DAY SEVEN

Structural Organisation in Animals

Learning & Revision for the Day

- Animal Tissue
- Organ and Organ system
- Structural Organisation in Some Animals

The term 'Tissue' was introduced by **Bichat**. A tissue is a group of similar cells specialised for performing a common function.

The branch of biological science which deals with the study of tissue is called **Histology**. Term 'Histology' was coined by **Mayer** (1819). **Marcello Malpighi** is known as founder of Histology.

Animal Tissue

Tissue in animals are classified as; epithelial tissue, connective tissue, muscular tissue and nerve tissue.

1. Epithelial Tissue

- These are ectodermal in origin and cover the outer surface of all body organs and also lines the cavities of all hollow organs of body.
- In this tissue, cells are compactly arranged and are held together by intercellular junctional complexes. Cells of the lower most layer rest on basement membrane.
- Based on their functions, epithelial tissue is divided into two types, i.e. covering and glandular epithelia.
  (i) **Covering epithelia** The covering epithelial tissue is nearest to the environment. Hence, plays an important role in the life activities of the animal. It is mainly concerned with protection, respiration, secretion, assimilation and elimination of waste products.

Based upon 'number and arrangement of cell layers' along with 'shape of the cells' the covering epithelia is categorised as simple or unilaminar (single layered), stratified or compound or multilaminar (multilayered) and specialised epithelium.

Types of Covering Epithelium

Structure	Location	Functions
1. Simple Epithelium		
• Squamous	Cavity of major organs (heart, air sacs of lungs)	Absorption, exchange of material, filtration
• Cuboidal	Tubules and ducts of glands, surface of ovary	Absorption and secretion
• Columnar	Gastrointestinal tract	Secretion of materials from special goblet cells and absorption
• Ciliated	Respiratory tract, Fallopian tube	Movement of mucus, urine, egg, etc.
• Pseudo-stratified	Salivary glands, male urethra, trachea	Protection and movement of secretion from glands
2. Stratified Epithelium		
• Squamous	Epidermis of skin and hair, oral cavity, tongue	Protection against abrasion
• Columnar	Epiglottis, mammary gland ducts, parts of urethra	Protection and secretion
• Cuboidal	Sweat glands, female urethra, anal canal.	Helps mechanical and chemical stress.
3. Specialised Epithelium		
• Transitional	Wall of urinary bladder	Allows expansion, capability to modify shape
• Neurosensory	Lining of retina, tongue, ear	Main receivers of stimuli
• Pigmented	Basal layer of retina and posterior part of iris	Provide the eye its colour

(ii) **Glandular epithelia** Glandular epithelial cells are specialised cells that perform the function of secreting hormones, sweat, mucus, enzyme and other products. They may be unicellular (e.g. goblet cells of alimentary canal) and multicellular (e.g. salivary gland).

Based on the mode of pouring of their secretions, glands may be **exocrine** (i.e. secretion releases through ducts or tubes) or **endocrine** (i.e. hormones secreted directly into blood).

Exocrine glands can be further classified as

Structure	Location	Functions
1. On the basis of nature of secretion		
Mucus	Goblet cell of intestine	Secretion of mucus
Serous	Sweat glands	Secretion of clear watery fluid or sweat
Mixed	Gastric glands and pancreatic glands	Secretion of gastric and pancreatic juices
2. **On the basis of excretory units**		
Simple	Intestinal	Secretory units are of same type
Compound	Liver, pancreas, salivary duct	More than one type of secretory units are present
3. **On the basis of secretory nature**		
Holocrine	Sebaceous glands	Complete secretory unit disintegrates
Merocrine	Sweat glands, salivary and intestinal	Secretion by diffusion
Apocrine	Mammary glands	Secretion accumulates in apical part of secretory unit

NOTE • Simple or compound glands can be further classified into **tubular** (tube-like secretory unit), **acinous** (rounded) and **alveolar** (flask-shaped).

Cell Junctions

The structures that provide structural and functional links between the adjacent epithelial cells are called cell junctions. Neighbouring cells are held together by different types of cell junctions. They may be

(i) **Tight junctions** (Zonula occludens), checks the flow of materials between the cells, e.g. brain.

(ii) **Gap junctions,** facilitate the communication between the cells by connecting the cytoplasm for rapid transfer of ions, small molecules and sometimes big molecules.

(iii) **Adhering junctions**, perform cementing function to keep neighbouring cells together.

2. Connective Tissues

- These are most abundant and widely distributed tissue of the body. These are **mesodermal** in origin.
- These bind together the various tissues of an organ to support different parts of the body and is involved in packaging around different organs.
- **Hertwig** (1883) coined the word mesenchyma for the mesodermal tissue present between ectoderm and endoderm.
- Connective tissues constitute about 30% of the body mass. These have both cellular and extracellular components.

- Connective tissues play an important role in body defence, tissue repair, fat storage, transport of materials, support, insulation, etc.
- There are three types of connective tissue

(i) Connective Tissue Proper

It has a viscous, gel-like matrix composed of proteoglycans. It is of following types

(a) **Loose connective tissue** Cells and fibres are loosely arranged in a semi-fluid matrix. They are of the following types

- **Areolar tissue** occurs beneath the epithelia of many hollow visceral organs, skin and in blood vessels (arteries and veins). It contains different types of cells like **fibroblasts** (irregularly shaped flat cells flat synthesise collagen and elastin and secrete major amount of matrix), **macrophage** (large irregular amoeboid cells, phagocytic in nature), **plasma cells** (synthesise antibodies) and **mast cells** (irregular ovoid cells containing basophilic granules made up of heparin (anticoagulant), serotonin (vasoconstrictor) and histamine (vasodilator).
- **Adipose tissue** is located mainly beneath the skin, heart, blood vessels, kidney and bone. It is specialised to store fats and reduces heat loss through the skin. There are two types of adipose tissue, **white/yellow tissue** (single layered fat droplet present in cell surrounded by small amount of cytoplasm) and **brown tissue** (has multiple small fat droplets surrounded by larger amount of cytoplasm). The former is found in blubber of whales while latter occurs in newborn babies and some hibernating animals.

(b) **Dense connective tissue** It is mainly made up of compactly packed bundles of collagen fibres with very little matrix. It is further classified as

- **Dense regular connective tissue** where collagen fibres are present in rows between many parallel bundles of fibres. White fibrous, e.g. **tendon** (connects muscle and bone) and yellow elastic, e.g. **ligament** (connects bone and bone) are two of its types.
- **Dense irregular connective tissue** having fibroblasts with many fibres oriented differently, e.g. in skin.

(ii) Supportive Connective Tissue

It is of following two types, i.e. cartilage and bone.

(a) **Cartilage** It is solid, semi-rigid with matrix and is composed of a firm, but flexible material called chondrin (protein) that is secreted by cells, called chondrocytes. It also contains fibres, mostly of collagen.

The cartilage is of three types as following

- **Hyaline cartilage** occurs in the larynx, nasal septum, tracheal rings and costal cartilage and found at the ends of bones to form articular cartilage.
- **Fibrous cartilage** contains prominent fibres in matrix and connects bones like pubis symphysis in pelvis and form intervertebral discs.
- **Elastic cartilage** provides strength and maintain shape of ear pinna, tip of the nose, epiglottis, Eustachian tube and larynx.

(b) **Bone** It is a solid, rigid connective tissue consisting of four parts, i.e. periosteum, matrix, endosteum and bone marrow.

- The outer dense and white fibrous sheath of bone is called **periosteum**.
- **Matrix** occurs in form of layers, the lamellae which are of three types namely Haversian lamellae, concentric lamellae, interstitial lamellae and is heavily deposited with apatite salts of Ca and phosphorus.
- False irregular spaces called **lacunae**, occur in the matrix. Each lacuna is occupied by flat bone cell or osteocyte (they are metabolically inactive cells).
- The medullary or marrow cavity of bone is lined with **endosteum** and **osteoblasts** are bone forming cells that secrete ossein protein in matrix.
- **Bone marrow** is a soft fatty tissue. It is of two types, i.e. red bone marrow (an active tissue, occurs in spongy parts of bone, red due to the presence of RBCs) and yellow bone marrow (a passive tissue, occurs in shafts of bone, yellow due to the presence of adipocytes).

(iii) Vascular Connective Tissue

It is also called fluid connective tissue. These are specialised connective tissue that circulate through the cardiovascular system. It is broadly classified as two main types, i.e. blood and lymph.

Blood

It is composed of a straw-coloured transparent fluid called plasma (55%), in which blood cells (45% formed elements) are suspended.

Plasma

It contains water (90-92%), inorganic salts (Na, Cl, K, Mg, etc.), plasma proteins (albumin, globulin, fibrinogen and prothrombin), nutrient and organic waste material, regulatory substances (hormones and enzymes) and gases (O_2, CO_2 and N_2).

Blood Cells (Formed Elements)

There are three major functional classes of blood cells

(i) **Erythrocytes** (Red Blood Cells/RBCs) These are circular, biconcave, non-nucleated without any cytoplasm or organelles and contain a red coloured respiratory pigment called **haemoglobin**.

- The process by which erythrocytes are formed is called **erythropoiesis**. It takes place in the red bone marrow of adults and in liver spleen of foetus.
- The adherence of RBCs together by their concave surfaces is called rouleaux formation.
- RBCs are destroyed in spleen, bone marrow and liver, out of which spleen is the most important site and hence is called as graveyard of RBCs.
- RBCs can be counted using **haemocytometer.**
- The lifespan of RBCs is **120 days** (80 days in rabbit and 100 days in frog).

(ii) **Leucocytes** (White Blood Cells/WBCs) These are the largest blood cells and can be circular or irregularly shaped with nucleus. The liferpan of RBCs is 3-4 days. It is divided into two main groups based on their nuclear shape and cytoplasmic granules.

A. **Granulocytes** (Granular with lobed nucleus) These are of three types
   - **Neutrophils** They have highly lobulated nucleus (2-7 lobes) and contain hydrolysing enzyme that kills the microbes by phagocytosis. They stimulate the production of interferons, antiviral substances.
   - **Eosinophils** They are larger than neutrophils and have bilobed nucleus. They phagocytose antigen-antibody complexes and their number increases on allergic conditions like asthma and hay fever.
   - **Basophils** They are intermediate in size between neutrophils and eosinophils. They are non-phagocytic with 2-3 lobes of nucleus and release heparin (anticoagulant) and histamine.

B. **Agranulocytes** (Agranular with non-lobed nucleus) These are of two types
   - **Monocytes** They are the largest corpuscles with eccentrically placed kidney-shaped nuclei. They are most active phagocytes and in tissue spaces they are transformed into macrophages like Kupffer cells in liver, osteoblasts in bone, etc.
   - **Lymphocytes** These are the smallest leucocytes with large, round dense nuclei. They are non-motile and non-phagocytic and are of two types namely T-lymphocytes (formed in thymus) and B-lymphocytes (formed in bone marrow) which are involved immunity and antibody production.

(iii) **Blood platelets** (Thrombocytes) are round or oval, biconvex discs, formed by fragmentation of huge cells called **megakaryocytes**.
- The formation of platelets are called **thrombopoiesis** which takes place in red bone marrow.
- The lifespan of platelets is about one week.
- Platelets contain a variety of substances that promote blood clotting like thromboplastin and various other blood clotting factors.

Lymph

- It is a colourless fluid connective tissue made up of plasma and WBCs mostly lymphocytes.
- It lacks RBCs, platelets and blood proteins.
- It carries materials from tissues to blood stream and also in reverse direction.
- Lymph capillaries present in the intestinal villi are called lacteals, which are associated with the absorption of digested food.

3. Muscular Tissue

- **Muscular tissues** are mesodermal in origin except iris and ciliary body of eyes which are ectodermal in origin. Study of muscles is called **Myology**.
- They contribute most to the total weight of body (about 40%-50%).
- The muscle cells are always elongated, slender and spindle-shaped fibre like cells. These are of three types, i.e. striated, non-striated and cardiac muscles.

Differences between Striated, Smooth (non-striated) **and Cardiac Muscles**

Character	Striated Muscle	Smooth Muscle	Cardiac Muscle
Location	Limbs, tongue, pharynx, beginning of oesophagus	In the wall of all visceral organs	Myocardium of heart
Size and shape	Long, cylindrical with blunt ends	Short, spindle-shaped with pointed ends	Short, cylindrical with flat ends
Nucleus	Multinucleate, nucleus peripheral	Uninucleate, nucleus central	Uninucleate, nucleus central
Myofibrils	The presence of dark and light bands	No bands	Bands present
Blood supply	Highly vascular	Less vascular	Highly vascular
Mitochondria and glycogen granules	Numerous	Less in number	Numerous
Innervation	From CNS	From ANS	Both CNS and ANS
Branching	Unbranched	Unbranched	Branched
Mode of contraction	Contract rapidly for short period, get fatigued very soon	Contract slowly for long period as do not get fatigued	Contract rapidly, rhythmically and never gets fatigued

4. Nervous Tissue

- These are specialised tissues with no intercellular spaces. Their main function is receiving stimuli and for conducting impulses to control and coordinate body functions.
- These tissues are devoid of power of division and regeneration and form nervous system of the animal.
- They are composed of following elements
  - Ependymal cells (lines the cavity of brain and spinal cord) neurons (conduct nerve impulse), neurosecretory cells (release neurohormones) and neuroglial cells (supporting cells).
  - Neuroglial cells are of three types, i.e. astrocytes or macroglia (most abundant supporing cells with repair function), oligodendrocytes (maintain myelin sheath) and microglia (specialised macrophages and scavenger of nervous system).
  - The structure of neuron consists of dendrites, cyton or cell body, nucleus, axon, synaptic buttons, Nissl's granules, neurilemma and nodes of Ranvier.

Organ and Organ System

Tissues organise to form organs, which in turn associate to form organ systems in the multicellular organisms. Such an organisation is essential for more efficient and better coordinated activities of millions of cells constituting an organism.

The Major Vertebrate Organ Systems

System	Component	Function
Integumentary system	Skin, hair, nails and sweat glands.	Covers the body and protects it.
Digestive system	Mouth, oesophagus, stomach, intestine, liver and pancreas.	Digests and absorbs soluble nutrients from ingested food.
Respiratory system	Lungs, trachea and other air passage ways.	Exchanges of gases (mainly O_2 and CO_2)
Circulatory system	Heart, blood vessels, blood, lymph and lymph nodes.	Transports materials throughout the body and connects various organ systems.
Urinary system	Kidney, bladder and associated ducts.	Removes nitrogenous metabolic wastes from the blood stream.
Skeletal system	Bones, cartilage and ligaments.	Protects the body and provides support for locomotion and movement.
Muscular system	Skeletal muscle, cardiac muscle and smooth muscle.	Produces body movement and heat.
Nervous system	Nerves, sense organs, brain and spinal cord.	Receives stimuli, integrates information and directs the body.
Endocrine system	Pituitary, adrenal, thyroid and other ductless glands.	Coordinates and integrates body activities.
Reproductive system	Testes, ovaries and associated reproductive structures.	Carries out reproduction.
Immune system	Lymphocytes, macrophages and antibodies.	Removes foreign bodies (pathogens) from the bloodstream.

Structural Organisation in Some Animals

1. Cockroach

These are brown-coloured, nocturnal (i.e. more active at night), omnivorous and cursorial insects.

These are found in places, where there is warmth, dampness and plenty of organic food available.

Morphology

- Body divided into head, thorax and abdomen. In each segment, exoskeleton consists of hardened plates called **sclerites**, joined to each other by a thin and flexible articular membrane (arthrodial membrane).
- The mouth parts consists of a labrum (upper lip), a pair of mandibles, a pair of maxillae and a labium (lower lip).
- Each thoracic segment bears a pair of walking legs. Forewings called tegmina are opaque dark and cover the hindwings when at rest.
- The hindwings are transparent, membranous and are used in flight.
- The abdomen in both males and females consists of 10 segments. 7th segment 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 lies at the hind end of abdomen bounded dorsally by 9th and 10th terga and ventrally by the 9th sternum.
- Males bear a pair of short, thread-like structure called anal styles, which are absent in females.
- In both sexes, 10th segment bears a pair of jointed filamentous structures called anal cerci.

Anatomy

(i) **Digestive system** is divisible into foregut, midgut and hindgut.

- The mouth leads to pharynx followed by oesophagus, which opens into a sac-like structure called crop that

is used to store food. The crop is followed by gizzard, which helps in grinding the food particles.

- Hepatic or gastric caecae present at the junction of foregut and midgut, secrete digestive juice.
- Hindgut is broader than the midgut and divisible into ileum, colon and rectum.

(ii) **Circulatory system** It is of open type with blood flowing in the open spaces. The blood flows freely in the body cavity which is called haemocoel.

- Heart consists of elongated muscular tube lying along the mid dorsal line of thorax and abdomen.
- Blood from sinuses enter in the heart through ostia and blood is pumped anteriorly to sinuses again.

(iii) **Respiratory system** consists of a network of trachea that opens through 10 pairs of small holes called **spiracles** present on the lateral side of the body. The opening of spiracles is regulated by the sphincters.

(iv) **Excretory system** consists of **Malpighian tubules** present at the junction of midgut and hindgut. Malpighian tubules are 100-150 yellow coloured thin filamentous tubules. In addition, the fat body nephrocytes and uricose glands also help in excretion.

(v) **Nervous system** consists of a series of fused, segmentally arranged ganglia joined by paired longitudinal connectives on the ventral side.

(vi) **Sensory organs** in cockroach includes 4 antennae, eyes, maxillary palps, labial palps and anal cerci. The compound eyes of cockroach consist of 2000 hexagonal ommatidia each. A cockroach can receive several images with the help of several ommatidia. This is called **mosaic vision**.

(vii) **Reproductive system** Cockroaches are dioecious animals, i.e. both the sexes have well-developed reproductive organs.

- **Male reproductive system** consists of a pair of testes one lying on each side in the 4-6th abdominal segments.
- The sperms are stored in the seminal vesicles and are glued together in the form of bundles called spermatophores, which are discharged during copulation.
- **Female reproductive system** consists of two large ovaries, lying laterally in the 2-6th abdominal segments. Oviducts of each ovary unite into a single median oviduct, which opens into the genital chamber.
- The fertilised eggs are encased in capsules called **oothecae**. Development is parametabolous, i.e. through nymphal stage. The nymph looks similar to adults except difference in size.
- The nymph grows by moulting about 13 times to reach the adult form. The last nymphal stage has wing pads, but only adult cockroaches have wings.

2. Earthworm

It inhabitates the upper layer of moist soil and can be traced by their faecal deposits called worm castings.

Morphology

- It is cylindrical and divided into similar segments (metameres).
- First body segment, peristomium contains the mouth. Segments 14-16 in a mature worm are covered by a prominent dark band of glandular tissue, clitellum.
- Four pairs of spermathecal apertures are present on ventro-lateral sides of intersegmental grooves, i.e. 5-9 segments.
- A pair of male genital pore and a single female genital pore is present on ventro-lateral side of 14th and 18th segments, respectively. Thus, it is a bisexual organism.

Anatomy

- Alimentary canal is straight. Calciferous glands, present in stomach, neutralise the humic acid present in humus. Typhlosole is present between 26-35 segments.
- Circulatory system closed type. No specialised breathing devices.
- Respiratory gaseous exchange through moist body surface.
- Excretory organ is called nephridia (3 types, septal integumentary and pharyngeal).
- Nervous system represented by ganglia.
- Sensory system have no eyes, but are light and touch sensitive organs. Special chemoreceptors (taste receptors) react to chemical stimuli.
- Sexual reproduction is present and development is direct.

3. Frogs

They are poikilotherms and have camouflaging ability (mimicry). During peak summers and winters, they take shelter in deep burrows, thus they show aestivation and hibernation, respectively.

Morphology

- **Skin** is smooth, slippery and absorbs water.
- **Body** is divided into head and trunk, exhibits sexual dimorphism, male frogs can be distinguished by sound producing vocal sacs and copulatory pad present on the first digit of forelimbs.

Anatomy

- **Digestive system** Alimentary canal is short and digestive glands are present.
- **Respiration** In water, respiration through skin (cutaneous respiration), while on land, skin and lungs (pulmonary respiration) both acts as respiratory organs.
- **Vascular system** closed type.
- **Excretory system** consists of a pair of kidneys, ureters, cloaca and urinary bladder, ureotelic animal.
- **Control and coordination** Endocrine glands as pituitary, thyroid, thymus, etc., are present and nervous system is well organised.
- **Reproduction** In male, a pair of yellowish testes present, while in female, a pair of ovaries present.
- **Fertilisation** external in water. Development involves a larval stage called tadpole. It undergoes metamorphosis to become an adult.
- **Metamorphosis** is a change in the form and structure of body tissues. It is controlled by thyroxine hormone of thyroid gland.

DAY PRACTICE SESSION 1

FOUNDATION QUESTIONS EXERCISE

1 A tissue is a
(a) group of separate organs that are coordinated in their activities
(b) group of similar cells that function together to perform an activity
(c) layer of cells surrounding an organ
(d) one layer thick sheet of cells

2 Simple tissue is defined as
(a) group of similar cells, which are common in origin
(b) different types of cells performing same functions
(c) different types of cells performing different functions
(d) organised group of cells performing many functions

3 Compound tissue is defined as
(a) similar types of cells held together by connective tissue
(b) different types of cells, which are different in structure and function
(c) different types of cells performing one function
(d) similar cells at different regions performing many functions

4 Epithelial tissue serves as
(a) protective covering (b) reproductive structures
(c) corpuscles (d) nerve cells

5 Epithelial tissue arises from
(a) ectoderm (b) endoderm
(c) mesoderm (d) All of these

6 Which of the following is the characteristic of epithelial tissues?
(a) They are highly vascularised
(b) They never possess glands
(c) They have large intercellular spaces
(d) They have a rapid rate of cell division

7 Brush-bordered epithelium is found in
(a) Fallopian tube (b) small intestine
(c) stomach (d) trachea

8 Vagina, oesophagus and urethra contain which type of tissue?
(a) Stratified squamous epithelium
(b) Simple squamous epithelium
(c) Ciliated epithelium
(d) Columnar epithelium

9 Transitional epithelium lines the
(a) epiglottis (b) skin
(c) urinary bladder (d) Fallopian tube

10 The junction, which helps to stop substances from leaking across a tissue is
(a) gap junction (b) tight junction
(c) adhering junction (d) All of these

11 Normal wear and tear of cells in simple epithelia is negligible because
(a) epithelial cells are very tough
(b) epithelial cells are closely fitted like tiles of a mosaic
(c) epithelial cells are kept moist due to the material that diffuse through it
(d) None of the above

12 Pavement epithelium is another name for
(a) cuboidal epithelium
(b) ciliated epithelium
(c) simple squamous epithelium
(d) stratified epithelium

13 The type of epithelial cells, which line the inner surface of Fallopian tubes, bronchioles and small bronchi is known as
(a) squamous epithelium (b) columnar epithelium
(c) ciliated epithelium (d) cubical epithelium

14 Select the correctly matched pair.
(a) Cuboidal epithelium — Blood vessels
(b) Columnar epithelium — Uterine endometrium
(c) Simple epithelium — Nasal cavity
(d) Stratified epithelium — Thyroid follicles

15 Choose the correctly matched pair. ➜ CBSE-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

16 An exocrine gland, in which a portion of the secretory cell is discharged with the secretion is termed as

(a) apocrine (b) merocrine
(c) endocrine (d) holocrine

17 The function of the gap junction is to ➜ CBSE-AIPMT 2015

(a) performing cementing to keep neighbouring cells together
(b) facilitate communication between adjoining cells by connecting the cytoplasm for rapid transfer of ions, small molecules and some large molecules
(c) separate two cells from each other
(d) stop substance from leaking across a tissue

18 The main difference in white and yellow fibres is of

(a) protein (b) colour of the fibres
(c) Both (a) and (b) (d) None of these

19 Which one is a specialised connective tissue among these?

(a) Adipose tissue (b) Bone
(c) Areolar tissue (d) Fibroblasts

20 All the following are examples of connective tissue except

(a) tendons (b) ligaments
(c) muscle (d) adipose tissue

21 Cartilage is a non-vascular connective tissue having matrix of

(a) elastin (b) keratin
(c) fibrin (d) chondrin

22 White fibrous tissue are present at the joints of

(a) cranial bones
(b) humerus and glenoid cavity
(c) femur and acetabulum
(d) carpals and metacarpals

23 Bone marrow is absent in

(a) reptilians (b) amphibians
(c) fishes (d) birds

24 Camel's hump is made up of

(a) skeletal tissue (b) muscular tissue
(c) cartilage (d) adipose tissue

25 Which one of the following substances, if introduced in the blood stream would cause coagulation at the site of its introduction?

(a) Fibrinogen (b) Prothrombin
(c) Heparin (d) Thromboplastin

26 Mark the odd one.

(a) Monocytes (b) Lymphocytes
(c) Neutrophils (d) Erythrocytes

27 Connective tissue is

(a) ectodermal in origin with intercellular spaces
(b) mesodermal in origin without intercellular spaces
(c) ectodermal in origin without intercellular spaces
(d) mesodermal in origin with intercellular spaces

28 Wharton's jelly present in umbilical cord is an example of

(a) adipose tissue
(b) mucous connective tissue
(c) areolar tissue
(d) elastic connective tissue

29 Select the correctly matched pair.

(a) Chondroblast — Matrix secreting cells of cartilage
(b) Elastic cartilage — In pubic symphysis
(c) Fibrous cartilage — Pinna of ear
(d) Hyaline cartilage — Intervertebral disc

30 The bone marrow is composed of

(a) muscle fibres and adipose tissue
(b) areolar tissue and adipose tissue
(c) adipose tissue and calcified cartilage
(d) adipose tissue, areolar tissue and blood vessel

31 Vascular tissue or fluid tissue is made up of

(a) RBCs, WBCs and plasma
(b) RBCs, plasma and platelets
(c) RBCs, WBCs, plasma and platelets
(d) WBCs, plasma and platelets

32 Which of the following is not correct?

(a) The brown adipose tissue cell has a single large droplet surrounded by a small amount of cytoplasm, whereas the white adipose tissue cell has many small droplets of fat suspended in a larger amount of cytoplasm
(b) Brown fat cells contain many mitochondria, while white fat cells have comparatively few
(c) Brown fat has a larger capacity for generating heat than white fat
(d) Brown fat is mainly found in newborn mammals

33 The striated appearance of a myofibril is due to the distribution pattern of

(a) actin and myosin (b) fascicles
(c) troponin (d) meromyosin

34 Cardiac muscle is found in

(a) pericardium (b) endocardium
(c) myocardium (d) peritoneum

35 What is not true about striated muscles?

(a) They are multinucleate and syncytial
(b) Are found in pulmonary vein
(c) Sarcolemma is found over them
(d) Jaw muscles are striated voluntary and strongest

36 Bundles of striated muscle fibres called fasciculi are enclosed by a sheath called

(a) epimysium (b) endomysium
(c) perimysium (d) peritoneum

37 The transparent lens in the human eye is held in its place by ➝ NEET 2018
(a) smooth muscles attached to the iris
(b) ligaments attached to the iris
(c) ligaments attached to the ciliary body
(d) smooth muscles attached to the ciliary body

38 Which one of the following statements is incorrect?
(a) Cardiac muscles experience fatigue
(b) Smooth muscles are uninucleate and involuntary
(c) Gluteus maximus is the largest muscle of the human body
(d) Triceps and biceps are antagonistic muscles

39 Smooth muscle fibres are
(a) cylindrical, branched, multinucleate
(b) spindle-shaped, unbranched, uninucleate
(c) cylindrical, unbranched, multinucleate
(d) spindle-shaped, branched, uninucleate

40 Smooth muscles are ➝ NEET-II 2016
(a) involuntary, fusiform, non-striated
(b) voluntary, multinucleate, cylindrical
(c) involuntary cylindrical, striated
(d) voluntary, spindle-shaped, uninucleate

41 Nerve cell is originated from embryonic
(a) ectoderm (b) mesoderm
(c) Both (a) and (b) (d) endoderm

42 Which statement is not true about nerve fibres in mammals?
(a) All nerve fibres are non-medullated
(b) Afferent (sensory) nerves transmit impulses to brain and spinal cord
(c) Efferent (motor) nerves carry signals from brain and spinal cord to effector organs
(d) Mixed nerves carry signals in both directions

43 What is not true about glial cells?
(a) Modified glial cell called Schwann cell secretes myelin sheath
(b) Assist in nourishment neurons
(c) Modulate nerves of impulses
(d) Secrete neurotransmitters that facilitate synaptic transmission

44 An organ is a
(a) group of two or more kinds of tissues, united structurally and coordinated together to perform an activity
(b) group of similar cells that function together in a specialised activity
(c) multilayered sheet of cells
(d) solid structure formed of embryonic mesoderm

45 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 style
(c) Presence of a boat-shaped sternum on the 9th abdominal segment
(d) Presence of anal cerci

46 In cockroach, the arthrodial membrane
(a) covers the compound eyes (b) forms the hypopharynx
(c) forms the tegmina (d) joins the sclerites

47 How many teeth are present in cockroach's gizzard?
(a) 4 (b) 8 (c) 12 (d) 6

48 Heart of cockroach is
(a) myogenic (b) neuromyogenic
(c) neurogenic (d) None of these

49 Type of respiration in cockroach is
(a) cutaneous (b) tracheal
(c) pulmonary (d) bracheal

50 Which among these is not involved in excretion in cockroaches?
(a) Malpighian tubules (b) Nephrocytes
(c) Uricose glands (d) Maxillary palps

51 Which one of the following is not a sensory structure in cockroach?
(a) Antennae (b) Eyes
(c) Anal cerci (d) Proventriculus

52 In male cockroaches, sperms are stored in which part of the reproductive system? ➝ NEET-II 2016
(a) Seminal vesicles (b) Mushroom glands
(c) Testes (d) Vas deferens

53 What external changes are visible after last moult of a cockroach nymph? ➝ NEET 2013
(a) Anal cerci develop
(b) Both forewings and hindwings develop
(c) Labium develops
(d) Mandibles become harder

54 Which one of the following features is not present in *Periplaneta americana* ➝ NEET-I 2016
(a) Indeterminate and radial cleavage during embryonic development
(b) Exoskeleton composed of N-acetylglucosamine
(c) Metamerically segmented body
(d) Schizocoelom as body cavity

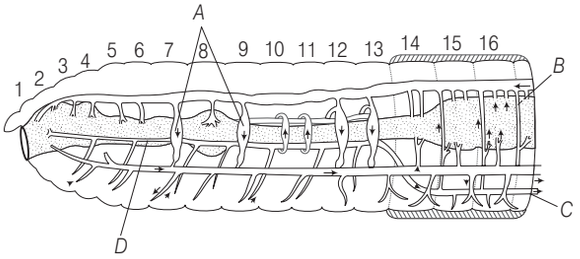
55 In earthworm, genital papillae occur in segments
(a) 16th and 17th (b) 16th and 18th
(c) 17th and 19th (d) 17th and 18th

56 The structure in earthworm which serves as a wedge to force open cracks in the soil is
(a) peristomium (b) clitellum
(c) typhlosole (d) prostomium

57 The main function of clitellum is
(a) cocoon formation (b) locomotion
(c) excretion (d) copulation

58 Which of the following correctly describes the location of some body parts in the earthworm (*Pheretima*)? ➝ CBSE-AIPMT 2009
(a) Two pairs of accessory glands in 16th-18th segments
(b) Four pairs of spermathecae in 4th-7th segments
(c) One pair of ovaries attached at intersegmental septum of 14th and 15th segments
(d) Two pairs of testes in 10th and 11th segments

59 In the circulatory system of *Pheretima A*, *B*, *C* and *D* represents



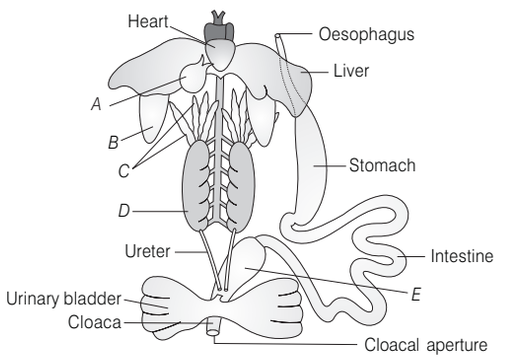
(a) *A*–Lateral hearts, *B*–Subneural vessel, *C*–Commissural vessel, *D*–Lateral oesophageal vessel
(b) *A*–Lateral hearts, *B* –Lateral oesophageal vessel, *C*–Subneural vessel, *D*–Commissural vessel
(c) *A*–Lateral hearts, *B*–Commissural vessel, *C*–Subneural vessel, *D*–Lateral oesophageal vessel
(d) *A*–Commissural vessel, *B*–Lateral hearts, *C*–Lateral oesophageal vessel, *D*–Subneural vessel

60 Chromatophores in skin of frog are found in stratum
(a) corneum (b) compactum
(c) germinativum (d) mostly spongiosum

61 Choose the incorrect statement regarding the circulatory system of frog.
(a) Sinus venosus receives, blood through major veins called vena cava
(b) The ventricle opens into a sac-like conus arteriosus
(c) The erythrocytes are nucleated
(d) Special venous connection between liver and intestine called renal portal system is present

62 Select the correct route for the passage of sperms in male frogs. ➝ NEET 2017
(a) Testes → Bidder's canal → Kidney → Vasa efferentia → Urinogenital duct → Cloaca
(b) Testes → Vasa efferentia → Kidney → Seminal vesicle → Urinogential duct → Cloaca
(c) Testes → Vasa efferentia → Bidder's canal → Ureter → Cloaca
(d) Testes → Vasa efferentia → Kidney → Bidder's canal → Urinogenital duct → Cloaca

63 The given figure is related to diagrammatic representation of internal organs of frog. Identify *A* to *E*.



	A	*B*	*C*	*D*	*E*
(a)	Gall bladder	Lung	Fat bodies	Kidney	Rectum
(b)	Gall bladder	Lung	Testes	Kidney	Rectum
(c)	Gall bladder	Lung	Fat bodies	Testes	Rectum
(d)	Gall bladder	Lung	Ovary	Testes	Rectum

64 Match the following columns.

	Column I		Column II
A.	Ligament	1.	Stores fat
B.	Tendon	2.	Connects bone to bone
C.	Areolar tissue	3.	Connects muscle to bone
D.	Adipose tissue	4.	Forms blood cells
		5.	Filling tissue

Codes

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

65 Match the following columns.

	Column I		Column II
A.	Phallomere	1.	Chain of developing ova
B.	Gonopore	2.	Bundles of sperm
C.	Spermatophore	3.	Opening of the ejaculatory duct
D.	Ovarioles	4.	The external genitalia

Codes

	A	B	C	D
(a)	3	4	2	1
(b)	4	3	2	1
(c)	4	2	3	1
(d)	2	4	3	1

Directions (Q. Nos. 66-67) *In each of the following questions a statement of Assertion is given followed by a corresponding statement of Reason. Of the statements, mark the correct answer as*
(a) If both Assertion and Reason are true and Reason is the correct explanation of the Assertion
(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(c) If Assertion is true, but Reason is false
(d) If both Assertion and Reason are false

66 **Assertion** Areolar tissue is a connective tissue.
Reason Areolar tissue is found beneath epithelia of stomach.

67 **Assertion** Earthworm possess both male and female reproductive organs.
Reason Self-fertilisation is absent in earthworm.

DAY PRACTICE SESSION 2

PROGRESSIVE QUESTIONS EXERCISE

1 Epithelial cells of the intestine involved in food absorption have on their surface
(a) pinocytic vesicles (b) phagocytic vesicles
(c) zymogen granules (d) microvilli

2 The connective tissue that connects the skin to the underlying structures is called
(a) areolar tissue (b) serous membrane
(c) reticular tissue (d) dense connective tissue

3 Which among the following is not characteristic of yellow fibres of connective tissue?
(a) Contain elastin
(b) Fewer in number
(c) Straight and branched
(d) Provide toughness and strength

4 Most of the neurons of our body are
(a) unipolar (b) bipolar
(c) pseudounipolar (d) multipolar

5 Four healthy people in their twenties got involved in injuries 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) Osteocytes (b) Malpighian layer of the skin
(c) Liver cells (d) Neurons

6 Tissue, which has power of division and regeneration throughout life is
(a) epithelial tissue (b) muscular tissue
(c) connective tissue (d) nervous tissue

7 The terga, sterna and pleura of cockroach body are joined by
(a) cementing glue (b) muscular tissue
(c) arthrodial membrane (d) cartilage

8 Skeletal muscle fibre is a 'syncytium' which means it is
(a) made up of many fibres
(b) made up of many proteins
(c) swollen in the middle with tapered ends
(d) multinucleated

9 Kidney of frog is
(a) archinephros (b) pronephros
(c) mesonephros (d) metanephros

10 Whale is a warm-blooded animal, which lives in cold sea. Which organ of its body makes it hot?
(a) Blubber (b) Pelage
(c) Muscles (d) Blood vessels

11 Bowman's glands are found in
(a) olfactory epithelium (b) external auditory canal
(c) cortical nephrons only (d) juxtamedullary nephrons

12 If a live earthworm is pricked with a needle in its outer surface without damaging its guts, the fluid that comes out is
(a) excretory fluid (b) coelomic fluid
(c) haemolymph (d) slimy mucus

13 Which one of the following tissues, in mammals shows the least capacity for regeneration?
(a) Epithelial tissue of the skin
(b) Endothelium of blood vessels
(c) Skeletal tissue of long bones
(d) Nervous tissue of brain

14 Fat bodies of cockroach are analogous to vertebrate
(a) spleen
(b) adipose tisssue
(c) kidney
(d) liver

15 Mycetocyte cells of the fat body of cockroach help in
(a) urea formation
(b) food storage
(c) synthesis of glycogen from glucose
(d) intermediary metabolism

16 Earthworms are
(a) uricotelic under conditions of water scarcity
(b) ammonotelic, when plenty of water is available
(c) ureotelic, when plenty of water is available
(d) uricotelic, when plenty of water is available

17 Identify the correctly matched pair.

(a)	Sarcomere	—	Basic unit of muscle contraction
(b)	Haemopoiesis	—	Formation of RBC
(c)	Lifespan of human RBC	—	10 days
(d)	Plasma	—	Blood minus clotting factors

18 Cockroach has no RBCs or haemoglobin because
(a) cockroach does not respire
(b) cockroach is invertebrate
(c) its blood does not transport O_2 and CO_2 and tissues have direct exchange of gases from air
(d) cockroach respires anaerobically

19 Which type of tissue correctly matches with its location?

	Tissue	Location
(a)	Areolar tissue	Tendons
(b)	Transitional epithelium	Tip of nose
(c)	Cuboidal epithelium	Lining of stomach
(d)	Smooth muscle	Wall of intestine

20 Which one of the following statements is incorrect?
(a) Cartilage contains chondrin, which makes the matrix
(b) Matrix of bone is formed by ossein
(c) Haversian canal system is characteristic of mammalian bone
(d) Volkman's canal connect the lacuna present in the cartilage

21 How do you differentiate a frog from a toad?
(a) Frog has no exoskeleton, but toad had scales
(b) Frog respires through lungs, but toad respires through skin
(c) Frog has a tail, but toad has no tail
(d) Frog has no parotid glands, but toad has a pair of parotid glands

22. Region of earthworm, which is referred to as forest of nephridia is
(a) clitellar region
(b) pharyngeal region
(c) typhlosolar region
(d) intestinal region

23. Identify the substance, which keeps the epithelial cells together.
(a) Hyaluronic acid (b) Collagen
(c) Mucin (d) Glycoprotein

24. Which one of the following pairs of structures distinguishes a nerve cell from other types of cell?
(a) Perikaryon and dendrites
(b) Vacuoles and fibres
(c) Flagellum and medullary sheath
(d) Nucleus and mitochondria

25 Identify the incorrect statement.
(a) Tendons connect skeletal muscle with bones
(b) Ligaments connect bones with bones
(c) Adipose tissue stores fats
(d) Matrix of cartilage is filled with mast cells and macrophages

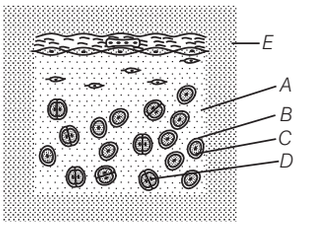
26 Chordae tendineae in heart of frog is found in the wall of
(a) ventricle (b) left auricle
(c) right auricle (d) sinus venosus

27 Which one of the following groups of structures/organs have similar function?
(a) Typhlosole in earthworm, intestinal villi in rat and contractile vacuole in Amoeba
(b) Nephridia in earthworm, Malpighian tubules in cockroach and urinary tubules in rat
(c) Antennae of cockroach, tympanum of frog and clitellum of earthworm
(d) Incisors of rat, gizzard (proventriculus) of cockroach and tube feet of starfish

28 Thousands of years old mummies are still in their condition as they were before due to the non-destruction of
(a) yellow elastin fibres (b) white elastin fibres
(c) collagen fibres (d) veins

29 Compound eyes of arthropods form apposition image in
(a) dim light (b) bright light
(c) Both (a) and (b) (d) None of these

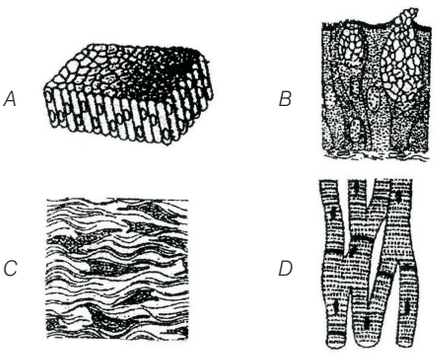
30 The given diagram is of a section of hyaline cartilage, the different parts have been indicated by alphabets. Choose the correct match.



(a) *A*–Chondrin, *B*–Chondrocyte, *C*–Lacuna, *D*–Capsular matrix, *E*–Perichondrium
(b) *A*–Chondrin, *B*–Lacuna, *C*–Chondrocyte, *D*–Capsular matrix, *E*–Perichondrium
(c) *A*–Perichondrium, *B*–Chondrocyte, *C*–Lacuna, *D*–Capsular matrix, *E*–Chondrin
(d) *A*–Capsular matrix, *B*–Chondrocyte, *C*–Lacuna, *D*–Perichondrium, *E*–Chondrin

31 Which of the following is/are false statement(s)?
(a) Compound squamous epithelium lies in the pancreatic duct of human
(b) Stratified epithelial lining is found in intestine
(c) The plasma membrane of intestinal cells are modified into microvilli
(d) Both (a) and (b)

32. The four sketches (*A, B, C* and *D*) given below, represent four different types of animal tissues. Which one of these is correctly identified in the options given, along with its correct location and function?



	Tissue	Location	Function
(a)	*B*–Glandular epithelium	Intestine	Secretion
(b)	*C*–Collagen fibres	Cartilage	Attach skeletal muscles to bones
(c)	*D*–Smooth muscle tissue	Heart	Heart contraction
(d)	*A*–Columnar epithelium	Nephron	Secretion and absorption

33 Frog's heart when taken out of the body continues to beat for some time.

Select the best option from the following statements.

I. Frog is a poikilotherm.

II. Frog does not have any coronary circulation.

III. Heart is myogenic in nature.

IV. Heart is autoexcitable.

(a) Only III (b) Only IV (c) I and II (d) III and IV

34 The H-zone in the skeletal muscle fibre is due to

(a) the absence of myofibrils in the central portion of A-band

(b) the central gap between myosin filaments in the A-band

(c) the central gap between actin filaments extending through myosin filaments in the A-band

(d) extension of myosin filaments in the central portion of the A-band

35 Consider the following statements.

I. Striped muscles are in the form of bundles of cells.

II. The Pal muscle fibres, which are called fasciculi.

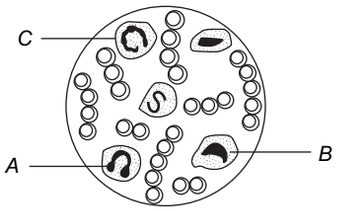
III. Skeletal muscles from the largest tissue in the body.

IV. Cardiac muscles in the embryo are originated from mesenchyma cell.

Choose the option with the correct statement(s).

(a) Only I (b) II and III (c) I, II and III (d) II and IV

36 Study the diagram given below and identify the cells labelled as *A*, *B* and *C*. Choose the correct option.



(a) *A* –Eosinophil, *B* –Erythrocyte, *C* –Neutrophil

(b) *A* –Eosinophil, *B* –Lymphocyte, *C* –Neutrophil

(c) *A* –Erythrocyte, *B* –Basophil, *C* –Neutrophil

(d) *A* –Eosinophil, *B* –Monocyte, *C* –Neutrophil

37 Match the following columns.

	Column I		Column II
A.	Neutrophils	1.	Kidney-shaped
B.	Eosinophils	2.	S-shaped
C.	Basophils	3.	3-5 lobes
D.	Monocytes	4.	2 lobes
		5.	Disc-shaped

Codes

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

Directions (Q. 38-39) *In each of the following questions, a statement of Assertion is given followed by the corresponding statement of Reason. Of the statements, mark the correct answer as*

(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion

(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Asseretion

(c) If Assertion is true, but Reason is false

(d) If both Assertion and Reason are false

38 **Assertion** Body cavity of earthworm has coelomic fluid within it.

Reason Coelom has no such significance.

39 **Assertion** Connective tissue contains a large amount of non-living intercellular or extracellular matrix.

Reason Intercellular substance is usually made up of protein fibres.

ANSWERS

SESSION 1

1 (b)	**2** (a)	**3** (c)	**4** (a)	**5** (a)	**6** (d)	**7** (a)	**8** (a)	**9** (c)	**10** (b)
11 (c)	**12** (c)	**13** (c)	**14** (b)	**15** (c)	**16** (a)	**17** (b)	**18** (c)	**19** (b)	**20** (c)
21 (d)	**22** (a)	**23** (d)	**24** (d)	**25** (d)	**26** (d)	**27** (d)	**28** (b)	**29** (a)	**30** (d)
31 (c)	**32** (a)	**33** (a)	**34** (c)	**35** (b)	**36** (c)	**37** (c)	**38** (a)	**39** (b)	**40** (a)
41 (a)	**42** (a)	**43** (d)	**44** (a)	**45** (d)	**46** (d)	**47** (d)	**48** (c)	**49** (b)	**50** (d)
51 (d)	**52** (a)	**53** (b)	**54** (a)	**55** (c)	**56** (d)	**57** (a)	**58** (d)	**59** (c)	**60** (d)
61 (d)	**62** (d)	**63** (a)	**64** (b)	**65** (a)	**66** (b)	**67** (b)			

SESSION 2

1 (d)	**2** (a)	**3** (d)	**4** (d)	**5** (d)	**6** (a)	**7** (c)	**8** (d)	**9** (c)	**10** (a)
11 (a)	**12** (b)	**13** (d)	**14** (d)	**15** (c)	**16** (b)	**17** (a)	**18** (c)	**19** (d)	**20** (d)
21 (d)	**22** (a)	**23** (d)	**24** (a)	**25** (d)	**26** (a)	**27** (b)	**28** (a)	**29** (b)	**30.** (a)
31 (d)	**32** (a)	**33** (d)	**34** (c)	**35** (c)	**36** (d)	**37** (d)	**38** (c)	**39** (b)	