CHAPTER-07

STRUCTURAL ORGANISATION IN ANIMALS

Introduction

In a multicellular organism, a group of similar cells along with intercellular substances perform a specific function. Such an 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 epithelium is composed of a single layer of cells and functions as the lining of body cavities, ducts, and tubes.
- The compound epithelium consists of two or more than two layers of cells and has a protective function.
- The squamous epithelium is made up of a single layer of flattened cells with irregular boundaries. They are present inlining of blood vessels, air sacs of the lungs.
- Cuboidal epithelium is made up of single-layered cube-like cells and found in ducts of glands and tubular parts of the nephron of the kidney for absorption and secretion.
- Columnar epitheliums are made up of tall and slender cells. The nuclei are located at the base. The free surface may have microvilli found inlining of the stomach and intestine. The ciliated one is called as ciliated epithelium.
- Columnar and cuboidal epithelium specialized for secretion is known as the glandular epithelium, which may be unicellular as in goblet cells of the alimentary canal or multicellular as in the salivary gland.

Endocrine glands	Exocrine glands
1. The endocrine gland secretes hormones. 2. Products are directly released at target sites through the blood.	1. Secretes enzymes, milk, mucus, saliva, etc. 2. Products are released through ducts.

- The main function of compound epithelium tissue is to protect against chemical and mechanical stress. They cover the dry surface of the skin, the moist surface of the buccal cavity, etc.
- Epithelial cells are held together by intercellular material to form a specialized junction.

Connective Tissues: They the are most abundant and widely distributed tissue that links and support the other tissues. All connective tissues except blood cells, of a structural protein, called collagen or elastin to provide elasticity and flexibility.

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

Areolar Connective Tissue	Adipose Connective Tissue
1. It contains fibroblast, macrophages, and,mast cells. 2. It acts as a support framework for epithelium.	1. Fibroblasts, macrophages, and mast cells are absent. 2. The cells are specialized to store fats beneath the skin.

- **Dense connective tissue** contains fib and fibroblasts compactly packed. The orientation of fibers may be a, 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	Ligament
1. Tendon connects bones to skeletal muscles. 2. It is made up of white fibrous tough tissue.	1. A ligament connects one bone to another bone. 2. It is made up of yellow elastic tissue with collagen fibers.

- Cartilage, bones, and blood are specialized connective tissue.

Cartilage	Bone
1. They are soft skeletal tissue. 2. Chondrocytes are enclosed in small cavities with the matrix. 3. They are present in tips of the nose, outer ear, between vertebral bones.	1. Bones are hard skeletal tissue. 2. They are rich in Calcium salt and collagen fibres. 3. They form the skeletal framework of vertebrates like limbs, legs, etc.

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

Muscle Tissue

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

Skeletal	Smooth	Cardiac
1. They are also known as striated, voluntary muscles. 2. Multinucleated with light and dark bands. 3. They are attached to bones.	1. They are known as unstriated or involuntary muscles. 2. They are uninucleated without bands. 3. They are present in vessels, oesophagus.	1. They are known as heart muscles and involuntary. 2. Uninucleated with faint light and dark bands. 3. They are present in the wall of the heart.

4. They are fibrous and un-branched, cylindrical.	4. They are fibrous and un-branched, spindle-shaped.	4. They are fibrous and branched, cylindrical.

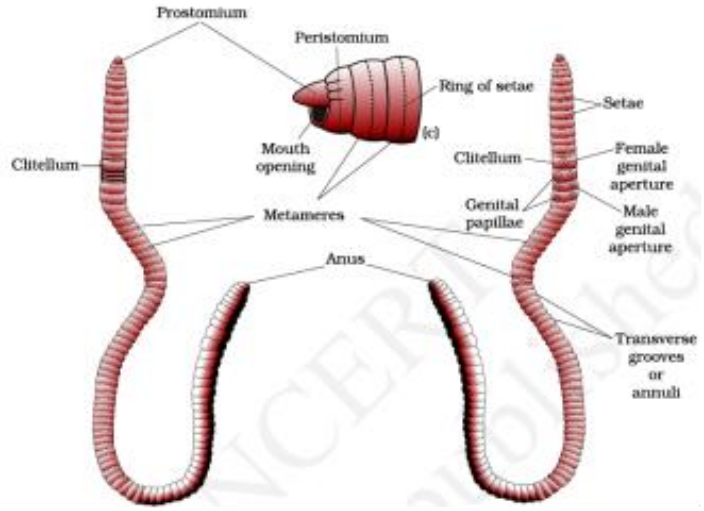
NeuralTissue

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

The tissues organize to form organs which in turn associate to form an organ system in multicellular organisms.

Earthworm

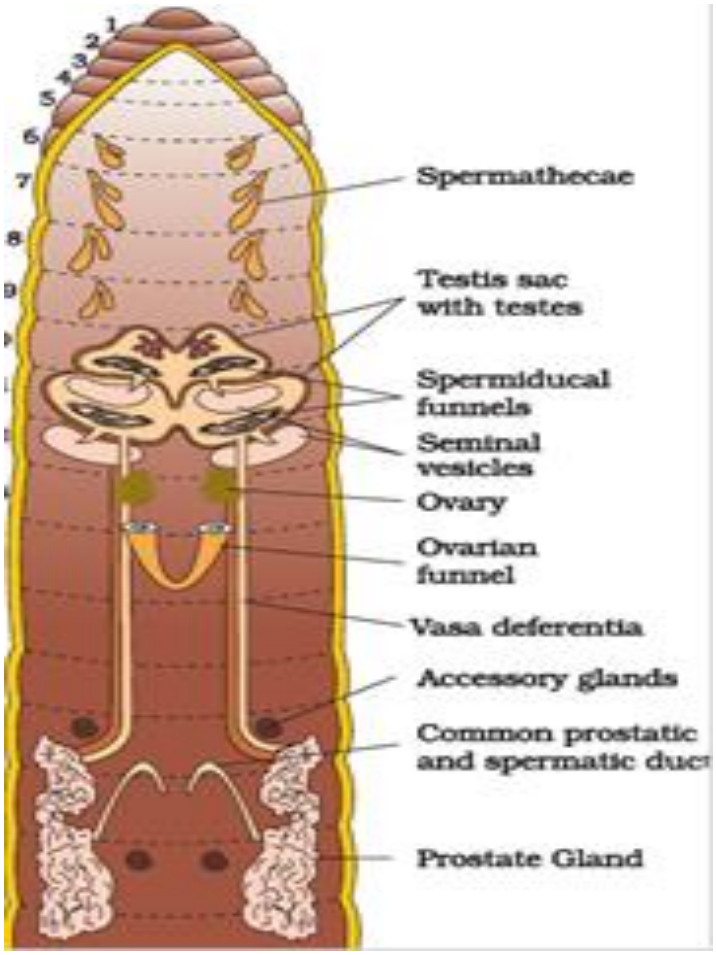
- The earthworm is a reddish-brown terrestrial invertebrate that lives in the upper layer of moist soil. The common Indian earthworms are *Pheretima* and *Lumbricus*.
- Earthworms have a long cylindrical body divided into segments called metameres. The ventral surface contains a genital pore and the dorsal surface contain a mid-dorsal line.
- The first body segment is called the **peristomium** which contains the mouth. 14-16 segments are covered by a dark band called **the clitellum**.



Morphology of an earthworm

- The single genital pore is present on the midventral line of the 14th segment. A pair of the male genital pore is present on the 18th segment on the ventrolateral side.
- All the segments except 1st, last, and clitellum contain S-shaped **setae** for locomotion.
- The alimentary canal is the straight tube from 1st to last segment having, buccal cavity, muscular pharynx, oesophagus that leads to gizzards, which help in grinding the soil particles and decaying leaves. The stomach and small intestine lead to the anus.
- Between 26-35 segments, the intestine has an internal median fold called **typhlosole**. This increases the effective area of absorption in the intestine.
- The closed vascular system consists of the heart, blood vessels, and capillaries. Blood glands are present on the 4th, 5th, and 6th segments. They produce blood cells and hemoglobin which is dissolved in blood plasma.
- Earthworms lack respiratory organs and respire through moist skin.
- Excretory organs are coiled segmental tubules called **nephridia**. There are three types of nephridia: Septalnephridia, integumentary nephridia, and pharyngeal nephridia.
- The nervous system is represented by ganglia arranged segmentwise on the ventral paired nerve cord. The nerve cord in the anterior region (3rd and 4th segments) bifurcates and joins the cerebral ganglia dorsally to form a **nerve ring.**

- The earthworm is hermaphrodite. Two pairs of the testis are present in the 10th and 11th segments. Prostrate and spermatic duct open to surface as a male genital pore on the 18th segment.



The reproductive system of an earthworm

- One pair of ovaries is attached to the intersegmental septum of 12th and 13th segments. Female genital pore open on the ventral side of the 14th segment. Mutual exchange of sperms takes place during mating.

- Mature sperms and egg cells along with nutritive materials are deposited in a cocoon in the soil where fertilisation takes place.

- Earthworms are known as friends of a farmer because they make burrows in the soil to make it porous for respiration and root penetration. Earthworms are also used for vermicomposting and as bait in game fishing.

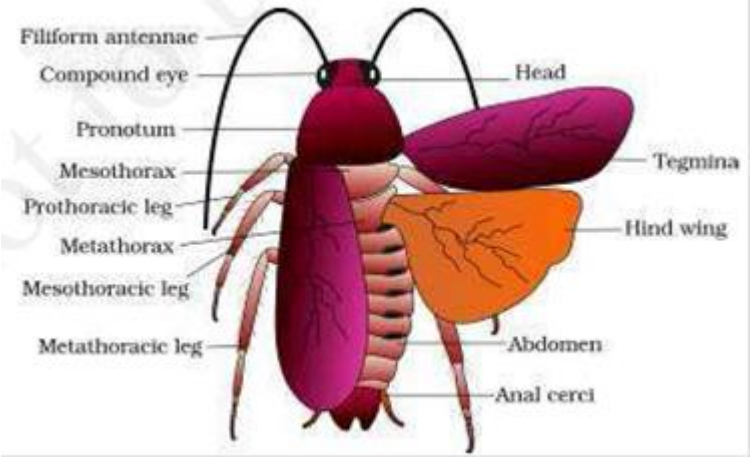
Cockroach*(Periplaneta americana)*

- Cockroaches are nocturnal omnivorous organisms that live in damp places everywhere. The body of cockroach is segmented and divisible into the **head, thorax and abdomen**. The body is covered by a hard chitinous exoskeleton.

- Head is triangular in shape formed by the fusion of six segments to show flexibility. Head bears compound eyes. An antenna attached to head help in monitoring the environment.
- Thorax consists of three parts- prothorax, mesothorax and metathorax. Forewings and hind wings are attached with the thorax. The abdomen consists of 10 segments.

MaleCockroach	FemaleCockroach
1. The abdomen is long and narrow. 2. Brood pouch is absent. 3. Male has a longer antenna. 4. Anal styles are present.	1. The abdomen is short and broad. 2. Brood pouch is present. 3. Female have shorter antennae. 4. Anal styles are absent.

DigestiveSystemofCockroach-

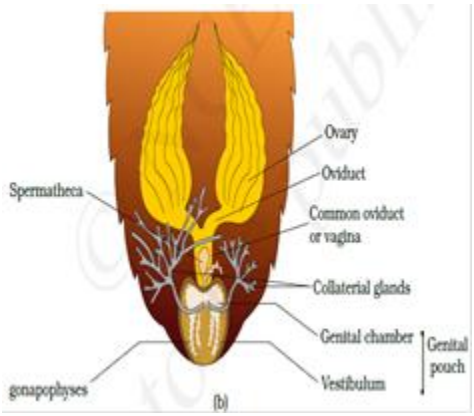


- The alimentary canal is divided into foregut, midgut and hindgut. Food is stored in crop. Gizzard help in grinding the food particles.

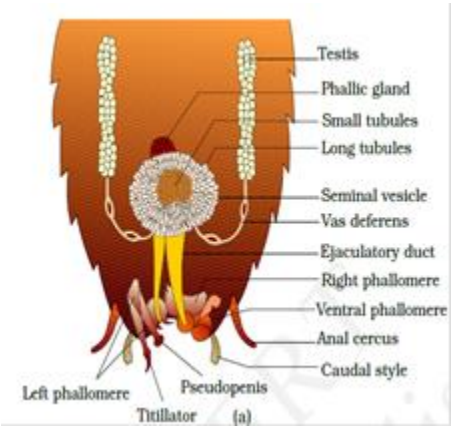
- At the junction of midgut and hindgut, yellow coloured filamentous **Malpighian tubules** are present which help in excretion.
- Blood vascular system is an open type having poorly developed blood vessels. The haemolymph is made of colourless plasma and haemocytes.
- The respiratory system consists of a network of the trachea which opens through 10 pairs of **spiracles** on the lateral side.
- 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.
- Each compound eye of cockroach consists of about 2000 hexagonal ommatidia. With the help of several ommatidia, a cockroach can receive several images of an object. This kind of vision is known as **a mosaic vision** with more sensitivity but less resolution,
- Cockroaches are dioecious. The male reproductive system consists of a pair of testes one lying on each lateral side in 4th-6th abdominal segments. The female reproductive system consists of two large ovaries situated on 2nd -6th abdominal segments.

Male reproductive system / Female reproductive system

- The fertilized eggs are encased in a capsule called oothecae. 9 to 10 oothecae are produced by each female.
- Cockroaches are pests and destroy the food, contaminate with smelly excreta.



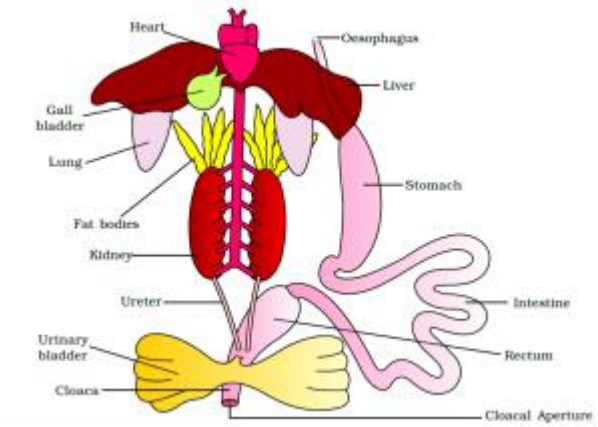
Female reproductive system



Male reproductive system

Frog (Ranatigrina)

Frogs are cold-blooded organism having the ability to change colours to hide from enemies. The body is divisible into head and trunk, bulged eyes covered by the nictitating membrane. Male frog is different from female having vocal sacs and copulatory pad on the first digit of the forelimb.



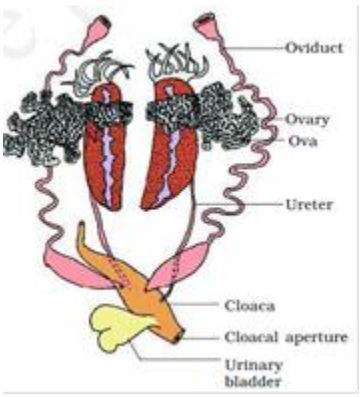
Anatomy of a frog

- The digestive system consists of the alimentary canal and digestive glands.
- Digestion starts in the stomach and final digestion occurs in the small intestine. Digested food is absorbed by villi and microvilli present in the inner wall of the small intestine.
- Skin acts as aquatic respiratory organs (cutaneous respiration). On lands skin, buccal cavity and lungs act as respiratory organs.
- The vascular system of the frog is a well-developed closed type. The heart is 3-chambered. Blood consists of plasma, RBC, WBC and Platelets.
- Frogs have a lymphatic system consisting of lymph, lymph channels and lymph nodes.
- The elimination of nitrogenous wastes is carried out by a well developed excretory system. The excretory system consists of a pair of kidneys, ureters, cloaca and urinary bladder. The frog excretes urea and thus is a **ureotelic** animal.
- The system for control and coordination is highly evolved in the frog. It includes both the neural system and endocrine glands
- Frogs have well-organised male and female reproductive systems. Male reproductive organs consist of a pair of yellowish ovoid testes, which are found adhered to the upper part of kidneys by mesorchium.

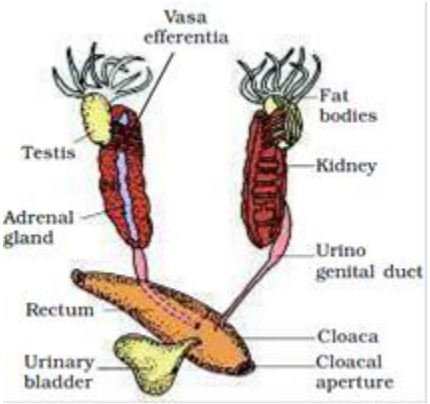
The female reproductive organs include a pair of ovaries which are situated near kidneys.

- Fertilisation is external and takes place in water. Development involves a larval stage called tadpole. Tadpole undergoes metamorphosis to form the adult.

Reproductivesystemsoffrog-



Female reproductive system



Male reproductive system

IMPORTANT TERMS

Sl No.	Terms	Explanation
1	**Tissue**	In multicellular animals, a group of similar cells along with intercellular substances perform a specific function. Such an organization is called tissue.
2	**Epithelial tissue**	We commonly refer to an epithelial tissue as epithelium (pl.: epithelia). This 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.
3	**simple epithelium**	The epithelium which is composed of a single layer of cells and functions as a lining for body cavities, ducts, and tubes.
4	**Compound epithelium**	The epithelium is made of more than one layer (multi-layered) of cells.

5	**Squamous epithelium**	It 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 functions like forming a diffusion boundary.
6	**Cuboidal epithelium**	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.
7	**Columnar epithelium**	The columnar epithelium is composed of a single layer of tall and slender cells. They are found in the lining of the stomach and intestine and help in secretion and absorption
8	**Ciliated epithelium**	If the columnar or cuboidal cells bear cilia on their free surface they are called the ciliated epithelium. They are mainly present in the inner surface of hollow organs like bronchioles and fallopian tubes.
9	**Glandular epithelium**	Some of the columnar or cuboidal cells get specialised for secretion and are called the glandular epithelium
10	**Loose connective tissue**	Connective tissue which has cells and fibres loosely arranged in a semi-fluid ground substance, for example, areolar tissue present beneath the skin
11	**Dense Connective tissue**	When fibres and fibroblasts are compactly packed to form dense connective tissues
12	**Cartilage**	It is a resilient and smooth elastic tissue.
13	**Chondrocytes**	The only cells found in healthy cartilage.
14	**Osteocytes**	It is a cell that lies within the substance of fully formed bone.
15	**Lacunae**	The bone cells (osteocytes) are present in the spaces called lacunae.
16	**Myofibrils**	Each muscle is made of many long, cylindrical fibres arranged in parallel arrays. These fibres are composed of numerous fine fibrils, called myofibrils.
17	**Neuroglia**	The supportive tissue of the nervous system.
18	**Hypopharynx**	A median flexible lobe, acting as the tongue, lies within the cavity enclosed by the mouthparts of cockroach.
19	**Gizzard**	An organ that helps in grinding the food particles in cockroach

20	**Supra-oesophageal ganglion**	The ganglion which supplies nerves to antennae and compound eyes in a cockroach.
21	**mimicry.**	The ability to change the colour to hide them from their enemies (camouflage). This protective colouration is called mimicry.
22	**uricotelic.**	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, this insect is called uricotelic.
23	**Brainbox(cranium)**	There are ten pairs of cranial nerves arising from the brain. Brains enclosed in a bony structure called brain box
24	**Spermatophore**	A spermatophore or sperm ampulla is a capsule or mass containing spermatozoa created by males of various animal species, especially salamanders and arthropods, and transferred in entirety to the female's ovipore during reproduction.
25	**Paurometabolous**	Paurometabolous is the development by gradual metamorphosis. In this form of development, immature stages (nymphs) resemble small adults and typically have external wing buds