9th Class Biology Notes
Sindh Board
Full Book Notes

Complete chapter-wise study notes with original practice questions for Class 9 Biology, Sindh Textbook Board (STBB), Jamshoro — for students of all Sindh boards: Karachi, Hyderabad, Sukkur, Larkana and Mirpurkhas.

About these notes

These notes follow the chapters of the Sindh Textbook Board Biology book for Class 9 (the revised nine-chapter book). The nine chapters covered, in order, are:

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

About the paper: The Class 9 Biology paper in Sindh is a theory paper of 60 marks, with a practical-based assessment (PBA) of 15 marks — 75 marks in total — as set out in the Ziauddin University Examination Board (ZUEB) Examination Syllabus for Biology Grade IX, based on the Provincial Revised Curriculum (Sindh). In that scheme Section A is 12 MCQs (12 marks), Section B is short answers — attempt any 8 of 12, 3 marks each (24 marks) — and Section C is detailed answers — attempt any 4 of 6, 6 marks each (24 marks). **Note:** some third-party reproductions of other Sindh boards' model papers give a different split of the 60 theory marks (12 + 30 + 18). The total of 60 theory marks is agreed in all sources; check your own board's current model paper before the examination.

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Contents

1. Introduction to Biology
2. Solving a Biological Problem
3. Biodiversity
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5. The Cell Cycle
6. The Enzymes
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9. Transport

How to use this book

- Read the study notes of one chapter, then answer its short and long questions in your own words before looking at the answers.
- Attempt the 10 MCQs of each chapter without looking at the answer key, then check your score and re-read the notes for any question you missed.
- Learn the definitions and key terms of each chapter, and practise drawing and labelling the diagrams your teacher asks for.

Key terms to remember

Chapter	Key terms
Introduction to Biology	Biology, botany, zoology, microbiology, taxonomy
Solving a Biological Problem	Hypothesis, observation, deduction, experiment
Biodiversity	Biodiversity, species, genus, binomial naming
Cells and Tissues	Cell theory, prokaryotic, eukaryotic, osmosis
The Cell Cycle	Interphase, mitosis, meiosis, crossing over
The Enzymes	Enzyme, substrate, active site, denaturation
Bioenergetics	ATP, photosynthesis, Calvin cycle, glycolysis
Nutrition	Autotroph, heterotroph, amylase, pepsin, bile
Transport	Atrium, ventricle, artery, vein, capillary

CHAPTER 1

Introduction to Biology

Study notes

What is biology? Biology is the branch of natural science that deals with the study of living beings — their structure, functions, growth, origin, evolution and distribution. The word comes from two Greek words: *bios* (life) and *logos* (study). A living being shows movement, respiration, feeding, growth, excretion, reproduction, irritability and metabolism.

Major divisions. Biology is traditionally divided into three large divisions: **Botany** (study of plants), **Zoology** (study of animals) and **Microbiology** (study of micro-organisms that cannot be seen with the naked eye).

Main branches. Morphology is the study of form and structure; anatomy is the study of internal structure; physiology is the study of functions and processes; embryology is the study of development of the embryo; taxonomy is the study of classification and naming; cell biology studies the cell; histology studies tissues; palaeontology studies fossils; environmental biology studies the relation of organisms with their environment; genetics studies heredity; immunology studies defence against disease; and biotechnology uses living organisms to make useful products.

Biology and other sciences. Biology is linked with physics (biophysics, e.g. the working of the eye and the lever action of bones), chemistry (biochemistry, e.g. digestion and photosynthesis), mathematics (counting, measuring and analysing biological data), geography (distribution of plants and animals) and economics (fisheries, agriculture and forestry).

Careers in biology. The study of biology leads to medicine and surgery, fisheries, agriculture, animal husbandry, biotechnology, horticulture, farming and forestry.

Levels of organisation. Life is organised in steps: bioelements (such as carbon, hydrogen, oxygen and nitrogen) join to form compounds and macromolecules (proteins, carbohydrates, lipids and nucleic acids); these form organelles; organelles form cells; cells form tissues; tissues form organs; and organs form organ systems in a complete organism.

Cellular organisation. In a unicellular organism such as *Amoeba*, one cell carries out all life processes. In a colonial organism such as *Volvox*, many similar cells live together. In a multicellular organism such as mustard or a frog, cells are specialised for different jobs.

Muslim scientists. Jabir bin Hayan worked on experimental methods; Abdul Malik Asmai wrote on plants and animals; and Bu Ali Sina (Avicenna) wrote a great medical work that guided medicine for centuries. The Holy Quran repeatedly invites human beings to observe the origin and characteristics of life.

Five groups of life. Living organisms are broadly placed in five groups: prokaryotes (bacteria, without a true nucleus), protists (mostly single-celled eukaryotes), fungi, plants and animals.

CHAPTER 1 — INTRODUCTION TO BIOLOGY

Short questions with answers

Q1. Define biology and name its three major divisions.

Answer: Biology is the study of living beings — their structure, functions, growth, origin and evolution. Its three major divisions are botany (plants), zoology (animals) and microbiology (micro-organisms).

Q2. What is the difference between morphology and anatomy?

Answer: Morphology is the study of the external form and structure of organisms, while anatomy is the study of their internal structure.

Q3. How is biology related to chemistry?

Answer: Chemistry explains the chemical processes of life. Digestion, respiration and photosynthesis are all chemical changes, so biochemistry links the two sciences.

Q4. Name four careers that the study of biology can lead to.

Answer: Medicine and surgery, fisheries, agriculture and forestry (also animal husbandry, biotechnology, horticulture and farming).

Q5. What are bioelements? Give two examples.

Answer: Bioelements are the chemical elements that make up living matter. Carbon, hydrogen, oxygen and nitrogen are the main bioelements.

Long questions with answers

Q1. Describe the levels of biological organisation from bioelements to organ systems, with an example at each level.

Answer: Life is built up step by step. Bioelements such as carbon, hydrogen, oxygen and nitrogen combine into compounds and then into macromolecules such as proteins and carbohydrates. Macromolecules are organised into organelles, for example the nucleus and mitochondria. Organelles work together inside a cell, the basic unit of life. Similar cells form a tissue, such as muscle tissue. Different tissues form an organ, such as the heart. Different organs work together as an organ system, such as the digestive system, and all the systems together make a complete organism.

Q2. Compare unicellular, colonial and multicellular organisation, giving one example of each.

Answer: In unicellular organisation a single cell performs every life process, as in Amoeba. In colonial organisation many similar cells live together as a colony, as in Volvox, but the cells are not highly specialised into tissues and organs. In multicellular organisation many cells are specialised for different jobs and are organised into tissues, organs and organ systems, as in a mustard plant or a frog. Multicellular organisation allows larger size, division of labour and greater complexity, while a unicellular organism depends entirely on one cell.

CHAPTER 1 — INTRODUCTION TO BIOLOGY

Multiple-choice questions

Choose the one correct answer for each question. The answer key is at the end of this page.

Q1. The study of living beings is called
(A) Botany (B) Biology (C) Zoology (D) Geology

Q2. The branch of biology that deals with plants is
(A) Zoology (B) Microbiology (C) Botany (D) Ecology

Q3. The study of the internal structure of organisms is
(A) Morphology (B) Anatomy (C) Physiology (D) Taxonomy

Q4. The study of classification and naming of organisms is called
(A) Genetics (B) Taxonomy (C) Histology (D) Embryology

Q5. Which of these is a bioelement?
(A) Iron (B) Carbon (C) Sodium (D) Calcium

Q6. Amoeba is an example of
(A) Multicellular organisation (B) Colonial organisation (C) Unicellular organisation (D) Tissue organisation

Q7. Volvox shows which type of organisation?
(A) Unicellular (B) Colonial (C) Multicellular (D) Organ level

Q8. Bu Ali Sina is famous for his work in
(A) Astronomy (B) Medicine (C) Mathematics (D) Geology

Q9. The basic unit of life is the
(A) Tissue (B) Organ (C) Organelle (D) Cell

Q10. The study of fossils is called
(A) Palaeontology (B) Immunology (C) Parasitology (D) Entomology

Answer key

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

CHAPTER 2

Solving a Biological Problem

Study notes

What is a biological problem? A biological problem is a question about living things that can be answered by observation and experiment. Science does not answer every question; it answers questions that can be tested with evidence.

Steps of the biological method. (1) Recognition of the biological problem — noticing something that needs explanation. (2) Observation — carefully watching and recording facts. (3) Hypothesis — a possible explanation that can be tested. A good hypothesis is testable and is stated clearly. (4) Deductions — working out what should happen if the hypothesis is true. (5) Experiments — testing the deductions under controlled conditions. (6) Results and inference — drawing a conclusion: the hypothesis is supported, modified or rejected.

The malaria example. Malaria was a serious disease whose cause was unknown. Careful observation showed that malaria was common where mosquitoes were common. Scientists formed the hypothesis that mosquitoes spread malaria. Experiments showed that the malarial parasite passes from a sick person to a healthy person through the bite of a female *Anopheles* mosquito. The hypothesis was supported and became accepted knowledge.

Controlled experiments. In a good experiment only one factor is changed at a time. The experimental group receives the treatment being tested and the control group does not, so the effect of that one factor can be seen clearly. The experiment must be repeatable by other workers.

Ratio and proportion. Biological problems often need counting and comparison. Ratio and proportion are used to compare quantities, for example the ratio of male to female plants, or the proportion of offspring showing a character. Mathematics is therefore an integral part of the scientific process.

Data analysis. Collected data must be organised in tables and graphs and analysed carefully. Analysis tells us whether the results confirm, modify or reject the hypothesis. A single experiment is rarely enough; results must be checked again.

Scientific attitude. A scientist observes honestly, records facts exactly, keeps an open mind and accepts a conclusion only when the evidence supports it. A hypothesis that fails is not a waste — it guides the next question.

CHAPTER 2 — SOLVING A BIOLOGICAL PROBLEM

Short questions with answers

Q1. What is a hypothesis?

Answer: A hypothesis is a possible, testable explanation of an observed problem. It is stated clearly so that experiments can support, modify or reject it.

Q2. List the steps of the biological method in order.

Answer: Recognition of the problem, observation, hypothesis, deductions, experiments, and results with inference (conclusion).

Q3. Why is a control group used in an experiment?

Answer: A control group does not receive the treatment being tested, so the effect of the single factor under study can be seen by comparison with the experimental group.

Q4. How did observation help in solving the problem of malaria?

Answer: Observation showed malaria was common where mosquitoes were common, which suggested mosquitoes might spread the disease and led to a testable hypothesis.

Q5. Why is mathematics important in biology?

Answer: Mathematics is used to count, measure, calculate ratios and proportions, and analyse data, so results can be compared and conclusions can be checked.

Long questions with answers

Q1. Describe the biological method, using malaria as an example.

Answer: The biological method begins with recognition of a problem — in this case, what causes malaria? Observation showed malaria was common in areas with many mosquitoes. A hypothesis was formed: mosquitoes spread malaria. From this, deductions were made: if mosquitoes spread malaria, people protected from mosquito bites should not fall ill, and the parasite should be found in mosquitoes. Experiments tested these deductions, and the malarial parasite was found in the female Anopheles mosquito and shown to pass to healthy people through its bite. The results supported the hypothesis, which became accepted knowledge. If the results had disagreed, the hypothesis would have been modified or rejected.

Q2. Explain the importance of data analysis in confirming, modifying or rejecting a hypothesis.

Answer: Data collected in an experiment must be organised, often in tables and graphs, and analysed before any conclusion is drawn. If the data agree with the deductions drawn from a hypothesis, the hypothesis is confirmed and supported. If the data agree only partly, the hypothesis is modified and tested again. If the data disagree, the hypothesis is rejected and a new one is formed. Without careful analysis, a scientist might accept a wrong idea or reject a correct one. Ratio and proportion help in this analysis by allowing fair comparison of quantities, and repeat experiments check that the result is reliable.

CHAPTER 2 — SOLVING A BIOLOGICAL PROBLEM

Multiple-choice questions

Choose the one correct answer for each question. The answer key is at the end of this page.

Q1. The first step of the biological method is
(A) Hypothesis (B) Experiment (C) Recognition of the problem (D) Conclusion

Q2. A testable possible explanation is called a
(A) Theory (B) Law (C) Hypothesis (D) Deduction

Q3. In the malaria study, the mosquito found to spread the disease was
(A) Male Culex (B) Female Anopheles (C) Male Anopheles (D) Female Culex

Q4. The group that does not receive the treatment in an experiment is the
(A) Experimental group (B) Control group (C) Test group (D) Sample group

Q5. A good hypothesis must be
(A) Vague (B) Untestable (C) Testable (D) Based on belief only

Q6. Deductions are made
(A) After the conclusion (B) From the hypothesis (C) Before observation (D) Without any data

Q7. If experimental results disagree with the hypothesis, the hypothesis should be
(A) Accepted anyway (B) Rejected or modified (C) Hidden (D) Repeated without change

Q8. Ratio and proportion in biology are used to
(A) Avoid experiments (B) Compare quantities (C) Replace observation (D) Prove a law

Q9. The final step of the biological method is
(A) Observation (B) Inference and conclusion (C) Hypothesis (D) Deduction

Q10. Science answers questions that
(A) Cannot be tested (B) Can be tested with evidence (C) Are based on opinion (D) Need no observation

Answer key

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

CHAPTER 3

Biodiversity

Study notes

What is biodiversity? Biodiversity is the variety of life on Earth — the variety of genes, species and ecosystems. It includes the variety within a species, the variety of species in an area, and the variety of habitats such as forests, deserts, rivers and seas.

Levels of biodiversity. Genetic diversity is the variety of genes within a species. Species diversity is the variety of different species in a habitat. Ecosystem diversity is the variety of different habitats and ecological communities in a region.

Classification. To study millions of kinds of organisms, biologists classify them into groups. The main ranks are kingdom, phylum (division in plants), class, order, family, genus and species. A species is a group of organisms that can interbreed and produce fertile offspring.

Five-kingdom classification. Living things are commonly placed in five kingdoms: Monera (prokaryotes, such as bacteria), Protista (mostly single-celled eukaryotes), Fungi, Plantae (plants) and Animalia (animals). This system is based on cell structure, body organisation and mode of nutrition.

Binomial nomenclature. Each species is given a scientific name of two parts: the genus name first, with a capital letter, and the species name second, in small letters. The name is written in italics (or underlined when handwritten), for example *Homo sapiens* for human beings.

Importance of biodiversity. Biodiversity gives food, medicine, timber, fibre and other raw materials. It keeps ecosystems stable, helps pollination and soil formation, and gives genetic resources for improving crops and livestock. Many medicines come from plants and other organisms.

Threats and conservation. Biodiversity is threatened by habitat destruction, over-hunting, pollution and climate change. Conservation means protecting habitats and species, for example by national parks and wildlife sanctuaries, by laws against hunting, and by breeding programmes. Every species has value, and the loss of one can disturb the whole ecosystem.

CHAPTER 3 — BIODIVERSITY

Short questions with answers

Q1. Define biodiversity.

Answer: Biodiversity is the variety of life on Earth — the variety of genes within species, of species in an area, and of ecosystems and habitats.

Q2. Name the three levels of biodiversity.

Answer: Genetic diversity, species diversity and ecosystem diversity.

Q3. What is a species?

Answer: A species is a group of organisms that can interbreed under natural conditions and produce fertile offspring.

Q4. Name the five kingdoms of living things.

Answer: Monera, Protista, Fungi, Plantae and Animalia.

Q5. What is binomial nomenclature? Give one example.

Answer: It is the system of giving each species a two-part scientific name — genus first, species second — for example Homo sapiens for human beings.

Long questions with answers

Q1. Describe the five-kingdom classification and the basis on which it is made.

Answer: The five-kingdom system places organisms in Monera, Protista, Fungi, Plantae and Animalia. Monera contains prokaryotes such as bacteria, which have no true nucleus. Protista contains mostly single-celled eukaryotes such as Amoeba and Paramecium. Fungi are eukaryotes that absorb food from dead or living matter and have cell walls of chitin. Plantae are multicellular eukaryotes that make food by photosynthesis and have cell walls of cellulose. Animalia are multicellular eukaryotes that feed by ingestion and have no cell walls. The system is based on cell structure (prokaryotic or eukaryotic), body organisation (unicellular or multicellular) and mode of nutrition (photosynthesis, absorption or ingestion).

Q2. Why is biodiversity important, and what threatens it? How can it be conserved?

Answer: Biodiversity is important because it provides food, medicine, timber, fibre and genetic material for improving crops and animals, and it keeps ecosystems stable through pollination, soil formation and natural balance. It is threatened by destruction of habitats, over-hunting and over-fishing, pollution and climate change. Conservation means protecting habitats through national parks and sanctuaries, enforcing laws against illegal hunting, reducing pollution, and running breeding programmes for endangered species. Protecting biodiversity protects the resources and the stable environment on which human life depends.

CHAPTER 3 — BIODIVERSITY

Multiple-choice questions

Choose the one correct answer for each question. The answer key is at the end of this page.

Q1. Biodiversity means the variety of
(A) Rocks only (B) Life on Earth (C) Chemicals (D) Soil types

Q2. The variety of genes within a species is
(A) Ecosystem diversity (B) Genetic diversity (C) Species diversity (D) Habitat diversity

Q3. The largest rank in classification listed here is
(A) Genus (B) Species (C) Kingdom (D) Family

Q4. Bacteria are placed in the kingdom
(A) Protista (B) Fungi (C) Monera (D) Plantae

Q5. The scientific name of human beings is
(A) Homo sapiens (B) Sapiens homo (C) Homo Sapiens (D) Man sapiens

Q6. In a scientific name, the genus is written
(A) Second, small letter (B) First, capital letter (C) First, small letter (D) Second, capital letter

Q7. Fungi obtain food by
(A) Photosynthesis (B) Ingestion (C) Absorption (D) Chemosynthesis

Q8. Which is a threat to biodiversity?
(A) National parks (B) Habitat destruction (C) Breeding programmes (D) Wildlife laws

Q9. A group of organisms that can interbreed and produce fertile offspring is a
(A) Genus (B) Family (C) Species (D) Order

Q10. Plants are placed in the kingdom
(A) Animalia (B) Fungi (C) Protista (D) Plantae

Answer key

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

CHAPTER 4

Cells and Tissues

Study notes

Cell theory. The cell theory states that all living things are made of cells, the cell is the basic unit of structure and function, and new cells arise only from pre-existing cells by division. The cell was first seen by Robert Hooke, and the theory was developed by Schleiden, Schwann and Virchow.

Prokaryotic and eukaryotic cells. A prokaryotic cell, such as a bacterial cell, has no true nucleus and no membrane-bound organelles; its DNA lies free in the cytoplasm. A eukaryotic cell, such as a plant or animal cell, has a true nucleus and membrane-bound organelles.

Cell membrane and cell wall. The cell membrane is a thin, flexible, selectively permeable layer that controls what enters and leaves the cell. The fluid-mosaic model describes it as a double layer of lipids with proteins floating in it. Plant cells, fungi and bacteria also have a cell wall outside the membrane; in plants it is made of cellulose and gives shape and protection.

Organelles. The nucleus controls the cell and contains the genetic material. Mitochondria release energy by respiration. Ribosomes make proteins. The endoplasmic reticulum transports materials; rough endoplasmic reticulum carries ribosomes, smooth endoplasmic reticulum makes lipids. The Golgi apparatus modifies and packs materials. Lysosomes digest waste. Vacuoles store water and substances — large in plant cells, small in animal cells. Plastids are found in plant cells: chloroplasts carry out photosynthesis, chromoplasts give colour, and leucoplasts store food. The cytoplasm is the jelly-like material in which the organelles lie.

Movement across the membrane. Diffusion is the movement of molecules from a region of higher concentration to a region of lower concentration. Osmosis is the movement of water across a selectively permeable membrane from a dilute solution to a concentrated solution. Active transport moves substances against the concentration gradient and uses energy.

Tissues. A tissue is a group of similar cells that perform a particular function. In plants, meristematic tissue divides and produces new cells, while permanent tissues include xylem, which carries water, and phloem, which carries food. In animals there are four main tissues: epithelial tissue covers surfaces, connective tissue supports and joins parts (blood, bone and cartilage), muscular tissue causes movement, and nervous tissue carries messages.

Microscopy. The light microscope uses visible light and lenses to magnify cells. The electron microscope uses a beam of electrons and gives much higher magnification and resolution, so fine structures inside the cell can be seen.

CHAPTER 4 — CELLS AND TISSUES

Short questions with answers

Q1. State the cell theory.

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

Q2. How does a prokaryotic cell differ from a eukaryotic cell?

Answer: A prokaryotic cell has no true nucleus and no membrane-bound organelles, while a eukaryotic cell has a true nucleus and membrane-bound organelles.

Q3. What is the function of the mitochondria?

Answer: Mitochondria release energy from food by respiration, so they are called the powerhouse of the cell.

Q4. Define osmosis.

Answer: Osmosis is the movement of water across a selectively permeable membrane from a dilute solution to a more concentrated solution.

Q5. Name the four main animal tissues.

Answer: Epithelial tissue, connective tissue, muscular tissue and nervous tissue.

Long questions with answers

Q1. Compare a plant cell with an animal cell.

Answer: Both plant and animal cells are eukaryotic: they have a cell membrane, cytoplasm, nucleus, mitochondria, ribosomes, endoplasmic reticulum and Golgi apparatus. A plant cell differs in having a rigid cell wall of cellulose outside the membrane, chloroplasts for photosynthesis, and a large central vacuole; it usually has no centrioles. An animal cell has no cell wall and no chloroplasts, has only small vacuoles, and usually has centrioles. The cell wall and large vacuole give the plant cell a fixed shape, while the animal cell is more flexible in shape.

Q2. Describe the structure and functions of the cell membrane, and explain diffusion and osmosis.

Answer: The cell membrane is a thin, flexible, selectively permeable layer around the cell. According to the fluid-mosaic model it is a double layer of lipids with proteins floating in it. It protects the cell, gives it shape, and controls the entry and exit of substances. Diffusion is the movement of molecules from higher to lower concentration and needs no energy, for example the movement of oxygen into a cell. Osmosis is the movement of water across the selectively permeable membrane from a dilute to a concentrated solution. Both processes move substances without energy, while active transport moves substances against the gradient and uses energy.

CHAPTER 4 — CELLS AND TISSUES

Multiple-choice questions

Choose the one correct answer for each question. The answer key is at the end of this page.

Q1. The basic unit of life is the
(A) Tissue (B) Organ (C) Cell (D) Organelle

Q2. The cell theory was developed by
(A) Darwin only (B) Schleiden, Schwann and Virchow (C) Mendel (D) Pasteur

Q3. Which cell has no true nucleus?
(A) Plant cell (B) Animal cell (C) Bacterial cell (D) Fungal cell

Q4. The powerhouse of the cell is the
(A) Nucleus (B) Ribosome (C) Golgi apparatus (D) Mitochondrion

Q5. Proteins are made by the
(A) Lysosome (B) Ribosome (C) Vacuole (D) Plastid

Q6. Photosynthesis takes place in the
(A) Mitochondrion (B) Chloroplast (C) Nucleus (D) Ribosome

Q7. The cell wall of a plant cell is made of
(A) Chitin (B) Cellulose (C) Protein (D) Lipid

Q8. Movement of water across a selectively permeable membrane is
(A) Diffusion (B) Osmosis (C) Active transport (D) Filtration

Q9. Xylem in plants carries
(A) Food (B) Water (C) Hormones (D) Oxygen

Q10. Nervous tissue carries
(A) Blood (B) Messages (C) Food (D) Oxygen

Answer key

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

CHAPTER 5

The Cell Cycle

Study notes

What is the cell cycle? The cell cycle is the series of events by which a cell grows, copies its genetic material and divides into two daughter cells. It has two main stages: interphase, when the cell grows and prepares, and the mitotic phase, when division takes place.

Interphase. Interphase is the longest part of the cycle and has three phases: G1, in which the cell grows and makes proteins; S, in which the DNA is copied so that each chromosome has two identical copies; and G2, in which the cell grows further and prepares for division.

Mitosis. Mitosis is nuclear division in which one parent cell produces two genetically identical daughter cells. It has four phases. In prophase the chromosomes become visible and the nuclear membrane begins to disappear. In metaphase the chromosomes line up in the middle of the cell. In anaphase the sister chromatids separate and move to opposite poles. In telophase new nuclear membranes form around the two sets of chromosomes. Then cytokinesis divides the cytoplasm, giving two daughter cells.

Importance of mitosis. Mitosis is needed for growth, for repair of damaged tissues, for replacement of worn-out cells, and for asexual reproduction in many organisms. Because the daughter cells are identical to the parent cell, the genetic material is passed on unchanged.

Meiosis. Meiosis is the division that produces gametes (sex cells). It has two divisions, meiosis I and meiosis II, and produces four haploid cells from one diploid cell. In meiosis I homologous chromosomes pair up and exchange segments (crossing over), then separate, so the chromosome number is halved. In meiosis II the sister chromatids separate, as in mitosis. The result is four genetically different haploid cells.

Mitosis and meiosis compared. Mitosis produces two identical diploid cells and is used for growth and repair; meiosis produces four different haploid cells and is used for sexual reproduction. Crossing over and independent assortment in meiosis create variation, which is important for evolution and for the survival of a species in changing conditions.

Cell death and cancer. Apoptosis is programmed cell death, a controlled process that removes old or damaged cells. Necrosis is uncontrolled death of cells caused by injury or disease. When the control of cell division fails and cells divide without stopping, a tumour may form; this uncontrolled growth is cancer.

CHAPTER 5 — THE CELL CYCLE

Short questions with answers

Q1. What is the cell cycle?

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

Q2. What happens in the S phase of interphase?

Answer: In the S phase the DNA is copied, so each chromosome comes to have two identical copies before division.

Q3. Name the four phases of mitosis in order.

Answer: Prophase, metaphase, anaphase and telophase.

Q4. What is crossing over?

Answer: Crossing over is the exchange of segments between homologous chromosomes during meiosis I, which creates new combinations of genes.

Q5. What is apoptosis?

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

Long questions with answers

Q1. Describe the phases of mitosis and explain why mitosis is important.

Answer: Mitosis has four phases. In prophase the chromosomes condense and become visible, and the nuclear membrane begins to break down. In metaphase the chromosomes line up along the middle of the cell. In anaphase the sister chromatids separate and move to opposite poles. In telophase new nuclear membranes form around each set of chromosomes, and then cytokinesis divides the cytoplasm into two daughter cells. Mitosis is important for growth, repair of damaged tissues, replacement of old cells and asexual reproduction. Because each daughter cell receives an exact copy of the genetic material, the character of the organism is maintained.

Q2. Compare mitosis and meiosis.

Answer: Mitosis is one division that produces two genetically identical diploid daughter cells from one diploid parent cell; it is used for growth, repair and asexual reproduction. Meiosis is two divisions that produce four genetically different haploid cells from one diploid cell; it is used to form gametes for sexual reproduction. In meiosis, homologous chromosomes pair and exchange segments by crossing over, and they separate in meiosis I, halving the chromosome number; no such pairing and halving takes place in mitosis. Meiosis therefore creates variation, while mitosis keeps the genetic material unchanged.

CHAPTER 5 — THE CELL CYCLE

Multiple-choice questions

Choose the one correct answer for each question. The answer key is at the end of this page.

Q1. The longest part of the cell cycle is
(A) Mitosis (B) Interphase (C) Cytokinesis (D) Anaphase

Q2. DNA is copied during the
(A) G1 phase (B) S phase (C) G2 phase (D) Prophase

Q3. Chromosomes line up in the middle of the cell in
(A) Prophase (B) Metaphase (C) Anaphase (D) Telophase

Q4. Sister chromatids separate in
(A) Prophase (B) Metaphase (C) Anaphase (D) Interphase

Q5. Mitosis produces
(A) Four haploid cells (B) Two identical diploid cells (C) Two different haploid cells (D) One diploid cell

Q6. Meiosis produces
(A) Two diploid cells (B) Four haploid cells (C) Two haploid cells (D) Four diploid cells

Q7. Crossing over takes place in
(A) Mitosis (B) Meiosis I (C) Cytokinesis (D) Interphase

Q8. Mitosis is important for
(A) Variation only (B) Growth and repair (C) Formation of gametes (D) Halving chromosome number

Q9. Programmed cell death is called
(A) Necrosis (B) Apoptosis (C) Cytokinesis (D) Fertilisation

Q10. Uncontrolled division of cells may cause
(A) Mitosis (B) Meiosis (C) Cancer (D) Apoptosis

Answer key

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

CHAPTER 6

The Enzymes

Study notes

What are enzymes? Enzymes are biological catalysts — mostly proteins — that speed up chemical reactions in living things without being used up themselves. Without enzymes, most reactions of life would be too slow to keep an organism alive. The substance an enzyme acts on is called its substrate, and the enzyme changes it into products.

Properties of enzymes. Enzymes are specific: each enzyme acts on a particular substrate. They are needed in small amounts, are not used up in the reaction, and can be used again. They are sensitive to temperature and pH, and they are denatured — their shape is destroyed — by high temperature or extreme pH.

How enzymes work. The lock-and-key model says the substrate fits exactly into a part of the enzyme called the active site, like a key fits a lock. The induced-fit model adds that the active site changes its shape slightly to fit the substrate better. After the reaction the products are released and the enzyme is free to act again.

Factors affecting enzyme action. (1) Temperature: enzyme action increases with temperature up to an optimum, then falls sharply as the enzyme is denatured. Most human enzymes work best near body temperature. (2) pH: each enzyme has an optimum pH; for example pepsin works best in the acid of the stomach. (3) Substrate concentration: the rate rises as more substrate is available, until all active sites are busy. (4) Enzyme concentration: more enzyme gives a faster rate while substrate is plentiful.

Inhibitors and activators. An inhibitor is a substance that slows down or stops an enzyme. Some inhibitors block the active site; others change the shape of the enzyme. Cofactors are non-protein helpers that some enzymes need, for example metal ions. Coenzymes are organic helpers, and many vitamins act as coenzymes.

Metabolism. All the chemical reactions in a cell together make up metabolism. Anabolism builds large molecules from small ones and uses energy, for example the building of proteins. Catabolism breaks large molecules into small ones and releases energy, for example respiration. Enzymes control both kinds of reaction.

CHAPTER 6 — THE ENZYMES

Short questions with answers

Q1. What is an enzyme?

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

Q2. What is a substrate?

Answer: A substrate is the substance on which an enzyme acts; the enzyme changes it into products.

Q3. What is the active site of an enzyme?

Answer: The active site is the part of the enzyme into which the substrate fits so that the reaction can take place.

Q4. What happens to an enzyme at a very high temperature?

Answer: At a very high temperature the enzyme is denatured — its shape is destroyed — and it loses its activity.

Q5. What is the difference between anabolism and catabolism?

Answer: Anabolism builds large molecules from small ones and uses energy; catabolism breaks large molecules into small ones and releases energy.

Long questions with answers

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

Answer: The lock-and-key model says that the substrate fits exactly into the active site of the enzyme, as a key fits into a lock. Only the matching substrate can fit, which explains why enzymes are specific. The induced-fit model improves this idea: the active site is flexible and changes its shape slightly when the substrate binds, gripping it more tightly and helping the reaction. In both models, once the reaction is complete the products leave the active site and the enzyme is unchanged, so it can act again on another substrate molecule.

Q2. Describe how temperature, pH and substrate concentration affect the rate of an enzyme-controlled reaction.

Answer: Temperature: as temperature rises, molecules move faster and the reaction rate increases, up to an optimum temperature. Beyond the optimum the enzyme is denatured and the rate falls sharply. pH: each enzyme has an optimum pH at which it works best; moving away from the optimum changes the shape of the active site and lowers the rate, and extreme pH denatures the enzyme. Substrate concentration: when substrate is scarce, adding more substrate increases the rate because more active sites become occupied. When all active sites are busy, adding more substrate cannot increase the rate further and the rate levels off.

CHAPTER 6 — THE ENZYMES

Multiple-choice questions

Choose the one correct answer for each question. The answer key is at the end of this page.

Q1. Enzymes are mostly made of
(A) Lipids (B) Proteins (C) Carbohydrates (D) Nucleic acids

Q2. The substance an enzyme acts on is called the
(A) Product (B) Cofactor (C) Substrate (D) Inhibitor

Q3. The part of the enzyme where the substrate fits is the
(A) Active site (B) Product site (C) Lock site (D) Base site

Q4. Enzymes are specific because
(A) They are large (B) Only a matching substrate fits the active site (C) They are proteins (D) They work fast

Q5. High temperature destroys an enzyme by
(A) Freezing it (B) Denaturing it (C) Dissolving it (D) Activating it

Q6. Pepsin works best in
(A) Alkaline conditions (B) Acid conditions (C) Neutral conditions (D) Dry conditions

Q7. Increasing substrate concentration increases the rate until
(A) The enzyme is used up (B) All active sites are busy (C) The pH changes (D) The temperature falls

Q8. A substance that slows down an enzyme is an
(A) Activator (B) Cofactor (C) Inhibitor (D) Coenzyme

Q9. Building large molecules from small ones is
(A) Catabolism (B) Anabolism (C) Hydrolysis (D) Denaturation

Q10. Many vitamins act as
(A) Inhibitors (B) Substrates (C) Coenzymes (D) Products

Answer key

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

CHAPTER 7

Bioenergetics

Study notes

What is bioenergetics? Bioenergetics is the study of how living things obtain, store and use energy. All life processes need energy, and the main source of energy for almost all life on Earth is sunlight, captured by photosynthesis.

ATP — the energy currency. Adenosine triphosphate (ATP) is the energy currency of the cell. Energy released by respiration is stored in ATP, and ATP is broken down to release energy wherever work is needed — for movement, active transport, building molecules and other life processes. ATP is made in mitochondria and in chloroplasts.

Photosynthesis. Photosynthesis is the process by which green plants make food from carbon dioxide and water, using sunlight and chlorophyll, and release oxygen. The overall word equation is: carbon dioxide + water —(light, chlorophyll)—> glucose + oxygen. It takes place in the chloroplast, mainly in the leaves.

Stages of photosynthesis. In the light reactions, light energy is absorbed by chlorophyll, water is split, oxygen is released, and ATP is made. In the dark reactions (Calvin cycle), the ATP is used to fix carbon dioxide into glucose. The rate of photosynthesis is affected by light intensity, carbon dioxide concentration, temperature and water supply.

Respiration. Respiration is the process by which food is broken down to release energy. Aerobic respiration uses oxygen and breaks glucose down completely into carbon dioxide and water, releasing a large amount of energy. Anaerobic respiration takes place without oxygen, breaks glucose down only partly, and releases much less energy; in yeast it produces ethanol and carbon dioxide, and in muscle cells it produces lactic acid.

Stages of aerobic respiration. Glycolysis takes place in the cytoplasm and splits glucose into two molecules of pyruvic acid, releasing a small amount of energy. The Krebs cycle and the electron transport chain take place in the mitochondria and release most of the energy. Altogether, aerobic respiration releases far more energy from each glucose molecule than anaerobic respiration does.

Photosynthesis and respiration. The two processes are linked: photosynthesis stores light energy in food and releases oxygen, while respiration releases that stored energy and gives out carbon dioxide and water, which plants use again for photosynthesis. Together they keep the balance of oxygen and carbon dioxide in the air.

CHAPTER 7 — BIOENERGETICS

Short questions with answers

Q1. What is ATP?

Answer: ATP (adenosine triphosphate) is the energy currency of the cell; energy is stored in it and released when it is broken down for life processes.

Q2. Write the word equation for photosynthesis.

Answer: Carbon dioxide + water —(light, chlorophyll)—> glucose + oxygen.

Q3. Where does photosynthesis take place?

Answer: Photosynthesis takes place in the chloroplasts, mainly in the leaves of green plants.

Q4. What is the difference between aerobic and anaerobic respiration?

Answer: Aerobic respiration uses oxygen, breaks glucose down completely and releases a large amount of energy; anaerobic respiration takes place without oxygen, breaks glucose down only partly and releases much less energy.

Q5. Name two factors that affect the rate of photosynthesis.

Answer: Light intensity and carbon dioxide concentration (also temperature and water supply).

Long questions with answers

Q1. Describe photosynthesis, its stages and the factors that affect its rate.

Answer: Photosynthesis is the process by which green plants use sunlight and chlorophyll to make glucose from carbon dioxide and water, releasing oxygen. It takes place in the chloroplast. In the light reactions, chlorophyll absorbs light energy, water is split, oxygen is released and ATP is made. In the dark reactions (Calvin cycle), carbon dioxide is fixed into glucose using that ATP. The rate of photosynthesis rises with light intensity up to a limit, rises with carbon dioxide concentration, and rises with temperature up to an optimum, after which enzymes are damaged. A shortage of water also lowers the rate because the stomata close and carbon dioxide cannot enter the leaf.

Q2. Compare aerobic and anaerobic respiration.

Answer: Aerobic respiration uses oxygen and takes place in the cytoplasm (glycolysis) and the mitochondria (Krebs cycle and electron transport chain). Glucose is broken down completely into carbon dioxide and water and a large amount of energy is released. Anaerobic respiration takes place without oxygen, only in the cytoplasm, and glucose is broken down only partly — into ethanol and carbon dioxide in yeast, or into lactic acid in muscle cells — releasing much less energy. Aerobic respiration is therefore the main way most organisms obtain energy, while anaerobic respiration is a short-term alternative when oxygen is absent.

CHAPTER 7 — BIOENERGETICS

Multiple-choice questions

Choose the one correct answer for each question. The answer key is at the end of this page.

Q1. The energy currency of the cell is
(A) DNA (B) ATP (C) ADP (D) Glucose

Q2. Photosynthesis takes place in the
(A) Mitochondrion (B) Chloroplast (C) Nucleus (D) Ribosome

Q3. The pigment that absorbs light in photosynthesis is
(A) Haemoglobin (B) Chlorophyll (C) Melanin (D) Carotene

Q4. Oxygen is released in photosynthesis from
(A) Carbon dioxide (B) Glucose (C) Water (D) Chlorophyll

Q5. The dark reactions of photosynthesis are also called the
(A) Krebs cycle (B) Calvin cycle (C) Glycolysis (D) Electron transport chain

Q6. Glycolysis takes place in the
(A) Mitochondrion (B) Nucleus (C) Cytoplasm (D) Chloroplast

Q7. Aerobic respiration produces
(A) Ethanol only (B) Lactic acid only (C) Carbon dioxide and water (D) Glucose

Q8. Anaerobic respiration in yeast produces
(A) Lactic acid (B) Ethanol and carbon dioxide (C) Oxygen (D) Glucose

Q9. Most of the energy in aerobic respiration is released in the
(A) Cytoplasm (B) Mitochondria (C) Nucleus (D) Vacuole

Q10. Which factor increases the rate of photosynthesis?
(A) Low light (B) More carbon dioxide (C) Very high temperature (D) Closed stomata

Answer key

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

CHAPTER 8

Nutrition

Study notes

What is nutrition? Nutrition is the process by which living things obtain and use food. Food provides energy, material for growth and repair, and substances that protect the body from disease. Organisms feed in different ways: autotrophs make their own food by photosynthesis, while heterotrophs feed on other organisms.

Human nutrition. Human beings are heterotrophs. Food is taken in, digested into small soluble molecules, absorbed into the blood, used by the cells, and the undigested waste is egested. The main food groups are carbohydrates and fats (energy), proteins (growth and repair), vitamins and minerals (protection and regulation), and water and fibre.

The human digestive system. Digestion begins in the mouth, where teeth cut and grind the food and saliva begins to digest starch. Food passes through the oesophagus to the stomach, where acid and the enzyme pepsin begin to digest protein. In the small intestine, bile from the liver and enzymes from the pancreas and the intestinal wall complete digestion, and the digested food is absorbed into the blood through the villi. Water is absorbed in the large intestine, and undigested waste is stored in the rectum and egested through the anus.

Enzymes in digestion. Amylase digests starch into maltose; pepsin digests proteins into peptides in the stomach; lipase digests fats into fatty acids and glycerol; and the enzymes of the small intestine complete the digestion of proteins and carbohydrates into amino acids and glucose, which are absorbed.

Disorders of the digestive system. Constipation is difficulty in passing faeces, often caused by a lack of fibre and water. Diarrhoea is the frequent passing of watery faeces, often caused by infection, and it can cause dangerous loss of water and salts. Ulcers are sores in the lining of the stomach or intestine. A balanced diet, clean water, clean food and regular meals help to prevent digestive disorders.

Mineral nutrition in plants. Plants need minerals from the soil for healthy growth. Nitrogen is needed for proteins and chlorophyll; a lack of nitrogen causes yellowing of leaves and poor growth. Phosphorus is needed for roots and for energy transfer. Potassium is needed for healthy growth and for opening and closing the stomata. Magnesium is part of chlorophyll. Plants take up minerals dissolved in water through their roots.

Deficiency diseases. A lack of a nutrient in the diet causes a deficiency disease. Lack of vitamin C causes scurvy (bleeding gums); lack of vitamin D causes rickets (soft, weak bones) in children; lack of iron causes anaemia (tiredness and pale skin); and lack of iodine causes goitre (swelling of the thyroid gland in the neck). A balanced diet containing all food groups prevents these diseases.

CHAPTER 8 — NUTRITION

Short questions with answers

Q1. What is the difference between an autotroph and a heterotroph?

Answer: An autotroph makes its own food by photosynthesis, while a heterotroph feeds on other organisms for food.

Q2. Name the main food groups and what each provides.

Answer: Carbohydrates and fats provide energy; proteins provide growth and repair; vitamins and minerals protect and regulate the body; water and fibre are also needed.

Q3. Where is digested food absorbed in the human body?

Answer: Digested food is absorbed into the blood in the small intestine, through the finger-like villi in its wall.

Q4. What is the function of bile?

Answer: Bile, made by the liver, breaks large fat droplets into small droplets so that lipase can digest fats more easily; it also neutralises stomach acid.

Q5. What causes anaemia, and how can it be prevented?

Answer: Anaemia is caused by a lack of iron in the diet. It can be prevented by eating iron-rich foods such as green vegetables, meat, eggs and pulses.

Long questions with answers

Q1. Describe the human digestive system and the part played by enzymes in digestion.

Answer: Digestion begins in the mouth, where teeth grind the food and salivary amylase begins to digest starch. Food travels down the oesophagus to the stomach, where hydrochloric acid kills germs and pepsin begins the digestion of proteins. In the small intestine, bile from the liver emulsifies fats, pancreatic enzymes and intestinal enzymes complete digestion: starch is digested to glucose, proteins to amino acids, and fats to fatty acids and glycerol. The digested food is absorbed through the villi of the small intestine into the blood. Water is absorbed in the large intestine, and the undigested waste is egested through the anus. Enzymes are essential at every stage, because they break large insoluble food molecules into small soluble ones that the blood can carry.

Q2. Explain mineral nutrition in plants and the deficiency diseases of human beings.

Answer: Plants absorb minerals dissolved in water through their roots. Nitrogen is needed for proteins and chlorophyll, and its lack causes yellow leaves and poor growth. Phosphorus is needed for root growth and energy transfer. Potassium is needed for healthy growth and for the opening and closing of stomata. Magnesium is part of the chlorophyll molecule. In human beings, lack of a nutrient causes a deficiency disease: lack of vitamin C causes scurvy, lack of vitamin D causes rickets in children, lack of iron causes anaemia, and lack of iodine causes goitre. Both plant and human health therefore depend on a proper supply of minerals and vitamins, and a balanced diet prevents most deficiency diseases.

CHAPTER 8 — NUTRITION

Multiple-choice questions

Choose the one correct answer for each question. The answer key is at the end of this page.

Q1. Organisms that make their own food are called
(A) Heterotrophs (B) Autotrophs (C) Parasites (D) Saprophytes

Q2. Protein in the diet is needed for
(A) Energy only (B) Growth and repair (C) Making bile (D) Absorbing water

Q3. Digestion of starch begins in the
(A) Stomach (B) Small intestine (C) Mouth (D) Large intestine

Q4. Pepsin digests
(A) Starch (B) Fats (C) Proteins (D) Vitamins

Q5. Digested food is absorbed in the
(A) Stomach (B) Small intestine (C) Large intestine (D) Oesophagus

Q6. Bile is made by the
(A) Pancreas (B) Liver (C) Stomach (D) Gall bladder

Q7. Lack of vitamin C causes
(A) Rickets (B) Scurvy (C) Anaemia (D) Goitre

Q8. Lack of iron in the diet causes
(A) Scurvy (B) Rickets (C) Anaemia (D) Goitre

Q9. Magnesium is needed by plants for
(A) Root growth (B) Chlorophyll (C) Opening stomata (D) Making flowers

Q10. Water is absorbed mainly in the
(A) Stomach (B) Small intestine (C) Large intestine (D) Mouth

Answer key

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

CHAPTER 9

Transport

Study notes

Why is transport needed? In large organisms, food, oxygen and other materials must be carried from one part of the body to another, and waste must be carried away. In human beings this is done by the blood circulatory system; in plants it is done by the xylem and phloem.

The human heart. The heart is a muscular pump with four chambers: two atria above and two ventricles below. The right side pumps blood to the lungs to pick up oxygen, and the left side pumps oxygen-rich blood to the whole body. Valves stop the blood from flowing backwards. The heart beats about 72 times a minute in a resting adult.

Blood vessels. Arteries carry blood away from the heart; they have thick, elastic walls. Veins carry blood towards the heart; they have thinner walls and valves. Capillaries are tiny, thin-walled vessels that join arteries and veins; exchange of food, oxygen and waste takes place through their walls.

Blood. Blood is made of plasma (the liquid part) and cells. Red blood cells carry oxygen because they contain haemoglobin; they have no nucleus. White blood cells defend the body against germs. Platelets help the blood to clot and stop bleeding. Plasma carries digested food, hormones, salts and waste products.

Double circulation. In human beings the blood passes through the heart twice in one complete circuit: once on its way to the lungs (pulmonary circulation) and once on its way to the body (systemic circulation). This keeps oxygen-rich and oxygen-poor blood separate and supplies the body efficiently.

Lymph. Lymph is the fluid that bathes the tissues. It collects extra fluid from the tissues, carries digested fats, and helps to defend the body against disease through the lymph nodes.

Transport in plants. Water and minerals are absorbed by the roots and carried up the plant in the xylem vessels. Food made in the leaves is carried to other parts in the phloem by translocation. Transpiration is the loss of water vapour from the leaves through the stomata; it pulls water up the plant and cools the leaves.

Disorders of the circulatory system. High blood pressure (hypertension) strains the heart and blood vessels. A heart attack happens when the blood supply to part of the heart muscle is blocked. Anaemia reduces the oxygen-carrying capacity of the blood. Regular exercise, a balanced diet low in excess salt and fat, and not smoking help to keep the circulatory system healthy.

CHAPTER 9 — TRANSPORT

Short questions with answers

Q1. Why is a transport system needed in large organisms?

Answer: Materials such as food and oxygen must be carried to all parts of the body and waste must be carried away; diffusion alone is too slow over long distances.

Q2. How many chambers does the human heart have? Name them.

Answer: Four chambers: the right atrium, right ventricle, left atrium and left ventricle.

Q3. What is the difference between an artery and a vein?

Answer: An artery carries blood away from the heart and has thick elastic walls; a vein carries blood towards the heart and has thinner walls with valves.

Q4. What is the function of red blood cells?

Answer: Red blood cells carry oxygen from the lungs to the tissues because they contain haemoglobin.

Q5. What is transpiration?

Answer: Transpiration is the loss of water vapour from the leaves of a plant, mainly through the stomata; it pulls water up the plant.

Long questions with answers

Q1. Describe the human circulatory system, including the heart, blood vessels and blood.

Answer: The human circulatory system consists of the heart, the blood vessels and the blood. The heart is a four-chambered muscular pump: the right side sends oxygen-poor blood to the lungs, and the left side sends oxygen-rich blood to the body. Arteries carry blood away from the heart, veins carry it back, and capillaries join them; exchange of food, oxygen and waste takes place through the thin walls of the capillaries. Blood consists of plasma and cells: red blood cells carry oxygen with haemoglobin, white blood cells defend the body against germs, platelets help clotting, and plasma carries food, hormones and waste. The blood passes through the heart twice in each circuit — double circulation — which keeps oxygen-rich and oxygen-poor blood separate.

Q2. Explain transport in plants: the roles of xylem, phloem and transpiration.

Answer: In plants, water and dissolved minerals are absorbed from the soil by the roots and carried upwards in the xylem vessels to the leaves. Food made by photosynthesis in the leaves is carried to the growing parts and storage organs in the phloem by translocation. Transpiration is the loss of water vapour from the leaves through the stomata. As water evaporates from the leaves, more water is pulled up through the xylem, so transpiration drives the upward movement of water. It also cools the leaves and helps minerals to reach all parts of the plant.

CHAPTER 9 — TRANSPORT

Multiple-choice questions

Choose the one correct answer for each question. The answer key is at the end of this page.

Q1. The human heart has
(A) Two chambers (B) Three chambers (C) Four chambers (D) One chamber

Q2. Arteries carry blood
(A) Towards the heart (B) Away from the heart (C) To the lungs only (D) To the veins only

Q3. Exchange of materials takes place in the
(A) Arteries (B) Veins (C) Capillaries (D) Heart

Q4. Red blood cells carry oxygen because they contain
(A) Chlorophyll (B) Haemoglobin (C) Plasma (D) Fibrin

Q5. White blood cells defend the body against
(A) Hunger (B) Germs (C) Cold (D) Thirst

Q6. Blood clotting is helped by
(A) Red cells (B) White cells (C) Platelets (D) Plasma

Q7. Water is carried up a plant in the
(A) Phloem (B) Xylem (C) Stomata (D) Root hairs

Q8. Food made in the leaves is carried in the
(A) Xylem (B) Phloem (C) Cambium (D) Epidermis

Q9. Transpiration is the loss of water vapour from the
(A) Roots (B) Stem (C) Leaves (D) Flowers

Q10. Double circulation means blood passes through the heart
(A) Once per circuit (B) Twice per circuit (C) Three times per circuit (D) Never

Answer key

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