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STRUCTURAL ORGANISATION IN ANIMALS

SYLLABUS

Animal tissues; Morphology, anatomy and functions of different systems (digestive, circulatory, respiratory, nervous and reproductive) of an insect (cockroach). (Brief account only)

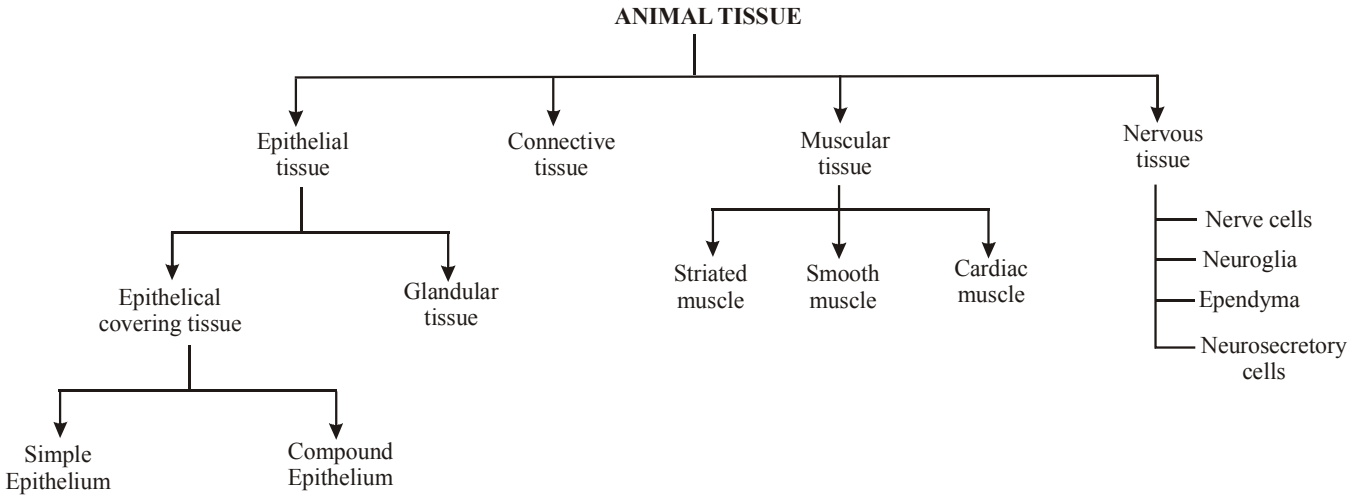
KEY CONCEPTS

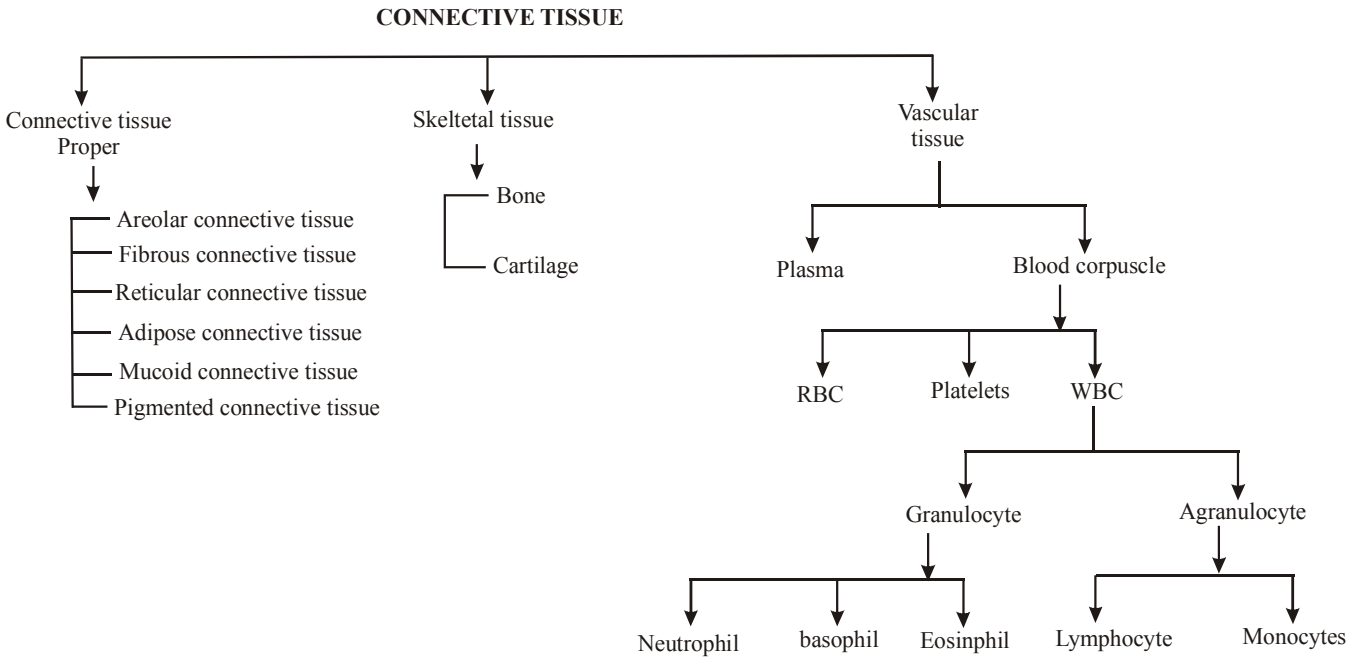
INTRODUCTION

* In multicellular animals, a group of similar cells alongwith intercellular substances perform a specific function. Such an organisation is called tissue.
* All complex animals consist of only four basic types of tissues. These tissues are organised in specific proportion and pattern to form an organ like stomach, lung, heart and kidney.
* When two or more organs perform a common function by their physical and/or chemical interaction, they together form organ system, e.g., digestive system, respiratory system, etc.

ANIMAL TISSUES

* The structure of the cells vary according to their function. Therefore, the tissues are different and are broadly classified into four types : (i) Epithelial, (ii) Connective, (iii) Muscular and (iv) Neural.





Kinds of Tissues

On the basis of function and location the tissues are of four types

Types	Origin	Function
1. Epithelial tissue	Ectoderm, endoderm, mesoderm	Protection, secretion, absorption, excretion, reproduction.
2. Connective tissue	Mesoderm	Attachment, support, storage.
3. Muscular tissue	Mesoderm	Movement of body part and locomotion.
4. Nervous tissue	Ectoderm	Control coordination by nerve impulse.

Epithelial Tissue

* Tissue has a free surface, which faces either a body fluid or the outside environment and thus provides a covering or a lining for some part of the body. The cells are compactly packed with little intercellular matrix.
* There are two types of epithelial tissues namely simple epithelium and compound epithelium. Simple epithelium is composed of a single layer of cells and functions as a lining for body cavities, ducts, and tubes. The compound epithelium consists of two or more cell layers and has protective function as it does in our skin.

* **Differences between simple and compound epithelium**

S.No.	Simple Epithelium	Compound Epithelium
1.	It consists of a single layer of cells.	It consists of more than one layer of cells.
2.	All the cells rest on the basement membrane.	Only cells of the deepest layer rest on the basement membrane.
3.	It is present over surfaces where wear and tear are little.	It is found over surfaces subject to wear and tear.
4.	It takes part in secretion, excretion and absorption.	It has little role in secretion, excretion and absorption.

* On the basis of structural modification of the cells, simple epithelium is further divided into three types. These are (i) Squamous, (ii) Cuboidal, (iii) Columnar.

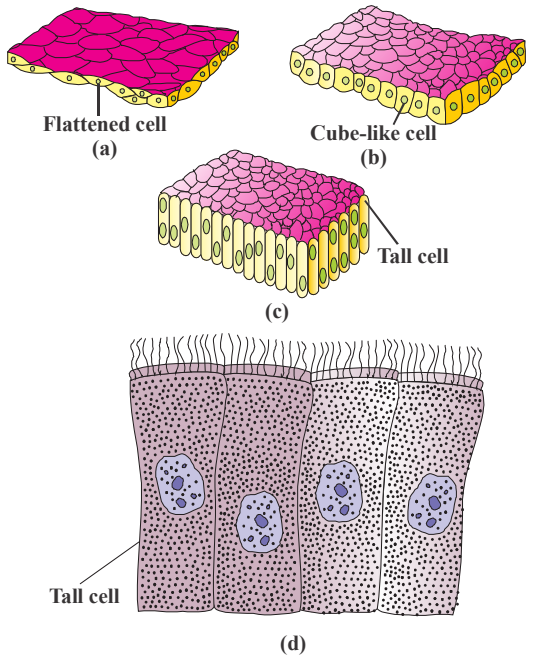


Figure : Simple epithelium: (a) Squamous (b) Cuboidal (c) Columnar (d) Columnar cells bearing cilia

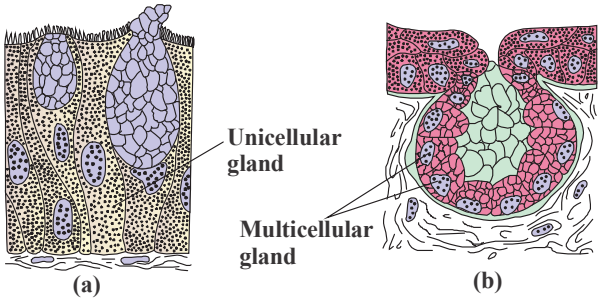


Fig: Glandular epithelium : (a) Unicellular (b) Multicellular

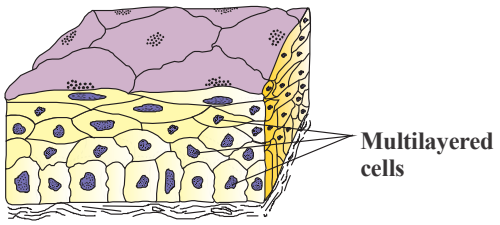


Figure : Compound epithelium

* The squamous epithelium is made of a single thin layer of flattened cells with irregular boundaries. They are found in the walls of blood vessels and air sacs of lungs and are involved in a functions like forming a diffusion boundary.
* The cuboidal epithelium is composed of a single layer of cube-like cells. This is commonly found in ducts of glands and tubular parts of nephrons in kidneys and its main functions are secretion and absorption. The epithelium of proximal convoluted tubule (PCT) of nephron in the kidney has microvilli.
* The columnar epithelium is composed of a single layer of tall and slender cells. Their nuclei are located at the base. Free surface may have microvilli. They are found in the lining of stomach and intestine and help in secretion and absorption. If the columnar or cuboidal cells bear cilia on their free surface they are called **ciliated epithelium**. Their function is to move particles or mucus in a specific direction over the epithelium. They are mainly present in the inner surface of hollow organs like bronchioles and fallopian tubes.

  Some of the columnar or cuboidal cells get specialised for secretion and are called **glandular epithelium**. They are mainly of two types: unicellular, consisting of isolated glandular cells (goblet cells of the alimentary canal), and multicellular, consisting of cluster of cells (salivary gland).

* **Compound epithelium** is made of more than one layer (multi-layered) of cells and thus has a limited role in secretion and absorption. Their main function is to provide protection against chemical and mechanical stresses. They cover the dry surface of the skin, the moist surface of buccal cavity, pharynx, inner lining of ducts of salivary glands and of pancreatic ducts.
* **Stratified squamous keratinised epithelium:** Stratified squamous epithelium is characterized by multiple layers of cells with typical flattened squamous cells at the free or outer surface of the sheet. The presence of keratin in these cells contributes to the protective qualities of skin covering the body surface. Keratin is dead and waterproof so it protects the underlying tissues from abrasion and infection e.g. epidermis of the skin of land vertebrates.
* **Stratified squamous non keratinised epithelium:** Its free surface is moist, and the outer epithelial cells, unlike those found in the skin, do not contain keratin.

This type of epithelium serves a protective function. It is found in lining the oral cavity (buccal cavity), pharynx, oesophagus, anal canal, lowerpart of urethra, vocal cords, vagina, cervix (lower part of uterus) and cornea of eyes.

* **Stratified columnar epithelium :** It is protective epithelium has multiple layers of columnar cells, only the most superficial cells are truly columnar in appearance. Epithelium of this type is rare. It is found in male urethra and in the mucous layer near the anus. It also lines mammary gland ducts and epiglottis.

* **Transitional epithelium (Urothelium) :** It is often ten or more layers thick. It lacks germinative layer, basement membrane. Stratified transitional epithelium is typically found in the body areas such as the wall of urinary bladder, ureter and renal pelvis.
It is located in all the hollow viscera subjected to stress and protects organ wall from tearing.

* **Neurosensory epithelium :** Olfactory mucosa, called Schneiderian membrane, lining of internal nares, retina of eyes and epithelial covering of tongue containing taste buds are examples of neurosensory epithelia. The sensory cells bear, at their free ends, slender "sensory hairs" to receive specific stimuli. Basely, these cells are connected, by means of synapses, with fine fibrils of sensory nerves.

* **Pigmented epithelium :** The epithelial cells of the basal layer of retina contain pigment. Hence, this layer is often referred to as a pigmented epithelium.
e.g. - Pigmented layer of retina, iris and skin.

* **Germinal epithelium :** Specialized cuboidal cells capable of producing gametes as found in gonads. Germinal epithelium produces gametes e.g., ova (Female gametes) and sperms (Male gametes)

* All cells in epithelium are held together with little intercellular material. In nearly all animal tissues, specialised junctions provide both structural and functional links between its individual cells.

* Three types of cell junctions are found in the epithelium and other tissues. These are called as tight, adhering and gap junctions.

* Tight junctions help to stop substances from leaking across a tissue.

* Adhering junctions perform cementing to keep neighbouring cells together.

* Gap junctions facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells, for rapid transfer of ions, small molecules and sometimes big molecules.

Connective tissue

* Connective tissues are most abundant and widely distributed in the body of complex animals. They are named connective tissues because of their special function of linking and supporting other tissues/organs of the body. They range from soft connective tissues to specialised types, which include cartilage, bone, adipose, and blood.

* In all connective tissues except blood, the cells secrete fibres of structural proteins called collagen or elastin.
The fibres provide strength, elasticity and flexibility to the tissue. These cells also secrete modified polysaccharides, which accumulate between cells and fibres and act as matrix (ground substance).

* Connective tissues are classified into three types: (i) Loose connective tissue, (ii) Dense connective tissue and (iii) Specialised connective tissue.

Figure : Areolar tissue

* **Loose connective tissue** has cells and fibres loosely arranged in a semi-fluid ground substance, for example, **areolar tissue** present beneath the skin. Often it serves as a support framework for epithelium.

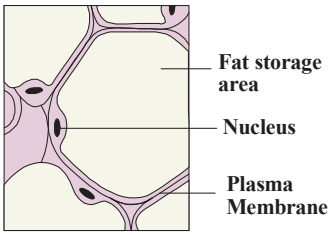


Figure : Adipose tissue

It contains fibroblasts (cells that produce and secrete fibres), macrophages and mast cells. **Adipose tissue** is another type of loose connective tissue located mainly beneath the skin. The cells of this tissue are specialised to store fats. The excess of nutrients which are not used immediately are converted into fats and are stored in this tissue.

* Fibres and fibroblasts are compactly packed in the **dense connective tissues**. Orientation of fibres show a regular or irregular pattern and are called **dense regular and dense irregular tissues**. In the dense regular connective tissues, the collagen fibres are present in rows between many parallel bundles of fibres. Tendons, which attach skeletal muscles to bones and ligaments which attach one bone to another are examples of this tissue. Dense irregular connective tissue has fibroblasts and many fibres (mostly collagen) that are oriented differently . This tissue is present in the skin.

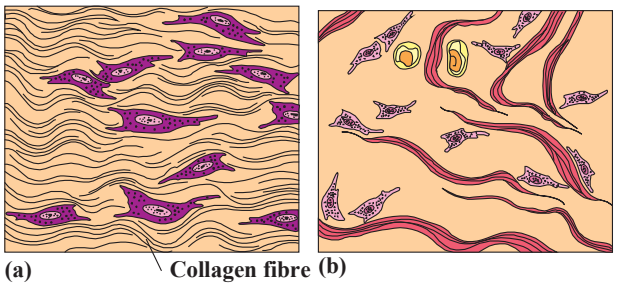


Figure : Dense connective tissue: (a) Dense regular (b) Dense irregular

* **Differences between Tendon and Ligament**

S.N.	Tendons	Ligaments
1.	Inelastic in nature.	Elastic in nature.
2.	Join muscle to bone.	Connect bone to bone.
3.	Made up of white collagen fibres.	Made up of bundles of elastic fibres and few collagen fibres.

* Cartilage, bones and blood are various types of **specialised connective tissues.**

* The intercellular material of **cartilage** is solid and pliable and resists compression. Cells of this tissue (chondrocytes) are enclosed in small cavities within the matrix secreted by them. Most of the cartilages in vertebrate embryos are replaced by bones in adults. Cartilage is present in the tip of nose, outer ear joints, between adjacent bones of the vertebral column, limbs and hands in adults.

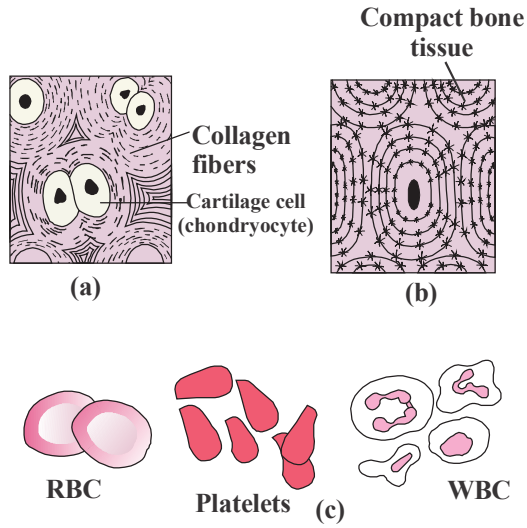


Figure : Specialised connective tissues : (a) Cartilage (b) Bone (c) Blood

* **Bones** have a hard and non-pliable ground substance rich in calcium salts and collagen fibres which give bone its strength. It is the main tissue that provides structural frame to the body. Bones support and protect softer tissues and organs. The bone cells (osteocytes) are present in the spaces called **lacunae**.

Limb bones, such as the long bones of the legs, serve weight-bearing functions. They also interact with skeletal muscles attached to them to bring about movements. The bone marrow in some bones is the site of production of blood cells.

* **Differences between Bone and Cartilage**

S.N.	Bone	Cartilage
1.	It is hard and rigid.	It is soft and flexible.
2.	Matrix has an inflexible material, the ossein.	Matrix has a flexible material, the chondrin.
3.	Matrix occurs in the form of lamellae.	Matrix occurs in a homogeneous mass i.e., lamellae are absent.
4.	Matrix always contains salts of calcium.	Calcium salts may or may not be present in the matrix.
5.	Bone marrow is present in long bones that produces blood corpuscles.	It is absent.
6.	Bones have rich blood supply.	Cartilages do not have rich blood supply.

* **Periosteum :** It is a membrane that forms an envelop around the bone. Periosteum is comprised of two distinct layers. Outer layer consist of thin white fibrous connective tissue.
* Inner layer consist of osteoblasts, osteoblasts are spider like bone cells, also known as bone forming cells, because they produces new bone materials.

* **Matrix :** Matrix is composed of protein called ossein. The matrix forms thin plates called lamellae. Lamellae are of three types. *Haversian lamellae* (occur around Haversian canal) concentric or circumferential lamellae (inner to periosteum and outer to endosteum) and interstitial lamellae (between Haversian system). In the lamellae minute bone cells osteocytes are present.

* **Endosteum :** It is present outer to the bone marrow cavity. Endosteum is a membrane which lines the marrow cavity. It is comprises of two distinct layers, one is of fibrous connective tissue and another is osteoblasts.

* **Bone marrow :** Bone marrow is a specialized type of soft, diffuse connective tissue called "Myeloid tissue". It takes part in production of blood cells hence known as haemopoietic tissue. It is composed of adipose tissue, areolar tissue and blood. It is of two types -

(i) **Red bone marrow :** Red in colour due to presence of lot of blood vessels. In foetal life and at birth present in entire skeleton. After 5th year red bone marrow replaced by yellow bone marrow, at 20-25 years red bone marrow present at ribs, sternum, clavicles, vertebrae, scapula, pelvis, epiphysis of humerus and femur. Produces RBCs, WBC, platelets, granular, leucocytes like basophils eosinophils and neutrophils.

(ii) **Yellow bone marrow :** Yellow in colour and has much fatty tissue (adipose tissue), present in shaft of long bones. Produces blood cells in emergency i.e. at the time of excessive loss of blood, yellow bone marrow may be replaced by red bone marrow in anaemia.

* Blood is a fluid connective tissue containing plasma, red blood cells (RBC), white blood cells (WBC) and platelets. It is the main circulating fluid that helps in the transport of various substances.

* **Plasma :** It constitutes about 5% of body weight. It represents matrix of blood. Plasma is slightly alkaline and transparent. It forms 55-60% by volume of blood. Plasma contains : Water (91-92%), Solid (8-9%). Plasma solid part consists of organic (7%) and inorganic (1%) substances.
* **Blood corpuscles :** Blood corpuscles form 40-50% of the blood and are of three types viz. Red blood corpuscles, white blood corpuscles and platelets.

(i) **Red blood corpuscles (RBCs or Erythrocytes) :**
These occur only in vertebrates and are the most abundant (99%) of blood corpuscles, imparting the characteristic red colour to the blood. The shape, size and structure of RBCs vary in different types of vertebrates, but their function is the same in all, namely to transport respiratory gases, especially the oxygen.

* **RBCs of human :** They are about 7.4µm in diameter and its thickness is 1 to 1.5µm. It is pale yellow in colour but appear to be red in group. Surface area of all RBCs of a person totals about 1500 to 2000 times the surface area of the body itself.

* **Structure of RBCs :** Each RBC is bounded by a dynamic, enzyme-containing plasma membrane. In a human RBC, about 26.5 crore molecules of haemoglobin are packed in the intracellular framework. Water constitutes about 60% of RBC. The rest is solid. Haemoglobin forms about 34% of wet and 90% of dry weight of an RBC. Thus, 100 ml of normal human blood contains about 15 gm of haemoglobin on an average.
* **Function of RBCs :** The major function of erythrocytes is to receive O_2 of respiratory surfaces and then transport and readily deliver it to all cells of body. This important function is performed by haemoglobin which has a great ability to combine loosely and reversibly with O_2 and is, hence, called "respiratory pigment". Haemoglobin, in annelids, is dissolved in the plasma because of absence of red blood corpuscles. In mollusc and some arthropods, etc., a different respiratory pigment, haemocyanin is found dissolved in the plasma. This pigment is bluish due to presence of copper in place of iron.
* **ESR :** It is called erythrocyte sedimentation rate. This test is measured by "Wintrobe's tube" and "Western blotting" method. It is the rate of sinking/ settling down of RBC in the plasma to form rouleaux. Man has lower ESR as compared to women and it is lowest in new born. Normal value of ESR in male is about 5 mm and in female 10 mm in first hour. A rise in ESR indicates the presence of infective/ destructive/ inflammatory diseases.

(ii) White blood corpuscles (WBCs) or Leucocytes:

* They are nucleated, colourless and complete cells.
* They are bigger than RBC but their number is less.
* WBC shown least constancy in shape. The number of WBC is 5,000 to 10,000 per cubic mm.
* They are formed in red bone marrow, spleen, thymus and lymph nodes from myelocytes and the process is called as myelecoeisis.
* The life of WBC is of 15 hours to 2 days.
* The WBC are destroyed outside the blood vessels and the process by which the come out is called as diapedesis.
* An increase in the number of white blood corpuscles is called leucocytosis.
* More than 20,000 per cubic mm. indicates some disease. A decrease below 5000/Cu.mm is called leucopenia as in typhoid fever.

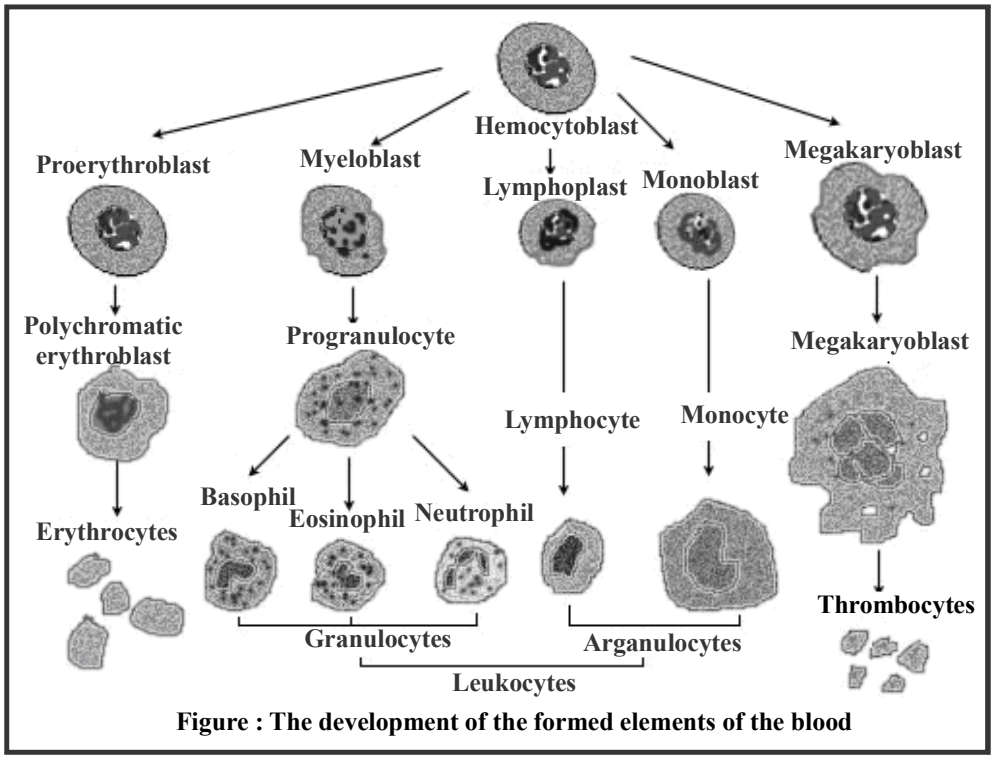


Figure : The development of the formed elements of the blood

(iii) Blood platelets : These are protoplasmic disc that are found in mammalian blood (lower vertebrates have spindle-shaped cells named thrombocytes). Platelets arise as detached tips of protoplasmic processes extending from the cytoplasm of giant cells, megakaryocytes of red bone marrow. The shape is oval to round, often stellate. There are approximately 300,000 platelets in a cubic millimetre of blood. Platelets are non-nucleated. Life span is about 5-9 days.

Major Types and Functions of Connective Tissues (CT)

Type	Location	Functions
Loose CT (unorganized collagen fibers)	Widely distributed throughout the body	Attaches skin to underlying tissue; fills spaces between organs and holds them in place; surrounds and supports blood vessels
Dense CT (abundance of collagen fibers)	Specific organs that require support of strong attachments	Provides capacity to withstand tension; supports underlying tissues of skin; forms tendons, ligaments, and some membranes.
Elastic CT (majority of elastic fibers)	Organs that expand and return to original size	Confers strength and elasticity to walls of arteries, trachea and bronchi, vocal cords, and lungs
Reticular CT (mostly reticular fibers)	Liver, lymph nodes, and spleen	Provides a framework for support of the cells that make up these organs
Adipose CT (fat cells)	Underlying skin; in loose CT	Serves as a storage site for fats; insulates, pads, and protects certain areas of the body
Cartilage (modified collagen fibers)	Certain skeletal structures, breathing tubes	Provides strong structural support for the embryonic skeleton and ends of bones; forms flexible structures such as the ear and nose
Bone (cells in a mineralized matrix)	Major potion of the adult skeleton	Provides support and protection; skeleton serves as the attachment site for muscles
Blood (cells in a fluid matrix)	In blood vessels; propelled throughout the body by the heart	Transports oxygen, nutrients, and other materials; aids in cellular immune functions

Coagulation or Clotting of blood

* Process of formation of blood clot is also known as blood coagulation. Normal time of blood clotting is 3 to 8 minutes. Blood clotting is checked in blood vessels by presence of anticoagulant.
* When an injury is caused to a blood vessel bleeding starts which is stopped by a process called blood coagulation or clotting. This process can be described under four major stages.

I. Damaged platelets or tissue cells release thromboplastin

II. Prothrombin $\xrightarrow[Ca^{2+}]{\downarrow}$ Thrombin

III. Fibrinogen $\xrightarrow{Ca^{2+}}$ Fibrin

IV. Fibrin + cells $\longrightarrow$ Clot

Blood coagulation is helped by thrombocytes.

* **Lymph :** Lymph can be defined as blood minus RBCs but more WBCs. Lymph is chiefly made of plasma plus leucocytes. Most important centre for the formation of lymph is interstitial space. Interstitial fluid, intercellular fluid, tissue fluid and lymph all are same in composition.

Exchange of materials between blood and tissue fluid occurs through blood capillaries.

* **Functions of lymph :** The basic function of lymph is to bring back, into the vascular circulation, the cell debris, large colloid particles and the part of the blood plasma that had diffused out from arterial capillaries into the tissue fluid but has failed to return back into venous capillaries. The white corpuscles of the lymph are the same as those of the blood and have the same functions of defense and of assistance in tissue repair and healing. In intestinal wall, lymph capillaries, called lacteals, are specially meant for absorption of fats.

Muscle Tissue

Each muscle is made of many long, cylindrical fibres arranged in parallel arrays. These fibres are composed of numerous fine fibrils, called myofibrils.

* Muscles are of three types, skeletal, smooth, and cardiac.
* **Skeletal muscle** tissue is closely attached to skeletal bones. In a typical muscle such as the biceps, striated (striped) skeletal muscle fibres are bundled together in a parallel fashion. A sheath of tough connective tissue encloses several bundles of muscle fibres.

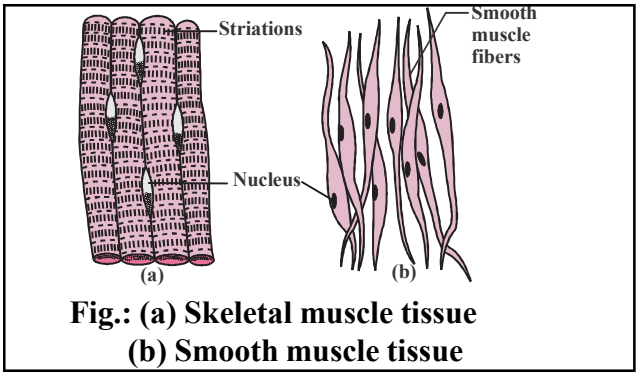
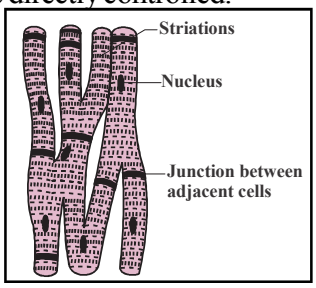


Fig.: (a) Skeletal muscle tissue (b) Smooth muscle tissue

* **The smooth muscle fibres** taper at both ends (fusiform) and do not show striations. Cell junctions hold them together and they are bundled together in a connective tissue sheath. The wall of internal organs such as the blood vessels, stomach and intestine contains this type of muscle tissue. Smooth muscles are 'involuntary' as their functioning cannot be directly controlled.
* **Cardiac muscle** tissue is a contractile tissue present only in the heart. Cell junctions fuse the plasma membranes of cardiac muscle cells and make them stick together. Communication junctions(intercalated discs) at some fusion **Cardiac muscle tissue** points allow the cells to contract as a unit, i.e., when one cell receives a signal to contract, its neighbours are also stimulated to contract.



Types of Muscle Tissue

Characteristics	Skeletal	Cardiac	Smooth
Microscopic appearance	Striated, multiple nuclei, cells not branched	Striated, single nucleus, cells branched	Nonstriated, single nucleus, cells spindle-shaped
Organ systems	Musclar system	Circulatory system	Digestive and urinary systems
Location	Most attached to bone; some to skin and muscles	Heart	Walls of digestive organs, blood vessels, and hair follicles
Nervous control	Voluntary	Involuntary	Involuntary
Contraction speed	Fast	Moderate	Slow

* **Differences between Striated, Non-striated and Cardiac Muscles**

S.N.	Striated Muscle	Non-striated Muscle	Cardiac Muscle
1.	Occur in the limbs, body wall, face, neck, etc.	Occur in posterior part of oesophagus, urinogenital tract, iris of eye etc.	Occur in the walls of heart.
2.	Cylindrical in shape.	Spindle shaped.	Cylindrical in shape.
3.	Multinucleated muscle fibres.	Uninucleate muscle fibres.	Uninucleate muscle fibres.
4.	Nuclei are peripheral.	Nucleus is central.	Nucleus is central.
5.	Myofibrils show alternate light and dark bands.	Myofibrils are without light and dark bands.	Myofibrils show faint light and dark bands.
6.	Fibres are unbranched.	Fibres are unbranched.	Fibres are branched.
7.	Intercalated discs are absent.	Intercalated discs are absent.	Intercalated discs are present.
8.	They soon get fatigued.	They do not get fatigued.	They never get fatigued.
9.	Voluntary in action.	Involuntary in action.	Involuntary in action.

Neural Tissue

* Neural tissue exerts the greatest control over the body's responsiveness to changing conditions.
* Neurons, the unit of neural system are excitable cells. The neuroglial cell which constitute the rest of the neural system protect and support neurons. Neuroglia make up more than onehalf the volume of neural tissue in our body.

COCKROACH

* Cockroaches are brown or black bodied animals that are included in class Insecta of Phylum Arthropoda. Bright yellow, red and green coloured cockroaches have also been reported in tropical regions.

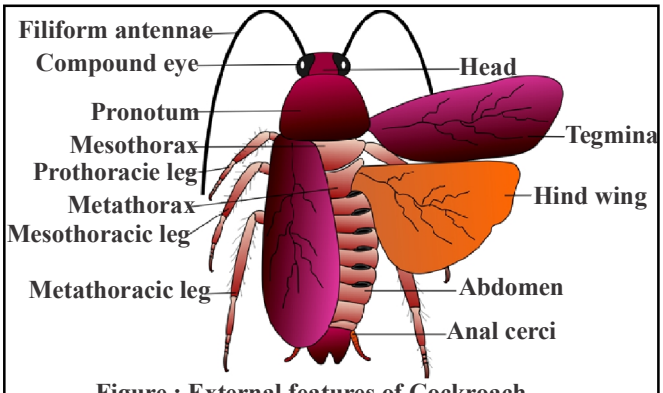


Figure : External features of Cockroach

Their size ranges from ¼ inches to 3 inches (0.6-7.6 cm) and have long antenna, legs and flat extension of the upper body wall that conceals head. They are nocturnal omnivores that live in damp places throughout the world.

Morphology

* The adults of the common species of cockroach, Periplaneta americana are about 34-53 mm long with wings that extend beyond the tip of the abdomen in males.
* The body of the cockroach is segmented and divisible into three distinct regions – head, thorax and abdomen
* The entire body is covered by a hard chitinous exoskeleton (brown in colour).
* In each segment, exoskeleton has hardened plates called sclerites (tergites dorsally and sternites ventrally) that are joined to each other by a thin and flexible articular membrane (arthrodial membrane).
* Head is triangular in shape and lies anteriorly at right angles to the longitudinal body axis. It is formed by the fusion of six segments and shows great mobility in all directions due to flexible neck. The head capsule bears a pair of compound eyes. A pair of thread like antennae arise from membranous sockets lying in front of eyes.

Antennae have sensory receptors that help in monitoring the environment.

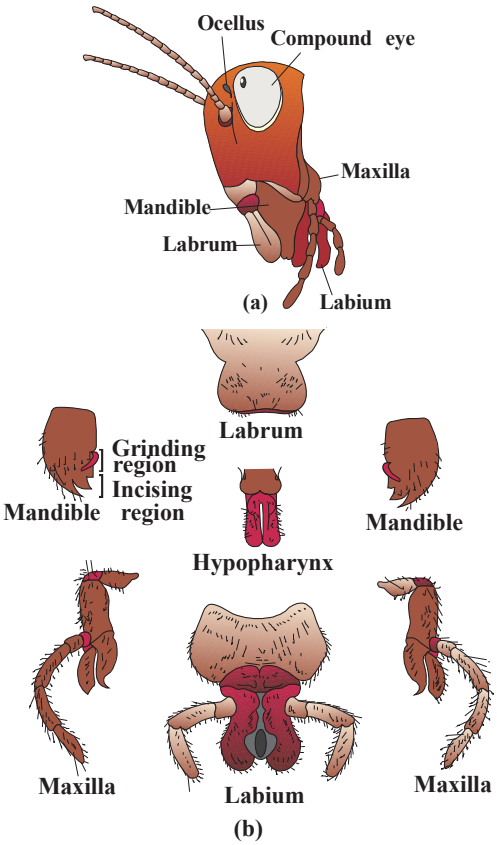


Figure : Head region of cockroach : (a) parts of head region (b) mouth parts

* Anterior end of the head bears appendages forming biting and chewing type of mouth parts. The mouthparts consisting of a labrum (upper lip), a pair of mandibles, a pair of maxillae and a labium (lower lip). A median flexible lobe, acting as tongue (hypopharynx), lies within the cavity enclosed by the mouthparts.
* Thorax consists of three parts – prothorax, mesothorax and metathorax. The head is connected with thorax by a short extension of the prothorax known as the neck. Each thoracic segment bears a pair of walking legs. The first pair of wings arises from mesothorax and the second pair from metathorax. Forewings (mesothoracic) called tegmina are opaque dark and leathery and cover the hind wings when at rest. The hind wings are transparent, membranous and are used in flight.
* The abdomen in both males and females consists of 10 segments. In females, the 7th sternum is boat shaped and together with the 8th and 9th sterna forms a brood or genital pouch whose anterior part contains female gonopore, spermathecal pores and collateral glands.
* In males, genital pouch or chamber lies at the hind end of abdomen bounded dorsally by 9th and 10th terga and ventrally by the 9th sternum. It contains dorsal anus, ventral male genital pore and gonapophysis. Males bear a pair of short, threadlike anal styles which are absent in females. In both sexes, the 10th segment bears a pair of jointed filamentous structures called anal cerci.

Anatomy

* The alimentary canal present in the body cavity is divided into three regions: foregut, midgut and hindgut.
* The mouth opens into a short tubular pharynx, leading to a narrow tubular passage called oesophagus. This in turn opens into a sac like structure called crop used for storing of food. The crop is followed by gizzard or proventriculus.
* It has an outer layer of thick circular muscles and thick inner culicle forming six highly chitinous plate called teeth. Gizzard helps in grinding the food particles. The entire foregut is lined by cuticle. A ring of 6-8 blind tubules called hepatic or gastric caecae is present at the junction of foregut and midgut, which secrete digestive juice.

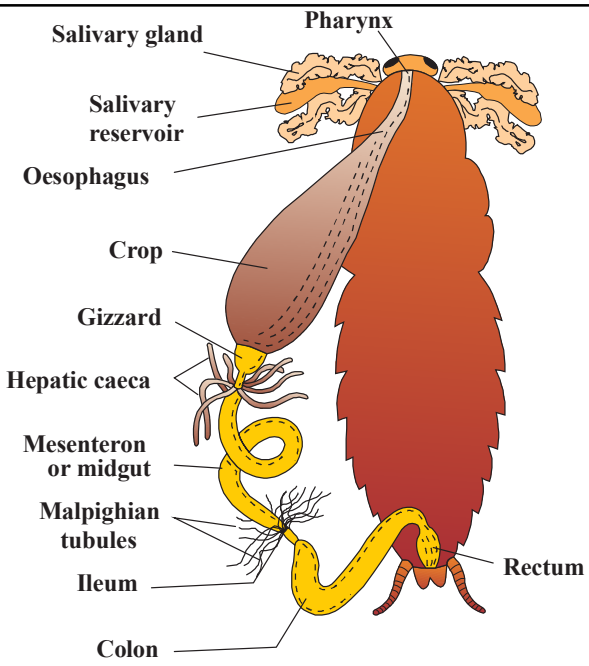


Figure : Alimentary canal of cockroach

* At the junction of midgut and hindgut is present another ring of 100-150 yellow coloured thin filamentous Malphigian tubules.
* They help in removal of excretory products from haemolymph. The hindgut is broader than midgut and is differentiated into ileum, colon and rectum. The rectum opens out through anus.
* Blood vascular system of cockroach is an open type. Blood vessels are poorly developed and open into space (haemocoel).

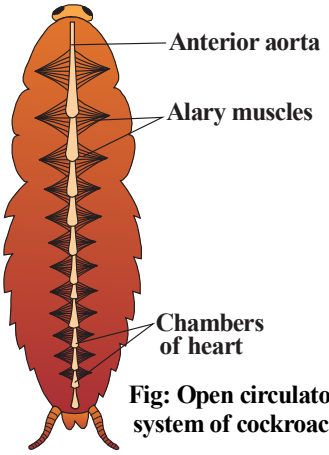


Fig: Open circulatory system of cockroach

Visceral organs located in the haemocoel are bathed in blood (haemolymph). The haemolymph is composed of colourless plasma & haemocytes. Heart of cockroach consists of elongated muscular tube lying along mid dorsal line of thorax and abdomen.

* It is differentiated into funnel shaped chambers with ostia on either side. Blood from sinuses enter heart through ostia and is pumped anteriorly to sinuses again.
* The respiratory system consists of a network of trachea, that open through 10 pairs of small holes called spiracles present on the lateral side of the body. Thin branching tubes (tracheal tubes subdivided into tracheoles) carry oxygen from the air to all the parts. The opening of the spiracles is regulated by the sphincters. Exchange of gases take place at the tracheoles by diffusion.
* Excretion is performed by Malpighian tubules. Each tubule is lined by glandular and ciliated cells. They absorb nitrogenous waste products and convert them into uric acid which is excreted out through the hindgut. Therefore, this insect is called **uricotelic**.
* In addition, the fat body, nephrocytes and urecose glands also help in excretion.
* The nervous system of cockroach consists of a series of fused, segmentally arranged ganglia joined by paired longitudinal connectives on the ventral side. Three ganglia lie in the thorax, and six in the abdomen. The nervous system of cockroach is spread throughout the body. The head holds a bit of a nervous system while the rest is situated along the ventral (belly-side) part of its body.
* In the head region, the brain is represented by supra-oesophageal ganglion which supplies nerves to antennae and compound eyes.
* In cockroach, the sense organs are antennae, eyes, maxillary palps, labial palps, anal cerci, etc. The compound eyes are situated at the dorsal surface of the head. Each eye consists of about 2000 hexagonal ommatidia (sing.: ommatidium). With the help of several ommatidia, a cockroach can receive several images of an object. This kind of vision is known as mosaic vision with more sensitivity but less resolution, being common during night (hence called nocturnal vision).
* Cockroaches are **dioecious** and both sexes have well developed reproductive organs.
* Male reproductive system consists of a pair of testes lying one on each lateral side in the 4th - 6th abdominal segments. From each testis arises a thin vas deferens, which opens into ejaculatory duct through seminal vesicle. The ejaculatory duct opens into male gonopore situated ventral to anus. A characteristic mushroom shaped gland is present in the 6th-7th abdominal segments which functions as an accessory reproductive gland. The external genitalia are represented by male gonapophysis or phallomere (chitinous asymmetrical structures, surrounding the male gonopore). The sperms are stored in the seminal vesicles and are glued together in the form of bundles called spermatophores which are discharged during copulation.

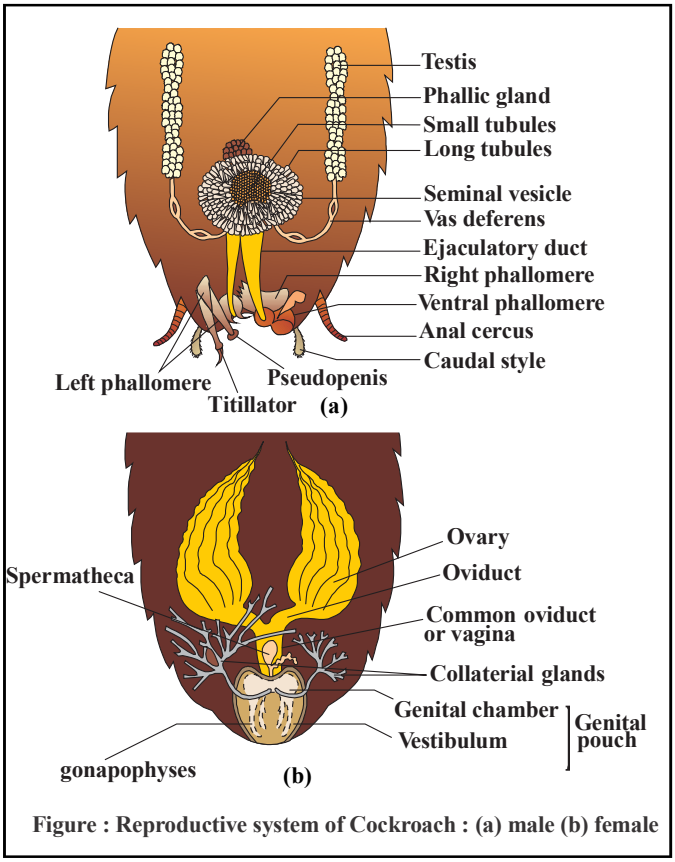


Figure : Reproductive system of Cockroach : (a) male (b) female

* The female reproductive sysytem consists of two large ovaries, lying laterally in the 2nd – 6th abdominal segments. Each ovary is formed of a group of eight ovarian tubules or ovarioles, containing a chain of developing ova. Oviducts of each ovary unite into a single median oviduct (also called vagina) which opens into the genital chamber. A pair of spermatheca is present in the 6th segment which opens into the genital chamber.
* Sperms are transferred through spermatophores. Their fertilised eggs are encased in capsules called oothecae. Ootheca is a dark reddish to blackish brown capsule, about 3/8" (8 mm) long. They are dropped or glued to a suitable surface, usually in a crack or crevice of high relative humidity near a food source. On an average, females produce 9-10 oothecae, each containing 14-16 eggs. The development of P. americana is paurometabolous, meaning there is development through nymphal stage. The nymphs look very much like adults. The nymph grows by moulting about 13 times to reach the adult form. The next to last nymphal stage has wing pads but only adult cockroaches have wings.

EARTHWORM

[Not in syllabus of NEET but study for various information]

* Earthworm is a reddish brown terrestrial invertebrate that inhabits the upper layer of the moist soil.
* The common Indian earthworms are Pheretima & Lumbricus.

Morphology

* Earthworms have long cylindrical body. The body is divided into more than hundred short segments which are similar (metameres about 100-120 in number).
* The dorsal surface of the body is marked by a dark median mid dorsal line (dorsal blood vessel) along the longitudinal axis of the body.
* The ventral surface is distinguished by the presence of genital openings (pores).
* Anterior end consists of the mouth and the prostomium, a lobe which serves as a covering for the mouth and as a wedge to force open cracks in the soil into which the earthworm may crawl.
* The prostomium is sensory in function.
* The first body segment is called the **peristomium** (buccal segment) which contains the mouth. In a mature worm, segments 14-16 are covered by a prominent dark band of glandular tissue called **clitellum**. Thus the body is divisible into three prominent regions – preclitellar, clitellar and postclitellar segments.
* Four pairs of spermathecal apertures are situated on the ventro-lateral sides of the intersegmental grooves, i.e., 5th -9th segments. A single female genital pore is present in the mid-ventral line of 14th segment.
* A pair of male genital pores are present on the ventro-lateral sides of the 18th segment. Numerous minute pores called nephridiopores open on the surface of the body. In each body segment, except the first, last and clitellum, there are rows of S-shaped **setae**, embedded in the epidermal pits in the middle of each segment. Setae can be extended or retracted. Their principal role is in locomotion.

Anatomy

* The body wall of the earthworm is covered externally by a thin non-cellular cuticle below which is the epidermis, two muscle layers (circular and longitudinal) and an innermost coelomic epithelium. The epidermis is made up of a single layer of columnar epithelial cells which contain secretory gland cells.
* The alimentary canal is a straight tube and runs between first to last segment of the body. A terminal mouth opens into the buccal cavity (1-3 segments) which leads into muscular pharynx. A small narrow tube, oesophagus (5-7 segments), continues into a muscular gizzard (8-9 segments). It helps in grinding the soil particles and decaying leaves, etc. The stomach extends from 9-14 segments.
* The food of the earthworm is decaying leaves and organic matter mixed with soil.
* Calciferous glands, present in the stomach, neutralise the humic acid present in humus.

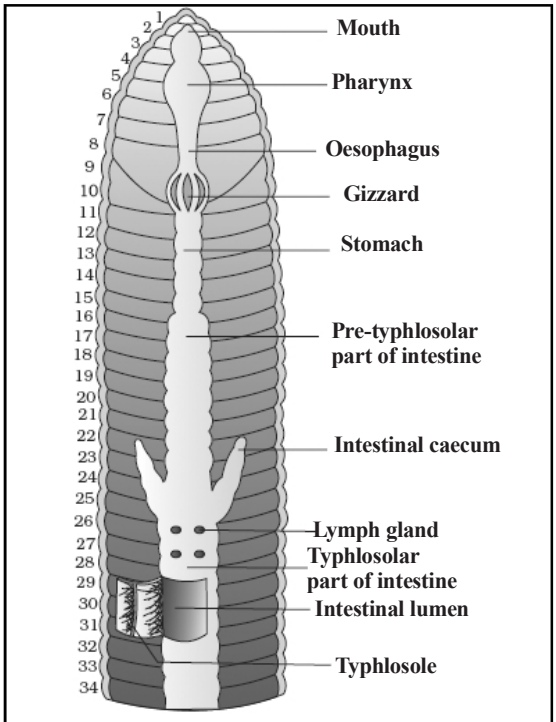


Figure : Alimentary canal of earthworm

* Intestine starts from the 15th segment onwards and continues till the last segment. A pair of short and conical intestinal caecae project from the intestine on the 26th segment. The characteristic feature of the intestine between 26-35 segments is the presence of internal median fold of dorsal wall called **typhlosole**. This increases the effective area of absorption in the intestine.
* The alimentary canal opens to the exterior by a small rounded aperture called anus.
* The ingested organic rich soil passes through the digestive tract where digestive enzymes breakdown complex food into smaller absorbable units. These simpler molecules are absorbed through intestinal membranes and are utilised.
* **Pheretima** exhibits a closed type of blood vascular system, consisting of blood vessels, capillaries and heart. Due to closed circulatory system, blood is confined to the heart and blood vessels. Contractions keep blood circulating in one direction. Smaller blood vessels supply the gut, nerve cord, and the body wall. Blood glands are present on the 4th, 5th and 6th segments. They produce blood cells and haemoglobin which is dissolved in blood plasma. Blood cells are phagocytic in nature.

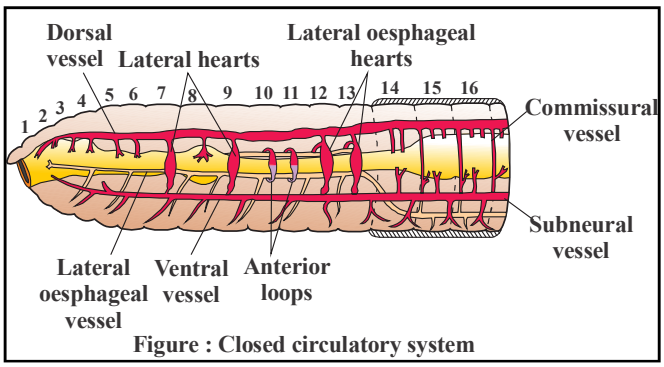


Figure : Closed circulatory system

* Earthworms lack specialised breathing devices. Respiratory exchange occurs through moist body surface into their blood stream.
* The excretory organs occur as segmentally arranged coiled tubules called nephridia (sing.: nephridium). They are of three types: (i) septal nephridia, present on both the sides of intersegmental septa of segment 15 to the last that open into intestine, (ii) integumentary nephridia, attached to lining of the body wall of segment 3 to the last that open on the body surface and (iii) pharyngeal nephridia, present as three paired tufts in the 4th, 5th and 6th segments. These different types of nephridia are basically similar in structure.

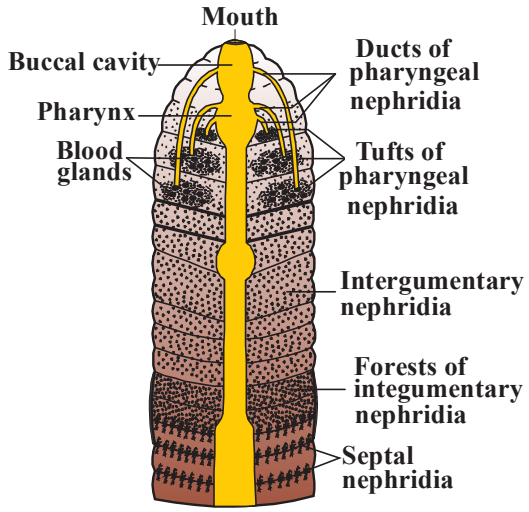


Figure : Nephridial system in earthworm

* Nephridia regulate the volume and composition of the body fluids. A nephridium starts out as a funnel that collects excess fluid from coelomic chamber. The funnel connects with a tubular part of the nephridium which delivers the wastes through a pore to the surface in the body wall into the digestive tube.
* Nervous system is basically represented by ganglia arranged segmentwise on the ventral paired nerve cord. The nerve cord in the anterior region (3rd and 4th segments) bifurcates, laterally encircling the pharynx and joins the cerebral ganglia dorsally to form a nerve ring. The cerebral ganglia alongwith other nerves in the ring integrate sensory input as well as command muscular responses of the body.
* Sensory system does not have eyes but does possess light and touch sensitive organs (receptor cells) to distinguish the light intensities and to feel the vibrations in the ground. Worms have specialised chemoreceptors (taste receptors) which react to chemical stimuli. These sense organs are located on the anterior part of the worm.

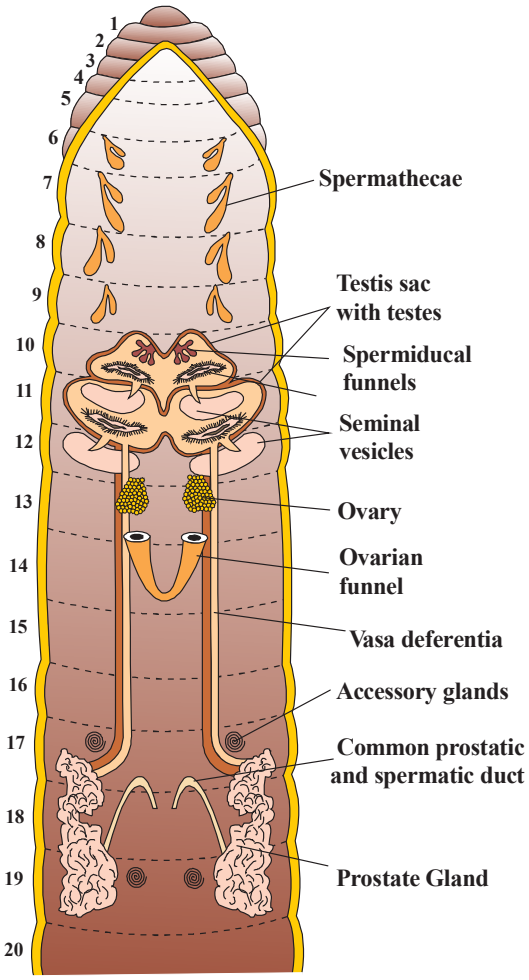


Figure : Reproductive system of earthworm

* Earthworm is hermaphrodite (bisexual), i.e., testes and ovaries are present in the same individual. There are two pairs of testes present in the 10th and 11th segments.
Their vasa deferentia run up to the 18th segment where they join the prostatic duct. Two pairs of accessory glands are present one pair each in the 17th and 19th segments.
* The common prostrate and spermatic duct (vary differential) opens to the exterior by a pair of male genital pores on the ventro-lateral side of the 18th segment. Four pairs of spermathecae are located in 6th-9th segments (one pair in each segment). They receive and store spermatozoa during copulation. One pair of ovaries is attached at the inter-segmental septum of the 12th and 13th segments. Ovarian funnels are present beneath the ovaries which continue into oviduct, join together and open on the ventral side as a

single median female genital pore on the 14th segment.

* A mutual exchange of sperm occurs between two worms during mating. One worm has to find another worm and they mate juxtaposing opposite gonadal openings exchanging packets of sperms called spermatophores. Mature sperm and egg cells and nutritive fluid are deposited in cocoons produced by the gland cells of clitellum. Fertilisation and development occur within the cocoons which are deposited in soil. The ova (eggs) are fertilised by the sperm cells within the cocoon which then slips off the worm and is deposited in or on the soil. The cocoon holds the worm embryos. After about 3 weeks, each cocoon produces two to twenty baby worms with an average of four. Earthworms development is direct, i.e., there is no larva formed.
* Earthworms are known as 'friends of farmers' because they make burrows in the soil and make it porous which helps in respiration and penetration of the developing plant roots. The process of increasing fertility of soil by the earthworms is called vermicomposting. They are also used as bait in game fishing.

CONCEPT REVIEW

* **Simple squamous epithelium:** It consists of a single layer of flat cells with irregular boundaries. It is found in the walls of the blood vessels and in the lining of alveoli.
* **Simple cuboidal epithelium:** It consists of a single layer of cube-like cells. It is present in regions where secretion and absorption of substances takes place such as the proximal convoluted tubule region of the nephron.
* **Simple columnar epithelium:** It consists of a single layer of tall, slender cells with their nuclei present at the base of the cells. They may bear micro-villi on the free surfaces. Columnar epithelium forms the lining of the stomach and intestines, and is involved in the function of secretion and absorption.
* **Ciliated epithelium:** It consists of columnar or cuboidal cells with cilia on their free surfaces. They are present in bronchioles and oviducts from where they direct mucus and eggs in specific directions.
* **Glandular epithelium:** It consists of columnar or cuboidal cells involved in the secretion of substances. Glands are of two types, unicellular glands (goblet cells of the alimentary canal) and multicellular glands (salivary glands). They can be classified as exocrine (ductless glands) and endocrine glands (duct glands) by the method through which they release enzymes.
* **Compound epithelium:** It consists of many layers of cells. It is involved mainly in the function of providing protection and has a limited role in secretion and absorption. Examples of compound epithelium include the dry surface of the skin or moist inner lining of the buccal cavity, pharynx, pancreatic ducts, and the inner lining of ducts of salivary glands.
* **Cardiac muscle and striated muscle**
Cardiac muscles are present in the heart, while striated muscles are present in articulatory joints. Cardiac muscle fibres are branched, while striated muscle fibres are unbranched. Cardiac muscles continuously contract and relax throughout the life, while striated muscles show movement as and when required.
* **Dense regular and dense irregular connective tissues**
The cells and fibres are loosely arranged in a semi-fluid matrix; in loose connective tissue. The cells and fibres are compactly packed in dense connective tissue. Areolar tissue is an example of loose connective tissue, while tendon and ligament are examples of dense connective tissue.
* **Functions of Connective Tissue**

1. Enclosing and separating. Sheets of connective tissues form capsules around organs such as the liver and kidneys. Connective tissue also forms layers that separate tissues and organs. For example, connective tissues separate muscles, arteries, veins, and nerves from one another.
2. Connecting tissues to one another. For example, tendons are strong cables, or bands, of connective tissue that attach muscles to bone,

and ligaments are connective tissue bands that hold bones together.

3. Supporting and moving. Bones of the skeletal system provide rigid support for the body, and the semirigid cartilage supports structures such as the nose, ears, and surface of joints. Joints between bones allow one part of the body to move relative to other parts.
4. Storing. Adipose tissues (fat) stores high-energy molecules, and bones store minerals such as calcium and phosphate.
5. Cushioning and insulating. Adipose tissue (fat). Cushions and protects the tissues it surrounds and provides an insulating layer beneath the skin that helps conserve heat.
6. Transporting. Blood transports substances throughout the body, such as gases, nutrients, enzymes, hormones, and cells of the immune system.
7. Protecting. Cells of the immune system and blood provide protection against toxins and tissue injury, as well as from microorganisms. Bones protect underlying structures from injury.

* **Adipose and blood tissue :** Adipose tissue is an example of loose connective tissue, while blood tissue is a specialized connective tissue. Adipose tissue is usually located beneath the skin. The cells of the adipose tissue are specialized to store fat. Blood facilitates transportation of various materials in the body.
* Exocrine, endocrine, and salivary glands are examples of simple glandular epithelium. **Ligament** is a connective tissue.
* **Functions of White Fibrocartilage:**

- Shock absorbers : The cartilage between the adjacent vertebrae absorbs the shocks that will otherwise damage and jar the bones while we run or walk.
- Provides sturdiness without impeding movement. The white fibrocartilage forms a firm joint between bones but still allows for a reasonable degree of movement.
- Deepens sockets : In articular cavities (such as the ball-and-socket joints in the hip and shoulder regions) white fibrocartilage deepens the sockets to make dislocation less possible.

* Earthworms (*Pheretima*) have closed blood vascular systems, which consists of the heart, blood vessels, and capillaries. The heart pumps blood for circulating it in one direction. Blood is supplied by smaller blood cells to the gut nerve cord and the body wall. Blood glands are present in the 4th, 5th, and 6th segments, which produce blood cells and haemoglobin dissolved in blood plasma. Blood cells in earthworms are phagocytic in nature.
* Special venous connection between liver and intestine of frog is known as **hepatic portal system** and venous connection between kidney and intestine is known as **renal portal system.**
* In cockroach, the hepatic caecae are present at the junction of foregut and midgut. The hepatic caecae function similar to vertebrate liver. They secrete digestive juices and thus, help in the digestion.
* Earthworm have long cylindrical body. It dorsal surface of the body is marked by a dark medium mid dorsal line (dorsal blood vessel) along the longitudinal axis of the body. The ventral surface is distinguished by the presence of genital openings known as genital pores.
* Cockroach have compound eyes for photoreception. Each eye consists of about 2000-2500 units called 'Ommatidium'. Compound eye contains from top to bottom a lens, two corneagen cells, a crystalline cone and surrounding four cone cells and seven retinular cells.
* Sickle-celled anaemia is a genetic disease common in South Africa. It is due to change in beta chain of haemoglobin.
* Thalassemia represents hereditary hemolytic anaemia due to defect in the synthesis of haemoglobin.
* Large amount of reduced haemoglobin in the arterial blood result a condition called cyanosis.
* Polycythemia refers to abnormal increase in the number of RBCs.
* Erythropoietin is a hormone secreted by kidney cells; it stimulates the RBC production in bone marrow.

* Old non-functional RBCs are destroyed in the spleen, liver and bone marrow. The most important site of RBCs disposal is spleen, so it is called their graveyard.
* The spleen also serves as a sort of blood bank.
* Blood is red but no RBCs are found in earthworm; haemoglobin directly dissolved in plasma.
* Haemocyanin is a copper containing respiratory pigment occuring in arthropods and molluscs. It is much less efficient oxygen carrier.
* Normal DLC is –

Neutrophils	-	60-70%
Eosinophils	-	2-4%
Basophils	-	0.5-1%
Lymphocytes	-	20-25%
Monocytes	-	3-8%

IMPORTANT POINTS

* The cells of cartilage are called chondrocytes.
* Neurilemma is composed of Schwann cells.
* Blood is a connective tissue.
* Mast cells occur in areolar tissue.
* Hardest substance of the body is enamel.
* B- and T-cells required for immune system are produced in bone marrow.
* Vitamin K is required for synthesis of prothrombin.
* R.B.C. are found stored in spleen.
* Smooth muscles occur in vein, artery and uterus.
* Muscular tissue is differentiated into unstriped, striated and cardiac.
* Connective tissue belongs to mesoderm.
* Protein present in cartilage is chrondrin.
* Vitamins B_{12} is a factor for the maturation of erythrocyte.
* The ensheathing band around muscles is fascia.
* Food reserve in muscles is glycogen.
* pH of human blood is 7.4.
* Largest smooth muscles occur in uterus of pregnant woman.
* In respiratory tract pseudostratified epithelium occurs.
* Collagen fibres are secreted by fibroblasts.
* Squamous epithelium = Skin of frog.
  Cialiated epithelium = Bronchioles.
  Striated cuboidal epithelium = Oesophagus.
  Glandular epithelium = Salivary gland.
* Type of tissue that forms glands is epithelial.
* Number of leucocytes in decreasing order in human blood is Neutrophils > Eosinophils > Basophils.
* Heparin in blood prevents blood clotting inside the body.
* Skin is a respiratory organ in frog.
* Beta cells = Insulin
  Mast cells = Histamine.
  Paneth cells = Lysosyme.
  Acinar cells = Pancreatic enzymes.
* Dead and keratinised layer of skin is made of stratified squamous.
* Thalassemia represents hereditary hemolytic anaemia due to defect in the synthesis of haemoglobin.
* Polycythemia refers to abnormal increase in the number of RBCs.
* Erythropoietin is a hormone secreted by kidney cells; it stimulates the RBC production in bone marrow.
* Old non-functional RBCs are destroyed in the spleen, liver and bone marrow. The most important site of RBCs disposal is spleen, so it is called their graveyard.
* The spleen also serves as a sort of blood bank.
* Blood is red but no RBCs are found in earthworm; haemoglobin directly dissolved in plasma.
* Haemocyanin is a copper containing respiratory pigment occuring in arthropods and molluscs. It is much less efficient oxygen carrier.
* Father of Histology - Bichat
* Word Epithelium was given by – Ruysch
* Brush bordered columnar epithelium : Gall bladder

QUESTION BANK

EXERCISE - 1 (LEVEL-1) [NCERT EXTRACT]

SECTION - 1 (VOCABULARY BUILDER)

Choose one correct response for each question.
For Q.1-Q.5
Match the column I with column II.

Q.1

	Column I	Column II
(a)	Squamous epithelium	(i) Present in bronchioles
(b)	Cuboidal epithelium	(ii) Present in lungs
(c)	Columnar epithelium	(iii) Present in stomach
(d)	Ciliated epithelium	(iv) Present in Kidneys

Codes
(A) a-ii, b-iv, c-iii, d-i (B) a-iv, b-iii, c-ii, d-i
(C) a-iii, b-ii, c-i, d-iv (D) a-i, b-ii, c-iii, d-iv

Q.2

	Column I	Column II
a.	Columnar epithelium	1. Larynx
b.	Ligaments	2. Eosinopaenia
c.	Chondrioblast	3. Elastic tissue
d.	Acidophils	4. Urinary bladder
e.	Uninucleated spindle shaped muscle fibres	5. Microvilli

(A) a-5, b-3, c-1, d-2, e-4
(B) a-5, b-1, c-3, d-2, e-4
(C) a-1, b-5, c-3, d-2, e-4
(D) a-5, b-3, c-1, d-4, e-2

Q.3

	Column I	Column II
(a)	Areolar tissue	(i) Fat cells
(b)	Adipose tissue	(ii) Osteocytes
(c)	Ligament	(iii) Loose connective tissue
(d)	Bone	(iv) Dense regular connective tissue

(A) a-iii, b-i, c-iv, d-ii (B) a-i, b-ii, c-iii, d-iv
(C) a-iv, b-iii, c-ii, d-i (D) a-ii, b-i, c-iv, d-iii

Q.4

	Column I		Column II
(a)	Neurons	i.	Short, branched cells with intercalated disks
(b)	Cardiac	ii.	Moves bones
(c)	Skeletal	iii.	Walls of tubes and cavities, primarily autorhythmic
(d)	Glial cells	iv.	Respond to stimuli with axon and dendrites
(e)	Smooth	v.	Support and electrical insulation

(A) (a) - iv, (b)-i, (c)-ii, (d)-v, (e)-iii
(B) (a) - i, (b)-ii, (c)-iii, (d)-iv, (e)-v
(C) (a) - ii, (b)-i, (c)-iii, (d)-iv, (e)-v
(D) (a) - i, (b)-iii, (c)-ii, (d)-v, (e)-iv

Q.5

	Column I	Column II
(a)	Compound epithelium	(i) Alimentary canal
(b)	Compound eye	(ii) Cockroach
(c)	Septal nephridia	(iii) Skin
(d)	Open circulatory system	(iv) Mosaic vision
(e)	Typhlosole	(v) Earthworm
(f)	Osteocytes	(vi) Phallomere
(g)	Genitalia	(vii) Bone

(A) (a) – ii, (b) – i, (c) – v, (d) – iii, (e) – iv, (f) – vii, (g) – vi
(B) (a) – ii, (b) – vi, (c) – v, (d) – iii, (e) – i, (f) – vii, (g) – iv
(C) (a) – iii, (b) – iv, (c) – v, (d) – ii, (e) – i, (f) – vii, (g) – vi
(D) (a) – i, (b) – ii, (c) – v, (d) – iv, (e) – iii, (f) – vi, (g) – vii

SECTION - 2 (BASIC CONCEPTS BUILDER)

For Q.6 to Q.20 :

Choose one word for the given statement from the list.

Fibroblast, Diffusion, Lateral, Squamous cells, Gap junction , Oothecae, Microvilli, Gizzard, Compound epithelium, Simple epithelium, Squamous epithelium, Osteoblasts, Sclerites, Protects, Supports.

Q.6 Endothelium is made up of _____.

Q.7 The cavities of alveoli of human lungs are lined by _____.

Q.8 Epithelial cells of the intestine involved in food absorption have ___ on their arm surface.

Q.9 Spiracles are present on the ____ side of the body of cockroach.

Q.10 In cockroach, fertilised eggs are stored in _____.

Q.11 Exchange of gases takes place in cockroaches by the process of _____.

Q.12 The type of epithelium seen in the walls of blood vessels is _____.

Q.13 Each segment of the cockroach exoskeleton has hardened plates called _____.

Q.14 Cells, which help in the formation of bones are called _____.

Q.15 The type of tissue lining present on the ducts of salivary gland and pancreas is _____.

Q.16 Cells of areolar tissues that produces or secrete fibres are called _____.

Q.17 Neuroglial cells ____ and ____ the neurons.

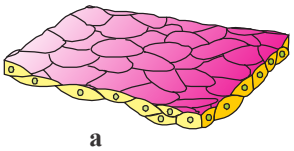
Q.18 _____ helps in grinding the food particles in cockroach.

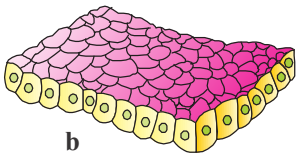
Q.19 The type of cell junction, which facilitates cell to cell communication is called the _____.

Q.20 Lining of body cavities, ducts and tubes are made up of _____.

SECTION - 3 (ENHANCE DIAGRAM SKILLS)

Q.21 Identify a, b and c following figures of simple epithelium tissue.


a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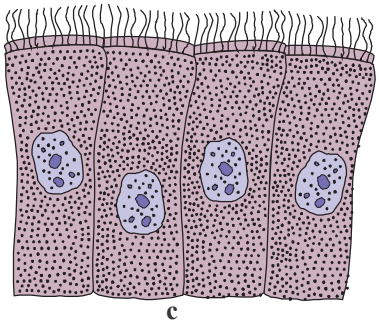
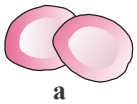
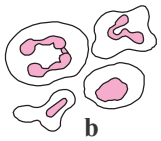
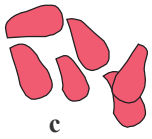

c

(A) a-Ciliated columnar, b-Squamous, c-Cuboidal
(B) a-Cuboidal, b-Squamous, c-Ciliated columnar
(C) a-Squamous, b-Ciliated columnar, c-Cuboidal
(D) a-Ciliated columnar, b-Cuboidal, c-Squamous

Q.22 Identify the given figure and select the correct option pertaining to the series a, b and c.

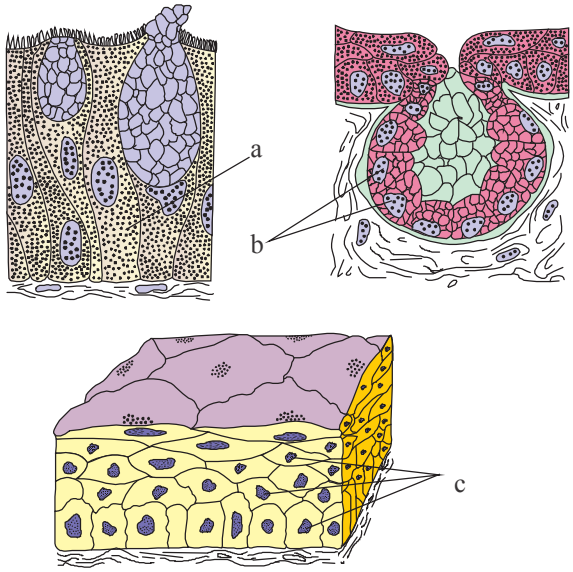

a


b


c

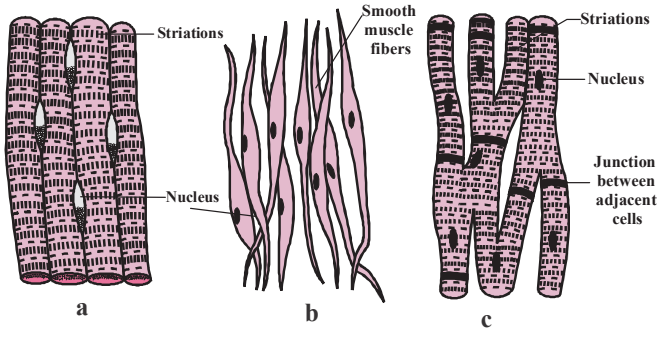
(A) a-Adipocyte, b-RBC, c-WBC
(B) a-Platelets, b-WBC, c-RBC
(C) a-RBC, b-WBC, c-Platelets
(D) a-Macrophages, b-RBC, c-Adipocyte

Q.23 Identify a, b and c in given figures and choose the correct combination of options.



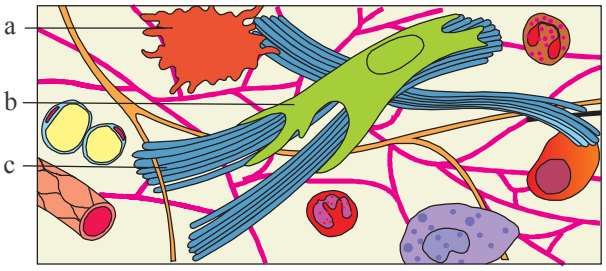
(A) a-Unicellular gland, b-Multicellular gland, c-Multilayered cells
(B) a-Multicellular gland, b-Unicellular gland, c-Squamous epithelium
(C) a-Goblet gland, b-Multicellular gland, c-Columnar epithelium
(D) a-Flattened cell, b-Multilayered cell, c-Transitional epithelium

Q.24 Examine the following figures, identify a, b, and c and choose the correct option.



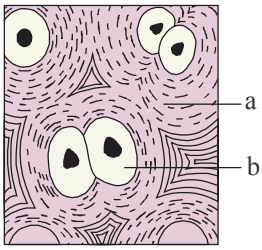
(A) a-Skeletal muscle, b-Voluntary muscle, c-Cardiac muscle
(B) a-Skeletal muscle, b-Smooth muscle, c-Cardiac muscle
(C) a-Cardiac muscle, b-Skeletal muscle, c-Smooth muscle
(D) a-Smooth muscle, b-Cardiac muscle, c-Skeletal muscle

Q.25 Identify a to c in the given diagram of areolar tissue.



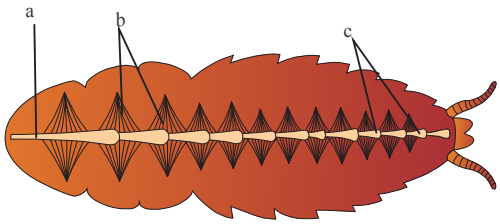
(A) a-Macrophage, b-Fibroblast, c-Collagen fibres,
(B) a-Mast cells, b-Collagen fibres, c-Plasma membrane,
(C) a-Chondrocyte, b-Fat storage area, c-Plasma membrane
(D) a-fibroblast, b-Macrophages, c-Mast cells

Q.26 In the given diagram of T.S. of cartilage, identify a and b.



(A) a-Collagen; b-Chondrocyte
(B) a-Osteocyte; b-Collagen
(C) a-Microtubule; b-Osteocyte
(D) a-Chondrocyte; b-Collagen

Q.27 Given below the figure of open circulatory system of cockroach. Identify a, b, and c choose the correct options.



(A) a-Lateral aorta, b-Ciliary muscles, c-Chambers of heart
(B) a-Internal aorta, b-Alary muscles, c-Chambers of heart
(C) a-Anterior aorta, b-Alary muscles, c-Chambers of heart
(D) a-Posterior aorta, b-Fibrous muscles, c-Chambers of heart

SECTION - 4 (ENHANCE PROBLEM SOLVING SKILLS)

Choose one correct response for each question.

PART - 1 : ANIMAL TISSUES

Q.28 The tissue which forms the glands in humans is
(A) muscular tissue (B) nervous tissue
(C) epithelium tissue (D) connective tissue

Q.29 Endothelium lining a blood vessel is formed of
(A) Ciliated epithelium
(B) Columnar epithelium
(C) Cuboidal epithelium
(D) Simple squamous epithelium

Q.30 Which of the following connective tissue does not contain collagen?
(A) Cartilage (B) Bone
(C) Blood (D) Adipose

Q.31 Which of the following is the most abundant component of the human blood?
(A) RBCs (. . . . . $^{+}$)
(C) Blood platelets (D) Cholesterol

Q.32 Collagen fibres are secreted by
(A) Histiocytes (B) Fibroblasts
(C) Mast cells (D) Macrophages

Q.33 The lining of intestine and kidneys in human is –
(A) keratinised (B) brush bordered
(C) ciliated (D) None of these

Q.34 The major constituent of connective tissue is
(A) vitamin (B) carbohydrate
(C) lipid (D) collagen

Q.35 Which of the following epithelium is composed of single layer of tall and slender cells?
(A) cuboidal epithelium
(B) columnar epithelium
(C) ciliated epithelium
(D) glandular epithelium

Q.36 Cells of squamous epithelium are
(A) Columnar
(B) Tall with elongated nuclei
(C) Flat plate like
(D) Cube like

Q.37 Each muscle is made up of long, cylindrical fibres arranged in parallel arrays. These fibres an composed of numerous fine fibrils called
(A) myofibrils (B) microfilament
(C) fibroblast (D) None of these

Q.38 Which of the following tissues provides a covering layer for some of the body parts?
(A) Connective tissues (B) Muscular tissues
(C) Epithelial tissues (D) Neural tissues

Q.39 Which of the following tissue performs the function of linking and supporting other tissues of the body?
(A) Epithelial tissue (B) Muscular tissue
(C) Connective tissue (D) Nervous tissue

Q.40 Simple epithelium is made of
(A) Non-cellular layer of hyaluronic acid.
(B) Actively dividing cells
(C) Loosely arranged cells
(D) Compactly packed single layer of cells

Q.41 Vagina, oesophagus and urethra contain which of the following type of tissues?
(A) Stratified squamous epithelium
(B) Simple squamous epithelium
(C) Ciliated epithelium
(D) Columnar epithelium

Q.42 Areolar tissue joins
(A) Integument to muscle
(B) Bones to muscle
(C) Bone to bone
(D) Fat body to muscle

Q.43 Matrix secreting cells of cartilage are known as
(A) chondrocytes (B) osteoblasts
(C) fibroblasts (D) mast cells

Q.44 Squamous epithelium is found in the walls of
(A) air sacs of lungs (B) kidney
(C) Fallopian tubes (D) salivary glands

Q.45 The kind of tissue that forms the supportive structure in our pinna (external ears) are also found in –
(A) phalanges (B) nails
(C) ear ossicles (D) tip of the nose

Q.46 Goblet cells are
(A) Unicellular glands
(B) Multicellular glands
(C) Dead keratinised cells
(D) Stratified epithelium

Q.47 Which of the following is not a function of epithelium?
(A) Protection (B) Connection
(C) Secretion or excretion (D) Adsorption

Q.48 Which of the following cells is/are contained in areolar connective tissue?
(A) mast cells (B) fibrobalsts
(C) macrophages (D) All of these

Q.49 Compound squamous epithelium occurs in
(A) Stomach (B) Intestine
(C) Trachea (D) Pharynx

Q.50 The contractile tissue that is present only in the heart is
(A) Cardiac tissue (B) Areolar tissue
(C) Adipose tissue (D) All of these

Q.51 In humans compound squamous epithelium is found in –
(A) stomach (B) intestine
(C) trachea (D) pharynx

Q.52 Which of the following is set of connective tissue only?
(A) Blood, Bone, Skin
(B) Blood, Bone, Muscle
(C) Bone, Tendon, Muscle
(D) Cartilage, Bone, Blood

Q.53 In humans ciliated epithelium is present in
(A) trachea (B) intestine
(C) ureter (D) nasal chamber

Q.54 Adipose tissue is a type of
(A) loose connective tissue
(B) dense connective tissue
(C) specialised connective tissue
(D) None of the above

Q.55 Which of the following gland do not have duct?
(A) Salivary gtand (B) Mammary gland
(C) Intestinal gland (D) Adrenal gland

Q.56 Bone marrow of long bones are the sites of –
(A) production of WBCs
(B) production of RBCs
(C) production of blood cells
(D) breakdown of RBCs

Q.57 Which of the following epithelium type helps in the secretion and absorption of nutrients?
(A) Cuboidal (B) Stratified squamous
(C) Squamous (D) Columnar

Q.58 Tendons helps in connecting
(A) muscles to bones (B) bone to bone
(C) bone to cartilage (D) cartilage to muscle

Q.59 In human body neuroglia cells occurs in the –
(A) liver (B) brain
(C) kidney (D) brain & spinal cord

Q.60 Microvilli of epithelial cells
(A) Increase the surface area
(B) Protect the cells
(C) Engulf the foreign matter
(D) Give movement to cells

Q.61 Which tissue is present in the lining of small intestine?
(A) Epithelial tissue (B) Connective tissue
(C) Nervous tissue (D) Muscular tissue

Q.62 Which is not a component of areolar tissue?
(A) Fibroblast (B) Macrophages
(C) Schwann cell (D) Mast cells

Q.63 Columnar epithelium in human body is found in
(A) stomach (B) lungs
(C) kidney (D) Fallopian tube

Q.64 Bones are made up of –
(A) magnesium phosphate (B) sodium chloride
(C) calcium phosphate (D) phosphorus

Q.65 Fat is abundant in
(A) Liver cells (B) Alveolar tissue
(C) Adipose tissue (D) Lymph glands

Q.66 Three types of, cell junctions, i.e., the tight, adhering and the gap junctions are found in –
(A) muscular tissue (B) connective tissue
(C) epithelial tissue (D) neural tissue

Q.67 Which of the following type of connective tissue is present at the tip of human nose?
(A) Cartilage (B) Bone
(C) Adipose tissue (D) None of these

Q.68 Which of the following junctions help to stop substances from leaking across a tissue?
(A) Adhering junctions (B) Gap junctions
(C) Tight junctions (D) Both (A) & (B)

Q.69 Collagen is a –
(A) phosphoprotein (B) globulin
(C) derived protein (D) scleroprotein

Q.70 Hardest tissue of the body is
(A) Cartilage (B) Fibrous connective tissue
(C) Bone (D) Areolar tissue

Q.71 Fibroblasts, macrophages and mast cells are present in the –
(A) epithelium tissue (B) connective tissue
(C) skeletal muscle tissue (D) smooth muscle tissue

PART - 2 : COCKROACH

Q.72 Which of the following segments constitute the thorax of the cockroach?
(A) Prothorax and prethorax
(B) Prothorax and mesothorax
(C) Mesothorax and metathorax
(D) Prothorax, mesothorax and metathorax

Q.73 Which of the following is wrong match in cockroach?
(A) Head - Hypognathous
(B) Heart - 13 chambered
(C) Anal styles - Female cockroach
(D) Excretion - Malpighian tubules

Q.74 Cockroach belongs to
(A) class Insecta of phylum – Echinodermata
(B) class Amphibia of phylum – Reptelia
(C) class Insecta of phylum – Arthropoda
(D) class Insecta of phylum – Annelida

Q.75 Structures which help In distinguishing a male cockroach from a female cockroach are
(A) Anal styles (B) Anal cerci
(C) Collaterial glands (D) Ocelli

Q.76 Respiratory system of the cockroach consists of
(A) a pair of lungs (B) a pair of bronchioles
(C) a network of trachea (D) a network of alveoli

Q.77 Open blood vascular system without any respiratory pigment is found in
(A) Earthworm (B) Cockroach
(C) Neries (D) Hydro

Q.78 Cockroach is –
(A) uriotelic (B) uricotelic
(C) ammonotelic (D) ureo-ammonotelic

Q.79 In female cockroach, which of the following part is absent?
(A) anal style (B) anal cerca
(C) sterna (D) tergum

Q.80 Which mouth part of cockroach acts as upper lip?
(A) labium (B) Labrum
(C) First maxilla (D) Hypopharynx

Q.81 Blood vascular system of the cockroach is of
(A) open type (B) closed type
(C) portal type (D) None of these

Q.82 Heart of the cockroach is
(A) 12 chambered (B) 13 chambered
(C) 15 chambered (D) 4 chambered

Q.83 Position of head in relation to body axis of cockroach is known as
(A) Epignathous (B) Hypognathous
(C) Prognathous (D) None of these

Q.84 In the exoskeleton of the cockroach, sclerites are joined to each other by
(A) ossicles (B) arthrodial membrane
(C) amino acids (D) chitin

Q.85 A pair of spermatheca is present in the 6th segment of the cockroach which opens into
(A) genital chamber (B) anus
(C) rectum (D) vagina

Q.86 Structure that helps the cockroach to walk on smooth surfaces is
(A) Trochcnter (B) Plantulae
(C) Cardo (D) Scape

Q.87 Thin Malpighian tubules in cockroach are present at the junction of
(A) fore gut and mid gut (B) mid gut and hind gut
(C) fore gut and hind gut (D) mid gut and gizzard

Q.88 Cockroaches are
(A) omnivorous (B) carnivorous
(C) herbivorous (D) parasite

Q.89 In male reproductive system of the cockroach, spermatheca is present in the
(A) 7th segment (B) 6th segment
(C) 5th segment (D) 4th segment

Q.90 Which of the following part of the cockroach helps in the removal of excretory products from the haemolymph?
(A) Rectum (B) Malpighian tubule
(C) Ileum (D) Cloaca

Q.91 Blood of a cockroach contains
(A) plasma and leucocytes
(B) erythrocytes and plasma
(C) erythrocytes and platelets
(D) All of these

Q.92 The head capsule of the cockroach bears
(A) no eyes (B) one eyes
(C) two eyes (D) many eyes

Q.93 Main function of blood vascular system in cockroach is
(A) Distribution of oxygen
(B) Distribution of absorbed nutrients
(C) Distribution of heat
(D) All of these

Q.94 The female reproductive system of the cockroach consists of
(A) two large ovaries (B) three large ovaries
(C) one large ovary (D) four large ovaries

Q.95 In the digestive system of cockroach gastric caecae is present at the junction of
(A) mid gut and hind gut(B) hind gut and fore gut
(C) fore gut and mouth (D) mid gut and fore gut

Q.96 In cockroach, malpighian tubules are the main organs of
(A) Respiration (B) Digestion
(C) Excretion (D) Reproduction

Q.97 In cockroach the heart is
(A) muscular and tube-like (B) three chambered
(C) membranous (D) small

Q.98 The body of the cockroach is segmented and divisible into
(A) head and tail
(B) head and thorax
(C) head and abdomen
(D) head, thorax and abdomen

EXERCISE - 2 (LEVEL-2)

Choose one correct response for each question.

Q.1 The demands placed on a cell are both
(A) internal and external
(B) physical and anatomical
(C) functional and physiological
(D) none of these

Q.2 Select the level that is encompassed by or within the other three.
(A) liver (B) epithelium
(C) mitochondria (D) hepatic (liver) cell

Q.3 Given the characteristics of lines a body cavity with little or no extracellular matrix, select the major tissue type.
(A) nervous (B) muscle
(C) connective (D) epithelial

Q.4 This tissue has cells involved in immunity as well as oxygen delivery to cells.
(A) nervous (B) muscle
(C) connective (D) epithelial

Q.5 This tissue is found in every organ or organ system. It is the most varied and is characterized by various cell types, fibers, and an extracellular matrix.
(A) nervous (B) muscle
(C) connective (D) epithelial

Q.6 Maintenance of osmotic balance, electrolytes, and pH are important functions of this organ system.
(A) Circulatory (B) Excretory
(C) Respiratory (D) Endocrine

Q.7 This organ system is involved in homeostatic mechanisms and chemical regulation which is carried in circulation.
(A) Circulatory (B) Excretory
(C) Respiratory (D) Endocrine

Q.8 This organ system has sweat glands and provides protection to the organism.
(A) Muscular (B) Integumentary
(C) Skeletal (D) Nervous

Q.9 Transitional epithelium is found in –
(A) Larynx
(B) Vein
(C) Kidney
(D) Ureter and renal pelvis

Q.10 Outer layer of skin that frog casts off is composed of –
(A) Simple squamous epithelium
(B) Tesselated epithelium
(C) Ciliated epithelium
(D) Cuboidal epithelium

Q.11 Areolar tissue connects –
(A) The skin with muscles
(B) Muscles to muscles
(C) Bone to bone
(D) Bone to muscles

Q.12 Matrix of the connective tissue is secreted by –
(A) Fibrocytes (B) Histiocytes
(C) Mast cells (D) Plasma cells

Q.13 Dermis of the skin is formed of –
(A) Adipose connective tissue
(B) Epithelial tissue
(C) Muscular tissue
(D) Areolar connective tissue

Q.14 Tendon is made up of –
(A) Yellow fibrous connective tissue
(B) Adipose tissue
(C) Modified white fibrous tissue
(D) Areolar tissue

Q.15 Which of the following cell contains fat droplets
(A) Macrophages (B) Plasma cells
(C) Adipoe cells (D) Leucocytes

Q.16 Tendons and ligaments belong to
(A) Muscular tissue
(B) Epithelial tissue
(C) Fibrous connective tissue
(D) Areolar connective tissue

Q.17 Fibres present in connective tissue are –
(A) Reticular (B) Elastic
(C) Collagen (D) All the above

Q.18 Histamine secreting cells are found in –
(A) Connective tissues (B) Lungs
(C) Muscular tissue (D) Nervous tissue

Q.19 Histiocyte is a connective tissue cell which takes part in
(A) Fibre production (B) Matrix production
(C) Phagocytosis (D) Secretion

Q.20 Mast cells occur in –
(A) Areolar tissue
(B) Adipose tissue
(C) White fibrous tissue
(D) Yellow fibrous tissue

Q.21 A tissue in which matrix is the source of structural and functional performance is –
(A) Muscular (B) Epithelial
(C) Connective (D) Nervous

Q.22 In Camel, the hump is mainly made of tissue
(A) Areolar (B) Adipose
(C) Muscular (D) Skeleton

Q.23 Yellow fibres are made up of –
(A) Ossein (B) Elastin
(C) Chondrin (D) Collagen

Q.24 Perichondrium covers the –
(A) Bone (B) Cartilage
(C) Decalcified bone (D) Dried bone

Q.25 The process of bone formation is called –
(A) Ossification (B) Calcification
(C) Calcination (D) None of these

Q.26 Matrix of cartilage is secreted by –
(A) Chondrocytes (B) Chondroblasts
(C) Osteocytes (D) Histiocytes

Q.27 The main difference between bone and cartilage is of –
(A) Mineral salts (B) Blood vessels
(C) Lymph vessels (D) Haversian canals

Q.28 60% inorganic components are present in
(A) Cartilage (B) Bone
(C) Connective tissue (D) None of these

Q.29 Matrix of bone is arranged –
(A) In concentric layers
(B) Not in concentric layers
(C) Matrix forms the ground substance
(D) None of these

Q.30 Function of stomodael valve in the gut of cockroach is to prevent the entry of food from –
(A) Gizzard into midgut (B) Preoral cavity
(C) Hindgut to midgut (D) Midgut into gizzard

Q.31 Blood cells are formed in bone marrow. The process is known as –
(A) Haemolysis (B) Erythroblastosis
(C) Haemopoiesis (D) None of these

Q.32 Blood platelets are not present in the blood of –
(A) Fishes (B) Amphibians
(C) Reptiles (D) All the above

Q.33 Agranulocytes normally develop in –
(A) Bone marrow
(B) Liver
(C) Lymph glands and spleen
(D) None of these

Q.34 Granulocytes are produced in –
(A) Liver (B) Bone marrow
(C) Spleen (D) None of these

Q.35 Formation of platelets is known as –
(A) Haemopoiesis (B) Thrombopoiesis
(C) Haemolysis (D) None of these

Q.36 Percentage of protein is more in –
(A) Lymph (B) Blood
(C) Plasma (D) W.B.C.

Q.37 Which of the following acts as middle man –
(A) W.B.C. (B) Plasma
(C) Blood (D) Lymph

Q.38 Blood is a –
(A) Epithelial tissue (B) Muscular tissue
(C) Connective tissue (D) Supportive tissue

Q.39 In man, the number of R.B.C. percubicmm of blood is –
(A) 1 to 3 millions
(B) 5 to 5.4 millions
(C) Less than one million but more than 50 thousand
(D) Less than 50 thousand

Q.40 Life span of a W.B.C. in man is
(A) 100 days (B) 50 days
(C) 7 days (D) None of the above

Q.41 The diameter of RBC is –
(A) 10-12 µm (B) 2-3 µm
(C) 7-8 µm (D) None of the above

Q.42 Formation of antibodies is the function of –
(A) Monocytes (B) Neutrophils
(C) Basophils (D) Lymphocytes

Q.43 Life span of mammalian R.B.C. is –
(A) 100-128 days (B) 100 days
(C) Less than 100 days (D) None of the above

Q.44 Muscle fibres having rounded ends are –
(A) Unstriped muscles (B) Smooth muscles
(C) Striped muscles (D) All the above

Q.45 Inter-calated discs are present in –
(A) Cardiac muscles (B) Striped muscles
(C) Unstriated muscles (D) Ligament

Q.46 The cytoplasm of muscle fibre is known as –
(A) Neuroplasm (B) Protoplasm
(C) Germ plasm (D) Sarcoplasm

Q.47 "All or Non" rule can't be implicate on –
(A) Non straited muscles
(B) Cardiac Muscles
(C) Straited muscles
(D) All the above

Q.48 Each myofibril has a diameter of-
(A) 1 to 2 µm (B) 0.1 to 0.2 µm
(C) 0.001 to 0.002 µm (D) None of the above

Q.49 Myofibrils show dark and light bands in –
(A) Cardiac muscles (B) Unstriped muscles
(C) Striped muscles (D) Both 1 and 3

Q.50 The total no of ganglia present on the nerve cord of cockroach is –
(A) 6 (B) 9
(C) 10 (D) 12

Q.51 Uninucleate muscles are –
(A) Smooth muscles (B) Cardiac muscles
(C) Involuntary muscles (D) All the above

Q.52 Multinucleate muscle cells are –
(A) Striped muscles (B) Smooth muscles
(C) Skeletal muscles (D) All the above

Q.53 Which of the muscles are attached to bones –
(A) Smooth muscles (B) Straited muscles
(C) Cardiac muscles (D) All the above

Q.54 Rhythmical contraction is noticed in-
(A) Cardiac muscles (B) Striped muscles
(C) Unstriped muscles (D) In all the muscles

Q.55 Muscles get fatigued due to accumulation of-
(A) Adenosine triphosphate
(B) CO_2
(C) Lactic acid
(D) Phosphate molecules

Q.56 Nissel's granules are absent in –
(A) Dendrons and dendrites
(B) Cyton
(C) Axon
(D) Dendrons and cyton

Q.57 Neuro-fibrils are present in –
(A) Cyton (B) Muscles
(C) Bones (D) Connective tissue

Q.58 Alary muscles in cockroach occur in
(A) Heart wall and help in blood circulation.
(B) Dogsal septum and connect the septum with heart and tergite.
(C) wall of gizzard and help in its contraction.
(D) intestinal wall and help in digestion.

Q.59 Collateral fibres are given out along its way is –
(A) Muscle fibre (B) Axon
(C) Dendron (D) Dendrites

Q.60 Myelin sheath is present around the –
(A) Non-medullated nerve fibre
(B) Medullated nerve fibre.
(C) Medullated and non-medullated nerve fibres
(D) Muscle fibres

Q.61 Which possesses nodes of Ranvier –
(A) Medullated nerve fibre
(B) Non-medullated nerve fibre
(C) Muscle fibre
(D) Medullated and non-medullated nerve fibres

Q.62 The packing cells around nerve cells in brain are called
(A) Histiocytes (B) Mast cells
(C) Matrix (D) Neuroglia cells

Q.63 Bipolar nerve cells are present in –
(A) Skin tactile corpuscles (B) Spinal cord
(C) Retina of eye (D) All the above

Q.64 Multipolar nerve cells are present in –
(A) Cochlea
(B) Dorsal root ganglia of spinal cord
(C) Retina of eye
(D) Brain

Q.65 Which is correct –
(A) A medullated nerve fibre appears grey
(B) A non medullated nerve fibre appears white
(C) Neurilemma is composed of Schwann cells
(D) Neurilemma is composed of neuroglia cells

Q.66 Tissue connecting bones is –
(A) Tendon (B) Ligament
(C) Areolar tissue (D) Adipose tissue

Q.67 Nissal granules found in cyton of a neuron and having affinity for basic dyes are composed of
(A) DNA (B) RNA
(C) Proteins (D) Amino acids

Q.68 Which one of the following contain the largest quantity of extra cellular material –
(A) Striated muscle
(B) Areolar Tissue
(C) Stratified layer
(D) Myelinated nerve fibre

Q.69 Ventricles of brain are lined by the cells called –
(A) Ependymal (B) Neuron cells
(C) Neuroglea (D) Schwann's cells

Q.70 Insects excrete nitrogen as –
(A) Uric acid (B) Guanine
(C) Urea (D) Ammonia

Q.71 Two common Indian cockroaches are
(A) Periplaneta american and Blatta indica
(B) Periplaneta orientalis and Blatta americana
(C) Periplaneta americana and Blattaorientalls
(D) Periplaneta indica and Blatta orientails

Q.72 Myelin sheath covers which of the following –
(A) Muscle fibre (B) Nerve fibre
(C) Collagen fibre (D) Tendon

Q.73 Number 16 in cockroach is concerned with –
(A) Body segments (B) mapighian tubule
(C) tracheae (D) optjeaca

Q.74 In a vertebrate which germ layer forms the skeleton muscles–
(A) Ectoderm (B) Endoderm
(C) Mesoderm (D) Both (A) and (C)

Q.75 Mast cells of connective tissue contain-
(A) Vasopressin and relaxin
(B) Heparin and histamin
(C) Heparin and calcitonin
(D) Serotonin and melanin

Q.76 Collagen fibre are secreted by –
(A) Mast cells (B) Macrophage
(C) Histiocytes (D) Fibroblasts

Q.77 The major constituent of connective tissue is –
(A) Collegen (B) Carbohydrate
(C) Lipid (D) Cholesterol

Q.78 Four healthy people in their twenties got involved in injures resulting in damage and death of a few cells of the following. Which of the cells are least likely to be replaced by new cells –
(A) Liver cells (B) Neurons
(C) Malpighian layer of the skin (D) Osteocytes

Q.79 Body of nephridia is V-shaped in –
(A) Septal nephridia
(B) Integumentary nephridia
(C) Pharyngeal nephridia
(D) All the above

Q.80 Which part of cockroach has both exoskeleton and endoskeleton
(A) Head (B) Thorax
(C) Both of these (D) None of these

Q.81 Male and female cockroaches can be distinguished externally through
(A) Anal styles in male
(B) Anal cerci in female
(C) Anal style and antennae in female
(D) both (B) and (C)

Q.82 The component units of compound eye of cockroach are called
(A) Eyelets (B) Fenestra
(C) Ommatidia (D) Ocelli

Q.83 Excretory organs of Earthworm are-
(A) Coelom (B) Flame cells
(C) Nephridia (D) Gizzard

Q.84 Just as there are nephridia in earthworm so are-
(A) Myotomes in fish
(B) Statocyst in prawn
(C) Parotid gland in toad
(D) Flame cells in liver fluke

Q.85 The function of blood vascular system in cockroach is –
(A) Distribution of absorb nutrients
(B) Distribution of oxygen
(C) Transportation of enzymes
(D) Transportation of heat

Q.86 To which one of the following categories does adipose tissue belong?
(A) Epithelial (B) Connective
(C) Muscular (D) Neural

Q.87 Which of the following is not a connective tissue?
(A) Bone (B) Cartilage
(C) Blood (D) Muscles

Q.88 Match the followings and choose the correct answer

a. Touch	i. Nasal epithelium
b. Smell	ii. Foramen magnum
c. Cranial nerves	iii. Sensory papillae
d. Medulla oblongata	iv. Peripheral nervous system

(A) a-iii, b-i, c-ii, d-iv (B) a-ii, b-i, c-iv, d-iii
(C) a-iii, b-iv, c-ii,d-i (D) a-iii, b-i, c-iv, d-ii

Q.89 Cartilage is formed by
(A) chondrocytes (B) osteoblasts
(C) osteoclasts (D) fibroblasts

Q.90 The cell junctions called tight, adhering and gap junctions are found in
(A) connective tissue (B) epithelial tissue
(C) neural tissue (D) muscular tissue.

Q.91 Which of the following is a transparent tissue?
(A) Tendon (B) Fibrous cartilage
(C) Hyaline cartilage (D) All of these

Q.92 Which one of the following contains the largest quantity of extracellular material?
(A) Striated muscle
(B) Areolar tissue
(C) Stratified epithelium
(D) Myelinated nerve fibres

Q.93 Mammalian bone differs from cartilage in the presence
(A) lymph vessels (B) collagen
(C) blood vessels (D) Haversian canals.

Q.94 Cardiac muscle cells differ from striated muscle cells in having
(A) a centrally located nucleus
(B) different myofibrils
(C) fewer mitochondria
(D) no sarcoplasmic reticulum

Q.95 Simple cuboidal epithelium lines all the following structures except the
(A) ovary (B) pancreatic ducts
(C) thyroid follicles (D) Fallopian tube

Q.96 Lining of intestine of man is
(A) brush bordered (B) ciliated
(C) non-keratinized (D) keratinized

Q.97 Bone is connected to muscles with the help of
(A) ligament (B) cartilage
(C) tendon (D) none of these

Q.98 Which of the following statements is correct regarding cockroach?
(A) It possesses ventral nerve cord.
(B) Its spiracles help in excretion.
(C) Phallomere is present in female cockroach.
(D) Compound eye is also called as ocellus.

Q.99 Keratinised dead layer of skin is made up of
(A) stratified squamous epithelium
(B) simple cuboidal epithelium
(C) simple columnar epithelium
(D) stratified columnar epithelium

Q.100 In male cockroach, genital pouch contains
(A) dorsal anus, ventral genital pore and gonapophysis.
(B) dorsal anus, gonopore and gonapophysis.
(C) ventral anus, dorsal spermathecal pore, gonapophysis.
(D) gonopore, spermathecal, pores and collateral glands.

Q.101 Which of the following statement is/are correct with reference to the columnar epithelium?
(i) It is composed of single layer of tall and slender cells.
(ii) Nucleus of the cell is located at its base.
(iii) Free surface may have microvilli.
(iv) It is commonly found in kidneys of mammal.
(A) i, ii, iv (B) i, ii, iii
(C) ii, iii (D) i, iii

Q.102 The type of tissue lining in the nasal passage and the bronchioles is
(A) columnar ciliated epithelium
(B) cuboidal epithelium
(C) neuro sensory epithelium
(D) germinal epithelium

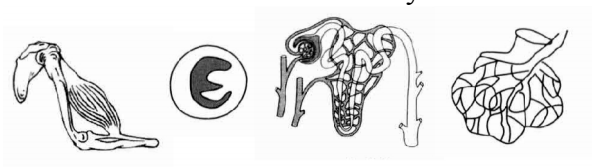
Q.103 Choose the incorrect pair from the matches given below.
(A) Antennae - Sensory receptors
(B) Metathoracic wings - Flying
(C) Malpighian tubule - Excretory role
(D) Crop - Grinding food

EXERCISE - 3 (LEVEL-3)

Choose one correct response for each question.

Q.1 If the stimulus resulted in amplification of the response, this would be an example of –
(A) negative feedback (B) positive feedback
(C) homeostasis (D) integration

Q.2 The diagrams below show tissue K, cell L, unit M and tissue N in a human body.



Tissue K Cell L Unit M Tissue N

Which systems are associated with tissue K, cell L, unit M and tissue N?

	Tissue K	Cell L	Unit M	Tissue N
(A)	Support system	Blood circulatory system	Excretory system	Respiratory system
(B)	Blood circulatory system	Support system	Respiratory system	Excretory system
(C)	Respiratory system	Excretory system	Support system	Blood circulatory system
(D)	Excretory system	Respiratory system	Blood circulatory system	Support system

Q.3 If body temperature exceeded the set point of the hypothalamus, you would expect the stimulus to activate sweat glands would –
(A) increase (B) decrease
(C) not change (D) Either B or C

Q.4 Metamorphosis in the life history of periplaneta is –
(A) Absent (B) Incomplete
(C) Complete (D) Pupa

Q.5 Young cockroach is called –
(A) Maggot (B) Ephyra
(C) Nymph (D) Pupa

Q.6 The first animals to fly were
(A) Mammals (B) Lizards
(C) Birds (D) Insect

Q.7 Diagnostic feature of insects in –
(A) Three pairs of legs (B) Compound eye
(C) Chitinous body (D) Two pairs of wings

Q.8 Match the followings and choose the correct option

(a)	Adipose tissue	i. Nose
(b)	Stratified epithelium	ii. Blood
(c)	Hyaline cartilage	iii. skin
(d)	Fluid connective tissue	iv. Fat storage

(A) a-i, b-ii, c-iii, d-iv (B) a-iv, b-iii, c-i, d-ii
(C) a-iii, b-i, c-iv, d-ii (D) a-ii, b-i, c-iv, d-iii

Q.9 Match the followings and choose the correct answer

a.	Hermaphrodite	i. Produces blood cells and haemoglobin
b.	Direct development	ii. Testis and ovary in the same animal
c.	Chemoreceptor	iii. Larval form absent
d.	Blood gland in earthworm	iv. Sense of chemical substances

Options:
(A) a-ii, b-iii, c-iv, d-i
(B) a-iii, b-ii, c-iv, d-i
(C) a-i, b-iii, c-ii, d-i
(D) a-ii, b-iv, d-iii, d-i

For Q.10-Q.14
(A) Statement- 1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement -1.
(B) Statement-1 is True, Statement -2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement - 1 is True, Statement- 2 is False.
(D) Statement -1 is False, Statement -2 is False.

Q.10 **Statement 1 :** Intercalated discs are important regions of cardiac muscle cells.
Statement 2 : Intercalated discs function as boosters for muscle contraction waves.

Q.11 **Statement 1 :** Urinary bladder can considerably expand to accommodate urine.
Statement 2 : It is lined by stretchable squamous epithelium.

Q.12 **Statement 1 :** Columnar epithelium lining the intestinal mucosa appears to have a brush like appearance.
Statement 2 : A large number of microvilli are present on brush bordered columnar epithelium.

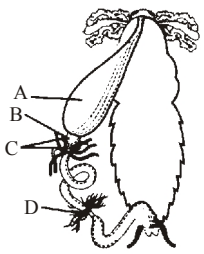
Q.13 **Statement 1 :** Cartilage (protein matrix) and bone (calcium matrix) are rigid connective tissue.
Statement 2 : Blood is connective tissue in which plasma is the matrix.

Q.14 **Statement 1 :** Specialization of cells is advantageous for the organism.
Statement 2 : It increase the operational efficiency of an organism.

Q.15 Which one of the following is correct pairing of a body part and the kind of muscle tissue that moves it?
(A) Biceps of upper arm –Smooth muscle fibres
(B) Abdominal wall – Voluntary smooth muscle
(C) Iris – Involuntary smooth muscle
(D) Heart wall – Involuntary unstriated muscle

Q.16 Consider the following statements (i)-(iii) and select the correct option stating which ones are true (T) and which ones are false (F).
(i) Stratified squamous epithelium covers moist surfaces like buccal cavity.
(ii) Fibroblasts store fat in adipose tissue.
(iii) Urinary bladder is lined by a stratified epithelium.
(A) (i)-F, (ii)-T, (iii)-T (B) (i)-T, (ii)-F, (iii)-F
(C) (i)-T, (ii)-F, (iii)-T (D) (i)-T, (ii)-T, (iii)-F

Q.17 The given figure shows alimentary canal of cockroach. Identify the parts labelled as A to D and select the correct option.



(A) A-Gizzard, B-Crop, C-Hepatic caecae D-Malpighian tubules
(B) A-Crop, B-Gizzard, C-Hepatic caecae, D-Malpighian tubules
(C) A-Crop, B-Gizzard, C-Malpighian tubules, D-Hepatic caecae
(D) A-Gizzard, B-Crop, C-Malpighian tubules, D-Hepatic caecae

Q.18 Read the statements and select the correct ones.
(i) In simple cuboidal epithelium nuclei are rounded and lie in the centre of the cells.
(ii) Non-keratinized epithelium is impermeable to water.
(iii) Yellow elastic fibrocartilage makes cartilage flexible.
(iv) Areolar tissue forms a shock absorbing cushion around the eye balls and kidneys.
(A) (i) and (iii) (B) (i) and (ii)
(C) (iii) and (iv) (D) (ii) and (iv)

Q.19 Select the correct statement from the ones given below with respect to *Periplaneta americana*.
(A) Nervous system located dorsally, consists of segmentally arranged ganglia joined by a pair of longitudinal connectives.
(B) Males bear a pair of short thread like anal styles.
(C) There are 16 very long Malpighian tubules present at the junctions of midgut and hindgut.
(D) Grinding of food is carried out only by the mouth parts.

Q.20 Which of the following structures is correctly matched with its description?
(A) Septal nephridia and pharyngeal nephridia - Both are exonephric
(B) Typhlosole - Helps in grinding the soil particles and decaying leaves.
(C) Hepatic caeca - Blind tubules present at the junction of foregut and mid-gut in the alimentary canal of the cockroach.
(D) Gizzard - Internal median fold present in the dorsal wall of the intestine of earthworm.

Q.21 Which of the following statement is/are correct about squamous epithelium?

(i) It consists of a single thin layer of flattened cells with irregular boundaries.
(ii) It is present on secretory and absorptive surfaces.
(iii) It is found on the walls of the kidney.
(iv) It is involved in many functions like forming a diffusion boundary.

(A) i, ii, iv (B) i, ii, iii
(C) ii, iii (D) i, iii

Q.22 Consider the given statements about *Periplanata* and select the correct order of True (T) and False (F) statement.

a. Blood vascular system is of open type.
b. Malpighian tubules helps in the removal of excretory products from the haemolymph.
c. They bear no eyes.
d. Female bear mushroom glands and male bear collaterial glands

(A) TFTF (B) TTFF
(C) FFTT (D) FTTT

EXERCISE - 4 (PREVIOUS YEARS AIPMT/NEET EXAM QUESTIONS)

Choose one correct response for each question.

Q.1 What external changes are visible after the last moult of a cockroach nymph? **[NEET 2013]**
(A) Labium develops
(B) Mandibles become harder
(C) Anal cerci develop
(D) Both fore wings with hind wings develop

Q.2 Choose the correctly matched pair : **[AIPMT 2014]**
(A) Tendon - Specialized connective tissue
(B) Adipose tissue - Dense connective tissue
(C) Areolar tissue - Loose connective tissue
(D) Cartilage - Loose connective tissue

Q.3 Choose the correctly matched pair – **[AIPMT 2014]**
(A) Inner lining of salivary ducts - Ciliated epithelium
(B) Moist surface of buccal cavity-Glandular epithelium
(C) Tubular parts of nephrons-Cuboidal epithelium
(D) Inner surface of bronchioles-Squamous epithelium

Q.4 The terga, sterna and pleura of cockroach body are joined **[AIPMT 2015]**
(A) Muscular tissue (B) Arthrodialmembrane
(C) Cartilage (D) Cementing glue

Q.5 Which of the following features is not present in *Periplaneta americana*? **[NEET 2016 PHASE 1]**
(A) Schizocoelom as body cavity.
(B) Indeterminate and radial cleavage during embryonic development.
(C) Exoskeleton composed of N-acetylglucosamine.
(D) Metamerically segmented body.

Q.6 Which type of tissue correctly matches with its location? **[NEET 2016 PHASE 1]**

	Tissue	**Location**
(A)	Smooth muscle	Wall of intestine
(B)	Areolar tissue	Tendons
(C)	Transitional epithelium	Tip of nose
(D)	Cuboidal epithelium	Lining of stomach

Q.7 In male cockroaches, sperms are stored in which part of the reproductive system? **[NEET 2016 PHASE 2]**
(A) Seminal vesicles (B) Mushroom glands
(C) Testes (D) Vas deferens

Q.8 Smooth muscles are **[NEET 2016 PHASE 2]**
(A) Involuntary, fusiform, non-striated
(B) Voluntary, multinucleate, cylindrical
(C) Involuntary, cylindrical, striated
(D) Voluntary, spindle-shaped, uninucleates

Q.9 Which of the following features is used to identify a male cockroach from a female cockroach? **[NEET 2018]**
(A) Forewings with darker tegmina.
(B) Presence of caudal styles.
(C) Presence of a boat shaped sternum on the 9th abdominal segment.
(D) Presence of anal cerci.

Q.10 Select the correct sequence of organs in the alimentary canal of cockroach starting from mouth **[NEET 2019]**
(A) Pharynx → Oesophagus → Crop → Gizzard→ Ileum → Colon → Rectum
(B) Pharynx → Oesophagus → Gizzard → Crop → Ileum → Colon → Rectum
(C) Pharynx → Oesophagus → Gizzard → Ileum → Crop → Colon → Rectum
(D) Pharynx → Oesophagus → Ileum → Crop → Gizzard → Colon → Rectum

Q.11 The ciliated epithelial cells are required to move particles or mucus in a specific direction. In humans, these cells are mainly present in **[NEET 2019]**
(A) Bile duct and Bronchioles.
(B) Fallopian tubes and Pancreatic duct.
(C) Eustachian tube and Salivary duct.
(D) Bronchioles and Fallopian tubes.

ANSWER KEY

EXERCISE-1 (SECTION-1&2)

(1) (A) **(2)** (A) **(3)** (A)
(4) (A) **(5)** (C)
(6) Squamous cells
(7) Squamous epithelium
(8) Microvilli
(9) Lateral **(10)** Oothecae
(11) Diffusion **(12)** Squamous epithelium
(13) Sclerites **(14)** Osteoblasts cells
(15) Compound epithelium
(16) Fibroblast **(17)** Protects, supports
(18) Gizzard **(19)** Gap junctions
(20) Simple epithelium

EXERCISE - 1 [SECTION-3 & 4]

Q	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
A	B	C	A	B	A	A	C	C	D	D	A	B	B	D	B	C	A	C	C	D	A	A	A	A	D
Q	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
A	A	B	D	D	A	D	D	A	A	D	C	D	A	D	A	A	C	A	C	C	C	A	C	D	C
Q	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
A	B	D	C	C	A	C	B	B	A	B	A	B	B	B	A	B	B	A	B	B	A	C	B	A	D
Q	96	97	98																						
A	C	A	D																						

EXERCISE - 2

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	A	C	D	C	C	B	D	B	D	A	A	C	A	C	C	C	D	A	C	A	C	B	B	B	A
Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A	B	D	B	A	D	C	D	C	B	B	B	D	C	B	C	C	D	A	A	A	D	D	C	D	B
Q	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
A	D	C	B	A	C	C	A	A	B	B	A	D	C	B	C	B	B	B	A	A	C	B	D	C	B
Q	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
A	D	A	B	B	C	A	C	C	D	A	B	D	D	A	B	C	B	D	A	D	A	C	A	A	A
Q	101	102	103																						
A	B	A	D																						

EXERCISE - 3

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
A	B	A	A	B	C	D	A	B	A	A	C	A	B	A	C	B	B	A	B	C	A	B

EXERCISE - 4

Q	1	2	3	4	5	6	7	8	9	10	11
A	D	C	C	B	B	A	A	A	B	A	D

SOLUTIONS

EXERCISE-1

(1) (A) **(2)** (A) **(3)** (A) **(4)** (A)
(5) (C)

(6) **Squamous cells.** Endothelium is a single layer of thin plate-like cells that lines the inner surfaces of blood, lymph vessels and the heart. It is made up of squamous epithelium. The edges of its cells fit closely together.

(7) **Squamous epithelium.** There are 300 million of alveoli (also called acini) in two lungs. The alveoli have very thin walls consisting of squamous epithelium.

(8) **Microvilli.** Epithelium cells of the intestine involved in food absorption have microvilli on their surface to increase surface area for food absorption.

(9) **Lateral.** Spiracles are present on the lateral side of the body of cockroach.

(10) **Oothecae.** In cockroach, fertilised eggs are stored in the dark reddish to blackish brown capsule, (about 3/8" (8 mm long) called oothecae. On an average, females produces 9-10 oothecae, each containing 14-16 eggs.

(11) **Diffusion.** Exchange of the gases in cockroaches takes place in tracheoles by the process of diffusion. Terminal parts of the tracheoles contains fluid that facilitate the exchange of O_2 and CO_2 by diffusion.

(12) The **squamous epithelium** is made of a single layer of flattened cells with irregular boundaries. These are found in the walls of blood vessels and involved in the functions like, forming a diffusion boundary.

(13) **Sclerites.** Body of the cockroach is covered by hard chitinous exoskeleton. Exoskeleton has hardened plates called sclerites, which are joined to each other by a thin and flexible articular membrane. These sclerites are formed of chitin which is a polysaccharide of acetylglucosamine molecules.

(14) **Osteoblasts cells** helps in the formation of bones and are present in the spaces called lecunae.

(15) **Compound epithelium** is made of multilayered cells. Their main function is to provide protection against chemical and mechanical stresses. They covers the dry surface of skin, the moist surface of buccal cavity, the inner lining of ducts of, salivary glands and pancreatic ducts.

(16) **Fibroblast.** The fibroblasts are the principle cells of the areolar tissue. They are large, flat, stellate cells with long processes and oval nucleus. They secrete matrix and the material of which, the fibres are formed.

(17) Protects, supports

(18) Gizzard

(19) **Gap junctions** facilitates the cells to communicate with each other by connecting the cytoplasm of adjoining cells for the rapid transfer of ions, small molecules and sometimes big molecules.

(20) **Simple epithelium** is composed of a single layer of cells and functions as a lining for body cavities, ducts and tubes.

(21) (B) **(22)** (C) **(23)** (A) **(24)** (B)
(25) (A) **(26)** (A) **(27)** (C)

(28) **(C).** Glandular epithelium consists of specialised columnar or cuboidal cells, which are specialised for secretion. They may be unicellular, e. g., goblet cells of alimentary canal or multicellular, e.g., salivary gland.

(29) (D) **(30)** (D)

(31) **(A).** The red blood corpuscles are the most numerous elements found in the blood. They are the most abundant cells in the human body. RBCs contains oxygen-carrying pigment (haemoglobin) in their cytoplasm.

(32) (B)

(33) **(B).** Lining of the intestine and kidney in human is formed by columnar epithelium, which has cells with microvilli on free surface and forms brush border. Brush bordered surface increases the absorptive area of the surface.

(34) **(D).** In all connective tissues, except blood, the cells secretes fibres of structural proteins called collagen. These fibres provide strength, elasticity and flexibility to the tissue.

(35) **(B).** The columnar epithelium is composed of single layer of tall and slender cells. Their nuclei are located at the base and microvilli are present on free surfaces

(36) (C)

(37) **(A).** Muscle fibres are composed of numerous fine fibrils called myofibrils. Muscles plays an important role in the movement of the body.

(38) **(C).** Epithelial tissue has a free surface, which faces either a body fluid or the outside environment and thus provides a covering to body parts.

(39) **(C).** Connective tissues are the most abundant and widely distributed in the body and performs the function of linking and supporting other tissues/organs of the body.

(40) (D)

(41) **(A).** Stratified squamous epithelium consists of two to many layers of flat cells. This type of epithelium lines the oral cavity, oesophagus and the vagina of mammals.

(42) (A)

(43) **(A).** Cartilage is solid and pliable, resists compression. Intercellular material cells of this tissue (chondrocytes) are enclosed in small cavities within the matrix secreted by them.

(44) **(A).** Squamous epithelium is present on absorptive and secretory surfaces. They are found in the walls of blood vessels and air sacs of lungs, where it is involved in the formation of diffusion boundary.

(45) **(D).** Yellow fibrous cartilage tissue is found in pinna (external ear). It also found at the tip of the nose.

(46) (A)

(47) **(B).** Connection is not the function of epithelium tissue. It is the function of connective tissue.

(48) **(D).** Areolar tissue is present beneath the skin and serves as a support framework for epithelium. It contains fibroblasts, macrophages and mast cells.

(49) (D)

(50) **(A).** Cardiac muscle tissue is a contractile tissue present only in the heart.

(51) **(D).** Compound epithelium is made of multilayered cells and their main function is to provide protection against chemical and mechanical stresses. This epithelium is found in mouth, oesophagus, parts of epiglottis (pharynx) and vagina.

(52) (D)

(53) **(A).** Ciliated epithelium lines the inside of the oviducts, ventricles of the brain, the spinal cord' as well as the respiratory passages like trachea, bronchi and bronchioles.

(54) **(A).** Adipose tissue is a type of loose connective tissue located mainly beneath the skin. The cells of this tissue are specialised to store fats.

(55) (D)

(56) **(C).** Long bones have a narrow cavity at their centre. These narrow cavities contains bone marrow. Bone marrow is a soft, fatty tissue. It is of two types red and yellow. The red bone marrow is composed of highly vascular, very loose reticular tissue. It produces red corpuscles and granular white corpuscles.

(57) **(D).** Columnar epithelium is found in the lining of stomach and intestine and helps in the secretion and absorption of nutrients.

(58) **(A).** Tendons connects muscles to bones.

(59) **(D).** Neuroglia consists of supporting and packing cells found in the brain, spinal cord and ganglia. These cells have different shapes and bears many processes.

(60) (A)

(61) **(A).** Epithelial tissue has free surfaces, which faces either a body fluid or the outside environment and thus, provides a covering or a lining for some parts of body. It is found on a lining of small intestine and helps in secretion and absorption.

(62) (C)

(63) **(A).** The columnar epithelium is composed of single layer of tall and slender cells, microvilli is present on free surfaces. They are found in the lining of stomach and intestine and helps in secretion and absorption.

(64) **(C).** Bones have hard and non-pliable ground substances, rich in calcium salts and collagen fibres which gives strength to bones.

(65) (C)

(66) **(C).** In epithelial tissue, the adjacent cells forms cells junctions for intercellular communication and chemical exchange. These junctions probably do not provide physical support.

(67) **(A).** Cartilage is a specialised connective tissue, which is solid, pliable & resists compression.

(68) (C)

(69) **(D).** Scleroproteins are the proteins of supportive tissue and occurs in the hard parts of animal body. These are insoluble in water, absolute alcohols dilute acids. Examples of scleroproteins are keratin, collagen, fibroin, chondrin, ossein, etc.

(70) (C)

(71) **(B).** Loose areolar connective tissue secretes fibroblasts (cells that produce and secretes fibres), macrophages and mast cells.

(72) **(D).** The thorax of a cockroach forms the middle part of the body. It consists of three segments the anterior prothorax, middle mesothorax, last rnetathorax.

(73) (C)

(74) **(C).** Cockroaches are brown or black bodied animals which belongs to Class- Insecta of phylum-Arthropoda.

(75) (A)

(76) **(C).** The respiratory system of the cockroach comprises a network of white, shining tubes called trachea, that opens out by 10 pairs of small holes called spiracles which are present on the lateral sides of the body.

(77) (B)

(78) **(B).** Cockroach is the uricotelic animal because uric acid is the main nitrogenous waste material they excrete.

(79) **(A).** Male posses a pair of short anal styles which are absent in females.

(80) (B)

(81) **(A).** Blood vascular system of the cockroach is of open type. Blood vessels are poorly developed and opens into the haemocoel.

(82) **(B).** Heart of cockroach is 13 chambered.

(83) (B)

(84) **(B).** In the exoskeleton of the cockroach, sclerites are joined to each other by arthrodial membranes to allow movements.

(85) **(A).** A pair of spermatheca is present in the 6th segment of the cockroach which opens into the genital chamber. The larger spermatheca stores spermatozoa received from the male during copulation. The smaller one is non-functional.

(86) (B)

(87) **(B).** Thin Malpighian tubules in cockroaches are present at the junction of mid gut and hind gut. These tubules have excretory role.

(88) **(A).** The cockroaches are omnivorous in diet. They take all the types of animals and vegetable foods.

(89) **(B).** In the male reproductive system of cockroach, a pair of spermatheca is present in the 6th segments which opens into the genital chambers.

(90) **(B).** Malpighian tubules are present at the junction of midgut and hindgut and helps in the removal of excretory products from haemolymph.

(91) **(A).** Blood of cockroach contains colourless plasma and leucocytes

(92) **(C).** The head capsule of a cockroach bears a pair of compound eyes. These are a pair of large, black, kidney-shaped organs situated dorsolaterally on the head, one on the either side.

(93) (B)

(94) **(A).** The female reproductive system of cockroach consists of two large ovaries, which are present laterally in the 2nd-6th abdominal segments.

(95) **(D).** In the digestive system of cockroach, a ring of 6-8 blind tubules called gastric caecae is present at the junction of foregut and midgut, which secrete digestive juices.

(96) (C)

(97) **(A).** Heart of the cockroach is elongated muscular tube lying along the mid dorsal line of the thorax and abdomen.

(98) **(D).** The body of a cockroach is segmented and divisible into three distinct regions head, thorax and abdomen.

EXERCISE-2

(1) **(A).** A cell must maintain homeostasis between the intracellular and extracellular environments.

(2) **(C).** The mitochondria (organelle) is within the hepatic cell which is within the epithelium (major tissue type) which is within the liver (organ)]

(3) **(D).** Epithelial tissue is characterized by lining body cavities with little or no extracellular matrix.

(4) **(C).** These characteristics are of blood, a connective tissue; red blood cells are involved in oxygen delivery to cells; and white blood cells are involved in immunity.

(5) **(C).** Connective tissue is the most varied and is characterized by specific cell types associated with the tissue type, fibers, and matrix

(6) **(B).** The excretory system is critical in maintaining osmotic balances, ions or electrolytes, and pH of body fluids.

(7) **(D).** The endocrine system is a major component of homeostatic mechanisms; hormones are chemical mediators that are transported to cells via the circulation.

(8) **(B).** Sweat glands are derivatives of the skin (integument) which is a major protective coat between the internal and external environment of organisms.

(9)	(D)	**(10)**	(A)	**(11)**	(A)	**(12)**	(C)
(13)	(A)	**(14)**	(C)	**(15)**	(C)	**(16)**	(C)
(17)	(D)	**(18)**	(A)	**(19)**	(C)	**(20)**	(A)
(21)	(C)	**(22)**	(B)	**(23)**	(B)	**(24)**	(B)
(25)	(A)	**(26)**	(B)	**(27)**	(D)	**(28)**	(B)
(29)	(A)	**(30)**	(D)	**(31)**	(C)	**(32)**	(D)
(33)	(C)	**(34)**	(B)	**(35)**	(B)	**(36)**	(B)
(37)	(D)	**(38)**	(C)	**(39)**	(B)	**(40)**	(C)
(41)	(C)	**(42)**	(D)	**(43)**	(A)	**(44)**	(A)
(45)	(A)	**(46)**	(D)	**(47)**	(D)	**(48)**	(C)
(49)	(D)	**(50)**	(B)	**(51)**	(D)	**(52)**	(C)
(53)	(B)	**(54)**	(A)	**(55)**	(C)	**(56)**	(C)
(57)	(A)	**(58)**	(A)	**(59)**	(B)	**(60)**	(B)

(61)	(A)	**(62)**	(D)	**(63)**	(C)	**(64)**	(B)
(65)	(C)	**(66)**	(B)	**(67)**	(B)	**(68)**	(B)
(69)	(A)	**(70)**	(A)	**(71)**	(C)	**(72)**	(B)
(73)	(D)	**(74)**	(C)	**(75)**	(B)	**(76)**	(D)
(77)	(A)	**(78)**	(B)	**(79)**	(B)	**(80)**	(C)
(81)	(A)	**(82)**	(C)	**(83)**	(C)	**(84)**	(D)
(85)	(A)	**(86)**	(B)	**(87)**	(D)	**(88)**	(D)

(89) **(A).** Cartilage is a soft skeletal tissue formed by cells called chondrocytes. Chondrocytes are mature, large and rounded cells with few surface projections.

(90) **(B).** The variously shaped cells present in the epithelial tissue are held together by intercellular junctions like tight, adhering and gap junctions.

(91) **(C).** Hyaline literally means glassy. Hyaline cartilage is known as a transparent tissue. It consists of a clear and slightly elastic matrix with less fibres. It forms articular surfaces at the joints of long bones, rings of trachea, sternal parts of ribs, hyoid apparatus, nasal septum etc.

(92) **(B).** Areolar tissue has largest quantity of extracellular material as more space is there in between the cells.

(93) **(D).** Haversian canal is a small canal that ramify throughout compact bone. It forms a central tube around which are alternate layers of bone matrix and lacunae containing bone cells. The lacunae are linked by minute channels called canaliculi.

(94) **(A).** The cardiac muscle fibres are uninucleate and their nuclei are centrally placed. Striated muscle fibres are multinucleate and their nuclei lie at irregular intervals.

(95) **(D).** Ciliated columnar epithelium lines the Fallopian tubes.

(96) **(A).** The outer surface of columnar epithelial cells lining the intestine of man is brush-bordered. It is made up of microvilli that greatly increase the surface area for absorption.

(97) **(C).** Tendons are cords of white fibrous connective tissue that connect bone with the muscles.

(98) **(A).** Cockroach possessesventral nerve cord. Spiracles help in respiration. Phallomere is present in male cockroach.

It helps in the transfer of spermatophore from male cockroach to female cockroach. Ocellus is a simple eye that occurs in insects and other invertebrates.

(99) **(A).** Stratified squamous epithelium is seen in the adult human body. It may be keratinised or non-keratinised. In keratinised stratified squamous epithelium, the outer few layers contains a hard waterproof protein in their cytoplasm.

(100) **(A).** In male cockroach, genital pouch contains dorsal anus, ventral genital pore and gonapophysis.

(101) **(B).** Columnar epithelium is found in the lining of stomach and intestine where it helps in the secretion and absorption of nutrients. Kidneys contains single layer of cube-like cells called cuboidal epithelium.

(102) **(A).** Ciliated columnar epithelium comprises columnar cells, which have cilia on the free surfaces. This epithelium lines most of the respiratory tract and fallopian tube (oviducts). It also lines the ventricles of the brain and the central canal of the spinal cord. It is also present in tympanic cavity of the middle ear and auditory tube.

(103) **(D).** Crop is a sac-like structure in the digestive system of cockroach and used for storing the food and not for grinding the food.

EXERCISE-3

(1) **(B).** Positive feedback systems are characterized by an amplification of the response or product.

(2) (A)

(3) **(A).** Sweat glands are a way to reduce body temperature by loss of water and the associated heat of that water. When body temperature increases, homeostatic mechanisms result in increased blood flow to the skin and increased activity of sweat glands.

(4) (B) **(5)** (C) **(6)** (D) **(7)** (A)

(8) (B) **(9)** (A) **(10)** (A) **(11)** (C)

(12) **(A).** Columnar epithelium is a type of simple epithelium characterised by the presence of tall column like cells. Its major function is absorption or secretion. It covers the inner surface of the intestine, stomach and gall bladder. In the intestine it appears to have a brush like appearance on the free surface, which is due to the presence of large number of microvilli.

(13) **(B).** Cartilage comprises of mucopolysacharide called chondroctin sulphate. Bone is a hard connective tissue. Blood is a fluid connective tissue.

(14) **(A).** Specialization of cells into tissue, organ and organ systems is advantages for the organism. It increase the operational efficiency through division of labour which avoids duplication of work.

(15) **(C).** Involuntary smooth muscles are those muscles that are not under the control of our will. The muscle fibres are without any striations (stripes), Iris has involuntary smooth muscle, Biceps of upper arm and abdominal wall have striated muscle fibres, Heart wall has involuntary striated muscle.

(16) **(B).** Non-keratinized stratified squamous epithelium covers moist surfaces like buccal cavity, pharynx, vagina, cervix, etc. Adipocytes store fat in adipose tissue. Urinary bladder is lined by transitional epithelium.

(17) **(B).** Alimentary canal of cockroach is a long and somewhat coiled tube of uneven diameter. Crop is large, thin-walled, pear-shaped sac, which extends well up to the third or fourth abdominal segment. It is the largest part of foregut. Crop serves as a reservoir for storing food. The gizzard or proventriculus, marks the end of foregut. In the gizzard, the cuticular lining first forms 6 plates with teeth to grind the food, and then bears bristles to let only the well crushed food to pass on. Opening into the anterior end of midgut are 7 or 8 short, narrow, blindly ending hollow tubes, called enteric or hepatic caeca. These are internally lined by epithelium and secrete digestive enzymes. From the junction of midgut and hindgut arise 80 to 90 very narrow, thread-like, yellow-coloured blind tubules projecting freely into haemocoel.

These are called Malpighian tubules and are excretory in function.

(18) **(A).** In simple cuboidal epithelium nuclei are rounded and lie in the centre of the cells. Keratinized epithelium is impermeable to water. Yellow elastic fibro cartilage makes cartilage flexible. Adipose tissue forms a shock absorbing cushion around the eye balls and kidneys.

(19) **(B).** In male cockroach, from the sides of the 9^{th} sternum, there arises a paired, small unjointed outgrowths called anal styles. These structures are sensitive to touch. These are absent in female cockroach. Nervous system is located ventrally. There are 100-150 Malpighian tubules. Grinding of food is carried out by gizzard.

(20) **(C).** (i) Septal nephridia and pharyngeal nephridia - Both are enteronephric.

(ii) Typhlosole -Internal median fold present in the dorsal wall of the intestine of earthworm, meant to increase the absorption surface area.

(iii) Hepatic caeca - Blind tubules present at the junction of foregut and mid-gut in the alimentary canal of the cockroach.

(iv) Gizzard - Helps in grinding the soil particles and decaying leaves.

(21) **(A).** Squamous epithelium is found on the walls of blood vessels and lungs not on the walls of kidneys.

(22) **(B).** *Periplaneta* bears compound eyes, which are situated dorsolaterallyon the head, one on the either side.

Cockroaches are dioecious and both sexes have well-developed reproductive crgans. Female bears collateral glands, while mushroom glands are present in males.

EXERCISE-4

(1) **(D).** In cockroach, development is paurometabolous. The nymph grows by moulting about 13 times to reach the adult form. The next to last nymphal stage has wing pads but only adult cockroaches have wings.

(2) **(C).** Areolar and adipose tissue are loose connective tissue while tendon is dense connective tissue. Cartilage is specialized connective tissue.

(3) **(C).** Moist surface of buccal cavity – Stratified non-keratinised squamous epithelium

Inner surface of bronchioles – Ciliated epithelium

Inner lining of salivary ducts – Cuboidal epithelium

(4) **(B).** Tegra, sterna & pleura are joined by a flexible arthrodialmembrane.

(5) **(B).** Cockroach has determinate cleavage during embryonic development.

(6) **(A).** Columnar epithelium is present in the lining of stomach.

* Tendon is dense connective tissue and connects muscle to bone. Tip of nose consists of elastic cartilage.

(7) **(A).** In male cockroach, sperms are stored in seminal vesicle.

(8) **(A).** Smooth muscles are involuntary, fusiform, nonstriated muscles.

(9) **(B).** Males bear a pair of short, thread like anal styles which are absent in females.

Anal/caudal styles arise from 9th abdominal segment in male cockroach.

(10) **(A).** The correct sequence of organs in the alimentary canal of cockroach starting from mouth is :

Pharynx $\rightarrow$ Oesophagus $\rightarrow$ Crop $\rightarrow$ Gizzard $\rightarrow$ Ileum $\rightarrow$ Colon $\rightarrow$ Rectum

(11) **(D).** Bronchioles and Fallopian tubes are lined with ciliated epithelium to move particles or mucus in a specific direction.