

Structural Organisation in Animals: Animal Morphology

1 INTRODUCTION (Cockroach)

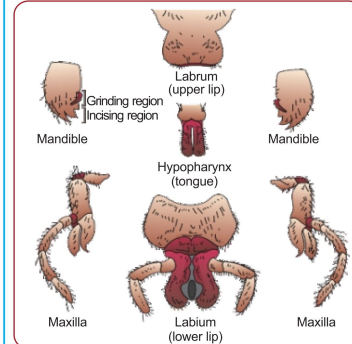
Classification

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**.

Body Divisions:

Head

- Triangular, right angle to longitudinal body axis

Thorax

- Prothorax
- Mesothorax
- Metathorax

Abdomen

- **Exoskeleton** : Hard, brown **chitinous** plates called **sclerites**
 - **Dorsal plates – Tergites**
 - **Ventral plates – Sternites**
- Plates connected by a thin, flexible articular/arthrodial membrane.

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 foregut 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

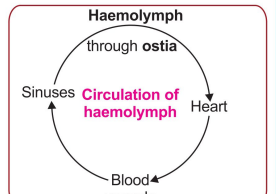
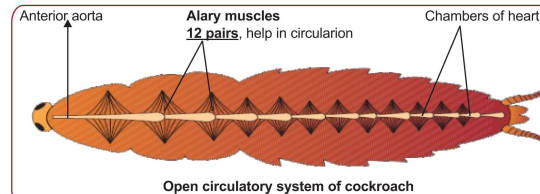
- Elongated muscular tube with **13 chambers**
- Lying along mid dorsal line of thorax and abdomen
- Funnel shaped chambers with **ostia** on either side
- Blood flows **anteriorly** in heart

Blood vessels

- Poorly developed
- Open into haemocoel

Haemolymph

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



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

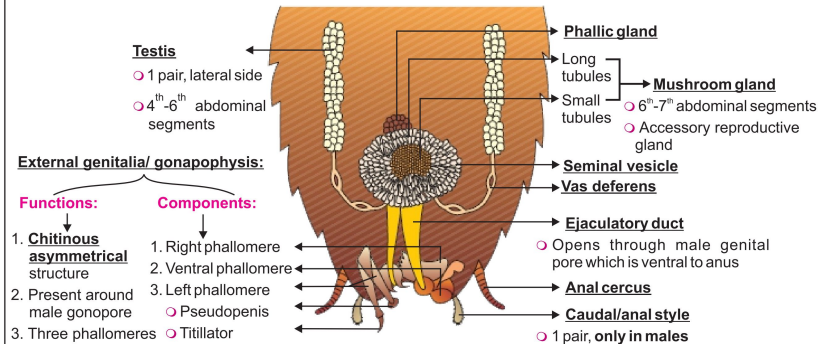
- Structure involved: Malpighian tubules, lined by **glandular** and **ciliated** cells.
- They absorb nitrogenous waste products and convert them into **uric acid** which is excreted out through hindgut.
- Excretory product: Uric acid (**Uricotelic**)
- Other excretory structures: Fat body, nephrocytes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



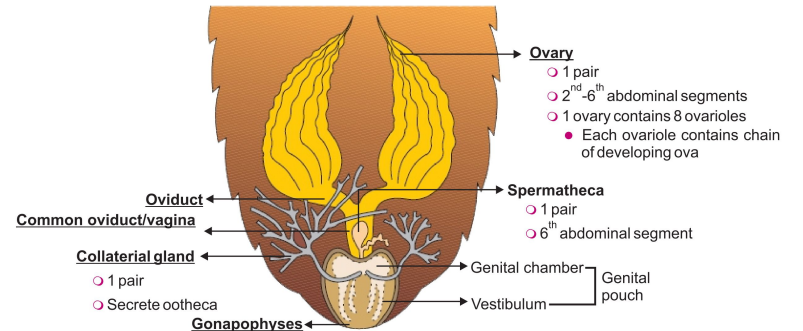
Male genital pouch is bounded dorsally by 9th and 10th terga and ventrally by 9th sternum.

Path of sperms

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

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

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 collateral glands

Path of ova

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

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

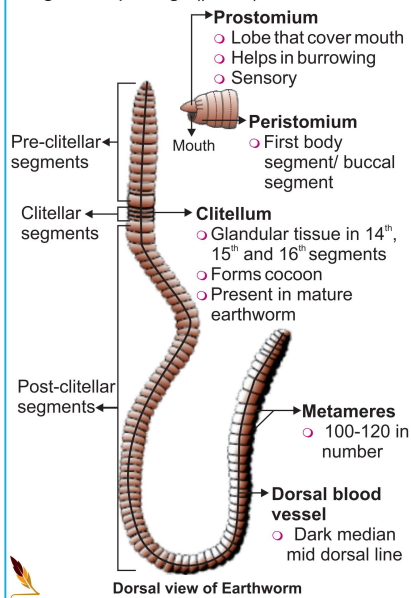
- Female deposits ootheca in crack or crevice
- Nymph **13 times moulting (Paurometabolous development)** → Adult
- Next to last nymphal stage has **wing pads** but only adult cockroaches have wings.

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

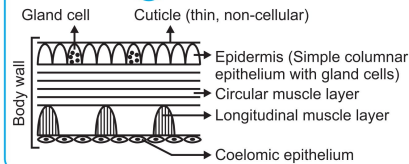
10 MORPHOLOGY

- 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)



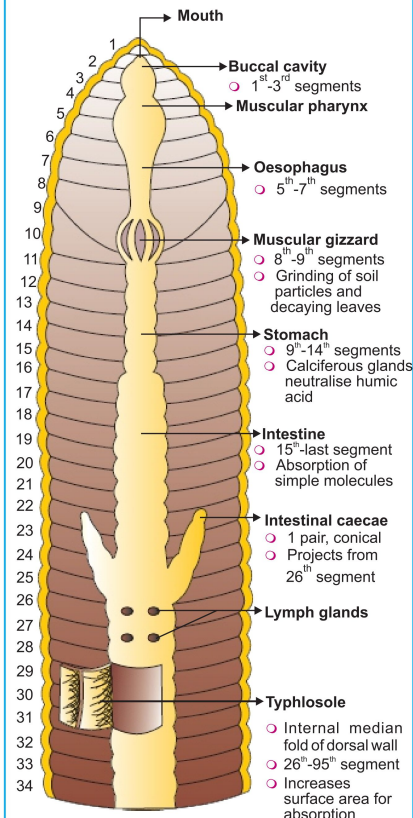
- **Setae**: S-shaped, ring of setae embedded in epidermal pits, present on each body segment except first, last and clitellum. Can extend or retract and helps in locomotion

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

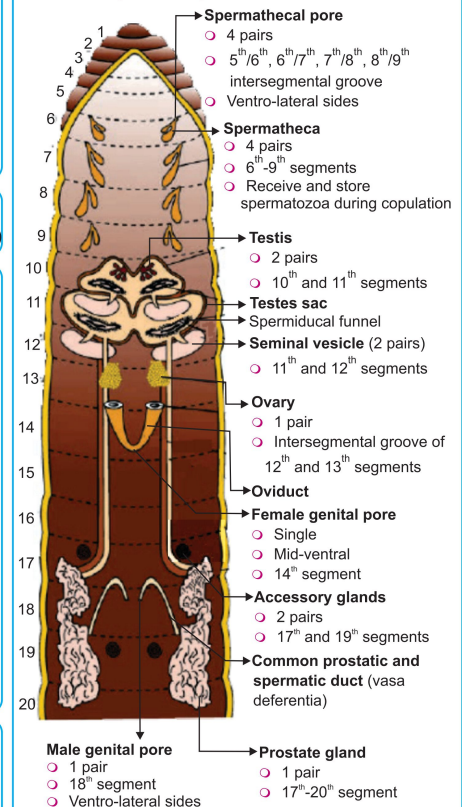
- Nephridia (segmentally arranged coiled tubules)
- 3 types (Similar in structure)
- 1. **Septal nephridia**
 - On both sides of intersegmental septa of 15th to last segment
 - Open into intestine
- 2. **Integumentary nephridia**
 - Attached to inner lining of body wall from 3rd to last segment
 - Open 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**



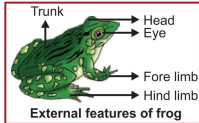
- **Fertilisation** and **development** occurs in **cocoons** produced by clitellum which are deposited in soil.
- After about **3 weeks** each cocoon produces **2-20 baby** worms with an **average of 4**
- Direct development (No **larval stage**)

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

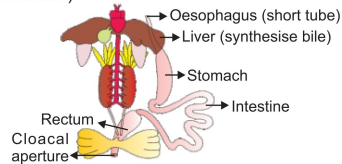
19 MORPHOLOGY

- **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
- | Parameter | Forelimbs | Hindlimbs |
|-----------|-----------|--------------------------|
| Digits | 4 | 5 |
| Size | Smaller | Larger and more muscular |
| Web | x | ✓, for swimming |
- Show sexual dimorphism
- | Parameter | Male | Female |
|----------------|-------------------------|--------|
| Copulatory pad | First digit of forelimb | x |
| Vocal sac | Prominent | x |



20 DIGESTIVE SYSTEM

Alimentary canal
(Short because frogs are carnivorous)



- 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

- Water, hibernation, aestivation
- Land

Mode of respiration

- Cutaneous (highly vascularised)
- Cutaneous, buccal cavity, pulmonary



- Lungs are a pair of elongated pink coloured sac-like 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
 - Ventricle opens into a sac like **conus arteriosus** on the ventral side of the heart
- Liver $\xleftarrow{\text{Hepatic Portal system}}$ Intestine
- Kidneys $\xleftarrow{\text{Renal Portal system}}$ Lower parts of the body
- **Blood:** Nucleated RBCs/erythrocytes contain haemoglobin, WBCs/leucocytes & platelets
 - **Lymphatic system:** Lymph (lacks few proteins and RBCs), lymph channels, Lymph nodes

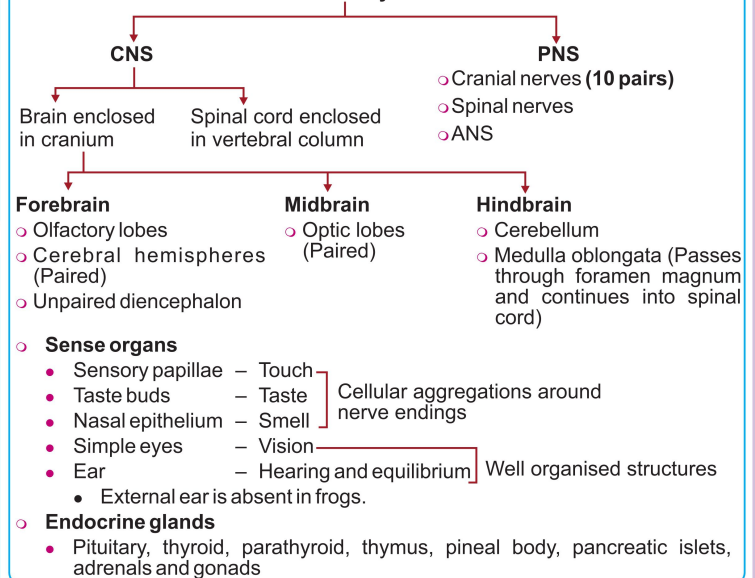
23 EXCRETORY SYSTEM

- **Ureotelic**
- **Adrenal gland**
- **Kidney**
 - Red, bean like
 - Each side of vertebral column
 - Nephron/uriniferous tubule (structural and functional unit)
- **Ureter**
 - Acts as urinogenital duct in males
 - In females, ureter and oviduct open separately in cloaca
- **Urinary bladder**
 - Red, bean like
 - Ventral to rectum
 - Opens in cloaca
- **Cloaca**
 - Small, median chamber
 - Helps store & pass faecal matter, urine and sperms to the exterior via cloacal aperture

24 CONTROL AND COORDINATION

- Include neural system and endocrine glands

Neural systems



25 REPRODUCTIVE SYSTEM

