10th Class Biology Notes
Federal Board (FBISE)
Full Book Notes

Complete chapter-wise study notes with original practice questions for Class 10 Biology, Federal Board of Intermediate and Secondary Education (FBISE), Islamabad.

About these notes

These notes follow the chapters of the National Book Foundation (NBF) Biology book for Class

10, Federal Board. The eleven chapters covered, in order, are:

1.Digestive System

2.Circulatory System

3.Respiratory System

4.Urinary System

5.Nervous System

6.Reproduction

7.Inheritance

8.Diseases

9.Immunity

10.Biotechnology

11.Biostatistics and Data Analysis

About the paper: The FBISE Class 10 Biology paper is SLO-based (student learning outcomes) as per the Federal Board. Students should check the current model paper on the official FBISE website, fbise.edu.pk, before their examination, because the board may revise the paper pattern.

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12. 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 questions, write full answers in your own words in a notebook, then compare them with the notes.

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

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

the current model paper on fbise.edu.pk.

CHAPTER 1

Digestive System

What is Digestion?

Digestion is the process by which large, complex food molecules are broken down into small, simple and soluble molecules that the body can absorb and use. It takes place in the alimentary canal, a long tube that runs from the mouth to the anus, with the help of digestive glands. The main parts of the alimentary canal are the mouth, pharynx, oesophagus, stomach, small intestine and large intestine. The associated glands are the salivary glands, the liver and the pancreas.

Digestion in the Mouth and Stomach

In the mouth, food is chewed by the teeth and mixed with saliva. Saliva contains the enzyme amylase, which begins the digestion of starch. The food is swallowed and pushed down the oesophagus by peristalsis, a wave of muscular contraction. In the stomach, food is churned and mixed with gastric juice, which contains hydrochloric acid and the enzyme pepsin. The acid kills germs and provides the right conditions for pepsin, which begins the digestion of proteins. The partly digested food in the stomach is called chyme.

Digestion and Absorption in the Small Intestine

Chyme passes into the small intestine, where most digestion and absorption take place. Bile from the liver emulsifies fats into small droplets, and pancreatic juice contains enzymes that digest starch, proteins and fats. Intestinal juice completes digestion. The inner wall of the small intestine has millions of finger-like projections called villi, which greatly increase the surface area for absorption. Digested food passes through the villi into the blood and is carried to all parts of the body.

The Liver and Common Disorders

The liver is the largest gland of the body. It produces bile, stores glucose as glycogen, breaks down excess amino acids, and removes harmful substances from the blood. Common disorders of the digestive system include constipation, diarrhoea, ulcers and jaundice. Eating fibre-rich food, drinking clean water and washing hands before meals help to keep the digestive system healthy.

Key Definitions

Term	Definition
Digestion	The breakdown of large, insoluble food molecules into small, soluble molecules that can be

	absorbed into the blood.
Peristalsis	A wave of muscular contraction and relaxation that pushes food along the alimentary canal.
Enzyme	A biological catalyst, usually a protein, that speeds up a chemical reaction in the body without being used up.
Villi	Tiny finger-like projections on the inner wall of the small intestine that increase the surface area for absorption.
Bile	A greenish liquid produced by the liver and stored in the gall bladder; it emulsifies fats into small droplets.

Key Terms to Remember

Term	Meaning
Alimentary canal	The long tube from mouth to anus through which food passes.
Chyme	Partly digested, semi-liquid food leaving the stomach.
Amylase	The enzyme in saliva that digests starch into maltose.
Pepsin	The stomach enzyme that begins the digestion of proteins.
Trypsin	A pancreatic enzyme that digests proteins in the small intestine.
Lipase	An enzyme that digests fats into fatty acids and glycerol.
Lacteal	A lymph vessel inside each villus that absorbs fatty acids and glycerol.
Absorption	The movement of digested food from the gut into the blood.

Multiple-Choice Questions

1. Digestion of starch begins in the

(A) mouth(B) stomach(C) small intestine(D) liver

2. Bile is produced by the

(A) pancreas(B) liver(C) gall bladder(D) stomach

3. Most absorption of digested food takes place in the

(A) stomach(B) large intestine(C) small intestine(D) oesophagus

4. The enzyme present in saliva is

(A) pepsin(B) trypsin(C) lipase(D) amylase

5. Peristalsis is the

(A) chewing of food(B) wave of muscular contraction that moves food along the gut(C) mixing of bile with food(D) absorption of water

6. Pepsin digests

(A) starch(B) fats(C) proteins(D) vitamins

7. Villi increase the

(A) length of the gut(B) surface area for absorption(C) acidity of the stomach(D) speed of peristalsis

8. The largest gland of the human body is the

(A) pancreas(B) thyroid(C) liver(D) salivary gland

9. The semi-liquid food formed in the stomach is called

(A) chyle(B) chyme(C) bolus(D) faeces

10. The end product of starch digestion is

(A) amino acid(B) fatty acid(C) glycerol(D) glucose

Short Questions

1. Define digestion.
   Digestion is the breakdown of large, insoluble food molecules into small, soluble molecules that the body can absorb and use.
2. What is peristalsis?
   Peristalsis is a wave of muscular contraction and relaxation that pushes food along the alimentary canal.
3. What is the function of bile?
   Bile emulsifies fats into small droplets so that lipase can digest them more easily.
4. What is the function of villi?
   Villi increase the surface area of the small intestine for the absorption of digested food into the blood.
5. What is chyme?
   Chyme is the partly digested, semi-liquid food that leaves the stomach and enters the small intestine.
6. What is the role of hydrochloric acid in the stomach?
   Hydrochloric acid kills germs in food and provides the acidic conditions needed for the enzyme pepsin to work.
7. Name the three main digestive glands.
   The salivary glands, the liver and the pancreas.
8. What is the function of the pancreas in digestion?
   The pancreas produces pancreatic juice containing enzymes that digest starch, proteins and fats in the

small intestine.

9. Why is the small intestine very long?
   Its length and the villi on its wall give a very large surface area for the digestion and absorption of food.
10. What is the difference between ingestion and egestion?
    Ingestion is taking food into the mouth, while egestion is the removal of undigested food as faeces.

Long Questions

1. Describe digestion in the mouth and stomach, naming the enzymes involved and their actions.
2. Explain how digested food is absorbed in the small intestine, describing the structure and function of villi.
3. Describe the role of the liver and the pancreas in digestion.

CHAPTER 2

Circulatory System

Blood and Its Composition

Blood is a fluid tissue that carries substances around the body. It is made of plasma, a pale yellow liquid, and blood cells floating in it. Plasma carries dissolved food, hormones, waste and proteins. Red blood cells contain haemoglobin, which carries oxygen. White blood cells defend the body against disease. Platelets help the blood to clot at a wound. Blood cells are formed in the bone marrow.

The Heart

The heart is a muscular organ that pumps blood around the body. It has four chambers: two atria on top and two ventricles below. The right side of the heart pumps blood to the lungs, and the left side pumps blood to the rest of the body. Valves between the chambers stop blood flowing backwards. The wall of the left ventricle is thicker than the right because it must pump blood to the whole body.

Blood Vessels and Double Circulation

Arteries carry blood away from the heart, veins carry blood back to the heart, and capillaries are tiny vessels where substances are exchanged with the tissues. Human circulation is called double circulation because blood passes through the heart twice in one complete circuit: once on its way to the lungs and once on its way to the body. The heartbeat, felt as the pulse, is the rhythmic contraction and relaxation of the heart.

Blood Groups and Disorders

Human blood is divided into four main groups: A, B, AB and O. Blood group O is called the universal

donor and AB the universal recipient, because of the antigens on red cells and antibodies in plasma. Common disorders of the circulatory system include anaemia, in which there are too few red cells or too little haemoglobin, high blood pressure, and leukaemia, a cancer of the white blood cells.

Key Definitions

Term	Definition
Plasma	The pale yellow liquid part of blood that carries dissolved food, hormones, waste products and proteins.
Double circulation	A circulation in which blood passes through the heart twice in one complete circuit, once to the lungs and once to the body.
Systole	The phase of the heartbeat in which the heart muscle contracts and pumps blood out.
Diastole	The phase of the heartbeat in which the heart muscle relaxes and the chambers fill with blood.
Blood pressure	The force exerted by the blood on the walls of the arteries.

Key Terms to Remember

Term	Meaning
Artery	A vessel that carries blood away from the heart.
Vein	A vessel that carries blood back to the heart.
Capillary	A tiny thin-walled vessel where exchange with tissues takes place.
Haemoglobin	The red pigment in red blood cells that carries oxygen.
Platelets	Cell fragments in blood that help it to clot.
Antigen	A substance on the surface of red blood cells that decides the blood group.
Antibody	A protein in plasma that reacts against a foreign antigen.
Pulse	The rhythmic throb felt in an artery as the heart beats.

Multiple-Choice Questions

1. Oxygen is carried in the blood mainly by

(A) plasma(B) platelets(C) haemoglobin in red cells(D) white cells

2. The human heart has

(A) two chambers(B) three chambers(C) four chambers(D) one chamber

3. Blood cells are formed in the

(A) liver(B) spleen(C) bone marrow(D) kidney

4. The universal donor blood group is

(A) A(B) B(C) AB(D) O

5. Arteries carry blood

(A) to the heart(B) away from the heart(C) to the lungs only(D) to the liver only

6. The valve between the left atrium and left ventricle is the

(A) tricuspid valve(B) bicuspid (mitral) valve(C) aortic valve(D) pulmonary valve

7. Platelets help in

(A) carrying oxygen(B) fighting germs(C) blood clotting(D) carrying food

8. The largest artery of the body is the

(A) vena cava(B) pulmonary artery(C) aorta(D) renal artery

9. The normal blood pressure of a healthy adult is about

(A) 80/60 mmHg(B) 120/80 mmHg(C) 140/100 mmHg(D) 100/70 mmHg

10. White blood cells defend the body against

(A) loss of water(B) disease and infection(C) high blood pressure(D) blood clotting

Short Questions

1. What are the functions of blood?
   Blood carries oxygen, digested food, hormones and waste, defends the body against disease, and helps to control body temperature.
2. What is the difference between an artery and a vein?
   An artery carries blood away from the heart with thick elastic walls, while a vein carries blood back to the heart with thinner walls and valves.
3. What is double circulation?
   Double circulation is a system in which blood passes through the heart twice in one complete circuit, once on its way to the lungs and once on its way to the body.
4. What is the function of platelets?
   Platelets help the blood to clot at a wound, stopping bleeding.
5. What is blood pressure?
   Blood pressure is the force exerted by the blood on the walls of the arteries.

6. Why is the wall of the left ventricle thicker than the right?
   The left ventricle must pump blood to the whole body, so it needs a thicker, stronger wall.
7. What is the function of valves in the heart?
   Valves stop blood from flowing backwards between the chambers and into the vessels.
8. Name the four blood groups.
   A, B, AB and O.
9. What is anaemia?
   Anaemia is a condition in which there are too few red blood cells or too little haemoglobin, so the blood carries less oxygen.
10. What is the function of capillaries?
    Capillaries are thin-walled vessels where oxygen, food and waste are exchanged between the blood and the body tissues.

Long Questions

1. Describe the structure of the human heart and explain how it works as a pump.
2. Explain double circulation in humans with the help of a flow chart.
3. Describe the composition of blood and the function of each of its parts.

CHAPTER 3

Respiratory System

The Air Passage

Air enters through the nose, where it is warmed, moistened and cleaned by mucus and tiny hairs. It passes through the pharynx and the larynx, the voice box, into the trachea, or windpipe. The trachea is kept open by C-shaped rings of cartilage and divides into two bronchi, one to each lung. Inside the lungs the bronchi divide into smaller bronchioles, which end in tiny air sacs called alveoli.

The Mechanism of Breathing

Breathing in, or inhalation, happens when the diaphragm contracts and flattens and the ribs move up and out, so the chest volume increases and air is drawn in. Breathing out, or exhalation, happens when the diaphragm relaxes and the ribs move down, so the chest volume decreases and air is pushed out. Breathing is controlled by the brain, and its rate increases during exercise when the body needs more oxygen.

Gaseous Exchange and Transport

Gaseous exchange takes place in the alveoli. Oxygen from the air diffuses into the blood, and carbon

dioxide diffuses out of the blood into the alveoli to be breathed out. Oxygen is carried to the tissues by haemoglobin in red blood cells, and carbon dioxide is carried back to the lungs mainly in dissolved form in the plasma. The alveoli have thin walls and a rich blood supply, which makes diffusion fast and efficient.

Respiratory Disorders

Common disorders of the respiratory system include asthma, in which the airways narrow and breathing becomes difficult; bronchitis, an inflammation of the bronchi; pneumonia, an infection of the lungs; and tuberculosis, a bacterial infection of the lungs. Smoking damages the airways and the alveoli and increases the risk of lung disease. Fresh air, exercise and avoiding smoke keep the respiratory system healthy.

Key Definitions

Term	Definition
Breathing	The physical process of taking air into the lungs and pushing it out again.
Gaseous exchange	The diffusion of oxygen into the blood and carbon dioxide out of the blood in the alveoli.
Alveoli	Tiny air sacs in the lungs where gaseous exchange takes place.
Diaphragm	The sheet of muscle below the lungs that helps in breathing.
Respiration	The chemical process in cells that releases energy from glucose using oxygen.

Key Terms to Remember

Term	Meaning
Trachea	The windpipe that carries air from the larynx to the bronchi.
Bronchi	The two tubes into which the trachea divides, one to each lung.
Bronchioles	The smaller branches of the bronchi inside the lungs.
Larynx	The voice box at the top of the trachea.
Pharynx	The passage behind the mouth and nose that leads to the larynx and oesophagus.
Pleura	The thin membrane covering the lungs.
Diffusion	The movement of a gas from a region of high concentration to low concentration.
Haemoglobin	The pigment in red blood cells that carries oxygen.

Multiple-Choice Questions

1. Gaseous exchange in humans takes place in the

(A) bronchi(B) trachea(C) alveoli(D) larynx

2. The voice box is the

(A) pharynx(B) larynx(C) trachea(D) bronchus

3. During inhalation the diaphragm

(A) relaxes and rises(B) contracts and flattens(C) stops moving(D) pushes air out

4. Oxygen is transported in the blood mainly by

(A) plasma(B) platelets(C) haemoglobin(D) white cells

5. The windpipe is kept open by

(A) muscle rings(B) C-shaped cartilage rings(C) bone rings(D) elastic fibres

6. Carbon dioxide is carried in the blood mainly as

(A) gas bubbles(B) bicarbonate ions in plasma(C) haemoglobin(D) urea

7. The membrane covering the lungs is the

(A) pericardium(B) pleura(C) peritoneum(D) meninges

8. Asthma mainly affects the

(A) alveoli(B) bronchi and bronchioles(C) trachea(D) diaphragm

9. The right lung has

(A) one lobe(B) two lobes(C) three lobes(D) four lobes

10. The breathing rate increases during exercise because the body needs

(A) less oxygen(B) more oxygen(C) less carbon dioxide(D) more water

Short Questions

1. What is the difference between breathing and respiration?
   Breathing is the physical movement of air in and out of the lungs, while respiration is the chemical release of energy from glucose inside cells.
2. What is the function of the alveoli?
   Alveoli are the sites of gaseous exchange: oxygen diffuses into the blood and carbon dioxide diffuses out.
3. How does the diaphragm help in breathing?

When it contracts and flattens, the chest volume increases and air is drawn in; when it relaxes, air is pushed out.

4. Why is the trachea supported by cartilage rings?
   The C-shaped cartilage rings keep the trachea open so that air can pass freely to the lungs.
5. How is oxygen transported in the body?
   Oxygen binds with haemoglobin in red blood cells and is carried to the tissues.
6. What is asthma?
   Asthma is a disorder in which the airways narrow and become inflamed, making breathing difficult.
7. What is the function of mucus and cilia in the air passage?
   Mucus traps dust and germs, and cilia sweep the mucus towards the throat to keep the airways clean.
8. What is pneumonia?
   Pneumonia is an infection of the lungs in which the alveoli fill with fluid, making breathing difficult.
9. How does smoking harm the lungs?
   Smoke damages the airways and alveoli, destroys cilia, and increases the risk of bronchitis, asthma and lung disease.
10. What is tuberculosis?
    Tuberculosis is a bacterial infection that mainly affects the lungs and spreads through the air when an infected person coughs.

Long Questions

1. Describe the mechanism of breathing in humans, explaining the role of the diaphragm and the ribs.
2. Explain gaseous exchange in the alveoli and the transport of oxygen and carbon dioxide in the blood.
3. Describe the air passage in humans and explain how the air is cleaned, warmed and moistened before it reaches the lungs.

CHAPTER 4

Urinary System

The Urinary System

The urinary system removes nitrogenous waste and excess water and salts from the body. It consists of two kidneys, two ureters, the urinary bladder and the urethra. Blood is filtered in the kidneys to form urine, which travels down the ureters to the bladder, where it is stored until it leaves the body through the urethra.

Structure of the Kidney and the Nephron

Each kidney is a bean-shaped organ with an outer cortex and an inner medulla. The functional unit of the kidney is the nephron. A nephron consists of a cup-shaped Bowman's capsule enclosing a knot of capillaries called the glomerulus, and a long tubule that runs through the cortex and medulla. Blood is filtered in the glomerulus, and useful substances are reabsorbed from the tubule back into the blood.

Urine Formation

Urine is formed in three steps. First, filtration: blood pressure forces water, salts, glucose and urea out of the glomerulus into the Bowman's capsule. Second, reabsorption: useful substances such as glucose, most of the water and salts are reabsorbed from the tubule into the blood. Third, secretion: extra waste and hydrogen ions are secreted into the tubule. The remaining liquid is urine, which is mostly water with urea and salts.

Osmoregulation and Disorders

The kidney also controls the water and salt balance of the body, a process called osmoregulation. The hormone ADH controls how much water is reabsorbed in the kidney. Common disorders include kidney stones, which are hard masses formed in the kidney, and kidney failure, in which the kidneys stop filtering the blood. In kidney failure, dialysis is used: a machine filters the blood outside the body.

Key Definitions

Term	Definition
Excretion	The removal of nitrogenous waste and excess substances from the body.
Osmoregulation	The control of the water and salt balance of the body.
Nephron	The functional unit of the kidney in which urine is formed.
Filtration	The forcing of fluid out of the blood in the glomerulus into the Bowman's capsule.
Dialysis	The filtering of the blood by a machine when the kidneys fail.

Key Terms to Remember

Term	Meaning
Ureter	The tube that carries urine from a kidney to the bladder.
Urinary bladder	The muscular sac that stores urine.
Urethra	The tube through which urine leaves the body.
Glomerulus	A knot of capillaries in the nephron where filtration takes place.

Bowman's capsule	The cup-shaped part of the nephron that surrounds the glomerulus.
Renal pelvis	The funnel-shaped part of the kidney where urine collects.
Urea	The main nitrogenous waste in human urine, formed in the liver.
ADH	A hormone that controls the reabsorption of water in the kidney.

Multiple-Choice Questions

1. The functional unit of the kidney is the

(A) glomerulus(B) nephron(C) ureter(D) cortex

2. Filtration of blood in the kidney occurs in the

(A) tubule(B) glomerulus(C) bladder(D) urethra

3. Urea is formed in the

(A) kidney(B) liver(C) bladder(D) spleen

4. Most reabsorption in the nephron takes place in the

(A) glomerulus(B) proximal convoluted tubule(C) bladder(D) ureter

5. The tube that carries urine from the kidney to the bladder is the

(A) urethra(B) ureter(C) renal vein(D) tubule

6. The main nitrogenous waste in human urine is

(A) ammonia(B) uric acid(C) urea(D) creatinine

7. Dialysis is used when the

(A) liver fails(B) kidneys fail(C) heart fails(D) lungs fail

8. ADH controls the

(A) filtration of blood(B) reabsorption of water(C) secretion of urea(D) formation of urine in the bladder

9. The outer part of the kidney is the

(A) medulla(B) cortex(C) pelvis(D) capsule

10. Urine is stored in the

(A) kidney(B) ureter(C) urinary bladder(D) urethra

Short Questions

1. What is excretion?
   Excretion is the removal of nitrogenous waste and excess water and salts from the body.
2. Describe the structure of a nephron.
   A nephron consists of a Bowman's capsule enclosing the glomerulus, and a long tubule that runs through the cortex and medulla of the kidney.
3. How is urine formed?
   Urine is formed by filtration in the glomerulus, reabsorption of useful substances from the tubule, and secretion of extra waste into the tubule.
4. What is the function of the glomerulus?
   The glomerulus filters the blood, forcing water, salts, glucose and urea into the Bowman's capsule.
5. What is osmoregulation?
   Osmoregulation is the control of the water and salt balance of the body, mainly by the kidneys.
6. Why must urea be removed from the body?
   Urea is a poisonous nitrogenous waste; if it collects in the blood it damages the body.
7. What are kidney stones?
   Kidney stones are hard masses of salts that form in the kidney and can block the flow of urine.
8. What is dialysis?
   Dialysis is the filtering of the blood by a machine when the kidneys fail to do it.
9. What is the function of ADH?
   ADH controls how much water is reabsorbed in the kidney, so it controls the amount and concentration of urine.
10. What is the difference between the ureter and the urethra?
    The ureter carries urine from the kidney to the bladder, while the urethra carries urine out of the body.

Long Questions

1. Describe the structure of the nephron and explain how it works.
2. Explain the process of urine formation in the human kidney.
3. Describe the human urinary system and explain the role of the kidney in osmoregulation.

CHAPTER 5

Nervous System

The Neurone

The nervous system controls and coordinates the body. Its basic unit is the neurone, a cell made of a

cell body, dendrites that receive messages, and a long axon that carries messages away. Messages travel as nerve impulses. The gap between two neurones is called a synapse, across which the impulse passes with the help of chemicals. Many axons are covered by a fatty myelin sheath, which speeds up the impulse.

The Central Nervous System

The central nervous system consists of the brain and the spinal cord. The brain has three main parts. The cerebrum, the largest part, controls thinking, memory, learning and voluntary actions. The cerebellum controls balance and the coordination of muscles. The medulla controls involuntary actions such as heartbeat, breathing and swallowing. The spinal cord runs down the backbone and carries messages between the brain and the body.

The Peripheral Nervous System and Reflex Action

The peripheral nervous system is made of nerves that connect the central nervous system to the sense organs and the muscles. A reflex action is a fast, automatic response to a stimulus, such as pulling the hand away from a hot object. The path of a reflex is called the reflex arc: receptor, sensory neurone, spinal cord, motor neurone and effector. Reflexes protect the body because they act before the brain has time to think.

Sense Organs and Disorders

Sense organs receive stimuli from the environment. The eye detects light, the ear detects sound and helps with balance, and the skin, nose and tongue detect touch, smell and taste. The light-sensitive layer of the eye is the retina, and sound is detected by the ear drum and the cochlea. Common disorders of the nervous system include epilepsy, in which the brain produces sudden bursts of uncontrolled activity, and injuries that damage the spinal cord.

Key Definitions

Term	Definition
Neurone	A nerve cell that carries messages as electrical impulses.
Reflex action	A fast, automatic response to a stimulus that does not involve conscious thought.
Synapse	The tiny gap between two neurones across which a nerve impulse passes.
Central nervous system	The brain and the spinal cord, which control and coordinate the body.
Stimulus	A change in the environment that is detected by a receptor.

Key Terms to Remember

Term	Meaning
Dendrites	Short branches of a neurone that receive messages.
Axon	The long fibre of a neurone that carries impulses away from the cell body.
Myelin sheath	A fatty layer around an axon that speeds up impulses.
Cerebrum	The largest part of the brain, controlling thought and voluntary action.
Cerebellum	The part of the brain that controls balance and coordination.
Medulla oblongata	The part of the brain that controls heartbeat and breathing.
Receptor	A cell or organ that detects a stimulus.
Effector	A muscle or gland that carries out a response.

Multiple-Choice Questions

1. The structural and functional unit of the nervous system is the

(A) nephron(B) neurone(C) alveolus(D) villus

2. The gap between two neurones is called the

(A) axon(B) synapse(C) dendrite(D) myelin

3. The largest part of the human brain is the

(A) cerebellum(B) medulla(C) cerebrum(D) spinal cord

4. Balance of the body is controlled by the

(A) cerebrum(B) cerebellum(C) medulla(D) hypothalamus

5. A reflex action is controlled mainly by the

(A) brain(B) spinal cord(C) cerebellum(D) medulla

6. A nerve impulse travels along a neurone as

(A) a chemical only(B) an electrical signal(C) a blood flow(D) a hormone

7. The part of the brain that controls heartbeat is the

(A) cerebrum(B) cerebellum(C) medulla(D) pons

8. Sensory neurones carry impulses

(A) from the CNS to muscles(B) to the CNS from receptors(C) between two muscles(D) to the heart

9. The myelin sheath

(A) slows down impulses(B) speeds up impulses(C) produces impulses(D) blocks impulses

10. The light-sensitive layer of the eye is the

(A) cornea(B) lens(C) iris(D) retina

Short Questions

1. Describe the structure of a neurone.
   A neurone has a cell body, dendrites that receive messages, and a long axon that carries impulses away from the cell body.
2. What is a reflex arc?
   A reflex arc is the path of a reflex: receptor, sensory neurone, spinal cord, motor neurone and effector.
3. What are the functions of the cerebrum?
   The cerebrum controls thinking, memory, learning, speech and voluntary actions.
4. What are the functions of the cerebellum?
   The cerebellum controls balance and the coordination of muscle movements.
5. What is the difference between the central and peripheral nervous systems?
   The central nervous system is the brain and spinal cord, while the peripheral nervous system is the nerves that connect it to the rest of the body.
6. What is a synapse?
   A synapse is the tiny gap between two neurones across which a nerve impulse passes with the help of chemicals.
7. What is the function of the medulla?
   The medulla controls involuntary actions such as heartbeat, breathing and swallowing.
8. How do sense organs work?
   Sense organs contain receptors that detect stimuli such as light, sound, touch, smell and taste and send impulses to the brain.
9. What is a stimulus?
   A stimulus is a change in the environment, such as heat, light or sound, that is detected by a receptor.
10. What is the function of the spinal cord?
    The spinal cord carries messages between the brain and the body and controls reflex actions.

Long Questions

1. Describe the structure of a neurone and explain how a nerve impulse travels from one neurone to another.
2. Explain reflex action with the help of the reflex arc, giving one example.
3. Describe the parts of the human brain and the function of each part.

CHAPTER 6

Reproduction

Asexual Reproduction

Reproduction is the process by which living things produce new individuals of their own kind. In asexual reproduction, a single parent produces offspring without gametes, and the offspring are genetically identical to the parent. Common methods are binary fission in Amoeba, budding in Hydra and yeast, fragmentation in Spirogyra, spore formation in fungi, and vegetative propagation in plants, for example new plants growing from potato tubers or stem cuttings.

Sexual Reproduction in Plants

In sexual reproduction, male and female gametes fuse to form a zygote. A flower has male parts, the stamens, which produce pollen grains, and female parts, the carpels, which contain ovules. Pollination is the transfer of pollen to the stigma. After pollination, a pollen tube grows down to the ovule and fertilisation takes place. The ovule becomes a seed and the ovary becomes a fruit.

Human Reproduction

In humans, the male reproductive system produces sperms in the testes, and the female system produces ova in the ovaries. Fertilisation takes place in the fallopian tube, where a sperm fuses with an ovum to form a zygote. The zygote divides and forms an embryo, which implants in the wall of the uterus and develops into a foetus. After about nine months the baby is born. Birth control methods, such as condoms, prevent fertilisation.

Sexually Transmitted Diseases

Some diseases spread through sexual contact and are called sexually transmitted diseases. Examples are AIDS, caused by the HIV virus, and gonorrhoea, caused by bacteria. These diseases can be prevented by avoiding unsafe sexual contact and by proper treatment. Education and awareness are the best protection, and infected persons need medical care and support, not blame.

Key Definitions

Term	Definition
Reproduction	The process by which living things produce new individuals of their own kind.
Pollination	The transfer of pollen grains from the anther to the stigma of a flower.
Fertilisation	The fusion of a male gamete and a female gamete to form a zygote.

Zygote	The single cell formed by the fusion of a sperm and an ovum.
Vegetative propagation	Asexual reproduction in plants from a stem, root, leaf or tuber.

Key Terms to Remember

Term	Meaning
Stamen	The male part of a flower that produces pollen.
Carpel	The female part of a flower that contains the ovules.
Ovule	The part of the carpel that becomes a seed after fertilisation.
Pollen grain	The male gamete carrier produced in the anther.
Testis	The male organ that produces sperms.
Ovary	The female organ that produces ova.
Uterus	The organ in which the embryo develops.
Embryo	The early stage of development after fertilisation.

Multiple-Choice Questions

1. Pollination is the transfer of pollen to the

(A) ovary(B) stigma(C) anther(D) ovule

2. Fertilisation in humans occurs in the

(A) uterus(B) ovary(C) fallopian tube(D) vagina

3. The male gamete in humans is the

(A) ovum(B) sperm(C) zygote(D) embryo

4. Binary fission occurs in

(A) Hydra(B) Amoeba(C) yeast(D) Spirogyra

5. The female reproductive cell is the

(A) sperm(B) ovum(C) zygote(D) pollen

6. The human embryo develops in the

(A) ovary(B) fallopian tube(C) uterus(D) vagina

7. Budding is seen in

(A) Amoeba(B) Hydra(C) Paramecium(D) moss

8. The part of the flower that produces pollen is the

(A) stigma(B) ovary(C) anther(D) petal

9. After fertilisation the ovule becomes a

(A) fruit(B) seed(C) flower(D) embryo

10. Vegetative propagation in potato is by

(A) seeds(B) leaves(C) tubers(D) flowers

Short Questions

1. What is the difference between asexual and sexual reproduction?
   Asexual reproduction needs one parent and produces identical offspring, while sexual reproduction needs two gametes and produces offspring that differ from the parents.
2. What is pollination?
   Pollination is the transfer of pollen grains from the anther to the stigma of a flower.
3. What are the types of pollination?
   Self-pollination, in which pollen goes to a flower of the same plant, and cross-pollination, in which pollen goes to a flower of another plant of the same kind.
4. Describe the structure of a flower.
   A flower has sepals, petals, stamens (male parts) and carpels (female parts), usually on a stalk.
5. What is fertilisation?
   Fertilisation is the fusion of a male gamete and a female gamete to form a zygote.
6. What is the function of the testis and the ovary?
   The testis produces sperms and the male hormone, while the ovary produces ova and female hormones.
7. What is a zygote?
   A zygote is the single cell formed when a sperm fuses with an ovum.
8. Name two methods of asexual reproduction.
   Binary fission in Amoeba and budding in Hydra.
9. What is vegetative propagation?
   Vegetative propagation is asexual reproduction in plants from a stem, root, leaf or tuber, for example potato tubers.
10. How are seeds formed?
    After fertilisation, the ovule becomes a seed and the ovary becomes a fruit.

Long Questions

1. Describe sexual reproduction in flowering plants, from pollination to seed formation.
2. Describe the human male and female reproductive systems and their functions.
3. Explain fertilisation and the development of the embryo in humans.

CHAPTER 7

Inheritance

Chromosomes, Genes and DNA

Inheritance is the passing of traits from parents to offspring. The instructions for these traits are carried by genes, which are sections of DNA on chromosomes. Humans have 46 chromosomes in each body cell, arranged in 23 pairs. A gene can have different forms, called alleles. The combination of alleles an organism has is its genotype, and the trait that is seen is its phenotype.

Mendel's Laws

Gregor Mendel studied inheritance using pea plants. His law of dominance says that in a cross between two pure parents, only the dominant trait appears in the first generation. His law of segregation says that the two alleles of a gene separate during gamete formation, so each gamete carries only one allele. His law of independent assortment says that alleles of different genes are inherited independently of each other.

Punnett Squares and Sex Determination

A Punnett square is a diagram used to predict the offspring of a cross. In a monohybrid cross between two heterozygous parents, the phenotypic ratio is 3:1 and the genotypic ratio is 1:2:1. Sex in humans is determined by the sex chromosomes: females have XX and males have XY. A child gets an X chromosome from the mother and either an X or a Y from the father, so the father decides the sex of the child.

Mutations and Genetic Disorders

A mutation is a sudden change in a gene or chromosome. Mutations cause variation, and some cause genetic disorders. Haemophilia is a disorder in which the blood does not clot properly, colour blindness is the inability to tell some colours apart, and thalassaemia is a disorder of haemoglobin. These disorders are inherited, and their study helps families to understand the risk to their children.

Key Formulae

> Monohybrid cross, two heterozygous parents: phenotypic ratio = 3 dominant : 1 recessive.

> Monohybrid cross, two heterozygous parents: genotypic ratio = 1 homozygous dominant : 2 heterozygous : 1 homozygous recessive.

Key Definitions

Term	Definition
Gene	A section of DNA on a chromosome that controls a particular trait.
Allele	One of the different forms of a gene.
Genotype	The combination of alleles an organism has for a trait.
Phenotype	The trait that is seen or expressed in an organism.
Mutation	A sudden change in a gene or in the structure or number of chromosomes.

Key Terms to Remember

Term	Meaning
Chromosome	A thread-like structure in the nucleus that carries genes.
DNA	The chemical that carries genetic information.
Dominant	An allele that is expressed even when only one copy is present.
Recessive	An allele that is expressed only when two copies are present.
Homozygous	Having two identical alleles for a gene.
Heterozygous	Having two different alleles for a gene.
Hybrid	The offspring of parents that differ in a trait.
Heredity	The passing of traits from parents to offspring.

Multiple-Choice Questions

1. The basic unit of heredity is the

(A) chromosome(B) gene(C) cell(D) nucleus

2. Mendel worked on the inheritance of traits in the

(A) pea plant(B) rose plant(C) mouse(D) fruit fly

3. The phenotypic ratio of a monohybrid cross between two heterozygous parents is

(A) 1:1(B) 1:2:1(C) 3:1(D) 2:1

4. Human body cells have

(A) 23 chromosomes(B) 44 chromosomes(C) 46 chromosomes(D) 48 chromosomes

5. Sex in humans is determined by the

(A) mother's ovum(B) father's sperm(C) uterus(D) placenta

6. Alternative forms of a gene are called

(A) chromosomes(B) alleles(C) genotypes(D) phenotypes

7. Colour blindness is a

(A) sex-linked disorder(B) infectious disease(C) deficiency disease(D) bacterial disease

8. The chemical that carries genetic information is

(A) protein(B) RNA only(C) DNA(D) lipid

9. A sudden change in a gene is called a

(A) variation(B) mutation(C) cross(D) hybrid

10. The offspring of two pure parents is called the

(A) F2 generation(B) hybrid (F1) generation(C) mutant(D) clone

Short Questions

1. What is a gene?
   A gene is a section of DNA on a chromosome that controls a particular trait.
2. What is the difference between genotype and phenotype?
   Genotype is the combination of alleles an organism has, while phenotype is the trait that is actually seen.
3. What is Mendel's law of segregation?
   The law of segregation says that the two alleles of a gene separate during gamete formation, so each gamete carries only one allele.
4. What is a Punnett square?
   A Punnett square is a diagram used to predict the possible genotypes and phenotypes of the offspring of a cross.
5. How is sex determined in humans?
   Females have XX chromosomes and males have XY. A child gets X from the mother and X or Y from the father, so the father decides the sex.

6. What is a mutation?
   A mutation is a sudden change in a gene or in the structure or number of chromosomes.
7. What is the difference between a dominant and a recessive allele?
   A dominant allele is expressed even with one copy, while a recessive allele is expressed only when two copies are present.
8. What is the difference between homozygous and heterozygous?
   Homozygous means having two identical alleles for a gene, while heterozygous means having two different alleles.
9. What is variation?
   Variation is the differences between individuals of the same species, caused by genes and the environment.
10. Name two genetic disorders.
    Haemophilia and colour blindness (also thalassaemia).

Long Questions

1. Explain Mendel's laws of inheritance with the help of a monohybrid cross.
2. Explain how sex is determined in humans, using the sex chromosomes.
3. Describe mutations and their effects, giving examples of genetic disorders.

CHAPTER 8

Diseases

What is Disease?

A disease is a condition in which the body does not work normally. Diseases are of two main kinds. Infectious diseases spread from one person to another and are caused by germs such as bacteria, viruses, fungi and protozoa. Non-infectious diseases do not spread, and include deficiency diseases, genetic disorders and diseases caused by a poor lifestyle. A disease-causing organism is called a pathogen.

Common Infectious Diseases

Cholera and typhoid spread through contaminated food and water. Malaria is caused by the protozoan Plasmodium and spread by the bite of the female Anopheles mosquito. Tuberculosis is a bacterial infection that mainly affects the lungs and spreads through the air. Hepatitis is a viral infection of the liver. Dengue is a viral disease spread by the Aedes mosquito. AIDS is caused by the HIV virus, which weakens the immune system.

Prevention and Control

Infectious diseases can be prevented by clean water, proper sanitation, washing hands, covering food, controlling mosquitoes, and vaccination. Antibiotics are medicines that kill bacteria or stop their growth, but they do not work against viruses. Vaccines protect the body by training the immune system to recognise a germ before the real infection arrives. Early treatment and isolation of patients help to stop a disease from spreading.

Epidemics

When a disease spreads rapidly among many people in an area, it is called an epidemic. Cholera, dengue and influenza have caused epidemics in the past. Public health measures such as clean drinking water, waste disposal, mosquito control and vaccination campaigns are used to control epidemics. Knowing how a disease spreads is the first step in stopping it.

Key Definitions

Term	Definition
Disease	A condition in which the body does not work normally.
Pathogen	A disease-causing organism, such as a bacterium, virus, fungus or protozoan.
Epidemic	The rapid spread of a disease among many people in an area.
Vector	An organism, such as a mosquito, that carries a disease from one person to another.
Antibiotic	A medicine that kills bacteria or stops their growth.

Key Terms to Remember

Term	Meaning
Bacteria	Single-celled organisms, some of which cause disease.
Virus	A tiny infectious particle that can only reproduce inside a living cell.
Fungus	An organism such as a mould or yeast; some cause skin and other diseases.
Protozoa	Single-celled organisms, some of which cause diseases such as malaria.
Cholera	A bacterial disease spread by contaminated water and food.
Malaria	A disease caused by Plasmodium and spread by the Anopheles mosquito.
Tuberculosis	A bacterial infection that mainly affects the lungs.
Hepatitis	A viral infection of the liver.

Multiple-Choice Questions

1. Malaria is caused by

(A) a bacterium(B) a virus(C) a protozoan (Plasmodium)(D) a fungus

2. Malaria is spread by the bite of the

(A) male Anopheles mosquito(B) female Anopheles mosquito(C) Aedes mosquito(D) housefly

3. Cholera spreads through

(A) air(B) contaminated water and food(C) mosquito bites(D) direct touch only

4. Tuberculosis mainly affects the

(A) liver(B) kidneys(C) lungs(D) brain

5. AIDS is caused by

(A) a bacterium(B) HIV, a virus(C) a fungus(D) a protozoan

6. Antibiotics kill

(A) viruses(B) bacteria(C) protozoa only(D) fungi only

7. Hepatitis affects the

(A) lungs(B) liver(C) kidneys(D) heart

8. Dengue is spread by the

(A) Anopheles mosquito(B) Aedes mosquito(C) housefly(D) flea

9. Typhoid is caused by

(A) Salmonella bacteria(B) a virus(C) a fungus(D) Plasmodium

10. A disease that spreads from person to person is called

(A) genetic(B) infectious (communicable)(C) deficiency(D) non-infectious

Short Questions

1. What is the difference between infectious and non-infectious diseases?
   Infectious diseases spread from person to person and are caused by germs, while non-infectious diseases do not spread.
2. What is a pathogen?
   A pathogen is a disease-causing organism, such as a bacterium, virus, fungus or protozoan.
3. How does cholera spread?

Cholera spreads through water and food contaminated with the cholera bacterium.

4. How can malaria be prevented?
   Malaria can be prevented by controlling mosquitoes, using mosquito nets, removing standing water, and taking treatment early.
5. What is an epidemic?
   An epidemic is the rapid spread of a disease among many people in an area.
6. How do antibiotics work?
   Antibiotics kill bacteria or stop them from growing; they do not work against viruses.
7. What is vaccination?
   Vaccination is giving a weakened or dead germ, or part of it, so that the immune system learns to fight the real germ.
8. How does tuberculosis spread?
   Tuberculosis spreads through the air when an infected person coughs or sneezes.
9. What is dengue?
   Dengue is a viral disease spread by the bite of the Aedes mosquito, causing high fever and body pain.
10. Why is clean drinking water important?
    Clean water prevents water-borne diseases such as cholera and typhoid.

Long Questions

1. Describe the cause, spread, symptoms and prevention of malaria.
2. Describe the cause, spread and prevention of cholera and typhoid.
3. Explain the role of antibiotics and vaccines in controlling infectious diseases.

CHAPTER 9

Immunity

What is Immunity?

Immunity is the ability of the body to defend itself against germs and other foreign substances. The immune system recognises anything that does not belong to the body, called an antigen, and destroys it. Immunity can be innate, which is present from birth and gives general protection, or adaptive, which develops after exposure to a germ and gives specific, long-lasting protection.

The Three Lines of Defence

The body defends itself in three lines. The first line is the skin and the mucus membranes, which act as physical barriers. The second line is non-specific: phagocytes engulf germs, inflammation walls off an infection, and fever makes the body less suitable for germs. The third line is specific: lymphocytes

recognise particular antigens and produce antibodies against them, and memory cells remember the germ for a faster response next time.

Antibodies, Lymphocytes and Vaccination

B lymphocytes produce antibodies, which are proteins that bind to antigens and mark them for destruction. T lymphocytes attack infected cells directly. After an infection, memory cells remain in the body, so a second attack by the same germ is met with a faster and stronger response. Vaccination uses this memory: a vaccine contains a weakened or dead germ, or part of it, and trains the immune system without causing the disease.

Active, Passive Immunity and Allergies

Immunity gained by making your own antibodies, after infection or vaccination, is active immunity and lasts a long time. Immunity gained by receiving ready-made antibodies, for example from the mother's milk or an injection, is passive immunity and lasts only a short time. Sometimes the immune system overreacts to a harmless substance such as pollen or dust; this overreaction is called an allergy.

Key Definitions

Term	Definition
Immunity	The ability of the body to defend itself against germs and foreign substances.
Antigen	A foreign substance, usually on the surface of a germ, that triggers an immune response.
Antibody	A protein produced by lymphocytes that binds to a specific antigen and marks it for destruction.
Vaccine	A preparation of a weakened or dead germ, or part of it, given to produce immunity without causing disease.
Phagocytosis	The engulfing and digestion of germs by phagocyte cells.

Key Terms to Remember

Term	Meaning
Lymphocyte	A white blood cell that produces antibodies or attacks infected cells.
Macrophage	A large phagocyte that engulfs germs and dead cells.
Inflammation	Redness, swelling, heat and pain at the site of an infection or injury.
Memory cell	A lymphocyte that remembers a germ for a faster response later.

Active immunity	Immunity from making your own antibodies.
Passive immunity	Immunity from receiving ready-made antibodies.
Allergy	An overreaction of the immune system to a harmless substance.
Immunisation	The process of making a person immune, usually by vaccination.

Multiple-Choice Questions

1. Antibodies are produced by

(A) red blood cells(B) platelets(C) lymphocytes (B cells)(D) phagocytes only

2. The first line of defence of the body is the

(A) phagocytes(B) skin and mucus membranes(C) antibodies(D) fever

3. Vaccination gives

(A) passive immunity(B) active immunity(C) no immunity(D) natural immunity only

4. Phagocytes destroy germs by

(A) producing antibodies(B) engulfing them(C) raising the temperature(D) blocking the blood

5. The cells that produce antibodies are

(A) T lymphocytes(B) B lymphocytes(C) red blood cells(D) platelets

6. Memory cells help in

(A) a faster response on second exposure(B) producing red cells(C) blood clotting(D) digestion

7. An antigen is

(A) an antibody(B) a foreign substance that triggers immunity(C) a white blood cell(D) a vaccine

8. Passive immunity is got from

(A) mother's milk or antiserum(B) vaccination(C) an infection(D) a fever

9. Inflammation is the body's

(A) first line of defence(B) response to injury or infection(C) production of antibodies(D) loss of blood

10. An allergy is

(A) a deficiency disease(B) an overreaction of the immune system(C) a bacterial infection(D) a genetic disorder

Short Questions

1. What is immunity?
   Immunity is the ability of the body to defend itself against germs and foreign substances.
2. What is the first line of defence?
   The first line of defence is the skin and the mucus membranes, which act as physical barriers against germs.
3. What is the second line of defence?
   The second line is non-specific defence: phagocytes, inflammation and fever.
4. What are antibodies?
   Antibodies are proteins made by lymphocytes that bind to a specific antigen and mark it for destruction.
5. What is the difference between active and passive immunity?
   Active immunity comes from making your own antibodies and lasts long, while passive immunity comes from ready-made antibodies and lasts only a short time.
6. How does vaccination work?
   A vaccine trains the immune system with a weakened or dead germ, so that memory cells give a fast, strong response when the real germ arrives.
7. What are lymphocytes?
   Lymphocytes are white blood cells: B cells produce antibodies and T cells attack infected cells.
8. What is the function of phagocytes?
   Phagocytes engulf and digest germs and dead cells.
9. What is an allergy?
   An allergy is an overreaction of the immune system to a harmless substance such as pollen or dust.
10. Why is the second exposure to a germ usually milder?
    Because memory cells from the first exposure give a faster and stronger immune response.

Long Questions

1. Describe the three lines of defence of the human body against germs.
2. Explain how vaccination produces immunity in the body.
3. Describe the role of lymphocytes and antibodies in adaptive immunity.

CHAPTER 10

Biotechnology

What is Biotechnology?

Biotechnology is the use of living organisms, cells or their parts to make useful products. It is an old

science: people have used yeast to make bread and bacteria to make yoghurt for centuries. Modern biotechnology uses genetic engineering, in which the genes of an organism are changed to give it a new, useful trait.

Genetic Engineering

In genetic engineering, a useful gene is isolated from one organism and inserted into another, often with the help of a plasmid, a small circular piece of DNA in bacteria. The organism that receives the gene is called transgenic. A famous example is the production of human insulin: the human insulin gene is inserted into bacteria, which then produce insulin for people with diabetes.

Applications in Medicine and Agriculture

In medicine, biotechnology produces insulin, vaccines, antibiotics and growth hormones, and it is used to diagnose genetic diseases. In agriculture, it produces crops that resist pests and diseases, give higher yields, or grow in poor soil. Tissue culture grows many new plants from a small piece of plant tissue, which helps to produce healthy, disease-free plants quickly.

Fermentation and Ethics

Fermentation is a process in which microorganisms break down sugars without oxygen. Yeast ferments sugar to make bread rise and to produce alcohol, and bacteria ferment milk to make yoghurt and cheese. Biotechnology raises questions too: people ask whether genetically modified food is safe, whether cloning is right, and who should control the new technology. These questions need open discussion and honest science.

Key Definitions

Term	Definition
Biotechnology	The use of living organisms or their parts to make useful products.
Genetic engineering	Changing the genes of an organism to give it a new, useful trait.
Recombinant DNA	DNA made by joining DNA from two different sources.
Cloning	Producing genetically identical copies of a cell or an organism.
Fermentation	The breakdown of sugars by microorganisms without using oxygen.

Key Terms to Remember

Term	Meaning
Gene	A section of DNA that controls a trait.

Plasmid	A small circular piece of DNA in bacteria, used as a vector in genetic engineering.
Vector	A carrier, such as a plasmid, that transfers a gene into a cell.
Insulin	A hormone that controls blood sugar; made by biotechnology for diabetics.
Tissue culture	Growing plants from small pieces of tissue in a nutrient medium.
Transgenic	An organism that carries a gene from another organism.
Fermenter	A large vessel in which microorganisms are grown for industrial production.
GMO	A genetically modified organism.

Multiple-Choice Questions

1. Insulin for diabetics is now produced by

(A) the pancreas of animals(B) genetically engineered bacteria(C) yeast in bread(D) plants

2. Recombinant DNA is made by joining

(A) two cells(B) DNA from two sources(C) two proteins(D) two chromosomes of the same cell

3. Tissue culture is used to grow

(A) animals only(B) plants from small pieces of tissue(C) bacteria only(D) seeds only

4. Fermentation is carried out by

(A) viruses(B) yeast and bacteria(C) algae only(D) protozoa only

5. A transgenic organism carries

(A) a foreign gene(B) no genes(C) only its own genes(D) a virus

6. Cloning produces

(A) different offspring(B) genetically identical copies(C) hybrids(D) mutants only

7. The small circular DNA in bacteria used in genetic engineering is the

(A) chromosome(B) plasmid(C) gene(D) nucleus

8. Yoghurt is made by fermentation of

(A) bread(B) milk(C) fruit juice(D) rice

9. GM crops are developed to

(A) resist pests and increase yield(B) grow without water(C) produce seeds only(D) stop photosynthesis

10. The first step in genetic engineering is

(A) inserting the gene(B) isolating the useful gene(C) growing the bacteria(D) harvesting the product

Short Questions

1. What is biotechnology?
   Biotechnology is the use of living organisms, cells or their parts to make useful products.
2. What is genetic engineering?
   Genetic engineering is changing the genes of an organism to give it a new, useful trait.
3. How is insulin made by biotechnology?
   The human insulin gene is inserted into bacteria using a plasmid, and the bacteria then produce human insulin.
4. What is tissue culture?
   Tissue culture is growing many new plants from a small piece of plant tissue in a nutrient medium.
5. What is fermentation?
   Fermentation is the breakdown of sugars by microorganisms such as yeast and bacteria without using oxygen.
6. Name two uses of biotechnology in agriculture.
   Producing pest-resistant crops and producing disease-free plants by tissue culture.
7. Name two uses of biotechnology in medicine.
   Producing insulin and producing vaccines.
8. What is a plasmid?
   A plasmid is a small circular piece of DNA in bacteria, used as a vector to carry a gene into a cell.
9. What is cloning?
   Cloning is producing genetically identical copies of a cell or an organism.
10. Name one ethical concern about biotechnology.
    People ask whether genetically modified food is safe and whether cloning is right; such questions need open discussion.

Long Questions

1. Describe the steps of genetic engineering, using the production of human insulin as an example.
2. Describe the applications of biotechnology in agriculture and medicine.
3. Explain fermentation and its uses in food production.

CHAPTER 11

Biostatistics and Data Analysis

What is Biostatistics?

Biostatistics is the use of statistics in biology. Biologists collect data, such as the heights of plants, the number of seeds in a fruit, or the pulse rates of students, and use statistics to describe it and to draw conclusions. Statistics helps a biologist to see patterns in data that are hard to see by looking at single measurements.

Mean, Median and Mode

The mean is the average of a set of values: add all the values and divide by the number of values. The median is the middle value when the values are arranged in order. The mode is the value that occurs most often. These three measures describe the centre of a set of data, and each is useful in different situations.

Range and Frequency Distribution

The range is the difference between the highest and lowest values in a set of data, and it shows how spread out the data is. A frequency distribution is a table that shows how often each value, or each group of values, occurs. From a frequency table, a bar chart or a histogram can be drawn to show the data as a picture.

Presenting and Interpreting Data

Data can be presented in tables, bar charts, histograms and line graphs. A bar chart compares categories, a histogram shows the distribution of measured values, and a line graph shows how something changes over time. When reading a graph, check the title, the labels on the axes, and the scale, and then describe what the pattern shows in words.

Key Formulae

> Mean = sum of all values / number of values.

> Range = highest value - lowest value.

Key Definitions

Term	Definition
Biostatistics	The use of statistical methods to collect, organise and interpret biological data.
Mean	The average of a set of values, found by dividing the sum of the values by the number of

	values.
Median	The middle value of a set of values arranged in order.
Mode	The value that occurs most often in a set of data.
Data	Facts or measurements collected for study.

Key Terms to Remember

Term	Meaning
Frequency	How often a value occurs in a set of data.
Frequency distribution	A table showing how often each value or group of values occurs.
Bar chart	A graph that uses bars to compare categories.
Histogram	A graph that shows the distribution of measured values.
Sample	A part of a population that is studied.
Population	The whole group being studied.
Variable	A quantity that can take different values.
Range	The difference between the highest and lowest values.

Multiple-Choice Questions

1. The mean of 2, 4 and 6 is

(A) 3(B) 4(C) 5(D) 6

2. The mode is the value that

(A) is in the middle(B) occurs most often(C) is the largest(D) is the smallest

3. The median of 3, 5 and 7 is

(A) 3(B) 4(C) 5(D) 7

4. A bar chart is used to show

(A) change over time(B) comparison of categories(C) the mean only(D) the range only

5. The range of 5, 9 and 12 is

(A) 4(B) 5(C) 7(D) 12

6. Biostatistics is the use of statistics in

(A) mathematics only(B) biology(C) chemistry only(D) physics only

7. The middle value of a set of data arranged in order is the

(A) mean(B) mode(C) median(D) range

8. Frequency means

(A) the largest value(B) how often a value occurs(C) the average(D) the total

9. The mean of 10, 20 and 30 is

(A) 10(B) 15(C) 20(D) 30

10. Data collected directly from the source is called

(A) secondary data(B) primary data(C) grouped data(D) old data

Short Questions

1. What is biostatistics?
   Biostatistics is the use of statistical methods to collect, organise and interpret biological data.
2. Define the mean.
   The mean is the average of a set of values, found by dividing the sum of the values by the number of values.
3. Define the median.
   The median is the middle value of a set of values arranged in order.
4. Define the mode.
   The mode is the value that occurs most often in a set of data.
5. How is the range calculated?
   The range is the highest value minus the lowest value in a set of data.
6. What is a frequency distribution?
   A frequency distribution is a table that shows how often each value, or each group of values, occurs.
7. What are bar charts used for?
   Bar charts use bars to compare different categories of data.
8. What is the difference between primary and secondary data?
   Primary data is collected directly from the source, while secondary data is taken from data already collected by others.
9. What is a sample?
   A sample is a part of a population that is studied to learn about the whole population.
10. Why is statistics useful in biology?
    Statistics helps biologists to describe data, see patterns, and draw conclusions from measurements.

Long Questions

1. Explain the mean, median and mode with one example for each.
2. Describe how to make a frequency distribution table and a bar chart from a set of biological data.
3. Explain the importance of biostatistics in biology, giving examples.

MCQ Answer Key (all chapters)

Chapter 1 — Digestive System

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

Chapter 2 — Circulatory System

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

Chapter 3 — Respiratory System

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

Chapter 4 — Urinary System

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

Chapter 5 — Nervous System

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

Chapter 6 — Reproduction

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

Chapter 7 — Inheritance

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

Chapter 8 — Diseases

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

Chapter 9 — Immunity

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

Chapter 10 — Biotechnology

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

Chapter 11 — Biostatistics and Data Analysis

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

End of book. Good luck with your studies.