), S (DNA synthesis) and G2 (preparation for division).

**Q3.** What is mitosis?

**Answer:** Mitosis is nuclear division that produces two genetically identical daughter cells.

**Q4.** How many chromosomes are in a human body cell and in a gamete?

**Answer:** A human body cell has 46 chromosomes and a human gamete has 23 chromosomes.

**Q5.** What is apoptosis?

**Answer:** Apoptosis is programmed cell death, the controlled removal of old, damaged or unwanted cells.

## Long Questions

**Q1.** Describe the stages of mitosis and state its importance.

**Answer:** Mitosis has four stages: prophase, when chromosomes condense and the nuclear membrane breaks down; metaphase, when chromosomes line up at the cell equator; anaphase, when sister chromatids separate to opposite poles; and telophase, when new nuclear membranes form, followed by cytokinesis, the division of the cytoplasm. Mitosis produces two identical daughter cells and is important for growth, repair of damaged tissues and asexual reproduction.

**Q2.** Compare mitosis and meiosis.

**Answer:** Mitosis produces two genetically identical diploid daughter cells in one division and is used for growth and repair. Meiosis produces four genetically different haploid cells in two divisions and is used to make gametes. Crossing over occurs in meiosis and creates variation, while mitosis keeps the chromosome number the same. Errors in meiosis can cause disorders such as Down syndrome, while uncontrolled mitosis can lead to cancer.

## Multiple-Choice Questions

**Q1.** DNA is copied during the:

a. G1 phase
b. S phase
c. G2 phase
d. Anaphase

**Q2.** Chromosomes line up at the equator in:

a. Prophase
b. Metaphase
c. Anaphase
d. Telophase

**Q3.** Mitosis produces:

a. Two identical cells
b. Four different cells
c. One gamete
d. Eight cells

**Q4.** Meiosis produces gametes with:

a. Double chromosomes
b. Half the chromosomes
c. No chromosomes
d. Same chromosomes

**Q5.** Crossing over takes place in:

a. Mitosis
b. Meiosis I
c. Cytokinesis
d. Interphase

**Q6.** A human gamete has how many chromosomes?

a. 46
b. 44
c. 23
d. 22

**Q7.** Uncontrolled cell division causes:

a. Diabetes
b. Cancer
c. Anaemia
d. Malaria

**Q8.** The division of the cytoplasm is called:

a. Mitosis
b. Meiosis
c. Cytokinesis
d. Apoptosis

**Q9.** Down syndrome is caused by an extra chromosome:

a. 21
b. 18
c. 13
d. X

**Q10.** Programmed cell death is called:

a. Necrosis
b. Apoptosis
c. Mitosis
d. Mutation

CHAPTER 6

# Enzymes

## What are Enzymes?

Enzymes are biological catalysts made of proteins. They speed up chemical reactions in living things without being used up themselves. Without enzymes, most reactions in the body would be too slow to keep us alive. Each enzyme works on a particular substance, called its substrate, and produces products. For example, amylase breaks down starch, and lipase breaks down fats.

## How Enzymes Work

An enzyme has an active site, a special shape into which the substrate fits. In the lock-and-key model, the substrate fits the active site exactly, like a key fits a lock. In the induced-fit model, the active site changes its shape slightly to fit the substrate. After the reaction, the products leave and the enzyme is free to work again.

## Factors Affecting Enzyme Activity

Temperature affects enzymes: they work best at an optimum temperature (about 37°C in the human body). At low temperatures they work slowly, and at high temperatures they are denatured — their shape is destroyed and they stop working. Each enzyme also has an optimum pH; for example, pepsin in the stomach works best at pH 2, while most enzymes work best near pH 7. The rate of reaction also rises with more substrate until all the active sites are full, and more enzyme increases the rate if substrate is available.

## Uses of Enzymes

Enzymes are used in industry and medicine. In washing powders, enzymes remove stains; in food making, they help produce cheese, bread and juices; in medicine, enzymes are used in tests and in treating some diseases. Enzymes from microorganisms are used in biotechnology.

# Chapter 6 — Enzymes: Questions

## Short Questions

**Q1.** Define enzyme.

**Answer:** An enzyme is a biological catalyst, usually a protein, that speeds up a chemical reaction without being used up.

**Q2.** What is a substrate?

**Answer:** A substrate is the substance on which an enzyme acts.

**Q3.** What is the active site?

**Answer:** The active site is the part of an enzyme into which the substrate fits during a reaction.

**Q4.** What is denaturation?

**Answer:** Denaturation is the loss of an enzyme's shape and function, usually caused by high temperature or extreme pH.

**Q5.** At what pH does pepsin work best?

**Answer:** Pepsin works best at pH 2, the acidic pH of the stomach.

## Long Questions

**Q1.** Explain the lock-and-key and induced-fit models of enzyme action.

**Answer:** In the lock-and-key model, the substrate fits exactly into the active site of the enzyme, like a key fits a lock, and the enzyme then breaks the substrate into products or joins substrates together. In the induced-fit model, the active site is flexible and changes its shape slightly when the substrate enters, so that the fit becomes exact. In both models, after the reaction the products are released and the enzyme remains unchanged and can be used again. The exact fit explains why each enzyme is specific for one substrate.

**Q2.** Describe how temperature and pH affect enzyme activity.

**Answer:** Enzymes work best at an optimum temperature, about 37°C in the human body. Below the optimum, the reaction is slow because molecules move slowly; above the optimum, the enzyme is denatured as heat breaks the bonds that hold its shape, and activity falls to zero. Each enzyme also has an optimum pH: most work best near pH 7, but pepsin works best at pH 2 in the stomach. Away from the optimum pH, the enzyme's shape changes and its activity falls.

## Multiple-Choice Questions

**Q1.** Enzymes are made of:

a. Lipids
b. Proteins
c. Carbohydrates
d. Nucleic acids

**Q2.** The substance an enzyme acts on is the:

a. Product
b. Substrate
c. Catalyst
d. Inhibitor

**Q3.** Amylase breaks down:

a. Fats
b. Proteins
c. Starch
d. Vitamins

**Q4.** The lock-and-key model was proposed by:

a. Fischer
b. Darwin
c. Mendel
d. Watson

**Q5.** Human enzymes work best at about:

a. 20°C
b. 37°C
c. 50°C
d. 0°C

**Q6.** Pepsin works best at pH:

a. 2
b. 7
c. 9
d. 12

**Q7.** High temperature causes enzymes to become:

a. Activated
b. Denatured
c. Dissolved
d. Frozen

**Q8.** Lipase breaks down:

a. Starch
b. Proteins
c. Fats
d. Sugars

**Q9.** After a reaction, an enzyme is:

a. Used up
b. Changed
c. Unchanged
d. Destroyed

**Q10.** Enzymes in washing powder help to:

a. Whiten clothes
b. Remove stains
c. Soften water
d. Add colour

CHAPTER 7

# Bio-Energetics

## Energy and Metabolism

Bio-energetics is the study of how living things obtain and use energy. Metabolism is the sum of all chemical reactions in the body. Anabolism builds large molecules from small ones and uses energy; catabolism breaks large molecules into small ones and releases energy. ATP (adenosine triphosphate) is the energy currency of the cell: energy released from food is stored in ATP and used when needed.

## Photosynthesis

Photosynthesis is the process by which green plants make food (glucose) from carbon dioxide and water using sunlight and chlorophyll. It takes place in chloroplasts, mainly in the leaves. The equation is: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ (in sunlight and chlorophyll). Oxygen is released as a by-product. Factors that affect the rate of photosynthesis are light intensity, carbon dioxide concentration and temperature.

## Respiration

Respiration is the process that releases energy from glucose. Aerobic respiration uses oxygen and takes place in mitochondria: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy. It releases much energy (about 38 ATP per glucose). Anaerobic respiration takes place without oxygen and releases little energy; in yeast it produces ethanol and carbon dioxide, and in muscle cells it produces lactic acid, which causes tiredness.

## Photosynthesis and Respiration Compared

Photosynthesis stores energy in glucose and uses carbon dioxide and water, while respiration releases energy from glucose and uses oxygen. Photosynthesis takes place only in green plants in light, while respiration takes place in all living cells all the time. The two processes balance each other in nature: photosynthesis produces the oxygen and food that respiration uses, and respiration produces the carbon dioxide that photosynthesis needs.

# Chapter 7 — Bio-Energetics: Questions

## Short Questions

**Q1.** Define metabolism.

**Answer:** Metabolism is the sum of all chemical reactions that take place in a living organism.

**Q2.** What is ATP?

**Answer:** ATP (adenosine triphosphate) is the energy currency of the cell; it stores and supplies energy for cell activities.

**Q3.** Write the equation for photosynthesis.

**Answer:** $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$, in the presence of sunlight and chlorophyll.

**Q4.** Where does aerobic respiration take place?

**Answer:** Aerobic respiration takes place in the mitochondria of the cell.

**Q5.** What is anaerobic respiration in yeast?

**Answer:** Anaerobic respiration in yeast breaks down glucose without oxygen to produce ethanol, carbon dioxide and a small amount of energy.

## Long Questions

**Q1.** Describe the process of photosynthesis and the factors that affect its rate.

**Answer:** Photosynthesis is the process by which green plants make glucose from carbon dioxide and water using sunlight trapped by chlorophyll in chloroplasts. The equation is $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$. Its rate is affected by light intensity (more light increases the rate up to a point), carbon dioxide concentration (more carbon dioxide increases the rate), and temperature (the rate rises to an optimum and then falls as enzymes are denatured). Water shortage also reduces photosynthesis because stomata close.

**Q2.** Compare aerobic and anaerobic respiration.

**Answer:** Aerobic respiration uses oxygen, takes place in mitochondria, breaks glucose completely into carbon dioxide and water, and releases a large amount of energy (about 38 ATP per glucose molecule). Anaerobic respiration takes place without oxygen, in the cytoplasm, breaks glucose only partly, and releases little energy: in yeast it forms ethanol and carbon dioxide, and in muscle cells it forms lactic acid, which causes fatigue. Aerobic respiration is more efficient and is used by most organisms most of the time.

## Multiple-Choice Questions

**Q1.** The energy currency of the cell is:

a. ADP
b. ATP
c. DNA
d. NAD

**Q2.** Photosynthesis takes place in the:

a. Mitochondrion
b. Nucleus
c. Chloroplast
d. Ribosome

**Q3.** The raw materials of photosynthesis are:

a. Glucose and oxygen
b. Carbon dioxide and water
c. Oxygen and water
d. Glucose and water

**Q4.** Aerobic respiration releases about how many ATP per glucose?

a. 2
b. 8
c. 38
d. 100

**Q5.** Anaerobic respiration in muscle cells produces:

a. Ethanol
b. Lactic acid
c. Oxygen
d. Glucose

**Q6.** Which pigment traps sunlight?

a. Haemoglobin
b. Chlorophyll
c. Melanin
d. Carotene

**Q7.** Respiration takes place in:

a. Only plants
b. Only animals
c. All living cells
d. Only leaves

**Q8.** Anabolism is the building of:

a. Small molecules from large ones
b. Large molecules from small ones
c. Energy from glucose
d. ATP from ADP

**Q9.** Oxygen is released during photosynthesis as a:

a. Reactant
b. By-product
c. Catalyst
d. Enzyme

**Q10.** The site of the light reactions of photosynthesis is the:

a. Stroma
b. Thylakoid
c. Cytoplasm
d. Vacuole

CHAPTER 8

# Nutrition

## Nutrition in Plants

Plants are autotrophs: they make their own food by photosynthesis. They also need minerals from the soil. Nitrogen is needed for proteins and chlorophyll, phosphorus for roots and flowers, and potassium for disease resistance. Plants absorb water and minerals through their roots. A lack of minerals causes deficiency symptoms, such as yellow leaves when nitrogen is missing.

## Nutrition in Humans

Humans are heterotrophs: they eat other organisms for food. Food contains nutrients: carbohydrates and fats give energy, proteins build and repair the body, vitamins and minerals protect health, and water and fibre are also needed. A balanced diet contains all nutrients in the right amounts. Deficiency diseases include scurvy (lack of vitamin C), rickets (lack of vitamin D), night blindness (lack of vitamin A) and anaemia (lack of iron).

## Human Digestive System

Digestion breaks food into small soluble molecules that the blood can absorb. In the mouth, teeth chew food and saliva begins starch digestion. In the stomach, acid and the enzyme pepsin digest proteins. In the small intestine, bile from the liver and enzymes from the pancreas complete digestion, and food is absorbed through villi into the blood. The large intestine absorbs water, and undigested food is removed as faeces. Villi are finger-like folds in the small intestine that increase the surface area for absorption.

## Disorders of the Digestive System

Common digestive problems include constipation (hard faeces from lack of fibre and water), diarrhoea (watery faeces, often from infection), ulcers (sores in the stomach lining, often linked with the bacterium Helicobacter pylori) and food poisoning from contaminated food. Eating a balanced diet with fibre, drinking clean water and washing hands help prevent these problems.

# Chapter 8 — Nutrition: Questions

## Short Questions

**Q1.** What is an autotroph?

**Answer:** An autotroph is an organism that makes its own food, such as a green plant by photosynthesis.

**Q2.** Name the nutrient that builds and repairs the body.

**Answer:** Proteins build and repair the body.

**Q3.** Which vitamin deficiency causes scurvy?

**Answer:** Lack of vitamin C causes scurvy.

**Q4.** What is the function of villi?

**Answer:** Villi are finger-like folds in the small intestine that increase the surface area for the absorption of digested food into the blood.

**Q5.** Where is bile made?

**Answer:** Bile is made in the liver and stored in the gall bladder.

## Long Questions

**Q1.** Describe the process of digestion in the human alimentary canal.

**Answer:** Digestion begins in the mouth, where teeth chew food and saliva starts starch digestion. Food passes down the oesophagus to the stomach, where hydrochloric acid kills germs and pepsin begins protein digestion. In the small intestine, bile emulsifies fats and pancreatic enzymes complete digestion. Digested food is absorbed through the villi into the blood. The large intestine absorbs water and salts, and the remaining undigested food is removed from the body as faeces.

**Q2.** Explain the importance of a balanced diet and the deficiency diseases caused by lack of vitamins and minerals.

**Answer:** A balanced diet provides carbohydrates and fats for energy, proteins for growth and repair, vitamins and minerals for protection, and water and fibre for health. Lack of vitamin A causes night blindness, lack of vitamin C causes scurvy, lack of vitamin D causes rickets, and lack of iron causes anaemia. Eating a variety of foods — cereals, vegetables, fruits, milk, meat and pulses — in the right amounts prevents these deficiency diseases.

## Multiple-Choice Questions

**Q1.** Plants are:

a. Heterotrophs
b. Autotrophs
c. Parasites
d. Saprophytes

**Q2.** Which mineral is needed for making chlorophyll?

a. Calcium
b. Nitrogen
c. Iron
d. Sodium

**Q3.** Scurvy is caused by lack of vitamin:

a. A
b. B
c. C
d. D

**Q4.** Protein digestion begins in the:

a. Mouth
b. Stomach
c. Small intestine
d. Large intestine

**Q5.** Villi are found in the:

a. Stomach
b. Oesophagus
c. Small intestine
d. Large intestine

**Q6.** Bile is produced by the:

a. Pancreas
b. Liver
c. Stomach
d. Gall bladder

**Q7.** Night blindness is caused by lack of vitamin:

a. A
b. C
c. D
d. B

**Q8.** Anaemia is caused by lack of:

a. Calcium
b. Iron
c. Iodine
d. Zinc

**Q9.** Water is absorbed mainly in the:

a. Stomach
b. Small intestine
c. Large intestine
d. Mouth

**Q10.** The enzyme pepsin digests:

a. Starch
b. Fats
c. Proteins
d. Sugars

CHAPTER 9

# Transport

## Transport in Plants

Plants transport water and food through vascular tissues. Xylem vessels carry water and minerals from the roots to the leaves. The water rises by transpiration pull: water evaporates from leaves through stomata, pulling more water up. Phloem carries food (mainly sucrose) from the leaves to all parts of the plant; this is called translocation. Root hairs increase the surface area for absorbing water from the soil.

Transpiration is the loss of water vapour from the aerial parts of a plant, mainly through stomata. It cools the plant and helps pull water up, but too much transpiration can wilt the plant. Plants reduce water loss by closing stomata, having a waxy cuticle, and shedding leaves in dry seasons.

## Transport in Humans: Blood

Blood is the transport medium of the human body. It has four parts: plasma (the liquid part, carrying dissolved substances), red blood cells (carrying oxygen with haemoglobin), white blood cells (fighting germs) and platelets (helping blood to clot). Blood carries oxygen, food, hormones and waste products, and it also controls body temperature and fights disease.

## The Human Heart and Circulation

The heart is a muscular organ that pumps blood around the body. It has four chambers: two atria and two ventricles. The right side pumps blood to the lungs to collect oxygen, and the left side pumps oxygenated blood to the body. This is called double circulation. Arteries carry blood away from the heart, veins carry blood back to the heart, and capillaries are thin vessels where exchange of materials takes place. The heartbeat is the pumping of the heart, and blood pressure is the force of blood against artery walls.

## Blood Groups and Disorders

Human blood groups are A, B, AB and O. Group O is the universal donor and group AB is the universal recipient. Blood pressure that is too high is called hypertension. Anaemia is a shortage of red blood cells or haemoglobin. A heart attack happens when blood flow to part of the heart muscle is blocked, often by a clot in a coronary artery. Eating a balanced diet, exercising and avoiding smoking keep the heart healthy.

# Chapter 9 — Transport: Questions

## Short Questions

**Q1.** What is transpiration?

**Answer:** Transpiration is the loss of water vapour from the aerial parts of a plant, mainly through the stomata of leaves.

**Q2.** Which tissue carries water in plants?

**Answer:** Xylem carries water and dissolved minerals from the roots to the leaves.

**Q3.** Name the four parts of blood.

**Answer:** Blood consists of plasma, red blood cells, white blood cells and platelets.

**Q4.** How many chambers does the human heart have?

**Answer:** The human heart has four chambers: two atria and two ventricles.

**Q5.** What is the universal donor blood group?

**Answer:** Blood group O is the universal donor because it can be given to people of any blood group.

## Long Questions

**Q1.** Describe how water is absorbed and transported to the leaves in a plant.

**Answer:** Water is absorbed from the soil by root hairs, which increase the surface area of the roots. Water moves into the root by osmosis and then into the xylem vessels. It rises to the leaves by transpiration pull: water evaporates from the leaves through stomata, creating a pull that draws water up the xylem. Cohesion between water molecules and adhesion to the vessel walls help the water column rise. Minerals dissolved in the water are carried with it to the leaves.

**Q2.** Describe the structure of the human heart and explain double circulation.

**Answer:** The heart has four chambers: the right atrium and right ventricle, and the left atrium and left ventricle. The right side pumps deoxygenated blood to the lungs, where it collects oxygen and releases carbon dioxide; this is the pulmonary circulation. The left side pumps oxygenated blood to the whole body, where oxygen and food are delivered and wastes are collected; this is the systemic circulation. Blood passes through the heart twice in one complete circuit, which is why it is called double circulation. Arteries carry blood away from the heart, veins return it, and capillaries allow exchange with tissues.

## Multiple-Choice Questions

**Q1.** Water is carried in plants by the:

a. Phloem
b. Xylem
c. Cambium
d. Epidermis

**Q2.** Food is carried in plants by the:

a. Xylem
b. Phloem
c. Pith
d. Cortex

**Q3.** Transpiration takes place mainly through the:

a. Roots
b. Stomata
c. Flowers
d. Stem

**Q4.** Red blood cells carry oxygen with the help of:

a. Plasma
b. Haemoglobin
c. Platelets
d. Fibrin

**Q5.** The universal recipient blood group is:

a. O
b. A
c. B
d. AB

**Q6.** Arteries carry blood:

a. To the heart
b. Away from the heart
c. To the lungs only
d. To the liver only

**Q7.** Blood clotting is helped by:

a. Red cells
b. White cells
c. Platelets
d. Plasma

**Q8.** The liquid part of blood is called:

a. Serum
b. Plasma
c. Lymph
d. Haemoglobin

**Q9.** A heart attack is caused by blockage of a:

a. Pulmonary artery
b. Coronary artery
c. Renal artery
d. Carotid artery

**Q10.** Capillaries are the vessels where:

a. Blood is made
b. Exchange of materials takes place
c. Blood pressure is highest
d. Blood is stored

# MCQ Answer Key

## Chapter 1 — Introduction to Biology

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

## Chapter 2 — Solving a Biological Problem

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

## Chapter 3 — Biodiversity

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

## Chapter 4 — Cells and Tissues

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

## Chapter 5 — Cell Cycle

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

## Chapter 6 — Enzymes

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

## Chapter 7 — Bio-Energetics

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

## Chapter 8 — Nutrition

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

## Chapter 9 — Transport

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

End of book. Good luck with your studies.