

BIOLOGY



STRUCTURAL ORGANISATION IN ANIMALS

Tissue

In multicellular organism a group of similar cells along with intercellular substances perform a specific function. Such organization is called tissue.



Epithelial Tissue

This tissue provides covering or lining for some part of the body. Cells are compactly packed without intercellular space.

Simple Epithelial: Composed of single layer of cells & Functions as lining for body cavities, ducts and tubes.

Squamous Epithelium: Single thin layer of flattened cells found in walls of blood vessels, air sacs of lungs.

Cuboidal Epithelium: Single layer of cube like cells found in ducts of glands and tubular parts of nephron.

Columnar Epithelium: Single layer of tall and slender cells & free surface may have microvilli & found in lining of stomach and intestine.

Ciliated Epithelium: Columnar or cuboidal cells with cilia move particles or mucus in specific direction, in bronchioles, fallopian tubes.

Cell junctions

In nearly all animal tissues, specialized junction provide structural and functional links between its individual cells.

Three Types of Cell junctions:

- i. **Tight junctions:** Plasma membranes of adjacent cells are fused at intervals. They help to stop substances from leaking across a tissue.
- ii. **Adhering junctions:** Perform cementing function to keep neighbouring cells together.
- iii. **Gap junction:** 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.

Compound Epithelium

- Made of more than one layer of cells.
- Provide protection against chemical and mechanical stresses.
- Cover dry surface of skin, moist cavity, pharynx, inner lining of ducts of salivary glands and pancreatic ducts.

Glandular Epithelium

- Exocrine glands
- Endocrine glands

Exocrine glands

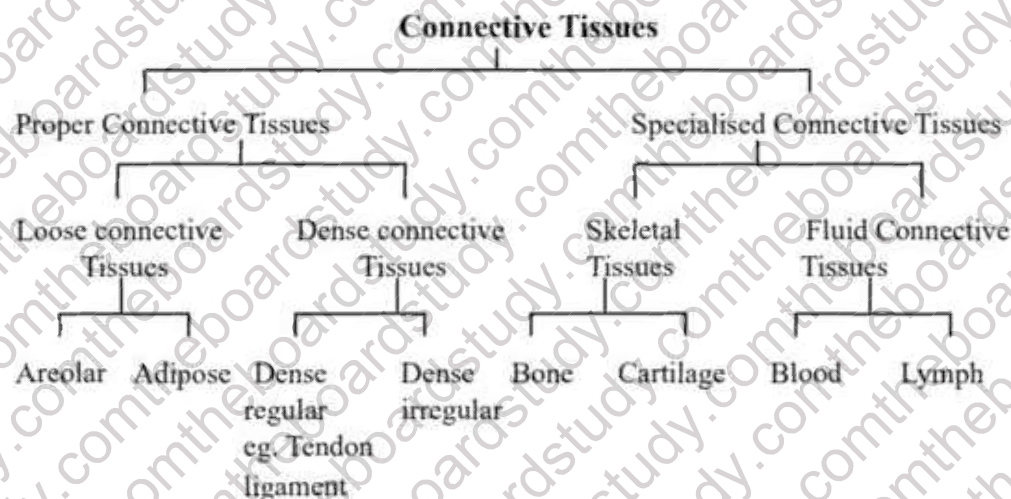
- Secrete mucus, saliva, oil, milk digestive enzymes.
- Products released through ducts.

Endocrine glands

- Secrete hormones.
- Secrete directly into the fluid bathing the gland.

Connective tissue

They are most abundant and widely distributed tissues which link and support the other tissues. All connective tissues except blood cells, secrete fibers of structural protein called collagen or elastin to provide elasticity and flexibility.



Loose Connective Tissue: contain cells and fibers loosely arranged in semi-fluid ground substance. It includes areolar tissue and adipose tissue.

Areolar Tissue

- Present beneath the skin.
- Contains fibroblasts, macrophages and mast cells.
- Serves as a support framework for epithelium.

Adipose Tissue

- Located beneath the skin.
- Cells are specialized to store fats.

Dense connective Tissue: Dense connective Tissue contains fibers and fibroblast compactly packed. The orientation of fibers may be regular or irregular pattern In dense regular connective tissues collagen fibers are present in rows between parallel bundles of fibers as in tendons and ligaments.

Tendon

- Tendon connects bones to skeletal muscles.
- It is made up of white fibrous tough tissue.

Ligament

- Ligament connects one bone to another bone.
- It is made up of yellow elastic tissue with collagen fibers.

Cartilage

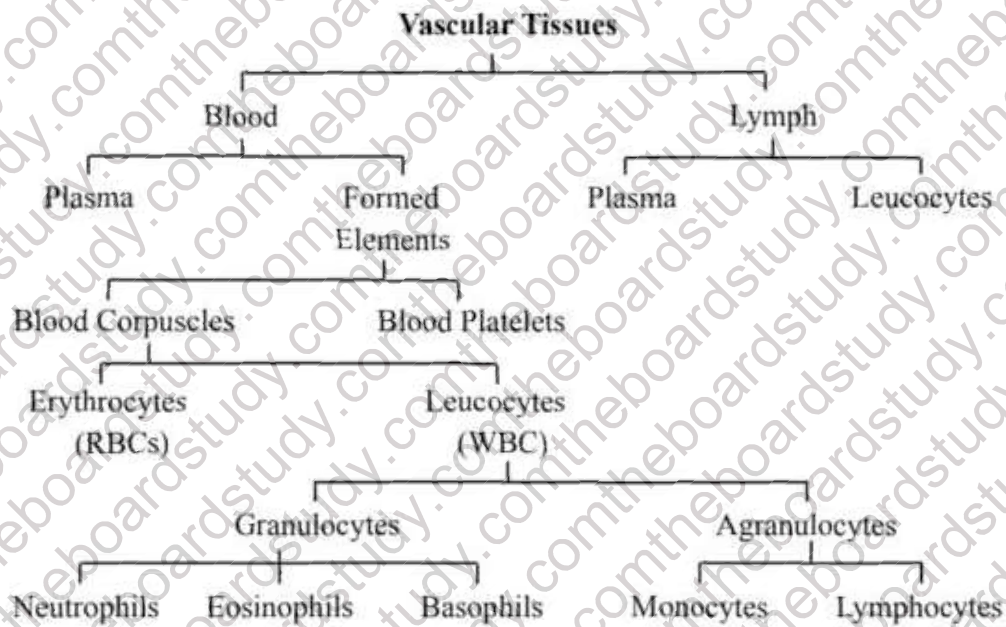
- They are soft skeletal tissue.
- chondrocyte are enclosed in small cavities with matrix.
- They are present in tips of nose, outer ear, between vertebral bones.

Bone

- Bones are hard skeletal tissue.
- They are rich in Calcium salt and collagen fibers.
- They form the skeletal framework of vertebrates like limbs, legs, etc.

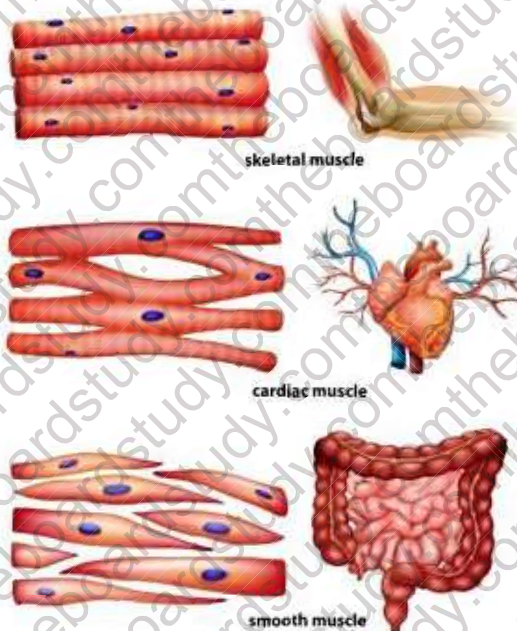
Blood

Blood is fluid connective tissue containing plasma, red blood cells, white blood cells and platelets. It helps in transportation of various substances between organs.



Muscle Tissue

Each muscle is made up of long cylindrical fibers arranged parallel to each other. Fibers are composed of fine fibrils called myofibrils. Muscle fibers contract and relax in response to stimulation.



Skeletal Muscle

- They are also known as striated, voluntary muscles.
- Multinucleated with light and dark bands.
- They are attached with bones.
- They are fibrous and un-branched, cylindrical in shape.

Smooth Muscle

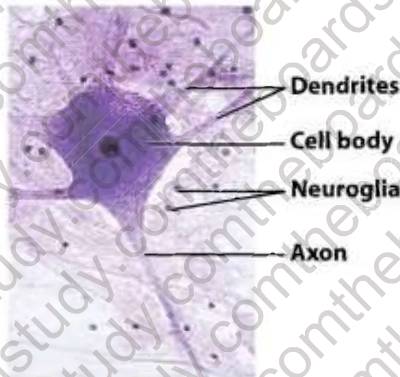
- They are known as unstriated or involuntary muscles.
- They are uninucleate without bands.
- They are present in vessels, oesophagus.
- They are fibrous and un-branched, spindle shaped.

Cardiac Muscle

- They are known as heart muscles and involuntary in nature.
- Uninucleate with faint light and dark bands.
- They are present in wall of heart.
- They are fibrous and branched, cylindrical in shape.

Neural Tissue

- The unit of neural system is neuron. Neuroglial cell protects and supports the neuron.
- When neuron get stimulated, electrical impulses are generated that travel along the plasma membrane (axon).



Cockroach

Periplaneta americana (Phylum-Arthropoda, Class-Insecta)

Habitat: Cockroach is a terrestrial, nocturnal, omnivorous, unisexual, oviparous insect. Body covered by a chitinous, hard exoskeleton of hard plates called sclerites.

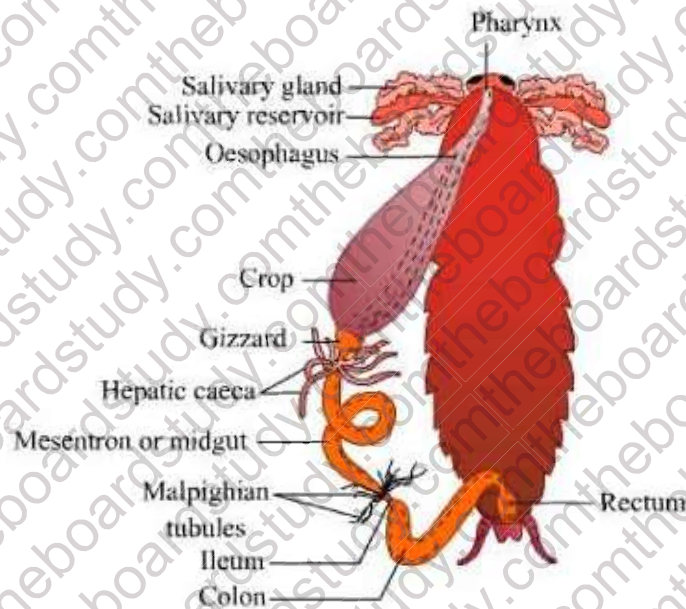
Morphology

- **Head:** Triangular, formed by fusion of 6 segments. Bears a pair of antennae, compound eyes. Mouth parts consists of labrum (upper lip), a pair of mandibles, a pair of maxillae, labium (lower lip), hypharynx (acts as tongue).
- **Thorax:** 3 segments; prothorax, mesothorax and metathorax. Bears 2 pairs of wings
- **Forewings:** tegmina (mesothoracic).
- **Hindwings:** transparent, membranous (metathoracic) 3 pairs of legs in thoracic segments. (one pair in each thoracic segment.)
- **Abdomen:** 10 segments. Bears a pair of long, segmented anal cerci in both sexes and a pair of short, unjoined anal styles in males only 7th segment is boat shaped. Also has anus and genital aperture at the hind end. Genital aperture surrounded by external genitalia called gonapophysis or phallomere.

Male Cockroach: Abdomen long and narrow, All nine sterna visible & Anal style present.

Female Cockroach: Abdomen short and broad, Seven sterna visible. (7th sternum fused with 8th and 9th sterna) & Anal style absent.

Alimentary canal: Divided into foregut, midgut and hindgut. Mouth → Pharynx → Oesophagus → Crop (stores food) → Gizzard (grinding of food) → Hepatic caecae (at junction of fore and midgut; secretes digestive juice) → Hindgut (ileum, colon, rectum) → Anus.



Blood vascular system: Open type, visceral organs bathed in haemolymph (colourless plasma and haemocytes). Heart consists of elongated muscular tube and differentiated into funnel shaped chambers with ostia on either side. Blood from sinuses enters heart through ostia and

is pumped anteriorly to sinuses again. Blood is colorless (haemolymph).

Respiratory system: Network of trachea which open through 10 pairs of spiracles. Spiracles regulated by sphincters. Oxygen delivered directly to cells.

Excretion and osmoregulation: by malpighian tubules; uricotelic (Uric acid as excretory product).

Nervous system: Consists of series of fused segmentally arranged ganglia joined by paired longitudinally connectives on the ventral side, three ganglia in thorax, six in abdomen. Brain represented by supraoesophageal ganglion. Each eye consists of 200 hexagonal ommatidia.

Reproductive system

Male reproductive system: Pair of testes (4th-6th segments) → vas deferens → ejaculatory duct → male gonophore. Glands—Seminal vesicle (stores sperms), mushroom shaped gland (6th-7th segment).

Female reproductive system:

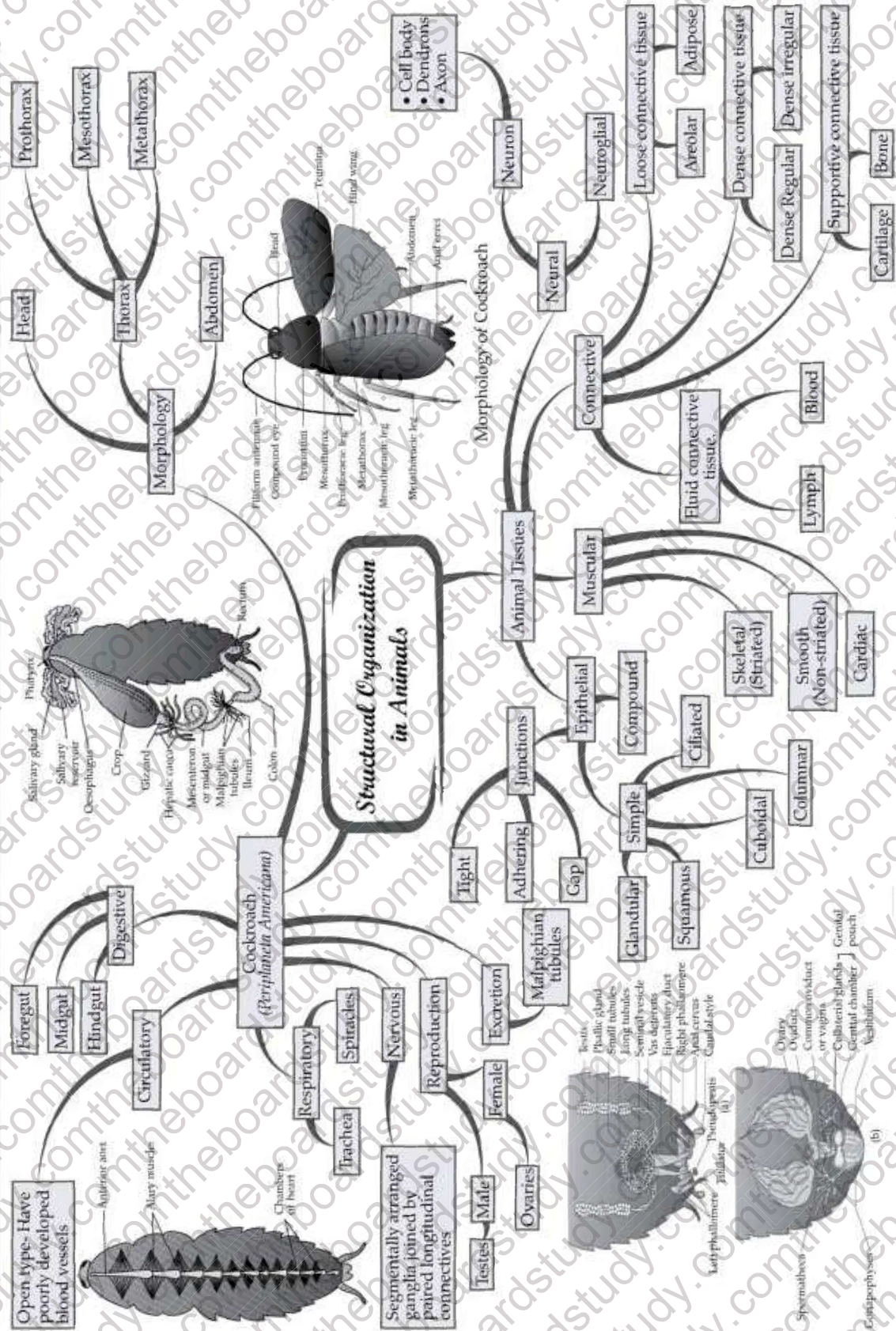
A pair of ovaries (with 8 ovarian tubules) → Oviduct → Genital chamber. Sperms transferred through spermatophores female produces 9–10 Ootheca. Fertilized eggs encased in capsules called oothecae (contains 14-16 eggs on an average) development of *P. americana* paurometabolous incompleting metamorphosis). Nymph grows by moulting 13 times to reach adult form.

Interaction with man:

Pests as destroy food and contaminate it.

Can transmit a variety of bacterial diseases (Vector).

CHAPTER : 7 STRUCTURAL ORGANIZATION IN ANIMALS



Important Questions

➤ Multiple Choice Questions:

Question 1. Ligaments joins

- (a) Muscle to Muscle
- (b) Bone to bone
- (c) Skin to muscles
- (d) Nerves to muscles

Question 2. Bone forming cells are

- (a) Chondroclasts
- (b) Osteoblasts
- (c) Chondroblasts
- (d) Osteoclasts

Question 3. Adjacent epithelial cells are held together by

- (a) Oxsomes
- (b) Ribosomes
- (c) Desmonemes
- (d) Desmosomes

Question 4. Afferent nerve fibres carries impulses from

- (a) Receptor to central nervous system
- (b) Central nervous system to muscles
- (c) Effector to central nervous system
- (d) Central nervous system to receptors.

Question 5. Most human neurons are

- (a) Unipolar
- (b) Bipolar
- (c) Multipolar
- (d) Pseudounipolar

Question 6. Epithelial tissue with thin flat cells appearing like packed tiles occurs on

- (a) Outer surface of ovary

- (b) Inner lining of cheek
- (c) Inner lining of fallopian tubes
- (d) Inner lining of stomach

Question 7. Achondroplasia is a disease related with the defect in the formation of

- (a) Mucosa
- (b) Bone
- (c) Cartilage
- (d) Membrane

Question 8. Cartilage is formed by

- (a) Chondriocytes
- (b) Fibroblasts
- (c) Osteoblasts
- (d) Osteoclasts

Question 9. Tendons connect

- (a) Nerve to muscle
- (b) Bone to muscle
- (c) Bone to bone
- (d) Muscle to muscle

Question 10. The camel's hump is composed of a tissue which provides water when oxidised. It is

- (a) Adipose
- (b) Skeletal
- (c) Areolar
- (d) Muscular

Question 11. Maximum numbers of white blood corpuscles is that of

- (a) Monocytes
- (b) Neutrophils
- (c) Eosinophils
- (d) Basophils

Question 12. Matrix of areolar tissue is secreted by

- (a) Fibrocytes

- (b) Mast cells
- (c) Histiocytes
- (d) None of these

Question 13. Urinary bladder is lined with

- (a) Simple epithelium
- (b) Pseudostratified epithelium
- (c) Stratified epithelium
- (d) Transitional epithelium

Question 14. Germinal epithelium of ovary is formed of

- (a) Columnar epithelium
- (b) Cuboidal epithelium
- (c) Stratified epithelium
- (d) Squamous epithelium

Question 15. Basement membrane is made up of

- (a) Endodermal cells only
- (b) Epidermal cells only
- (c) No cells at all, but is product of epithelial cells
- (d) Both epidermal and endodermal cells.

➤ Fill In the Blanks:

1. The body of a simple organism like is made of different types of cells and the number of cells in each type can be in
2. 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 and
3. The tissues are different and are broadly classified into four types as (i) (ii) (iii) and (iv)
4. There are two types of epithelial tissues namely and
5. Simple epithelium is further divided into three types. These are (1) (2) (3)
6. Some of the columnar or cuboidal cells get specialised for secretion and are called

➤ True or False:

1. In multicellular animals, a group of similar cells along with inter-cellular substance perform a specific function. Such an organisation is called tissue.

2. The tissues are different and are broadly classified into three types as (i) Neural (ii) Muscular (iii) Connective
3. On the basis of structural modification of the cells, simple epithelium is further divided into two types. There are 1. Squamous, 2. Columnar
4. Some of the columnar or cuboidal cells get specialised for secretion and are called ciliated epithelium
5. Loose connective tissue has cells and fibres loosely arranged in a semi-fluid ground substance, for example, adipose tissue present between the skin.
6. The intercellular material of cartilage is solid and pliable and resists compression.

➤ Very Short Question:

1. What is a ligament?
2. Name the tissue which forms the inner lining of blood vessels
3. Name the functional unit of a muscle.
4. Name any two granulocytes
5. What are cell junctions?
6. Name the tissue that lines the intestinal wall.
7. State the function of neuroglial cells.
8. Name few epidermal structures.
9. Define organ.
10. What is the function of the ligament?

➤ Short Questions:

1. What is the utility of transitional epithelium in constituting the surface layer of the urinary bladder?
2. Classify the muscular tissue into different types.
3. What is the major function of haemoglobin?
4. What are the general characteristics of epithelial tissue?
5. What are oligodendrocytes? What are their functions?
6. Why does oedema occur in persons suffering from a dietary deficiency of proteins?
7. Name the specific tissue that forms the outermost exposed surface of the human skin. State any two advantages of this tissue being there.
8. Write a short note on erythropoiesis.

➤ Long Questions:

1. Enumerate the various functions of epithelial tissue.
2. What is a gland? Differentiate between simple and compound exocrine gland.
3. What is connective tissue? Give its important functions.
4. What is adipose tissue? Where does it lie in the human body? Give its important functions.

Assertion Reason Question-

1. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (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 Assertion
- (c) If Assertion is true but Reason is false.
- (d) If both Assertion and Reason are false.

Assertion: Specialization of cells is advantageous for the organisms.

Reason: It increases the operational efficiency of an organism.

2. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

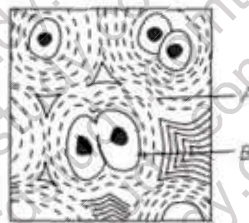
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- (c) If Assertion is true but Reason is false.
- (d) If both Assertion and Reason are false.

Assertion: The squamous epithelium is made of a single thin layer of flattened cells with irregular boundaries.

Reason: They are found in walls of blood vessels and air sacs of wings. [AIIMS 2017]

Case Study Based Question-

1. Identify the figure of a type of specialised connective tissue and answer the questions that follow.



- (i) Choose the correct option for the labels A and B in the above given specialized connective tissue.

- (a) A—Collagen fibres, B—Chondrocyte

(b) A—Cartilage cell, B—Chondrocyte

(c) A—Chondrocyte, B—Collagen fibres

(d) A—Cartilage cell, B—Collagen fibres

(ii) The connective tissue which lack fibres is

(a) areolar tissue

(b) adipose tissue

(c) blood

(d) ligament

(iii) Strongest connective tissue with little or no ground substance is

(a) cartilage

(b) bone

(c) blood

(d) adipose tissue

(iv) The most common cell found within connective tissue is

(a) histocytes

(b) leucocytes

(c) lymphocytes

(d) fibroblast

(v) In humans, the cartilage

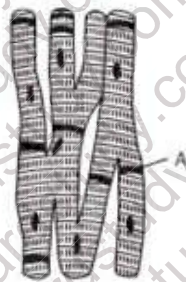
(a) contains solid and pliable intercellular material

(b) in vertebrate embryo gets replaced by bones in adults

(c) is found in between the bones of vertebral column

(d) All of the above

2. Study the figure given below of cardiac muscle and answer the questions that follow



(i) Choose the correct option for the labelled part A in figure above.

- (a) It represents junction between adjacent cells
 - (b) It represents intercalated disc
 - (c) It represents distinct and large myofibril
 - (d) Both (a) and (b)
- (ii) Cardiac muscles are different from skeletal muscles in a way as
- (a) they are smooth
 - (b) they are non-striated
 - (c) they are voluntary
 - (d) they are striated and involuntary
- (iii) Cardiac muscles contract
- (a) quickly and are fatigued
 - (b) slowly and are fatigued
 - (c) quickly and are not fatigued
 - (d) slowly and are not fatigued
- (iv) 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
- (v) Cardiac muscles are
- (a) elongated with tapering ends
 - (b) striped, skeletal muscles
 - (c) cylindrical, branched to form network
 - (d) large myofibrils and distinct

✓ Answer Key-

➤ Multiple Choice Answers:

1. (b) Bone to bone
2. (b) Osteoblasts
3. (d) Desmosomes
4. (a) Receptor to central nervous system
5. (c) Multipolar

6. (b) Inner lining of cheek
7. (c) Cartilage
8. (a) Chondriocytes
9. (b) Bone to muscle
10. (a) Adipose
11. (b) Neutrophils
12. (b) Mast cells
13. (d) Transitional epithelium
14. (b) Cuboidal epithelium
15. (c) No cells at all, but is product of epithelial cells

➤ **Fill In the Blanks:**

1. hydra, thousands
2. stomach, lung, heart, kidney
3. Epithelial, Connective, Muscular, Neural
4. simple epithelium, compound epithelium
5. Squamous, Cuboidal, Columnar
6. glandular epithelium

➤ **True or False:**

1. True
2. False
3. False
4. False
5. False
6. True

➤ **Very Short Answers:**

1. Answer: It is a connective tissue that joins one bone to another bone.
2. Answer: Squamous epithelium
3. Answer: Sarcomere.
4. Answer: Eosinophils and basophils.
5. Answer: Cell junctions are the structures that hold the adjacent cells of tissue together when they are not separated widely by extracellular material.
6. Answer: Columnar epithelium.

7. Answer: Serves as packing and supporting material between the nerve cells.
8. Answer: Hair, nails, claws and scales.
9. Answer: Organ: A number of tissues together form an organ that works as a unit for the benefit of an organism.
10. Answer: The ligament is a dense fibrous connective tissue that connects bones at the joints.

➤ Short Answer:

1. Answer: Transitional epithelium is highly stretchable and it does not allow the urinary bladder to get torn off when it is completely filled with urine. It undergoes considerable expansion to accommodate the maximum quantity of urine.
2. Answer: The muscular tissues can be divided into two broad categories depending upon their cytologic characteristic.
These are
 - i. Striated muscles and
 - ii. Non-striated.Striated muscle cells, in turn, may be subdivided into two additional categories-skeletal and cardiac.
So these are summarised into three different types:
 - i. Striated or striped-skeletal and voluntary muscle fibres.
 - ii. Non-striated or unstriped plain or smooth and involuntary muscle fibres.
 - iii. Cardiac – striated and involuntary muscle fibres.
3. Answer: Functions of haemoglobin:
 - i. It is essential for oxygen carrier from the lungs to the tissue in the form of oxyhaemoglobin. Each molecule of haemoglobin carries about 1.33 ml of oxygen.
 - ii. It plays an important part in the transport of CO₂ as Carbomino haemoglobin from tissue to the lungs. About 23 per. cent of CO₂ is transported back to the lungs through the haemoglobin.
 - ii. It acts as a buffer and regulates the blood reactions by maintaining a constant pH.
4. Answer:
 - It consists of closely packed cells of various types and shapes which forms the lining membrane of several organs.
 - The cells of the epithelial membrane are arranged in one or more layers resting upon the thin non-cellular basement membrane and these cells are supported by intercellular cementing substance and close vascular connective tissues.
 - The basement membrane is formed of protein fibres interspersed in the matrix of

polysaccharide. The matrix is secreted by underlying connective tissue.

- The cementing substance between the cells is formed of mucoprotein containing hyaluronic and calcium salts.

5. Answer: Oligodendrocytes are a type of neuroglia cells that hold the neurons in position in the central nervous system. Their process spirally wraps around the nerve fibres to form a myelin sheath in the absence of Schwann cells in the central nervous system.

Answer: Albumin and globulin proteins are necessary for retaining water in the blood plasma by their, osmotic effects. In the dietary deficiency of proteins, enough water is not retained in the blood plasma and it gets filtered out from the blood into the tissue and leads to the swelling of hands and feet.

Answer: Keratinised squamous epithelium. It contains insoluble protein-keratin which is impervious to water and so prevents the loss of water. It also provides protection to the skin against mechanical pressure, friction, injury and water loss.

Answer: The formation of new erythrocytes is called erythropoiesis and it takes place from the haemopoietic tissue. The haemopoietic tissue in the young foetus is the liver and spleen whereas in the adults it is the bone marrow, of long bones.

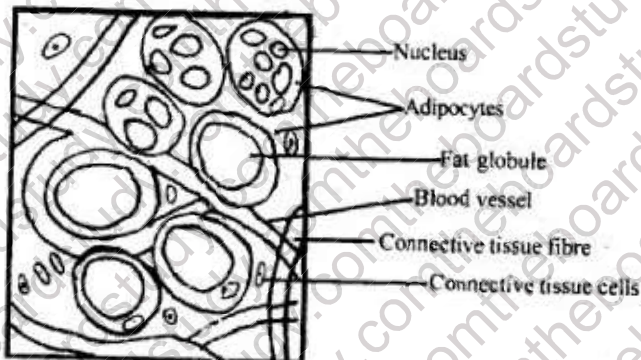
The haemopoietic tissue synthesises millions of RBCs every minute to replace the worn-out erythrocytes promoted by erythropoietin, a glycoprotein produced by renal tissue in response to the liberation of ACTH. The deficiency of iron, folic acid and vitamin B leads to anaemia, megaloblastic anaemia and pernicious anaemia etc.

➤ Long Answer:

1. Answer: Function:

1. Protection: It protects the underlying or overlying soft tissues against heat, injury, chemicals, virus and bacteria etc.
2. Absorption: It absorbs the digestive food especially with columnar cells of the intestine.
3. Secretion: The glandular epithelial cells lining the inner cavities secrete various substances like mucous, enzymes and hormones which are necessary for various metabolic activities.
4. Excretion: The epithelial cells of kidney tubules and sweat glands help in the excretion of wastes from the body.
5. Sensation: The nerve ending in the epithelial cells of the retina, olfactory organs and nasal chamber etc. receive the stimuli from the external atmosphere and transfer them to the brain for interpretation.
6. Other functions: The trachea contains the ciliated epithelium to facilitate the transport of mucous and other substances from one part of the body to another. The lungs' epithelium helps in the exchange of gases during respiration and the germinal epithelium of testes and ovaries form the sperms and ova respectively. The epithelium also forms the exoskeleton structure as scales, feathers, hairs, nails, claws, horns etc.

2. Answer: Any organ or structure that secretes specific useful substances is known as a gland. A gland develops from the epithelium tissues and is generally cubical, short columnar or polyhedral in shape.
1. Simple exocrine gland: Simple exocrine gland has no branch but consists of a single unbranch duct lined by epithelial cells. The secretory part of the gland also consists of epithelial cells arranged in a simple tube, coiled tube in a flask which send their secretion into a single duct. So these are simple tubular glands, simple coiled tubular glands and simple alveolar glands respectively.
 2. Compound exocrine gland: Compound exocrine gland has a branched system of ducts. The secretory part consists of tubules-Compound tables, many acini or alveoli-compound alveolar glands or a combination of both tubules and acini-compound tubuloalveolar gland.
3. Answer: Connective tissue is mesodermal in origin and form of matrix, fibres and cells. It constitutes the extracellular ground substance and fills up the intercellular spaces between the cells.
- Functions of connective tissue: The connective tissue perform various functions and these are:
1. It serves the function of packing material nearly for all organs.
 2. It binds one tissue or organ to another and serves the purpose of a strong elastic rope.
 3. It provides skeletal support and shape to the body.
 4. It protects the vital organs of the cranial and thoracic cavities, deep blood vessels and nerves from mechanical injuries.
 5. The adipose connective tissue stores fat and represent stored energy.
 6. It provides defence against foreign particles like bacteria. The phagocytes of leucocytes inges the bacteria and germs and protect the body against infection.
 7. The lymphocytes from the antibodies against the action of antigens and provide immunity to the body.
4. Answer: Adipose tissue: It is the specialized form of areolar tissue where it contains fat cells or adipocytes in the matrix. Each fat cell is large, rounded occupied by big fat droplets and its nucleus and cytoplasm are pushed towards the periphery of the cell. This imparts a 'signet' ring like look to the fat cell.
- These fat cells can easily be stained by Sudan III or osmic acid. The matrix is supported by a loos framework of areolar tissue containing fibroblasts, macrophage, white collagen fibres of small size, elastic fibres; lymphatics and blood vessels.
- The lactating tissue lies in the subcutaneous tissue of the skin, in the mesentery and in the perinephric and sub periodical tissue of the body. The lactating mammary gland of human also contain abundant amounts of adipose tissue but these are quite lacking in penis, scrotum, eyeli and in the cranial cavity.



Adipose tissue

Functions: It synthesises, stores and metabolises the fat and forms the insulating layer beneath the skin. It collects around the viscera especially kidneys and prevents them from shock and injury.

Assertion Reason Answer-

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

Explanation: Specialization of cells into tissue, organ and organ systems is advantageous for the organisms. It increases the operational efficiency through division of labour which avoids duplication of work.

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

Explanation: Squamous epithelium is a single layer of flattened cells in contact with basal lamina of the epithelium. This type of epithelium is often permeable and occurs where small molecules need to pass quickly through membranes.

Case Study Answer-

1. Answer:

(i) (a)

(ii) (c)

(iii) (b)

(iv) (d)

(v) (d)

2. Answer:

(i) (d)

(ii) (d)

(iii) (c)

(iv) (a)

(v) (c)