Structural Organisation in Animals: Animal Tissues

2A Chapter

(1) TISSUE

- A group of similar cells along with intercellular substances which perform a specific function.
- **Organs** such as stomach, lungs, heart and kidney comprise specific proportion and pattern of **all basic types of tissues**.
- **Division of labour** contributes to survival of multicellular organisms e.g., *Hydra*.

(2) TYPES OF TISSUES

Based on
- Structure of cells
- Function performed by cells

→ Epithelial tissue
→ Connective tissue
→ Muscular tissue
→ Neural tissue

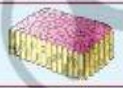
(4) CELL JUNCTIONS

Tight junctions
- **Prevent leakage** across a tissue

Adhering junctions
- Perform **cementing** to keep neighbouring cells together

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

(3) EPITHELIAL TISSUE

Characteristics	Squamous	Cuboidal	Columnar	Ciliated	Glandular
Figure					
Cells	Flattened, irregular boundaries	Cube-like	Tall and slender	Cuboidal or columnar	Cuboidal or columnar
Nucleus	Central	Central	At base	Central or at base	Central or at base
Function	Diffusion boundary	Secretion and absorption	Secretion and absorption	Move particles or mucus in a specific direction	Specialised for secretion
Location	Air sacs of lungs, walls of blood vessels	Tubular parts of nephron (PCT), ducts of glands	Stomach and intestine	Bronchioles and fallopian tubes	Salivary glands

Simple epithelium (single-layered)

Compound epithelium (multi-layered)

Layers	2 or more cell layers
Function	○ Protection against mechanical and chemical stresses ○ Limited role in secretion and absorption
Location	Dry surface of skin, buccal cavity, pharynx, inner lining of ducts of salivary glands and pancreas

- **Microvilli** present in PCT and small intestine increase surface area for absorption.
- Epithelial tissue provides a covering or a lining for some part of the body.
- Free surface of this tissue faces body fluid or outside environment.
- Its cells are compactly packed with little intercellular matrix.

Types of glands:

I. Based on the number of cells

- **Number of cells**: Single → Unicellular; Many → Multi-cellular
- **Example**: Goblet cells (Secrete mucus); Salivary glands (Secrete saliva)

II. Based on the mode of pouring their secretions

	Exocrine glands	Endocrine glands
Ducts	Present	Absent
Secretions	Mucus, saliva, earwax, oil, milk, digestive enzymes and other cell products	Hormones

- Endocrine glands directly release their secretions into the fluid bathing the gland

5 CONNECTIVE TISSUE

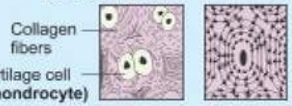
- Most abundant and widely distributed tissue
- Links and supports other tissues and organs
- **Components of Connective tissue:**
  - **Matrix/ground substance :** Modified polysaccharides **or Intercellular material**
  - **Cells:** Fibroblasts, macrophages, adipocytes etc.
  - **Fibres:** Fibroblasts secrete collagen or elastin fibres

Fibres provide strength, elasticity and flexibility to the tissue

III. SPECIALISED CONNECTIVE TISSUE

1. Skeletal Connective Tissues

	Cartilage	Bones
Matrix	Solid, pliable	Hard and non-pliable
Cells in lacuna	Chondrocytes	Osteocytes
Location/ Functions	Tip of nose, outer ear joints, between vertebrae, limbs and hands in adults Most of the cartilages in vertebrate embryos are replaced by bones in adults	Constitutes main structural framework; Interact with skeletal muscles to bring movements; **Bone marrow** in some bones is the site of production of blood cells.



2. Fluid Connective Tissue

- Blood – main circulating fluid that helps in the transport of various substances
- Composed of plasma, RBC, WBC, platelets
- Fibroblasts and fibres are absent in blood.

- Cartilage resists compression.
- Calcium salts and collagen fibres in ground substance provide strength to the bones.
- Lacunae are small cavities enclosing cells with in matrix secreted by them.

6 THREE TYPES OF CONNECTIVE TISSUE

I. LOOSE CONNECTIVE TISSUE

- Cells and fibres are loosely packed in semi solid matrix

Types

	Areolar tissue	Adipose tissue
Major cells	Fibroblasts, macrophages, mast cells	Adipocytes
Function(s)	Serve as support framework for epithelium	Reservoir of stored fats
Location	Beneath skin	Mainly beneath skin

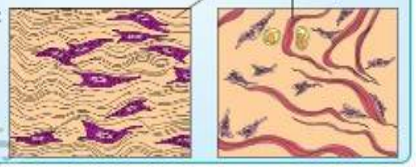
- Excess of nutrients not meant for immediate use are converted to fats and are stored in adipose tissue

II. DENSE CONNECTIVE TISSUE

- Fibroblasts and fibres are compactly packed in matrix

Types

	Dense regular	Dense irregular
Cells and fibres	Parallel bundles of collagen fibres	Fibroblasts and fibres are oriented differently
Location	**Tendons** (attach skeletal muscles to bone) **Ligaments** (attach bone to bone)	Skin
Arrangement of fibres and cells		



7 MUSCULAR TISSUE

- $(\text{Myofibrils})_n \rightarrow (\text{Muscle fibres})_n \rightarrow$ Muscle
- Show **contractility** and return to their uncontracted state in a coordinated fashion
- Play an active role in all movements

Parameters	Skeletal muscle fibres	Smooth/Visceral muscle fibres	Cardiac muscle fibres
Shape	Cylindrical	Spindle/fusiform	Cylindrical
No. of nuclei	Multi-nucleated	Uninucleated	Uninucleated
Location of nuclei	Peripheral nuclei	Central	Central
Striations	Striated	Non striated	Faint striations
Branching	Unbranched	Unbranched	Branched
Under control of will	Yes (Voluntary)	No (Involuntary)	No (Involuntary)
Junctions	Absent	Present	Present
Location	Attached to bones *e.g.* Biceps	Blood vessels, stomach, intestine	Heart wall

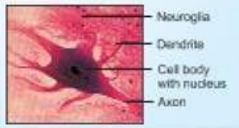
- **Communication junctions (intercalated discs)** at some fusion points allow the cells of cardiac muscles to contract as a unit.

8 NEURAL TISSUE

- Tissue with greatest control over the body's responsiveness to changing conditions.

Tissue Components

	Neurons	Neuroglial cells
	Unit of neural system	More than one half the volume of neural tissue
Excitability	✓	✗
Function	Respond to changing conditions through various stimuli	Protect and support neurons



- Upon suitable stimulation, the electrical disturbance generated travels swiftly along the plasma membrane of neuron.

Sharpen Your Understanding

1. Simple epithelium is present in all the following regions **except** [NCERT Pg. 101 and 102]
(1) Stomach (2) Fallopian tube
(3) Air sacs of lung (4) Skin

2. In which tissue, are cells compactly packed with little intercellular matrix? [NCERT Pg. 101]
(1) Epithelial tissue
(2) Muscular tissue
(3) Neural tissue
(4) Connective tissue

3. Select the single layered epithelium in which cells are tall, slender and nuclei are present at the base [NCERT Pg. 101]
(1) Squamous epithelium
(2) Cuboidal epithelium
(3) Columnar epithelium
(4) Compound epithelium

4. Single layer of cube-like cells having microvilli on their free surface are present in [NCERT Pg. 101]
(1) Ducts of glands (2) PCT of nephron
(3) Bronchioles (4) Fallopian tubes

5. The epithelium, made up of a single layer of flattened cells with irregular boundaries is present in [NCERT Pg. 101]
(1) Walls of blood vessels
(2) Pharynx
(3) Buccal cavity
(4) Skin

NCERT Based MCQs

6. Finger like projections of epithelial cells which increase surface area for absorption are present in [NCERT Pg. 101]
(1) Stomach (2) Small intestine
(3) Bronchioles (4) Fallopian tubes

7. Which of the following is **not** the secretion of exocrine glands? [NCERT Pg. 102]
(1) Mucus
(2) Milk
(3) Ear wax
(4) Hormones

8. Epithelium responsible for providing protection against mechanical and chemical stresses is absent in [NCERT Pg. 102]
(1) Pancreatic ducts
(2) Ducts of salivary glands
(3) Buccal cavity
(4) Tubular parts of nephron

9. Cell junctions in epithelial tissue that perform cementing to keep neighbouring cells together are [NCERT Pg. 102]
(1) Tight junctions
(2) Adhering junctions
(3) Gap junctions
(4) Communication junctions

10. Which is the most abundant and widely distributed tissue in the body? [NCERT Pg. 102]
(1) Epithelial tissue
(2) Connective tissue
(3) Muscular tissue
(4) Neural tissue

11. Tendons join [NCERT Pg. 103]
(1) Skeletal muscle to bone
(2) Bone to bone
(3) Smooth muscles to bone
(4) Striated muscle to non striated muscle

12. Dense irregular connective tissue is present in [NCERT Pg. 103]
(1) Tendon
(2) Ligament
(3) Skin
(4) Cartilage

13. Fibres are absent in [NCERT Pg. 103]
(1) Areolar tissue
(2) Blood
(3) Bones
(4) Tendons

14. Cartilage is present in all the given regions **except** [NCERT Pg. 104]
(1) Outer ear joints
(2) Tip of nose
(3) Between vertebrae
(4) Ligaments

15. Biceps is a type of _____.
Select the option that fills the blank **correctly**. [NCERT Pg. 104]
(1) Skeletal muscle
(2) Smooth muscle
(3) Cardiac muscle
(4) Non-striated muscle

16. Choose the **odd** one w.r.t. location of non-striated, involuntary muscle. [NCERT Pg. 105]
(1) Wall of blood vessels
(2) Stomach
(3) Intestine
(4) Heart

17. Select the involuntary muscle in which both adhering junction and intercalated discs are present [NCERT Pg. 105]
(1) Skeletal muscle
(2) Smooth muscle
(3) Non-striated muscle
(4) Cardiac muscle

18. Which of the following statement is **incorrect** w.r.t. neural tissue? [NCERT Pg. 105]
(1) All cells are excitable in this tissue
(2) This tissue exerts greatest control over the body's responsiveness
(3) Neuroglial cells protect and support neurons
(4) Neurons are unit of neural system

19. Read the following statements and select the **incorrect** statement w.r.t. given muscle fibres [NCERT Pg. 105]
(1) Smooth muscle fibres taper at both ends
(2) Cell junctions hold smooth muscle fibres together
(3) Smooth muscle fibres are bundled together in a connective tissue sheath
(4) Cardiac muscle fibres are unbranched

20. Select the tissue having hard, non pliable ground substance. [NCERT Pg.104]
(1) Enamel
(2) Bone
(3) Cartilage
(4) Ligament

Thinking in Context

1. The structure of the cells vary according to their _____. [NCERT Pg. 100]
2. Function of _____ is to move particles or mucus in a specific direction over the epithelium. [NCERT Pg. 101]
3. _____ cells of the alimentary canal are example of unicellular exocrine glands. [NCERT Pg. 102]
4. _____ junctions help to stop substances from leaking across a tissue. [NCERT Pg. 102]
5. _____ junctions facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells, for rapid transfer of ions, small molecules and sometimes big molecules. [NCERT Pg. 102]
6. Areolar tissue is present beneath the _____ and often serves as a support framework for epithelium [NCERT Pg. 103]
7. _____ cells secrete fibres and matrix. [NCERT Pg. 103]
8. _____ are phagocytic cells of connective tissue. [NCERT Pg. 103]
9. Cells of _____ tissue are specialized to store fats. This tissue is located mainly beneath the _____. [NCERT Pg. 103]
10. _____, _____ and _____ are various types of specialized connective tissues. [NCERT Pg. 104]
11. The intercellular material of _____ is solid, pliable and resists compression. [NCERT Pg. 104]

12. Ground substance of bones is rich in _____ and _____ fibres which give bone its strength. [NCERT Pg. 104]

13. Osteocytes are present in the fluid filled spaces called _____. [NCERT Pg. 104]

14. The bones interact with _____ muscles attached to them to bring about movements. [NCERT Pg. 104]

15. Blood is a _____ connective tissue. [NCERT Pg. 104]

16. Muscle fibres are composed of numerous fine fibrils, called _____. [NCERT Pg. 104]

17. _____ junctions at _____ allow the cells of cardiac muscles to contract as a unit. [NCERT Pg. 105]

18. _____ fuse the plasma membranes of cardiac muscle cells and make them stick together. [NCERT Pg. 105]

19. _____ make up more than one-half the volume of neural tissue in our body. [NCERT Pg.105]

20. Arrival of the disturbance at the neuron endings, triggers events that may cause _____ or _____ of adjacent neurons. [NCERT Pg.106]

❑ ❑ ❑

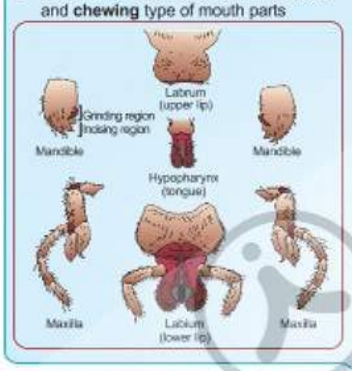
Structural Organisation in Animals: Animal Morphology

2B Chapter

1 INTRODUCTION (Cockroach)

- **Classification**
  - **Kingdom** : Animalia
  - **Phylum** : Arthropoda
  - **Class** : Insecta
  - **Genus** : *Periplaneta*
  - **Species** : *americana*
- **Characteristics:**
  - **Size** : 34-53 mm long
  - **Colour** : Brown or black colour; Bright yellow, red and green coloured reported in tropical regions.
  - **Habitat** : Damp places throughout world
  - **Habit** : Nocturnal, Omnivorous
- **Economic importance** : Pests as they spoil food and contaminate with smelly excreta. Transmit several diseases by contaminating food material.

- Head bears appendages forming **Biting** and **chewing** type of mouth parts



2 MORPHOLOGY

- Body divisions → Head – 6 segments; Thorax – 3 segments; Abdomen – 10 segments
- **Wings extend** beyond the tip of **abdomen in males.**
- **Exoskeleton** : Hard, brown **chitinous** plates called **sclerites** — **Dorsal** plates – **Tergites**; **Ventral** plates – **Sternites**

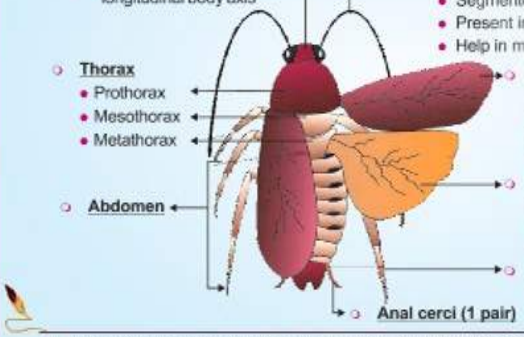
Plates connected by a thin, flexible articular/ **arthrodial membrane**.

Body Divisions:

- **Head**
  - Triangular, right angle to longitudinal body axis
- **Thorax**
  - Prothorax
  - Mesothorax
  - Metathorax
- **Abdomen**

Appendages:

- **Filiform antennae**
  - Long, sensory thread like
  - Segmented arise from membranous socket
  - Present in front of eyes
  - Help in monitoring environment
- **Mesothoracic wings/ Forewings/ Tegmina (1 pair)**
  - Opaque, dark and leathery
  - Cover hindwings at rest
- **Metathoracic wings/ Hindwings (1 pair)**
  - Transparent and membranous
  - **Meant for flight**
- **Legs (3 pairs)**
  - 1 pair of walking legs on each thoracic segment
- **Anal cerci (1 pair)**



- Head connected to thorax by short extension of prothorax known as **neck**. It provide great mobility of head in all directions.

3 DIGESTIVE SYSTEM

Alimentary canal

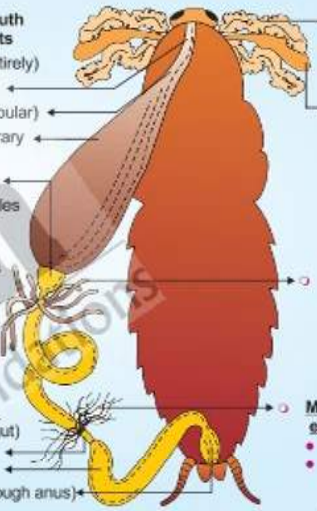
Well developed with a mouth surrounded by mouth parts

- **Foregut** (Lined by cuticle entirely)
  - **Pharynx** (shorts tubular)
  - **Oesophagus** (Narrow tubular)
  - **Crop** (sac like for temporary **storage of food**)
  - **Gizzard/proventriculus**
    - Outer thick circular muscles and inner six chitinous teeth
    - Grinding of food particles
- **Mesenteron/ Midgut** (Between forgut and hindgut)
- **Hindgut** (Broader than midgut)
  - **Ileum**
  - **Colon**
  - **Rectum** (Opens out through anus)

Accessory glands

- **Salivary gland**
  - 1 pair
  - Present near crop
- Salivary reservoir

- **Hepatic/gastric caecae**
  - Ring of 6-8 blind tubules
  - At the junction of foregut and midgut
  - Secrete digestive juice
- **Malpighian tubules (part of excretory system)**
  - 100-150 in number
  - Yellow coloured, thin filamentous tubules at the junction of midgut and hindgut



4 BLOOD VASCULAR SYSTEM

- Open type

Heart

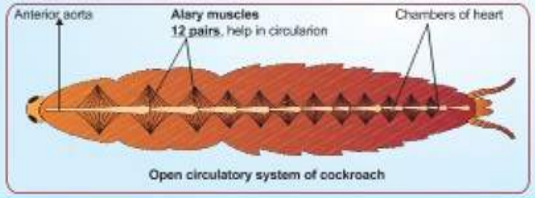
- Elongated muscular tube with **13 chambers**
- Lying along mid dorsal line of thorax and abdomen
- Funnel shaped chambers with **ostia** on either side
- Blood flows **anteriorly** in heart

Blood vessels

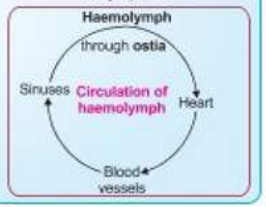
- Poorly developed
- Open into haemocoel

Haemolymph

- Composed of colourless plasma and **haemocytes**
- Visceral organs bathed in haemolymph



Open circulatory system of cockroach



5 RESPIRATORY SYSTEM

- **Structures involved:** Network of trachea (thin, branching tubes) that open through **10 pairs of spiracles** present on **lateral side** of the body
- Opening of spiracles is guarded by **sphincters**
- **Site for exchange of gases:** Tracheoles by **diffusion**.

6 EXCRETORY SYSTEM

- **Structure involved:** Malpighian tubules, lined by **glandular** and **ciliated** cells.
- They absorb nitrogenous waste products and convert them into **uric acid** which is excreted out through hindgut.
- **Excretory product:** Uric acid **(Uricotelic)**
- **Other excretory structures:** Fat body, nephrocytes and uricose glands.

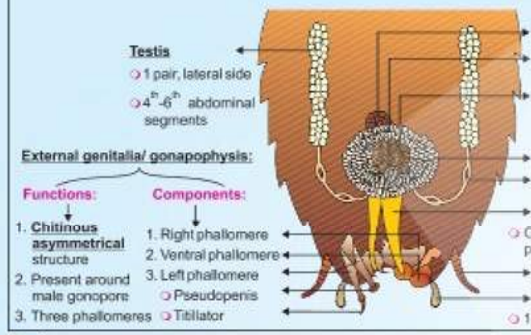
7 NERVOUS SYSTEM

Parameters	Head	Ventral part of body
Proportion of nervous system	Bit of nervous system	Most part of nervous system
Structure	Supra-oesophageal ganglion (brain) → Supply nerves to Antennae and compound eyes (Each compound eye consists of **2000** hexagonal **ommatidia**)	Paired longitudinal connectives with series of fused ganglia • **3 ganglia** in **thorax** and **6** ganglia in **abdomen**.

- **Sense organs:** Antennae, Labial palps, Eyes, Maxillary palps, Anal cerci
- Cockroach has **mosaic vision** with **more sensitivity and less resolution**
- If head of cockroach is cut off, it will still live for as long as one week

8 REPRODUCTIVE SYSTEM

MALE REPRODUCTIVE SYSTEM

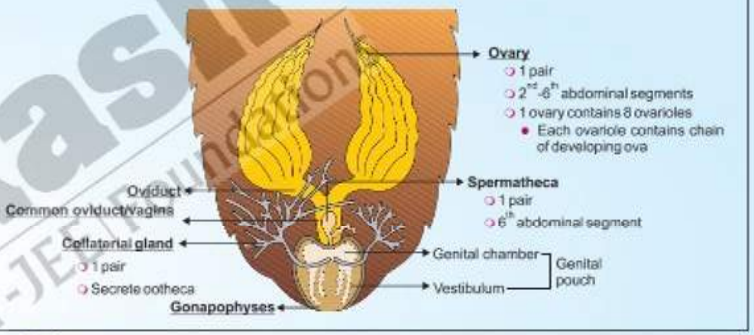


Male genital pouch is bounded dorsally by 9th and 10th terga and ventrally by 9th sternum.

Path of sperms

- Testes → Vas deferens → Seminal vesicle → Ejaculatory duct → Male genital pore → Spermatheca of female during copulation

FEMALE REPRODUCTIVE SYSTEM



- Genital pouch is bounded by 7th sternum (boat shaped) along with 8th and 9th sterna
- Anterior part of genital pouch: female gonopore, spermathecal pores and collaterial glands

Path of ova

- Female genital pore ← Common oviduct/Vagina ← Oviduct ← Ovary (Ovarioles)

Sperms → Ova

Anal cerci	Anal style
Paired, long	Paired, short
Jointed	Unjointed
Filamentous	Thread like
♀ and ♂	♂

- **Female genital pouch**
- Fertilisation
- Secretion of **collaterial glands** form ootheca
- On an average female produces **9-10 ootheca**, each containing **14 to 16 fertilised eggs**

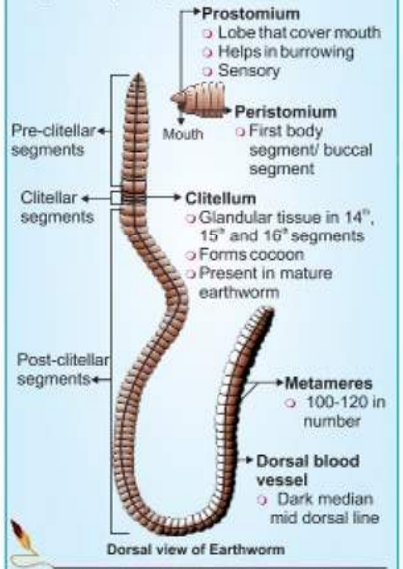
- Female deposits ootheca in crack or crevice
- Nymph —(**13 times moulting (Paurometabolous development)**)→ Adult
- Next to last nymphal stage has **wing pads** but only adult cockroaches have wings.

9 INTRODUCTION (EARTHWORM)

- **Phylum :** Annelida
- **Habitat:** Upper layer of the moist soil
- During day, live in burrows (made by boring and swallowing the soil
- Can be traced by faecal deposits known as **worm castings**
- *Pheretima* and *Lumbricus* are common Indian earthworms

10 MORPHOLOGY

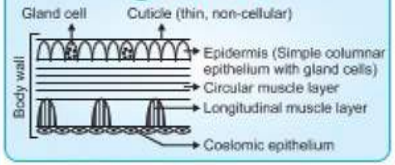
- Long cylindrical body
- 100-120 segments/metameres
- **Dorsal side:** Marked by mid dorsal line (Dorsal blood vessel)
- **Ventral side:** Marked by presence of genital openings (pores)



Dorsal view of Earthworm

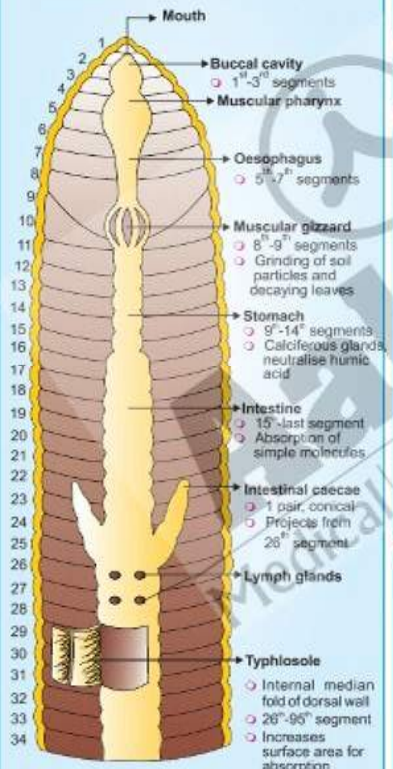
- **Setae:** S-shaped, ring of setae embedded in epidermal pits, present on each body segment except first, last and clitellum. Can extend or retract and helps in locomotion

11 ANATOMY



12 ALIMENTARY CANAL

- Straight tube between first and last segment
- Starts from mouth and opens to the exterior by rounded anus.



13 CIRCULATORY SYSTEM

- Closed type
- 4 pairs of tubular hearts, blood vessels and capillaries
  - **Lateral oesophageal hearts** 2 pairs, 7th and 9th segments
  - **Lateral hearts** 2 pairs, 12th and 13th segments
- **Dorsal blood vessel is largest blood vessel**
- **Anterior loops**-1 pair, 10th & 11th segments
- **Blood glands** 4th, 5th and 6th segments, they produce blood cells (phagocytic) and haemoglobin which is dissolved in blood plasma.

14 RESPIRATION

- Moist body surface (**cutaneous** respiration)

15 EXCRETORY ORGANS

- Nephridia (segmentally arranged coiled tubules)
  - 3 types (Similar in structure)

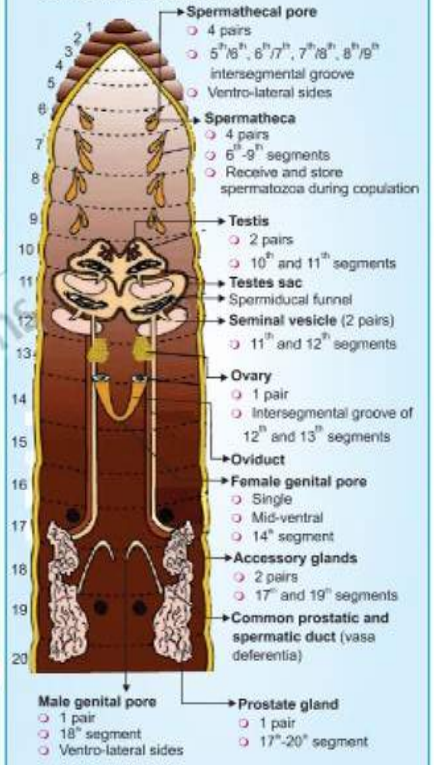
1. **Septal nephridia**
   - On both sides of intersegmental septa of 15th to last segment
   - Open into intestine
2. **Integumentary nephridia**
   - Attached to inner lining of body wall from 3rd to last segment
   - Open on the body surface through a pore
   - **Forest of integumentary nephridia** on clitellar segments
3. **Pharyngeal nephridia**
   - 3 paired tufts in 4th, 5th and 6th segments

16 NERVOUS SYSTEM

- Represented by ganglia arranged segment wise on the ventral paired nerve cord.
- The nerve cord in the anterior region (3rd and 4th segments) bifurcates, laterally encircling the pharynx and joins the cerebral ganglia dorsally to form a **nerve ring**.
- Receptor cells for light, touch and taste are present on anterior part. **Eyes absent.**

17 REPRODUCTIVE SYSTEM

- Hermaphrodite (bisexual)
- **Protandrous** condition, cross fertilisation
- Mutual exchange of sperms occur between two worms during mating
- Mate in **Juxtaposing opposite** gonadal openings exchanging packets of sperms called **spermatophores**



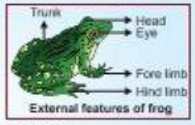
- **Fertilisation** and **development** occurs in **cocoons** produced by clitellum which are deposited in soil.
- After about **3 weeks** each cocoon produces **2-20 baby** worms with an **average of 4**
- Direct development (No **larval stage**)

18 INTRODUCTION (FROG/*Rana tigrina*)

- **Class:** Amphibia
- **Habitat:** Fresh water and land
- **Habit:** Poikilotherms, camouflage, undergo aestivation (summer sleep) and hibernation (winter sleep), never drink water but absorb through skin
- **Economic importance:**
  - Beneficial to mankind as they eat insects and protect the crops
  - Maintain ecological balance as they serve as link of food chain and food web in the ecosystem.
  - Muscular legs are used as food in some countries

19 MORPHOLOGY

- **Dorsal side:** Olive green with dark irregular spots.
- **Ventral side:** Pale yellow
- **Body division:** Head and Trunk, **Neck and Tail absent**
- **Limbs** helps in swimming, walking, leaping, burrowing



External features of frog

Parameter	Forelimbs	Hindlimbs
Digits	4	5
Size	Smaller	Larger and more muscular
Web	×	✓, for swimming

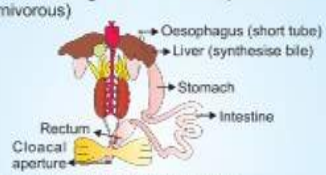
- Show sexual dimorphism

Parameter	Male	Female
Copulatory pad	First digit of forelimb	×
Vocal sac	Prominent	×

20 DIGESTIVE SYSTEM

Alimentary canal (Short because frogs are carnivorous)

Digestive glands Liver, pancreas



- Food is captured by the **bilobed tongue**
- Digestion of food by the action of HCl and gastric juices occur in stomach and is called **Chyme**
- Bile (emulsifies fat) and pancreatic juice through common bile duct digest carbohydrates and proteins in intestine
- **Digestion completes in small intestine**
- Digested food is absorbed by **villi and microvilli**
- Undigested waste moves into the rectum and passes out through cloaca

21 RESPIRATION

Location/during	Mode of respiration
Water, hibernation, aestivation	Cutaneous (highly vascularised
Land	Cutaneous, buccal cavity, pulmonary

- Lungs are a pair of elongated pink coloured sac-lik structures present in the thorax
- **Pulmonary respiration:** Air → Nostrils → buccal cavity → lungs

22 CIRCULATORY SYSTEM

- **Closed** type with single circulation
- Three chambered heart (two atria and one ventricle) covered by **pericardium**
- **Sinus venosus** (triangular) joins the right atrium
- Ventricles opens into a sac like **conus arteriosus** on the ventral side of the heart

Liver ← Hepatic Portal system — Intestine

Kidneys ← Renal Portal system — Lower parts of the body

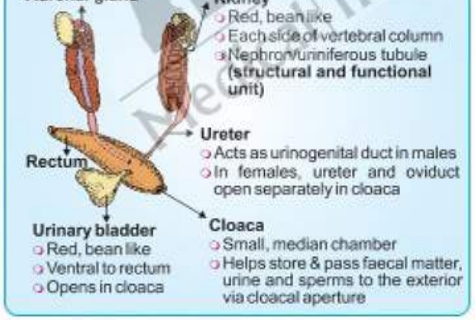
- **Blood:**

Nucleated RBCs/erythorocytes contain haemoglobin, WBC's/leucocytes & platelets

- **Lymphatic system:** Lymph (lacks few proteins and RBCs), lymph channels, Lymph nodes

23 EXCRETORY SYSTEM

- **Ureotelic**



24 CONTROL AND COORDINATION

- Include neural system and endocrine glands

Neural systems

CNS

Brain enclosed in cranium

Spinal cord enclosed in vertebral column

PNS

- Cranial nerves **(10 pairs)**
- Spinal nerves
- ANS

Forebrain	Midbrain	Hindbrain
Olfactory lobes	Optic lobes (Paired)	Cerebellum
Cerebral hemispheres (Paired)		Medulla oblongata (Passes through foramen magnum and continues into spinal cord)
Unpaired diencephalon		

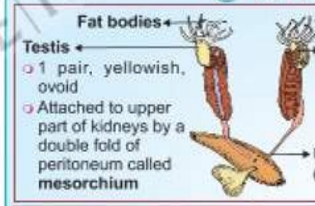
- **Sense organs**
  - Sensory papillae – Touch
  - Taste buds – Taste
  - Nasal epithelium – Smell

  Cellular aggregations around nerve endings
  - Simple eyes – Vision
  - Ear – Hearing and equilibrium

  Well organised structures
  - External ear is absent in frogs.
- **Endocrine glands**
  - Pituitary, thyroid, parathyroid, thymus, pineal body, pancreatic islets, adrenals and gonads

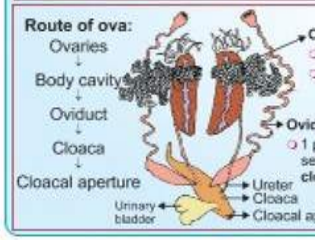
25 REPRODUCTIVE SYSTEM

Male



Route of sperm: Testis → Vasa efferentia → Bidder's canal → Urinogenital duct → Cloaca → Cloacal aperture

Female



- A mature female can lay 2500 to 3000 ova at a time.
- Fertilisation is external and takes places in water.
- Development involves a larval stage called **tadpole**. Tadpole undergoes metamorphosis to form the adult.

Sharpen Your Understanding

1. All of the following characteristics describe sexual dimorphism in *Periplaneta americana*, **except** [NCERT Pg. 111]
   (1) Wings extend beyond the tip of abdomen in males
   (2) 7^{th} sternum is boat shaped in females
   (3) Anal styles are present in males and absent in females
   (4) Anal cerci are present in females and absent in males
2. The first pair of wings in cockroach arises from [NCERT Pg. 112]
   (1) Prothorax (2) Pronotum
   (3) Mesothorax (4) Metathorax
3. Transparent, membranous wings which are used in flight in cockroach are [NCERT Pg. 112]
   (1) Mesothoracic wings
   (2) Metathoracic wings
   (3) Tegmina
   (4) Forewings
4. Hepatic caecae are present at the junction of [NCERT Pg. 113]
   (1) Proventriculus and foregut
   (2) Gizzard and midgut
   (3) Midgut and hindgut
   (4) Crop and gizzard
5. Choose the **mismatch** w.r.t. cockroach [NCERT Pg. 113]
   (1) Abdomen – 10 segments
   (2) Anal cerci – 10^{th} segment
   (3) Malpighian tubules – 100-150
   (4) Tracheal system – 10 spiracles
6. Grinding of food first occurs by which structure in cockroach? [NCERT Pg. 112 & 113]
   (1) Six chitinous teeth in gizzard
   (2) Crop
   (3) Mandible
   (4) Maxillae
7. Which of the following is **incorrect** w.r.t. circulatory system of cockroach? [NCERT Pg. 113]
   (1) Open circulatory system
   (2) Blood vessels are absent
   (3) Haemocytes are present in haemolymph
   (4) Haemolymph flows in heart anteriorly
8. Exchange of gases in cockroach take place at the [NCERT Pg 114]
   (1) Trachea (2) Tracheoles
   (3) Spiracles (4) Ostia
9. Read the following statements and choose the **correct** option.
   Statement-A : Nervous system of cockroach consists of a series of fused, segmentally arranged ganglia joined by paired longitudinal connectives.
   Statement-B : In cockroach, head holds a bit of a nervous system while the rest is situated along the dorsal part of the body. [NCERT Pg.114]
   (1) Statement A is incorrect
   (2) Statement B is correct
   (3) Both A and B statements are incorrect
   (4) Only statement B is incorrect
10. Nerves from supra-oesophageal ganglion in cockroach innervates A and B. Choose the option which **correctly** fill the blanks A and B. [NCERT Pg. 114]

	A	B
(1)	Antennae	Compound eyes
(2)	Labrum	Labium
(3)	Antennae	Labium
(4)	Compound eyes	Mandibles

11. Match the following columns w.r.t. cockroach and choose the **correct** option [NCERT Pg. 114]

	Column-I		Column-II
a.	Testes	(i)	6^{th} abdominal segment
b.	Ovary	(ii)	4^{th}-6^{th} abdominal segments
c.	Mushroom gland	(iii)	2^{nd}-6^{th} abdominal segments
d.	Spermatheca	(iv)	6^{th}-7^{th} abdominal segments

   (1) a(ii), b(iii), c(iv), d(i)
   (2) a(iii), b(ii), c(i), d(iv)
   (3) a(iv), b(iii), c(i), d(ii)
   (4) a(i), b(ii), c(iv), d(iii)

NCERT Based MCQs

12. In female cockroach, sperms are stored in [NCERT Pg. 114]
(1) Seminal vesicles
(2) Spermatheca
(3) Ejaculatory duct
(4) Vagina

13. Ootheca, which is dark reddish to blackish brown capsule, about 3/8" (8 mm) long is formed by the secretions of [NCERT Pg. 114]
(1) Mushroom gland
(2) Phallic gland
(3) Collaterial glands
(4) Long tubules of male accessory gland

14. Choose the **odd** one w.r.t. external genitalia in male cockroach [NCERT Pg. 112, 114, 115]
(1) 3 pairs of gonapophyses
(2) Chitinous asymmetrical structures
(3) Pseudopenis and titillator are part of left phallomere
(4) Present in male genital pouch, ventral to anus

15. Posterior part of female genital pouch is called [NCERT Pg. 115]
(1) Vestibulum
(2) Vagina
(3) Genital chamber
(4) Gonapophyses

16. Select the **incorrect** statement w.r.t. sensory system in earthworm. [NCERT Pg. 110]
(1) Eyes are absent but receptor cells are present to distinguish light intensities
(2) Receptor cells for touch are present to feel vibrations in the ground
(3) Sense organs are located on the anterior part of earthworm
(4) Taste receptors (chemoreceptors) are absent in earthworm

17. Earthworms are known as "Friends of Farmers" because [NCERT Pg. 108, 111]
a. They make the soil porous
b. Increases soil fertility
c. Larger soil particles are grind up into finer ones
d. They neutralises humic acid present in the soil.
How many of the above statements are **correct**?
(1) Four
(2) Three
(3) Two
(4) One

18. Which of the following structure acts as urino genital duct in male frogs? [NCERT Pg.118]
(1) Urethra
(2) Ureters
(3) Urinary bladder
(4) Vasa efferentia

19. Male frog can be distinguished externally from female frog by all of the following features **except** [NCERT Pg. 116]
a. Presence of sound producing vocal sacs
b. Presence of copulatory pad on the first digit of the forelimbs
c. Ureters carry both sperms and urine in male frog
d. Testes are adhered to the upper part of kidneys by a double fold of peritoneum called mesorchium
(1) a, b, c and d
(2) a and b only
(3) a, b and c only
(4) c and d only

20. On land, frog respires by [NCERT Pg. 118]
(1) Skin only
(2) Skin and buccal cavity only
(3) Skin, lungs and buccal cavity
(4) Lungs only

Thinking in Context

1. Size of cockroaches ranges from _____ inches to _____ inches (____to ____ cm).
[NCERT Pg. 111]

2. Head of cockroach is formed by fusion of _____ segments and lies anteriorly at _____ angle to the longitudinal body axis, head shows greater mobility in all directions due to flexible _____. [NCERT Pg. 112]

3. In female cockroach, _____ is boat shaped and together with _____ and _____ forms a blood or genital pouch. [NCERT Pg. 112]

4. Anterior part of genital pouch in female cockroach contains _____, _____ and _____. [NCERT Pg. 112]

5. In male cockroach, genital pouch or chamber is bounded dorsally by _____ and _____ and ventrally by the _____.
[NCERT Pg. 112]

6. Male genital pouch in cockroach contains dorsal _____, ventral _____ and _____.
[NCERT Pg. 112]

7. In cockroach excretion is performed by _____. In addition, the _____, _____ and _____ also help in excretion.
[NCERT Pg. 114]

8. Malpighian tubules are lined by _____ and _____ cells. They absorb _____ waste products and convert them into _____ which is excreted out through the _____.
[NCERT Pg. 114]

9. In cockroach, brain is represented by _____
[NCERT Pg. 114]

10. Each compound eye consists of _____ hexagonal ommatidia. _____ vision is present in cockroach with more _____ and less _____. [NCERT Pg. 114]

11. On an average, a female cockroach produces _____ ootheca, each containing _____ eggs. [NCERT Pg. 115]

12. The development of *Periplaneta americana* is _____. The nymph grows by moulting about _____ to reach the adult form.
[NCERT Pg. 115]

13. The _____ nymphal stage has _____ but only _____ cockroaches have wings.
[NCERT Pg. 115]

14. In cockroach, the ejaculatory duct opens into _____ situated _____ to anus.
[NCERT Pg. 114]

15. In cockroach, each ovary is formed of a group of _____ ovarioles. Oviducts of each ovary unite into a single median _____.
[NCERT Pg. 114]

16. The process of increasing fertility of soil by the earthworms is called _____.
[NCERT Pg. 111]

17. The characteristic feature of the intestine of earthworm is the presence of internal median fold of dorsal wall called _____. This increases area of _____. [NCERT Pg. 108]

18. Summer sleep is called _____ and winter sleep is called _____. [NCERT Pg. 116]

19. Vasa efferentia in frog are _____ in number that arise from _____. They enter the kidneys on their side and open into _____.
[NCERT Pg. 119]

20. _____ of cranial nerves are present in frog.
[NCERT Pg. 119]

❑ ❑ ❑