Aakash + BYJU'S NOTES

Structural Organisations in Animals - II

Key Takeaway

1 Earthworm

- Morphology
- Anatomy
- Alimentary canal
- Circulatory system
- Excretory system
- Nervous system
- Reproductive system
- Fertilisation & development

2 Cockroach

- Morphology
- Anatomy
- Alimentary canal
- Blood vascular system
- Respiratory system
- Excretion system
- Nervous system
- Reproductive system
- Fertilisation
- Development

Key Takeaway

Frog — 3

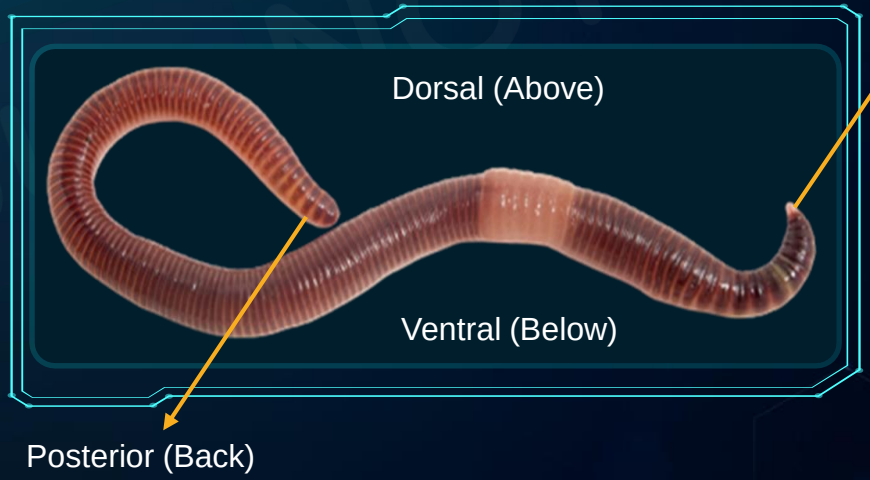
- Morphology
- Anatomy
- Digestive system
- Respiratory system
- Circulatory system
- Lymphatic system
- Excretory system
- Nervous system
- Reproductive system
- Fertilisation & development

Summary

Earthworm

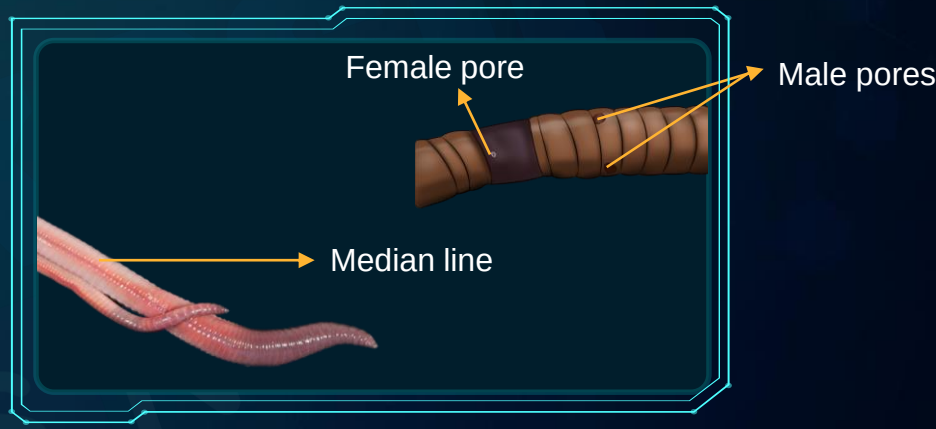
Earthworms are:

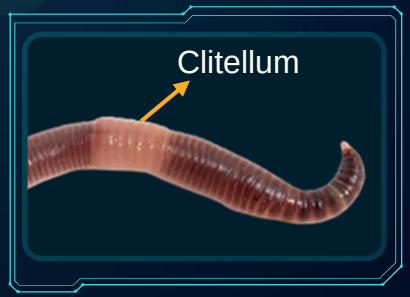
- Members of phylum **Annelida** and class **Clitellata**
- **Reddish brown** in color
- Commonly known as nightcrawlers, angleworms, lob worms, dew worms, granddaddy earthworms (Canada), or just as **earthworms**.
- **Terrestrial invertebrates**
- Live in **upper layers of moist soil**
- Form and live in **burrows**



Earthworm: Morphology

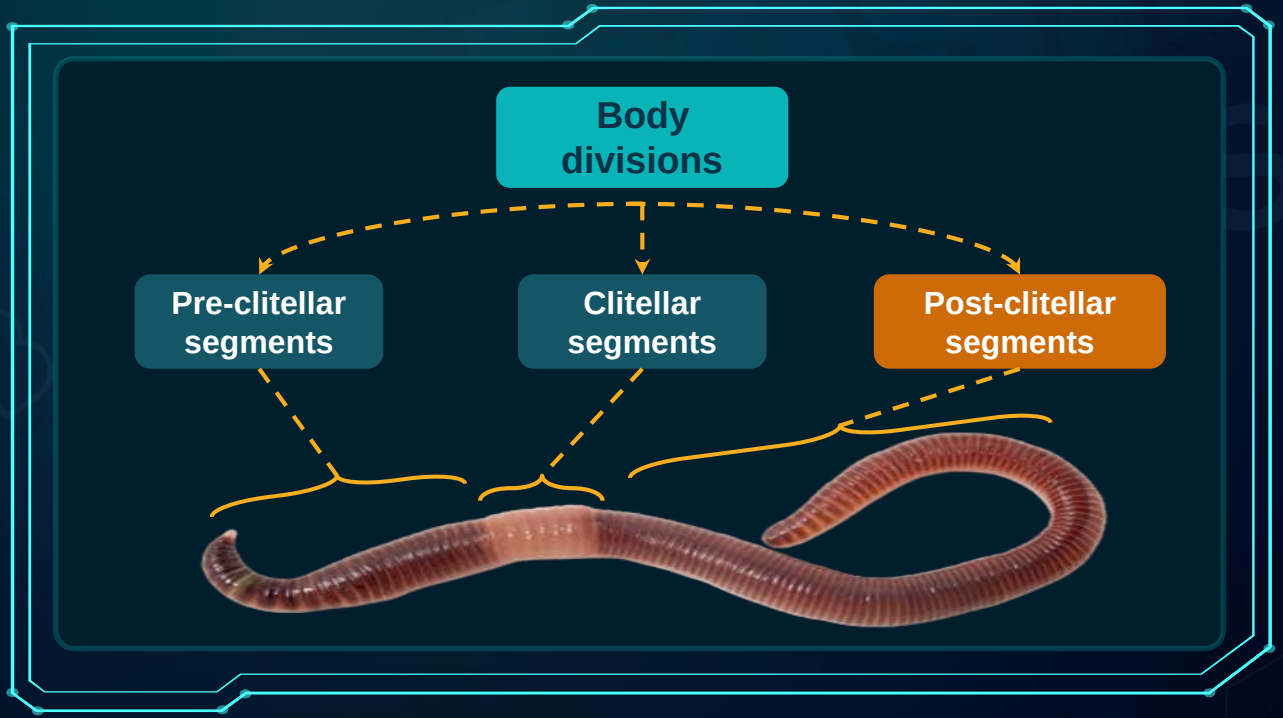
- Earthworms have:
  - **cylindrical body**
  - metamerically segmented body with **100-120 segments**
- **Dorsal surface** of earthworm bears the **median mid dorsal line**.
- **Ventral surface** bears the **genital pores**.
- In mature worms, a **dark prominent bulged part** is visible around the **14th-16th** segment, known as the **clitellum**.
  - It is a glandular tissue.





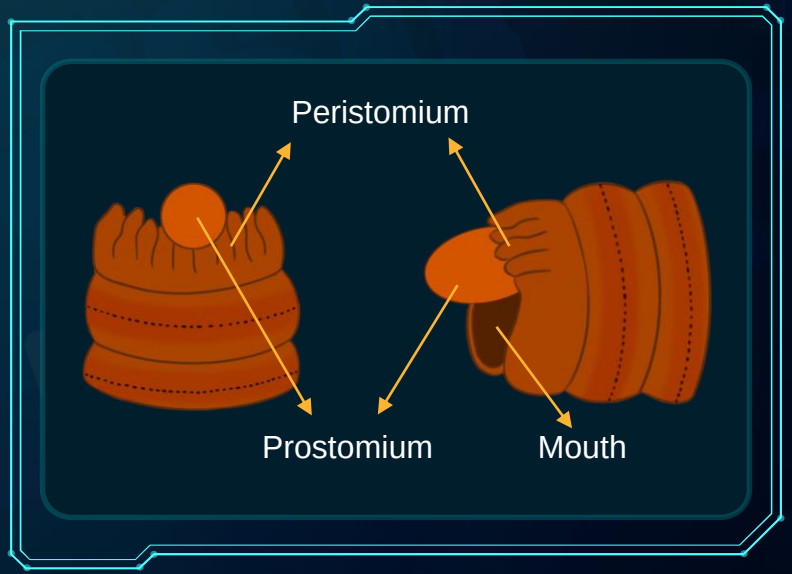
Earthworm: Morphology

Body segments



Earthworm: Morphology

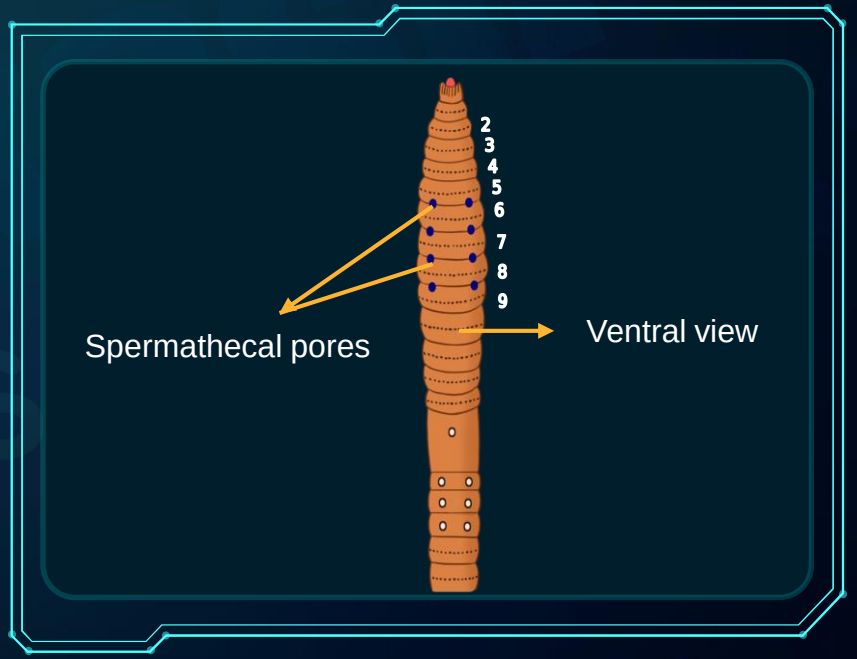
- **Prostomium** is a **sensory organ**
- It also acts as the **covering of the mouth**.
- **Prostomium** is **not the first segment** of the body.
- **Prostomium** also helps in **opening up cracks in the soil** so that the earthworms can crawl into those cracks.
- The first body segment is called the **peristomium**.



Earthworm: Morphology

Spermathecal apertures (pores)

- **Four pairs** of spermathecal apertures are present
- Situated on the ventro-lateral position
- They are present on the intersegmental grooves, i.e., **5th** to **9th** segment.
- They **store sperm** that is released by the male during copulation.

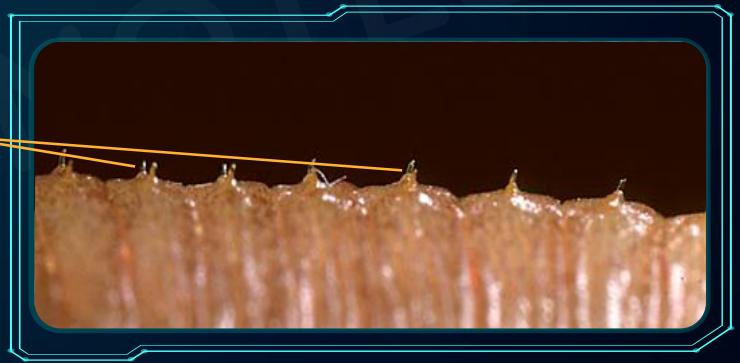


Earthworm: Morphology

Structures common to all segments

- **Nephridiopores**
  - They are a part of the excretory system.
  - Nitrogenous wastes are expelled through them.

- **Setae**
  - Minute **S-shaped hair-like bristles**
  - Present on each segment (Except the first and last segments, and clitellum)
  - Can be extended or retracted
  - **Help in locomotion**



Earthworm: Anatomy

Body wall

- The outer part is made up of **non-cellular cuticles**.
- Inner **epidermis:**
  - It is made up of **columnar epithelial** cells that contain **secretory glands**.

Muscle layers

- The body is made up of two types of muscle layers, i.e., **circular** and **longitudinal**.
  - These muscles, along with setae, are used for the **movement** of earthworms.
- **Coelom**, which is located between the intestinal canal and the body wall, is covered by the innermost **coelomic** epithelium.

Earthworm: Alimentary Canal

Alimentary canal

Mouth

- **First segment** has the mouth
- Lobe over the mouth is termed as **prostomium**

Buccal cavity

- Mouth leads to the buccal cavity
- Present on segments **1-3**

Pharynx

- **Muscular** and **pear-shaped**
- Present in **segment 4**

Oesophagus

- **Thin-walled**
- Present in segments **5-7**

Gizzard

- Present in segments **8-9**
- Helps in **grinding** the soil particles and decaying leaves

Earthworm: Alimentary Canal

Stomach

- Extends from **9th to 14th** segment
- **Narrow** and **tubular**
- Highly **vascularised** and **glandular**
- **Calciferous glands** that are present in the stomach neutralise the **humic acids** present in the **humus**

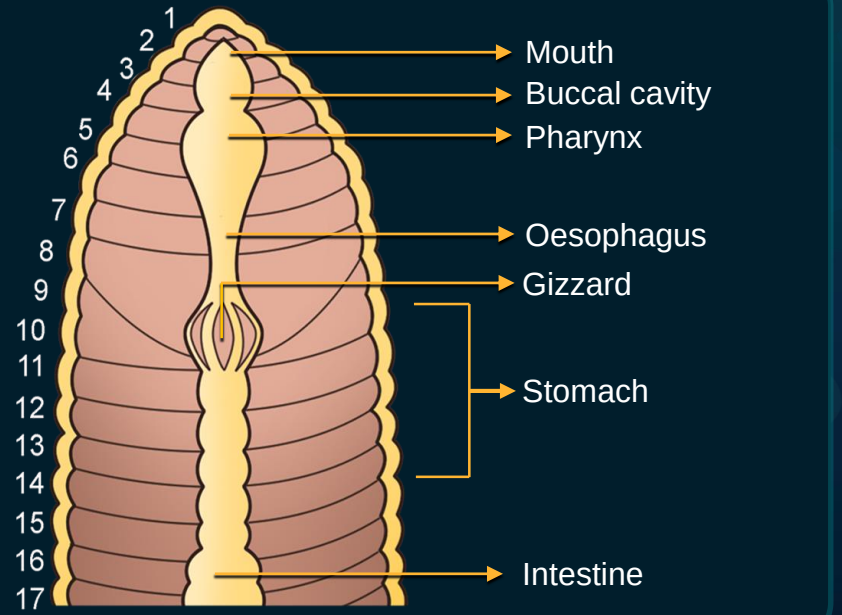
Intestine

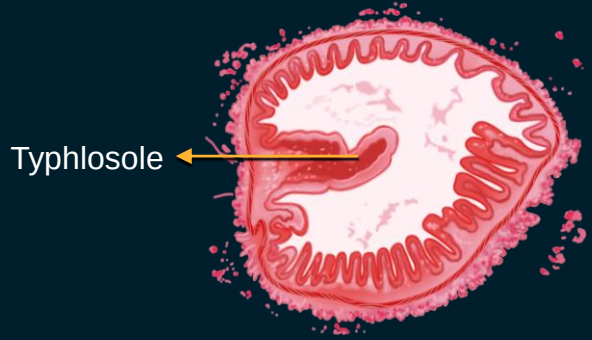
- Extends from the **15th** segment till the end
- Ends in the **anus**
- Lining of the intestine are **ciliated** and has **glandular cells**
- Intestinal lining is folded to form **villi**
- One of these villi becomes larger and well-developed than the others to form **typhlosole**

Typhlosole

- It hangs in the lumen of the intestine and runs mid-dorsally from the **26th** segment up to the last except the last **23rd - 25th segment**.

Earthworm: Alimentary Canal

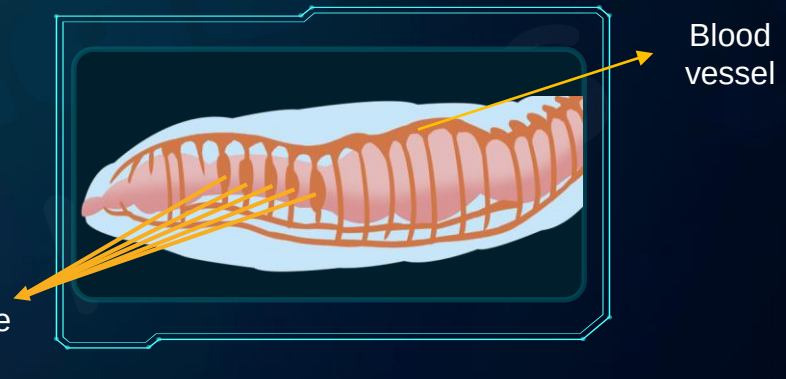




Cross section of earthworm

Earthworm: Circulatory System

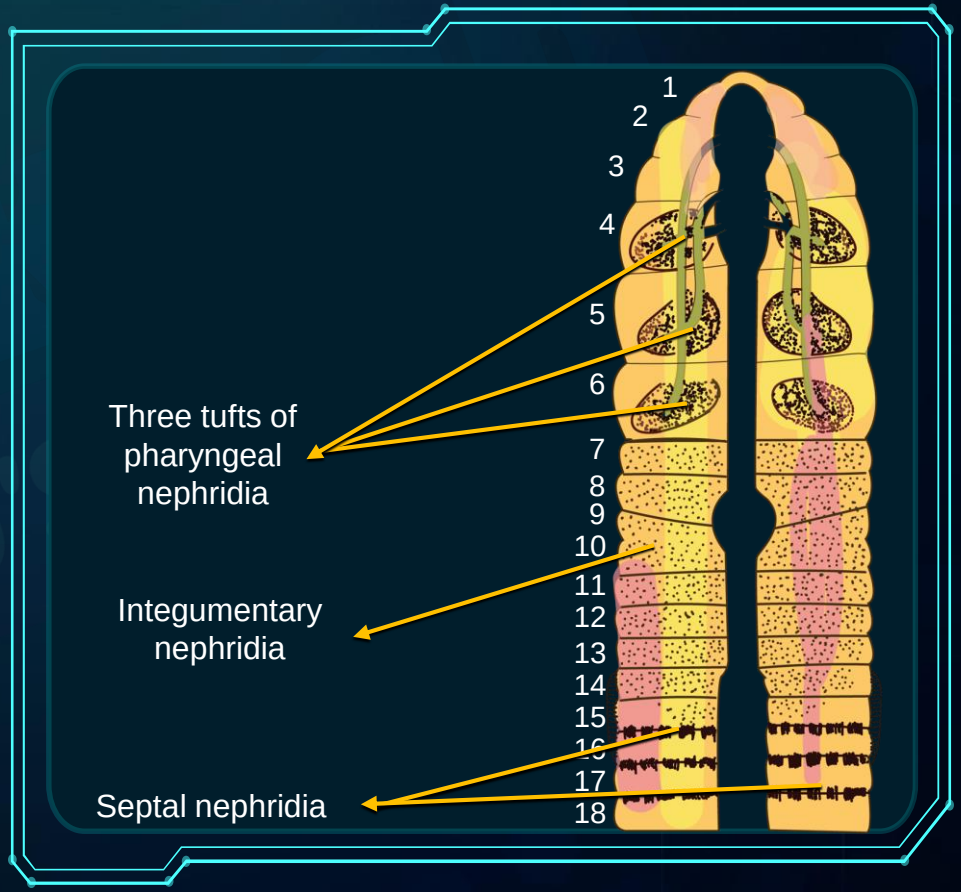
- Consists of blood vessels, capillaries, heart, and exhibits a **closed type** of blood vascular system
  - Due to a closed circulatory system, blood does not flow beyond heart and blood vessels.
- **Multiple hearts** are present
- Blood is supplied to and from the heart by blood vessels.
- Blood circulation in **one direction** is maintained by contractions.
- Smaller blood vessels supply in the gut, nerve cord, and body wall
- **Blood glands**
  - Present on **4th**, **5th**, and **6th** segments
  - Produce **haemoglobin** (gets dissolved in plasma)
  - Produce **phagocytic blood cells**



Closed Circulatory System

Earthworm: Excretory System

- The **excretory organs** in earthworms are in the form of segmentally arranged coiled tubules called **nephridia**.
- They **regulate** the **volume** and **composition** of the body fluids.
- They are of three types:
  - **Septal** nephridia
  - **Integumentary** nephridia
  - **Pharyngeal** nephridia



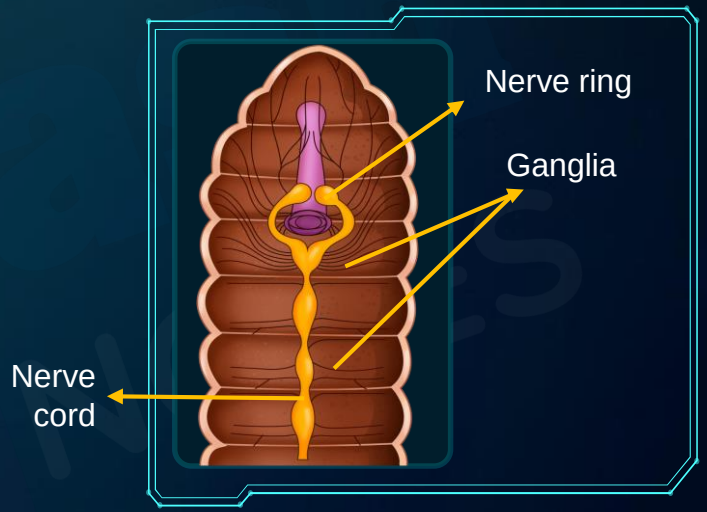
Earthworm: Nervous System

Central nervous system

- **Nerve ring**
  - Ring-like spherical structure
  - Bilobed (cerebral ganglia)
  - Present in the third and fourth segments
  - Forms a ring around the pharynx
- **Ventral nerve cord**
  - Runs from the fifth segment to the last

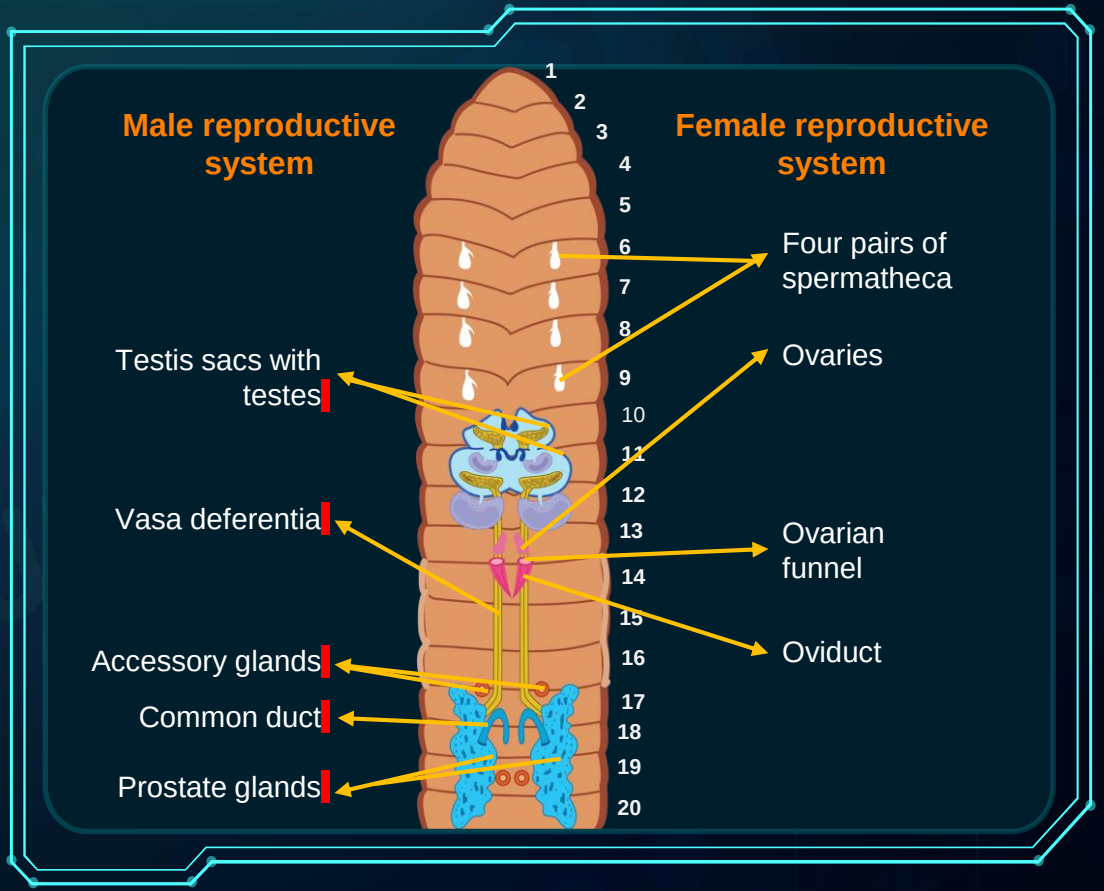
Peripheral nervous system

- Represented by nerves
- Arises from the ventral nerve cord
- Found in every segment



Earthworm: Reproductive System

- Earthworms are **hermaphrodites**
  - Male and female sex organs present
- Earthworms **cannot fertilise their own eggs** because
  - Positions of male and female genital apertures is **different**
  - They are **protandrous** i.e., male sex **matures faster** than female sex
- Only **cross-fertilisation** can take place



Earthworm: Reproductive System

Male reproductive system

- Represented by **two pairs of testes**
  - Present on the **10th** and **11th** segments
  - Sperms are formed in the testes
- **Vasa deferentia**
  - One from **each testis**
  - Runs upto **18th** segment
  - Duct that collects sperms from the spermatic funnel
- **Two pairs** of accessory glands which holds two worms during copulation
- **Prostatic** duct
  - **One** from each gland are short, thick and curved
  - Produce **prostatic fluid** that is alkaline in nature
  - **Activates sperms** and **keeps sperms motile**
- **Common** prostatic and spermatic duct
  - Formed when prostatic duct joins the two vasa deferentia
  - Common duct opens separately through a pair of male genital aperture on the ventro-lateral side

Earthworm: Reproductive System

Female reproductive system

- Represented by a pair of **ovaries**
  - Present at **intersegmental septum (12th** and **13th)**
  - **Produce ova**
- Four pairs of **spermatheca.**
  - Present from **6th - 9th** segment
  - **Receive** and **store spermatozoa** during copulation
- **Ovarian funnels**
  - Present beneath ovary and continue into oviducts
  - **One** from each gland
- **Single genital pore** on the **14th segment**

Earthworm: Fertilisation & Development

Cross fertilization in earthworms

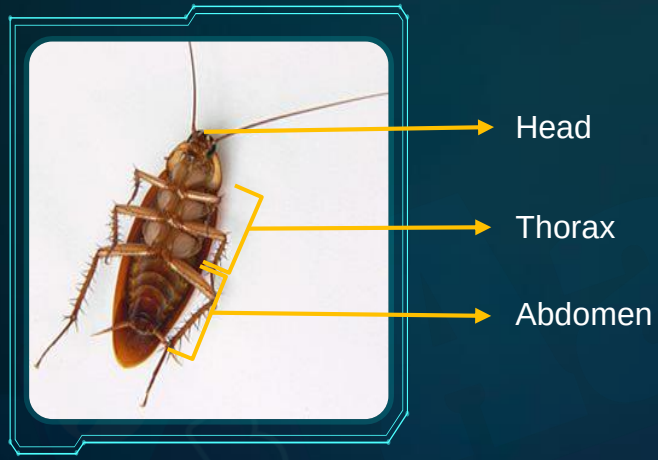
- Any two earthworms can mate by joining (**juxtaposing**) and exchanging packets of sperms called **spermatophores**.
- A tube of mucus **secreted by the clitellum forms an egg case** (**cocoon**).
  - **Ova** are fertilised by **sperm** in the egg case.
- **Fertilisation** occurs and the **egg case** slips off the worm body.
- **New worms hatch** from the eggs.

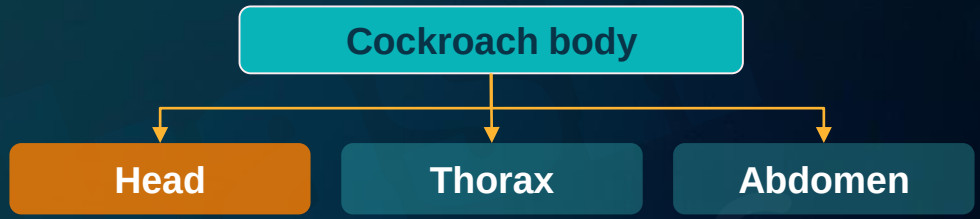
- **Direct development:** Process of formation of mature adults from fertilised eggs without going through the larval stage
- After about three weeks, each cocoon produces two to twenty baby worms with an average of four that resemble the adult except in size and with the absence of clitellum.

Cockroach: Characteristics

- **Nocturnal:** Mostly active at night
- **Omnivores:** Feed on both plants and animals
- **Habitat:** Prefer damp places
- **Size:** Range from 0.6 cm to 7.6 cm
- **Colour:** Black, brown, red, green, and yellow
- **Common species:** *Periplaneta americana* (size ranges from 34–53 mm)
- **Phylum:** Arthropoda
  - Presence of jointed appendages
  - Jointed appendages allow the animal much greater flexibility and range of movement.
- **Class:** Insecta
  - Due to three pairs of legs or six legs

Cockroach: Morphology

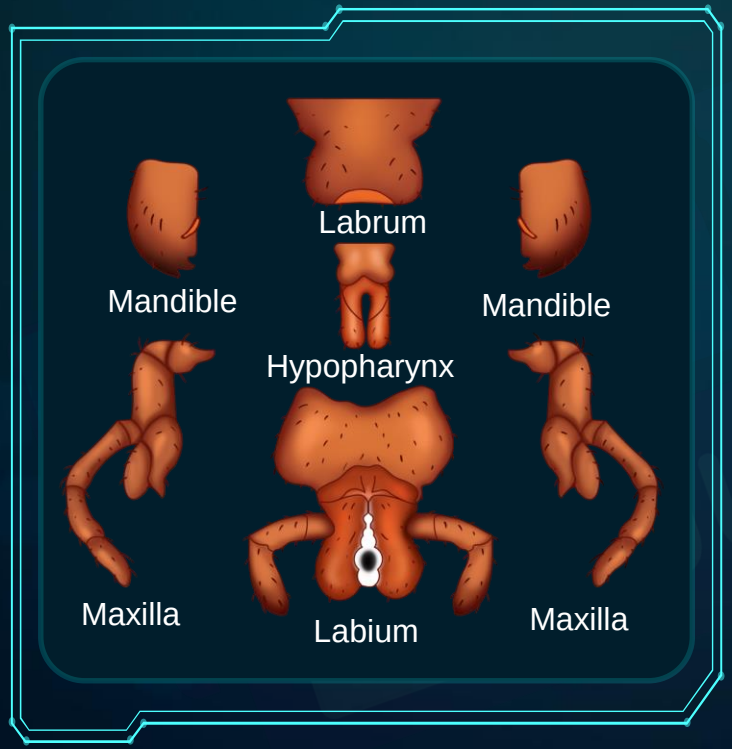




- The head is **triangular** in shape. **Mobility** of head in all directions is due to its flexible neck.
- Head of cockroach is made of **six segments** that are fused.
- The exoskeleton of head is made up of **six sclerites** (plates). It provides protection and prevents water loss in terrestrial arthropods.

- Head of cockroach bears one pair of **compound eyes**. Each compound eye has **2000 hexagonal units called ommatidia**.
- A pair of **antenna**: sense organs in cockroach
- The mouthparts of cockroach are **biting and chewing type** as it takes in solid food.

Cockroach: Morphology

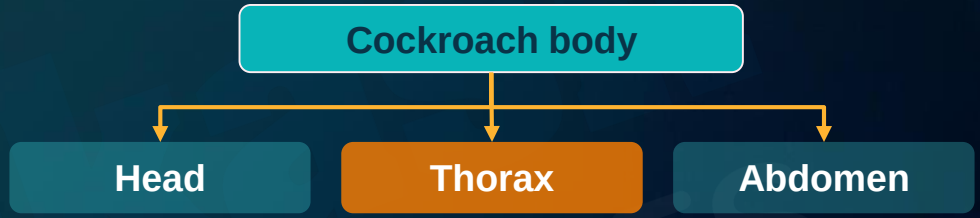


Mouthparts:

- Labrum (upper lip)
- Labium (lower lip) has labial palps.
- Mandibles help in grinding of food.
- A pair of maxillae are present with maxillary palps.
- Tongue or hypopharynx lies within the cavity enclosed by mouth parts. It is flexible.

Cockroach: Morphology

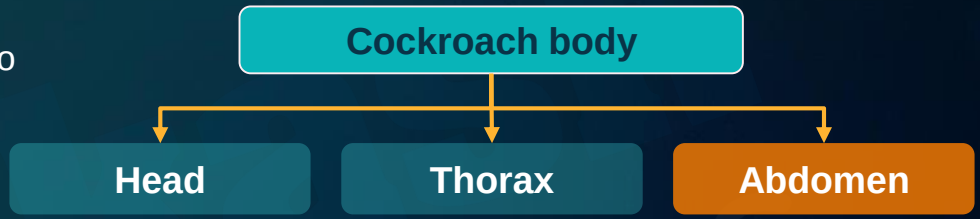
- Thorax is made of **3 segments**, prothorax, mesothorax and metathorax.
- Thorax bears **six legs on ventral side**:
  - The pair of legs that appear from prothorax is called **prothoracic leg**
  - The pair of legs that appear from mesothorax is called **mesothoracic leg**
  - The pair of legs that appear from metathorax is called **metathoracic leg**.



- Thorax bears **2 pairs of wings** on dorsal side:
  - **Fore wings** (protect hind wings and arises from mesothorax)
    - Opaque, dark, and leathery wings
    - Cover and protect hind wings at rest
  - **Hind wings** (help in flight and arises from metathorax).
    - Transparent and membranous
    - Help in flight

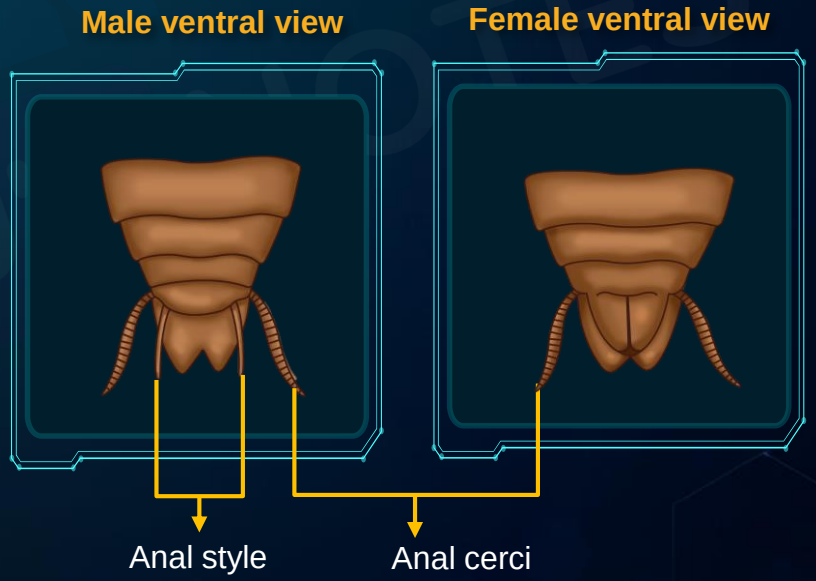
Cockroach: Morphology

- **Abdomen-** Broader than thorax with 10 segments in both male and female; embryo has 11 segments
  - It is broader in females than in males.

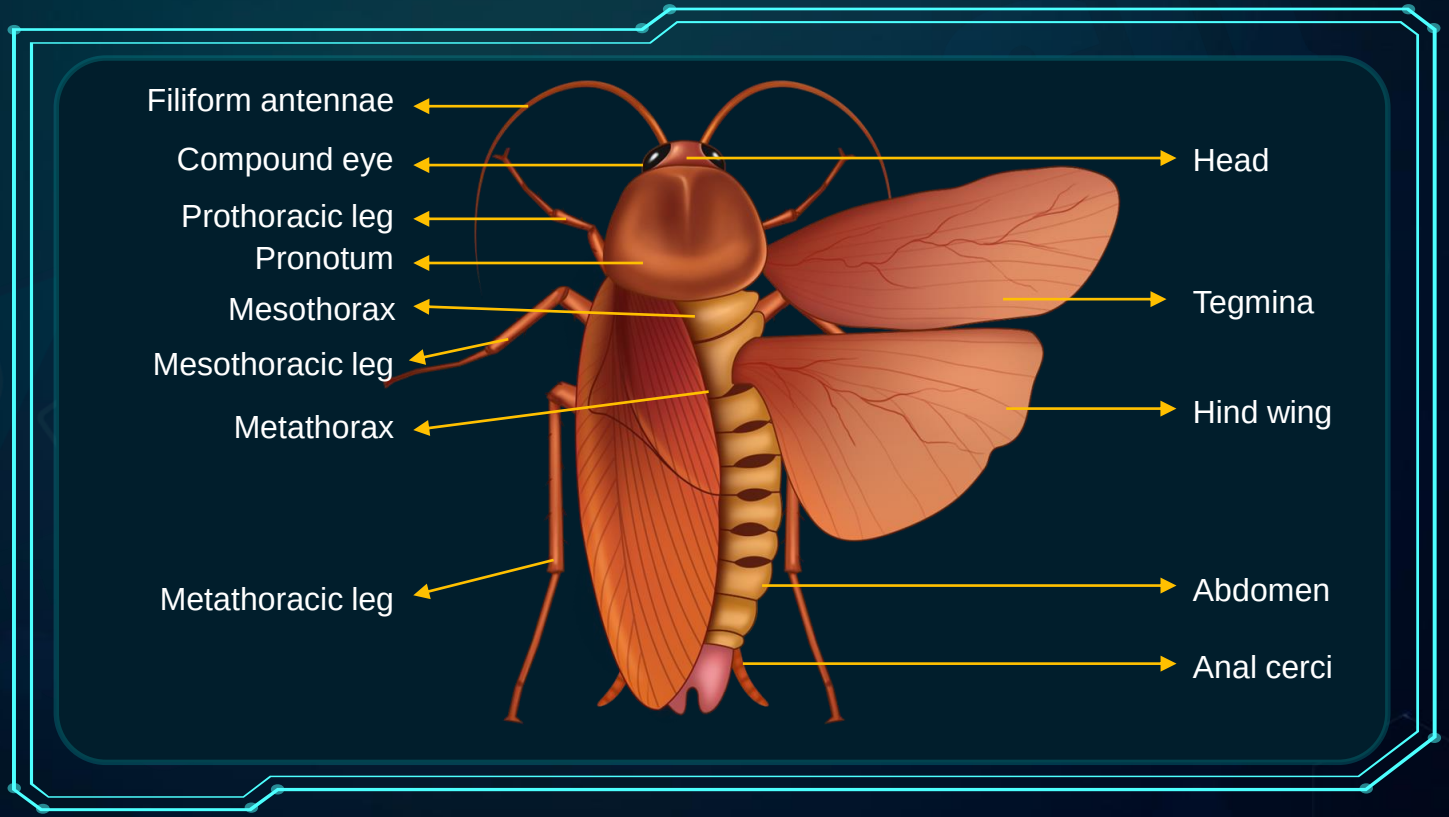


Abdominal appendages

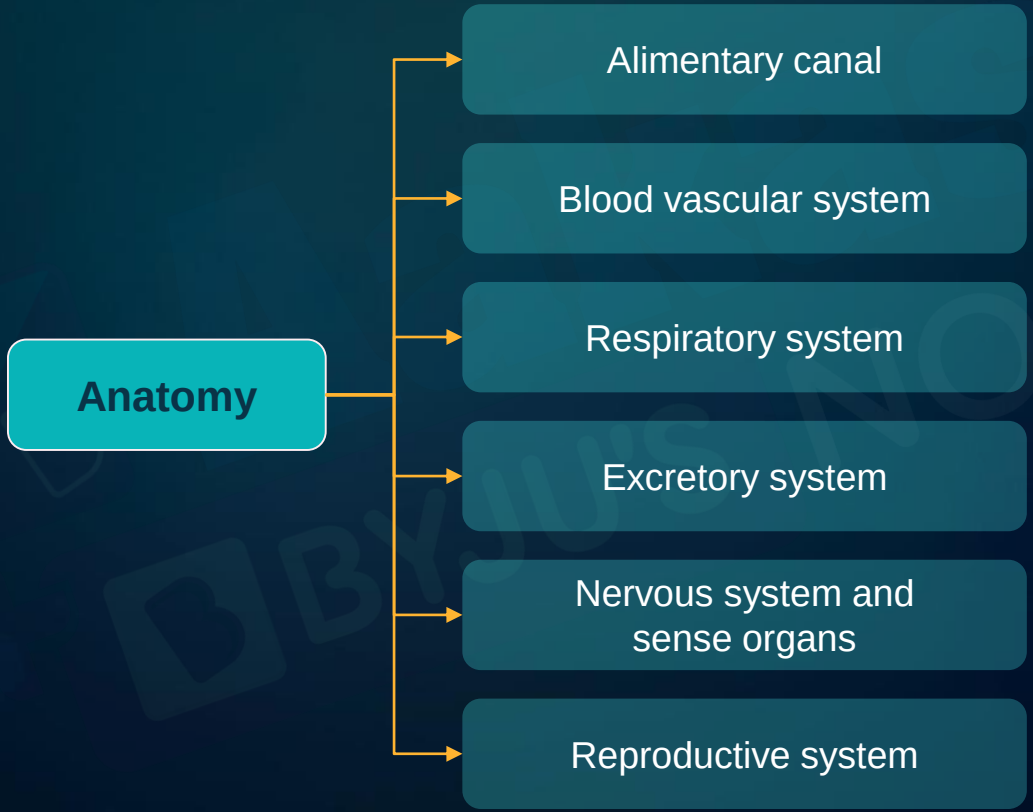
- Appendages are an organism's **external** body parts.
- **Anal cerci** are filamentous sensory structures present in the 10th segment.
- **Anal style** is a pair of short, thread-like structure.
- **Sexual dimorphism:** Males and females can be distinguished externally.
  - Males have anal styles
  - Females do not have anal styles



Cockroach: Morphology



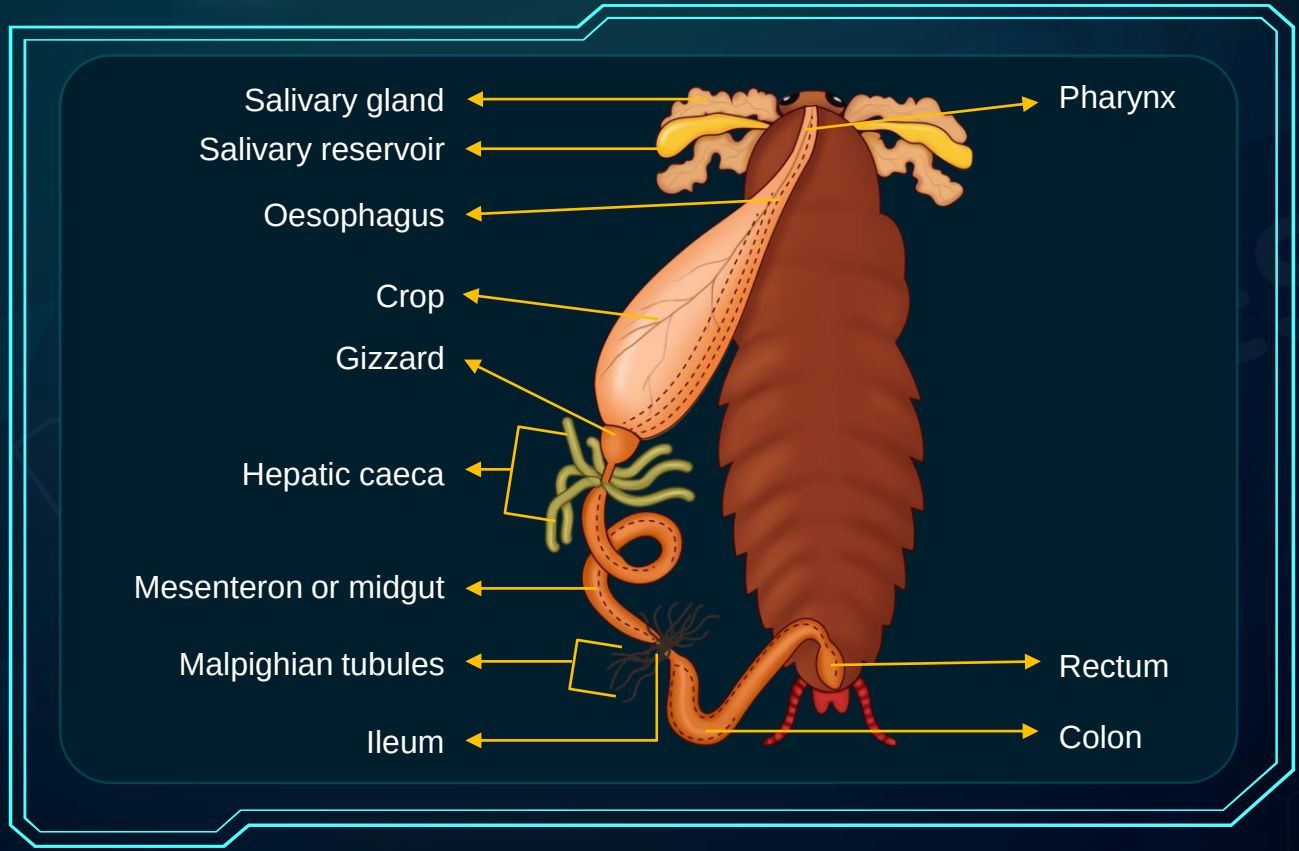
Cockroach: Anatomy



Cockroach: Alimentary Canal

- The alimentary canal of the cockroach is divided into three regions – **foregut**, **midgut**, **hindgut**.
- The **foregut** consists of mouth, pharynx, oesophagus, crop and gizzard.
- The food enters through the **mouth cavity** into the tubular **pharynx**.
- The pharynx leads to a narrow tube called the **oesophagus**.
- The oesophagus opens into a sac-like structure called the **crop** that stores food.
- The food from the crop enters into the **gizzard**, which helps in the grinding of food.
  - It has an outer layer of circular muscles and an inner layer of cuticle that forms chitinous teeth.
- **Midgut** is also known as **mesenteron**.
- At the junction of foregut and midgut, there are 6–8 blind tubules known as **hepatic or gastric caeca** which secrete digestive juices.
  - These digestive juices **help in digestion and absorption**.
- There are 100–150 yellow-coloured thin filamentous **malpighian tubules** that help in excretion.
  - They remove excretory wastes from the blood.
- **Hindgut** has three regions differentiated into a short narrow **ileum**, a long coiled **colon**, and a short wide **rectum**.
- Hindgut is broader than midgut.
- Rectum opens outside through anus.

Cockroach: Alimentary Canal



Cockroach: Blood Vascular System

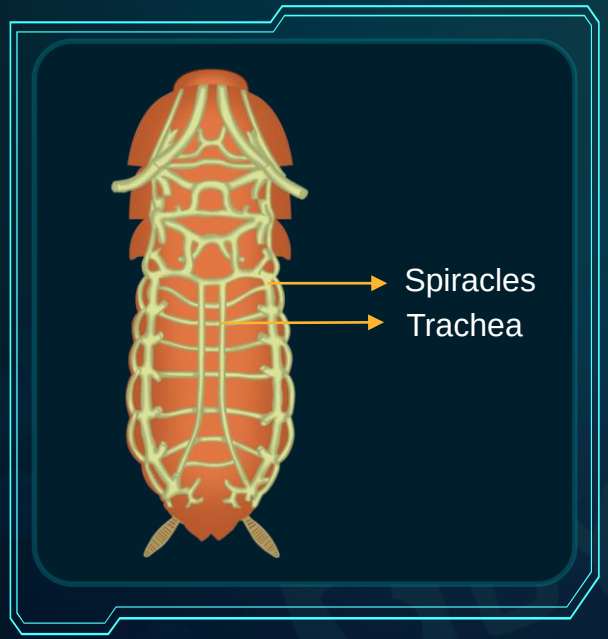
Blood vascular system:

- **Open type** as blood does not flow through blood vessels, rather blood is pumped into the body cavity
  - Blood consists of plasma and haemocytes
- As body cavity is filled with blood, it is called **haemocoel**
- Heart consist of **elongated muscular tube with ostia** on either side

Path of circulation:

- Heart pumps blood and is associated with **alary muscles**
- Blood from perivisceral sinus enters heart through ostia
- Heart pumps the blood into head by aorta.

Cockroach: Respiratory System

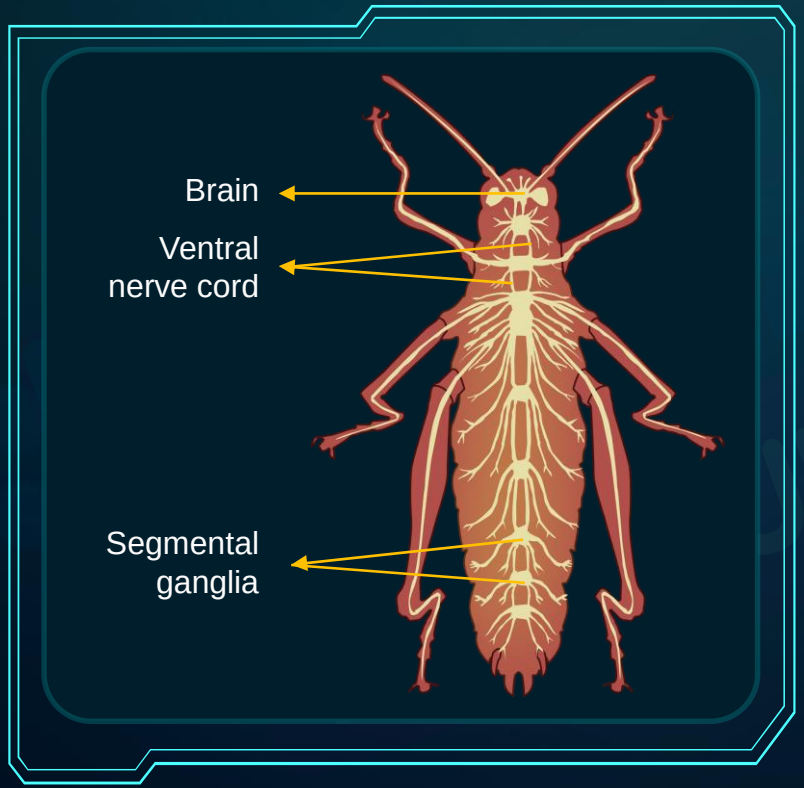


- **Consists of 10 pairs of spiracles**
  - Openings on the lateral sides of the body through which air enters and reaches the tracheal tubes.
- **Tracheal system** that delivers oxygen directly to cells has evolved in insects.
- **Tracheal tubes** divide repeatedly and form **tracheoles**.
- Tracheoles are fine tubes that enter into cells and deliver oxygen.
- Exchange of gases through **diffusion**.
- The blood is colourless due to the **absence of respiratory pigment**.

Cockroach: Excretion System

- Excretion occurs through **malpighian tubules**.
- Malpighian tubules are lined by **glandular** and **ciliated cells**.
- These are **100–150** yellow-coloured thin filamentous structures present at the junctions of midgut and hindgut.
- They convert **nitrogenous wastes** into **uric acid** which is released through the hindgut.
- Fat body, nephrocytes, and urecose glands also help in excretion.
- Cockroach is **uricotelic** (secrete waste in form of uric acid).
- **Uricotelic organisms** are those that excrete nitrogen in the form of uric acid.

Cockroach: Nervous System

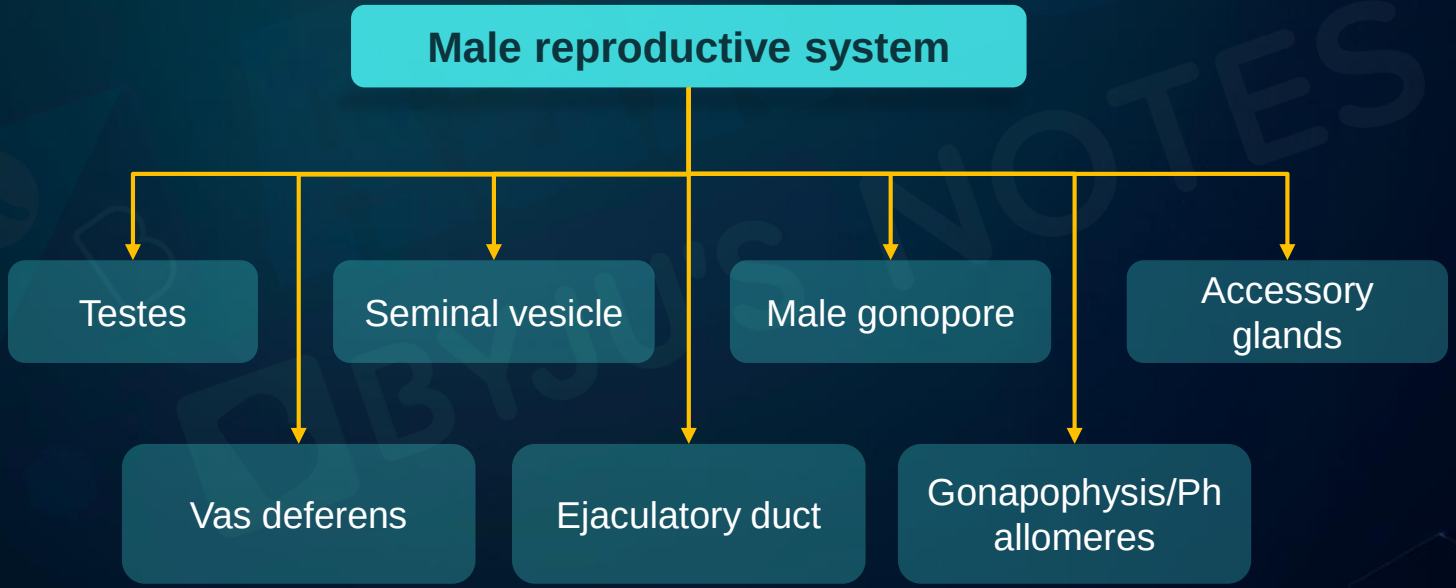


Nervous system of cockroach:

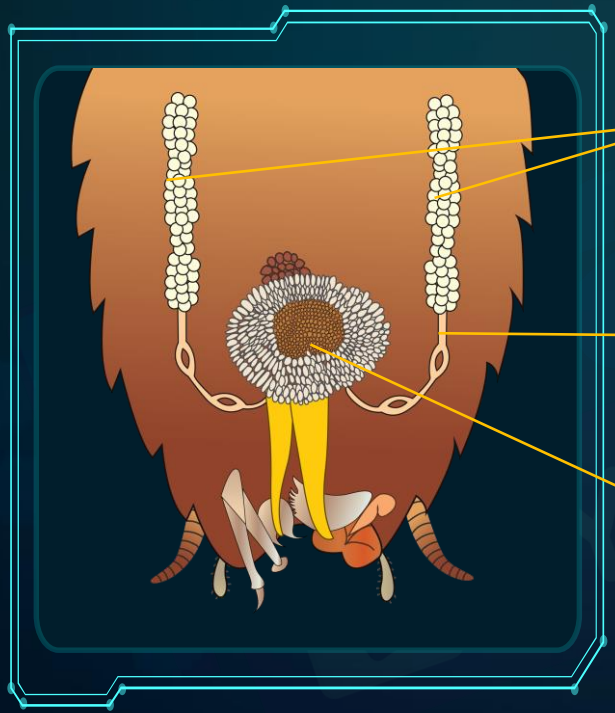
- Includes serially arranged fused **ganglia** and **nerve cord**
  - **3 ganglia** lie in **thorax** and **6** in **abdomen**
- Brain is represented by **supra-oesophageal ganglion**
  - Supplies nerves to antennae and compound eyes
- Double ventral nerve cord
- **Sense organs** include antennae, eyes, maxillary palps, labial palps, anal cerci etc.

Cockroach: Reproductive System

- Cockroaches exhibit **sexual dimorphism**. They have **distinct male** and **female** members.
- Cockroaches have well-developed reproductive organs in both males and females.



Cockroach: Male Reproductive System



Testes

One pair of trilobed testes

Present in 4-6th abdominal segments

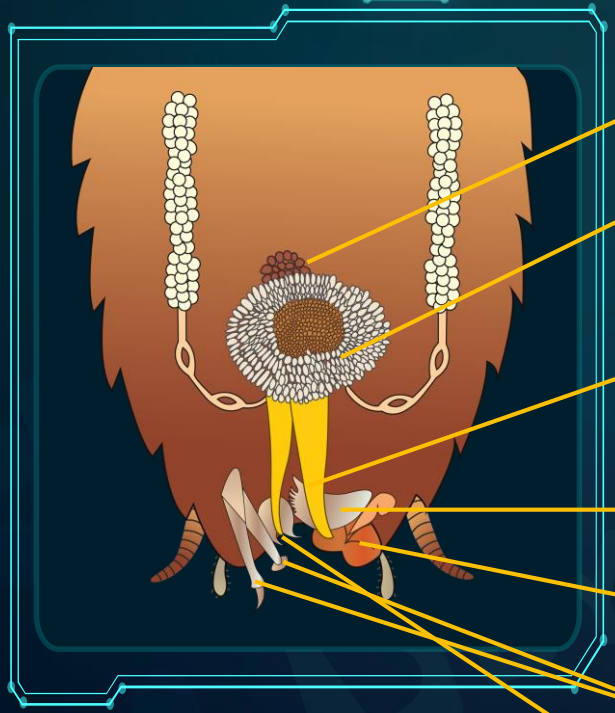
Vas deferens

It arises from the testes and opens into the ejaculatory duct through seminal vesicles.

Seminal vesicles

These are sac-like structures that secrete fluid in the semen.

Cockroach: Male Reproductive System



Phallic gland
Helps in formation of spermatophores

Mushroom gland
Present in 6-7th abdominal segments
Functions as accessory reproductive gland

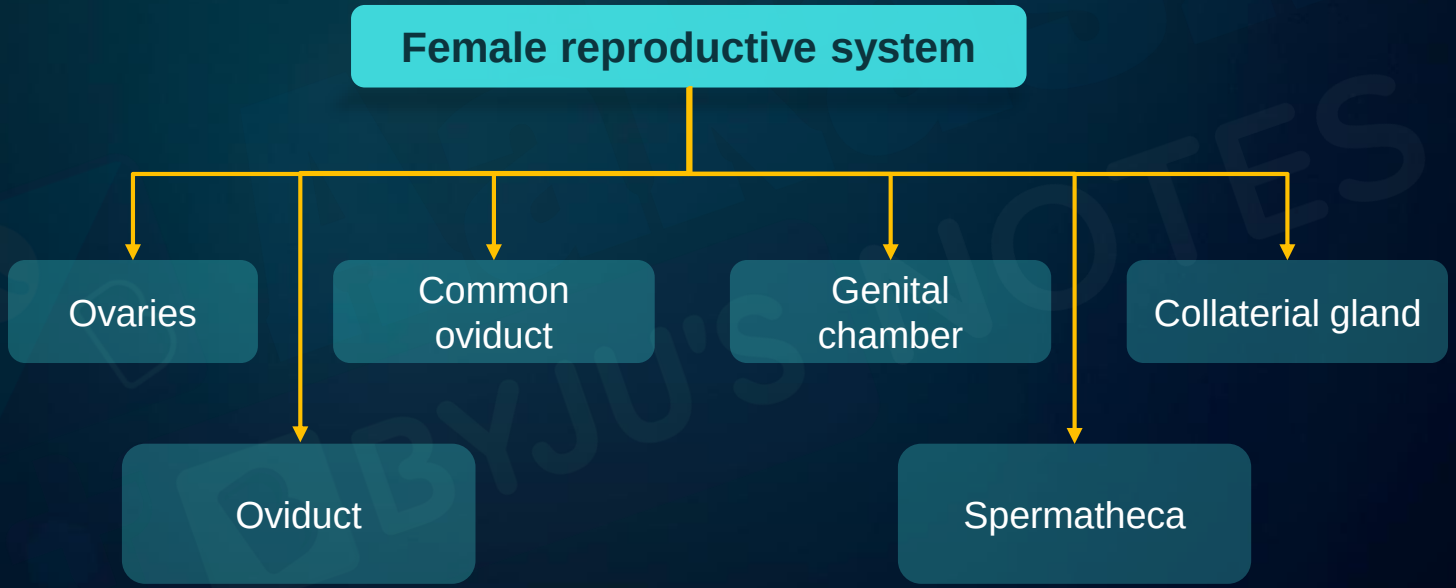
Ejaculatory duct
Opens into male gonopore

Right phallomere
Ventral phallomere
Left phallomere

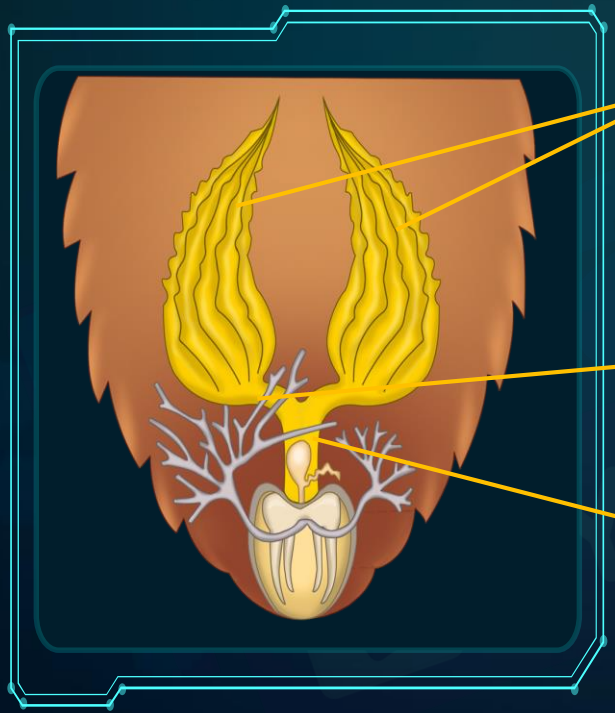
Male gonapophysis
Chitinous, asymmetrical structures called phallomeres or external genitalia

Male gonopore
Genital pore through which sperms pass into a vagina

Cockroach: Reproductive System



Cockroach: Female Reproductive System



Ovaries

Pair of large ovaries present from 2nd - 6th abdominal segments

Each ovary - a group of 8 **ovarian tubules/ovarioles** with developing ova

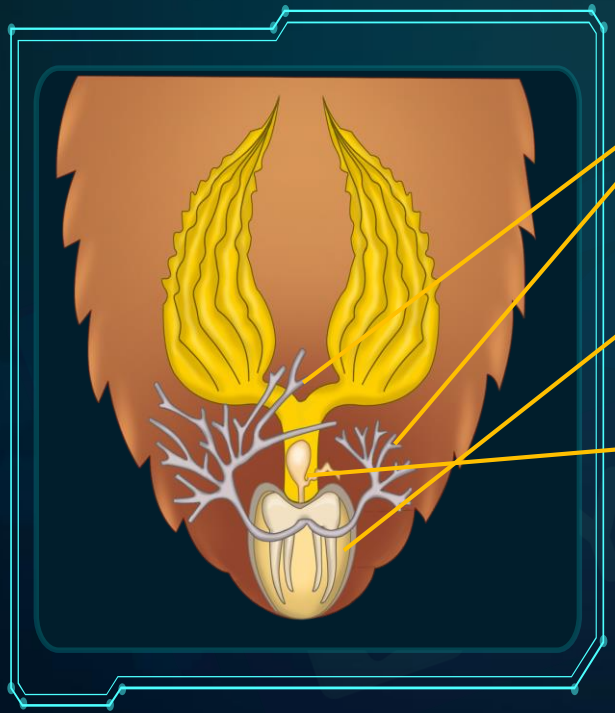
Oviduct

Each ovary leads into an oviduct that joins to form vagina that opens into genital chamber

Common oviduct (Vagina)

Oviducts join to form a single median (common) oviduct or vagina.

Cockroach: Female Reproductive System



Collaterial glands
Sections help in formation of egg case (ootheca)

Genital chamber
It is a chamber to pass ova and sperms. Vagina and spermatheca opens into it.

Spermatheca
One pair present in **6th abdominal segment**, opens into genital chamber, stores sperms received during copulation

Cockroach: Fertilisation

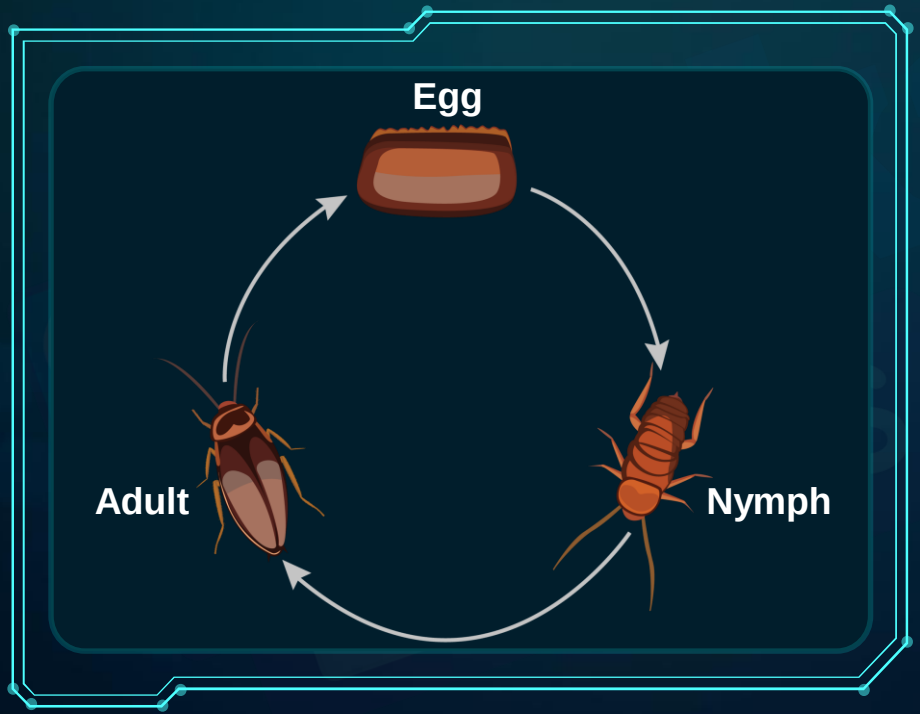
Fertilization in Cockroach

- Internal fertilisation occurs in genital chamber of female cockroach
- Female lays **9-10 oothecae**
- Each ootheca has **14-16 fertilised eggs**
- Since they produce numerous eggs that develop so quickly, their population grows very rapidly.

Oothecae (eggcase)

- Fertilised eggs in capsules found in damp places and food source
- Dark reddish to blackish brown in colour

Cockroach: Development



- The embryo develops into a mature individual through an intermediate sexually immature larval stage.
- **Development is hence paurometabolous** (indirect) i.e., through gradual metamorphosis which has a **nymphal stage.**
- **Nymphs** look very much like adults, but they don't have wings and unable to reproduce like adult cockroaches.

Frog

Occurrence & Habitat

- **Scientific name:** *Rana tigrina* (Indian bullfrog)
- **Occurrence:** Commonly found in India
- **Habitat:** Freshwater bodies like ponds, lakes, rivers

Classification of Frog

Kingdom: Animalia

Phylum: Chordata

Sub Phylum: Vertebrata

Class: Amphibia

Family: Ranidae

Order: Anura

Genus: Rana

Species: *Rana tigrina*

Frog: Characteristics

Amphibian
Can easily live on both land & in water

Moist skin
Skin is always smooth & slippery due to presence of mucous

Aestivation
Remains dormant during summers

Hibernation
Remains dormant during winters

Camouflage
Changes colour to hide from predators and kill preys

Mimicry
Evolved resemblance between species to protect themselves from predators

Cold-blooded
Cannot regulate their body temperature as per environment

Frog: Morphology

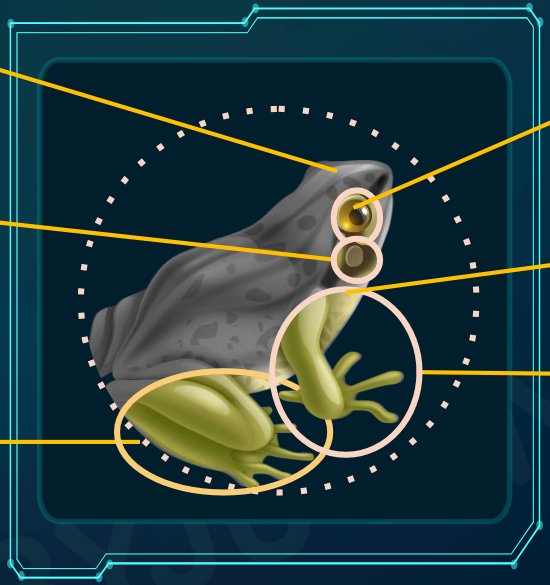
- Body is divided into head & trunk
- Neck & tail are absent
- Body has 2 surfaces- Dorsal & Ventral

Frog: Morphology

Nostrils
Pair of nostrils above the mouth

Tympanum
Membrane on sides of eyes, used for hearing

Hindlimb
Has five digits, larger & muscular than forelimbs and webbed



Eyes
A pair of bulging eyes covered by nictitating membrane

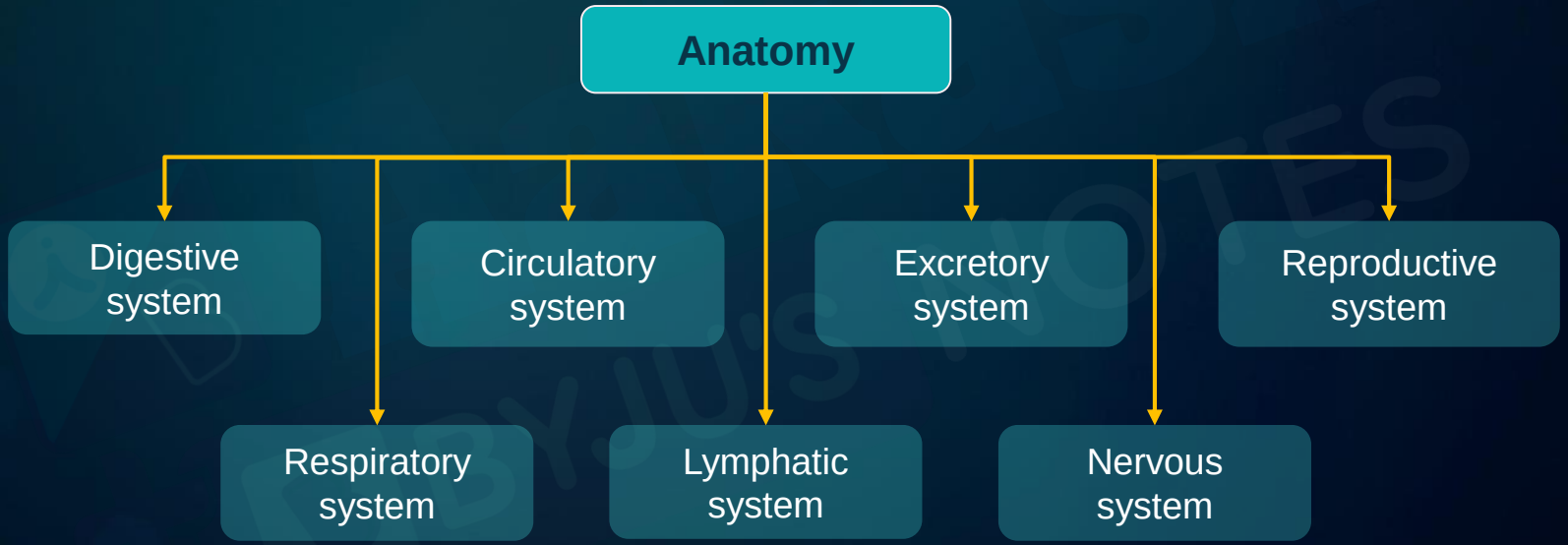
Skin
Have smooth and slippery skin

Forelimb
Four digits, smaller than hindlimb

Limbs help in

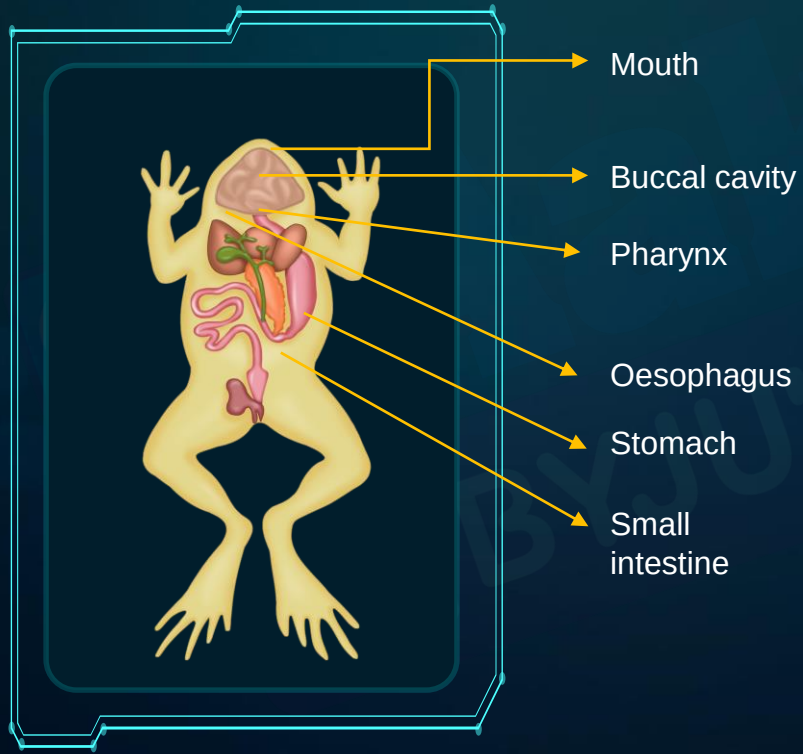
- Leaping
- Swimming
- Burrowing

Frog: Anatomy



Frog: Digestive System

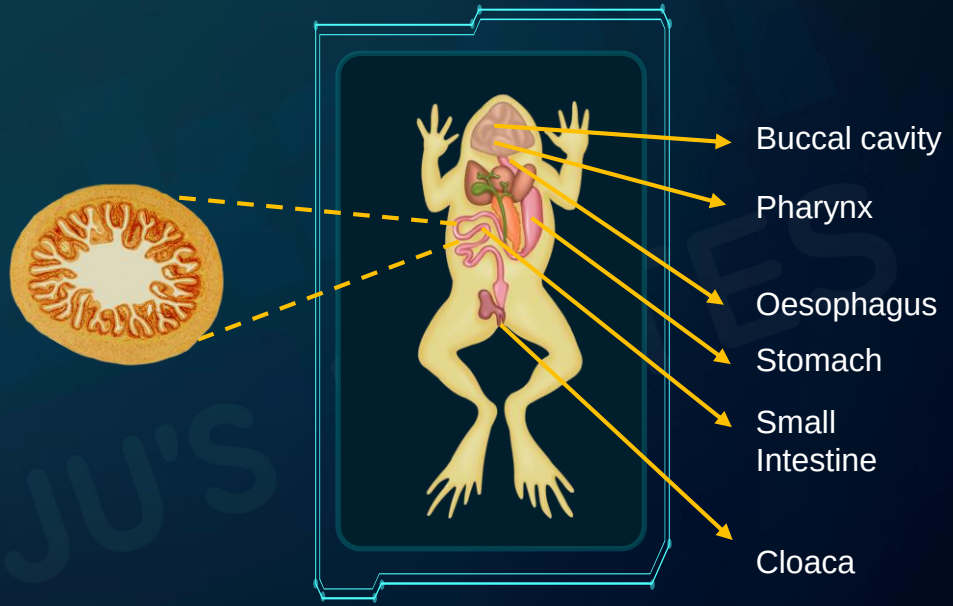
Step 1: Ingestion (Food is consumed)



- Frog captures its prey like insects using **bilobed tongue**
- Ingests food via **mouth**
- Food travels from **buccal cavity**, **pharynx** to **oesophagus** during ingestion
- Oesophagus opens into the **stomach**
- Food is partially digested (called **chyme**) with the **help of HCl** and **gastric juices**
- Chyme move into the first part of the **small intestine** – duodenum
- **Duodenum** receives bile from gallbladder and pancreatic juice from pancreas called **common duct**
  - **Bile emulsifies fat**
  - **Pancreatic juices digest carbohydrates and proteins**

Frog: Digestive System

- Simple molecules, after the chemical and **enzymatic breakdown of food**, are absorbed in the small intestine.
- **Villi** and **microvilli** are microscopic projections present in the small intestine.
- Villi absorbs nutrients in the small intestine.
- Undigested food is ejected through the **cloaca**.



Frog: Respiratory System

Respiratory System of Frog

Pulmonary respiration

- Respiration by lungs
- Occurs on land

Lungs

Cutaneous respiration

- Respiration by skin through diffusion
- Occurs on land & water

Moist skin

Absorb the dissolved oxygen from air

Buccopharyngeal respiration

- Athin, high vascular lining of the buccopharyngeal membrane
- Occurs on land

Buccopharyngeal membrane

Frog: Circulatory System

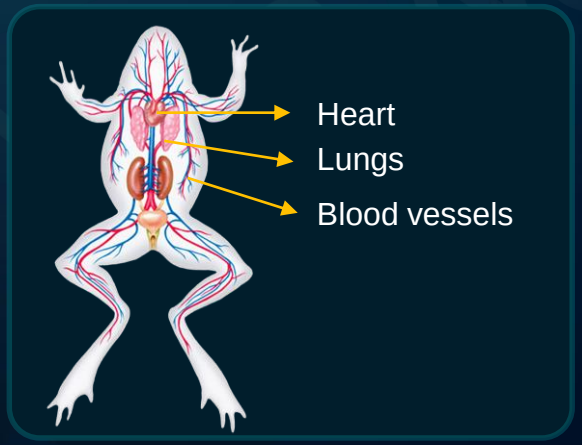
Organs of circulatory system in frog

Heart

- Pumps blood to all body parts
- Muscular, located in upper body cavity
- Covered by pericardium
- Three-chambered
  - 2 atria
  - 1 ventricle

Lungs

- Helps in oxygenation of blood



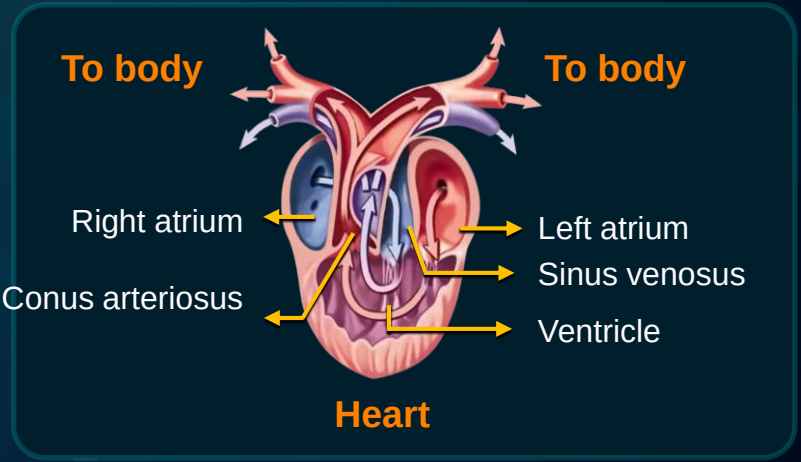
Blood vessels

- Tubular structures that help carry nutrients & waste materials via blood across body

Frog: Circulatory System

Heart

- The right atrium receives deoxygenated blood and pumps it to the ventricle.
- **Sinus venosus** is through which the heart receives deoxygenated blood.
  - This occurs at the dorsal side of the heart.
  - Sinus venosus is a **triangular structure**.
  - It empties into the right atrium.
- Oxygenated blood from the lungs enters the left atrium.
- Both the atria simultaneously pump blood into the ventricle.



- The **ventricle opens into** a sac-like structure called **conus arteriosus** on the ventral side of the heart.
- From the ventricle, this blood is pumped into the lungs via the **conus arteriosus**.
  - The ventricle receives deoxygenated blood from the right atrium. It also receives oxygenated blood from the left atrium.
  - This blood (mixture of oxygenated and deoxygenated blood) is pumped into the **conus arteriosus**.

Frog: Circulatory System

Closed circulatory system

Blood is pumped by a heart through vessels, and does not normally fill body cavities

Arterial system

Blood from the heart is carried to all parts of the body by the arteries.

Venous system

Veins collect blood from different parts of body and brings it to the heart.

Hepatic portal system

Special venous connection between liver and intestine

Renal portal system

Special venous connection between kidney & posterior parts of body

Frog: Lymphatic System

- Network of tissues, vessels and organs that help circulate colorless, watery fluid called lymph back into circulatory system
- Lymph is the fluid that flows through the lymphatic system network.
  - Lacks proteins and RBCs unlike blood
  - Helps in the removal of excess water from the the tissues of the body

Lymph vessels

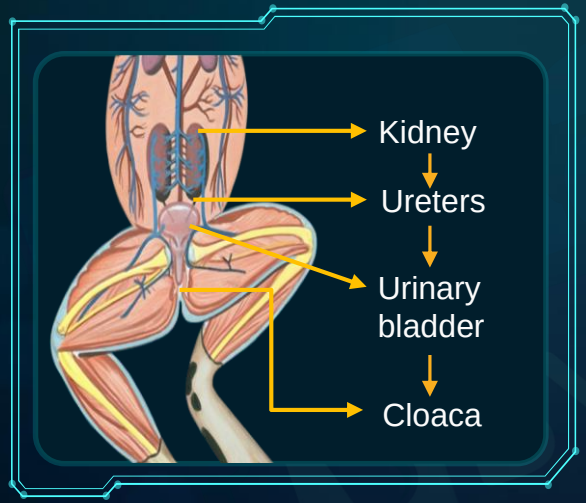
Thin walled tubular structures that help carry lymph all over the body

Lymph nodes

Small swellings in the lymphatic system where lymph is filtered and lymphocytes are formed

Frog: Excretory System

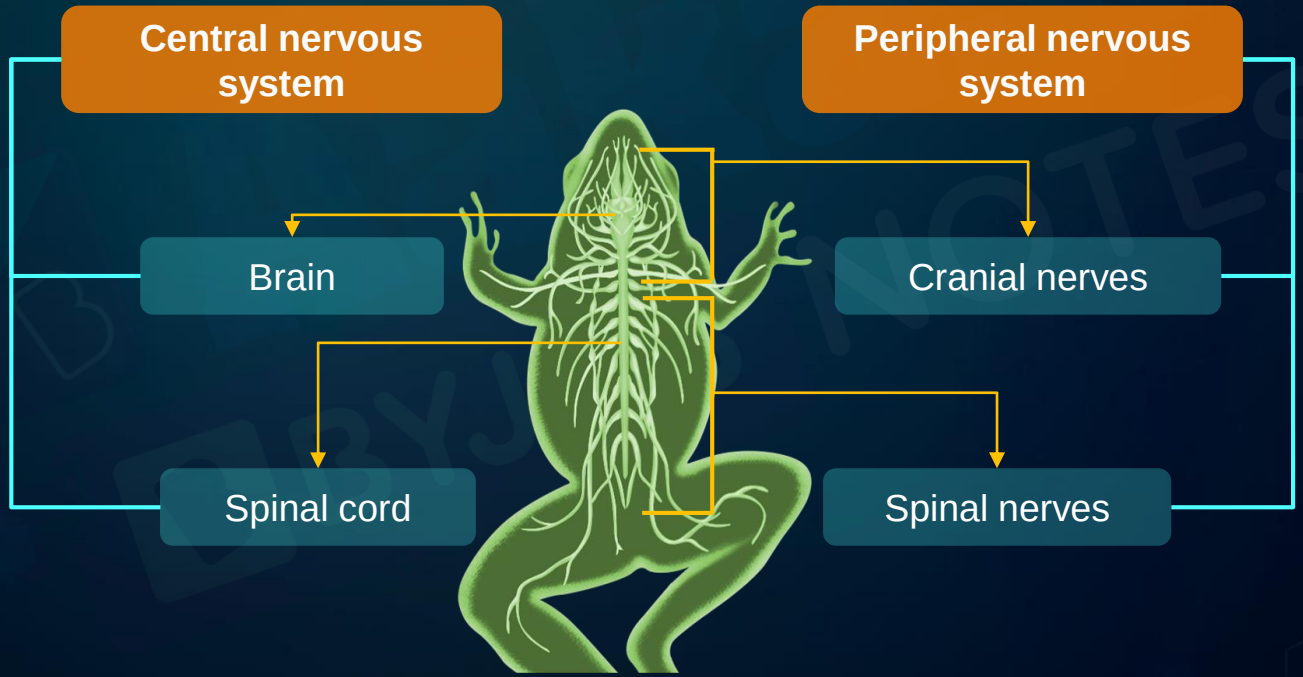
Biological system that helps remove excess & unnecessary materials like nitrogenous waste, salts, etc.



- **Kidneys** are compact, dark red, bean-shaped structures.
  - Present on either sides of the vertebral column
- Structural and functional unit called **nephrons**, present in large numbers in the kidney
  - Helps filter the blood to remove the nitrogenous wastes
  - Frogs excrete nitrogenous wastes in the form of urea and are hence called **ureotelic animals**
- The **ureters** acts as urinogenital duct which opens into cloaca in males while ureter and oviduct open separately into cloaca in females
- Ureters lead to the **urinary bladder** which stores urine
- **Cloaca** is the opening for the removal of urea

Frog: Nervous System

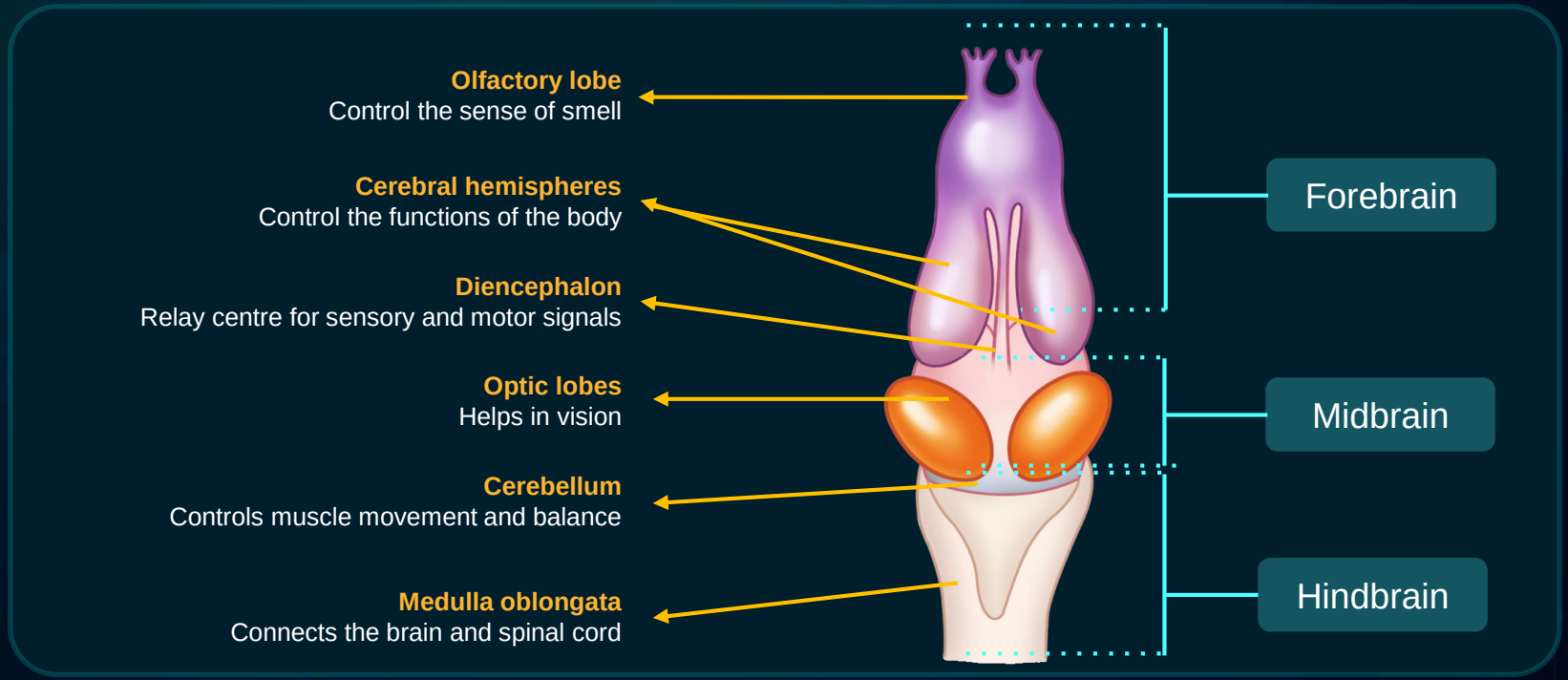
Complex network of nerves and cells that carry messages to and from the brain



Frog: Nervous System

Parts of brain

- Mass of nerve tissue enclosed in a cranium
- 10 pairs of cranial nerves arise from the brain



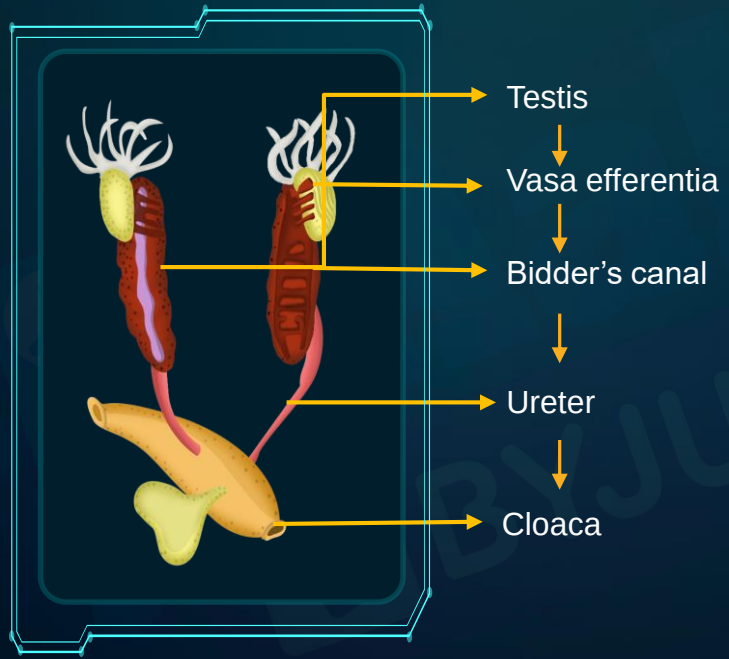
Frog: Nervous System

Endocrine gland

- The chemical coordination of various organs of the body is achieved by **hormones** which are **secreted by the endocrine glands**.
- The prominent endocrine glands found in frog are:
  - Pituitary
  - Thyroid
  - Parathyroid
  - Thymus
  - Pineal body
  - Pancreatic islets
  - Adrenals
  - Gonads

Frog: Male Reproductive System

Produce, maintain and transport the male reproductive cells called sperms



A pair of testes

- Yellowish and ovoid in appearance
- Attached to the kidneys by the **mesorchium** (double fold of peritoneum)
- Produces **sperm**

Vasa efferentia

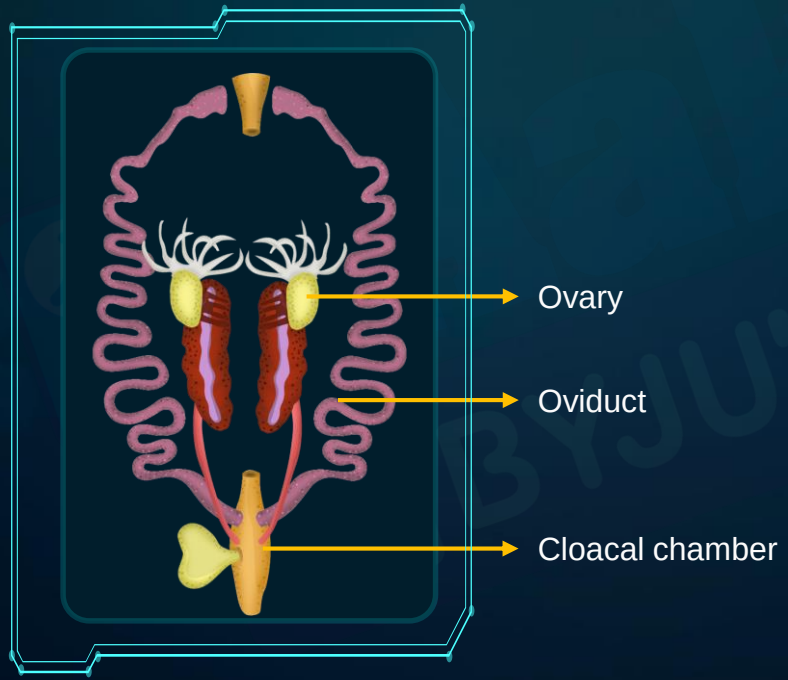
- 10–12 in number
- Arise from the testes
- Enter the kidneys and open into the **Bidder's canal**

Cloaca

- Opens to the exterior of the body through the **cloacal aperture**
- Passes urine, sperm, and faecal matters

Frog: Female Reproductive System

Produce, maintain and transport the female reproductive cells called ova (2500 to 3000 ova at a time)



Ovaries

- Situated near the kidneys
- Produce about 2500–3000 ova at a time

Oviduct

- Carries ova from the ovary to the oviduct

Cloacal chambers

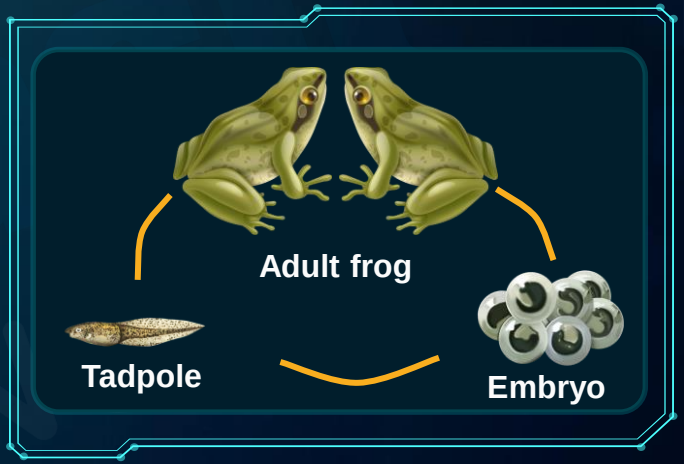
- Pass urine and faecal matters

Frog: Fertilisation and Development

- Fertilisation is **external** as ova and sperms are **released into water**.
- The egg and sperm fuse together to form the **zygote**.
- After fertilisation, the zygote divides to form an embryo and then the **tadpole** hatches out.

Metamorphosis

- The process by which an immature larva **transforms** into the adult form is known as **metamorphosis**.



Frog

Importance

- They play a role of **bioindicators**.
  - They are sensitive to environmental changes like pollution.
  - Pollution can cause developmental malformations in frogs.
- They are an important part of the **food chain** and **food web**.
- They help in protecting crops by **feeding on harmful insects**.
- They serve as a food source.
  - In some cultures, muscular frog legs are consumed.

Summary

Earthworm

Anatomy

Excretory system
(Excretion through nephridia) Nephridia is classified into

- **Septal nephridia**
  (Found on the posterior part of the body)
- **Integumentary nephridia**
  (Attached to the body of the lining wall)
- Three tufts of **pharyngeal nephridia**

Circulatory system
(Closed type, multiple hearts present, blood glands produce haemoglobin and blood cells)

Alimentary canal
(Consists of mouth, buccal cavity, pharynx, oesophagus, gizzard, stomach, and intestine)

Earthworm

Summary

Anatomy of earthworm

Nervous system

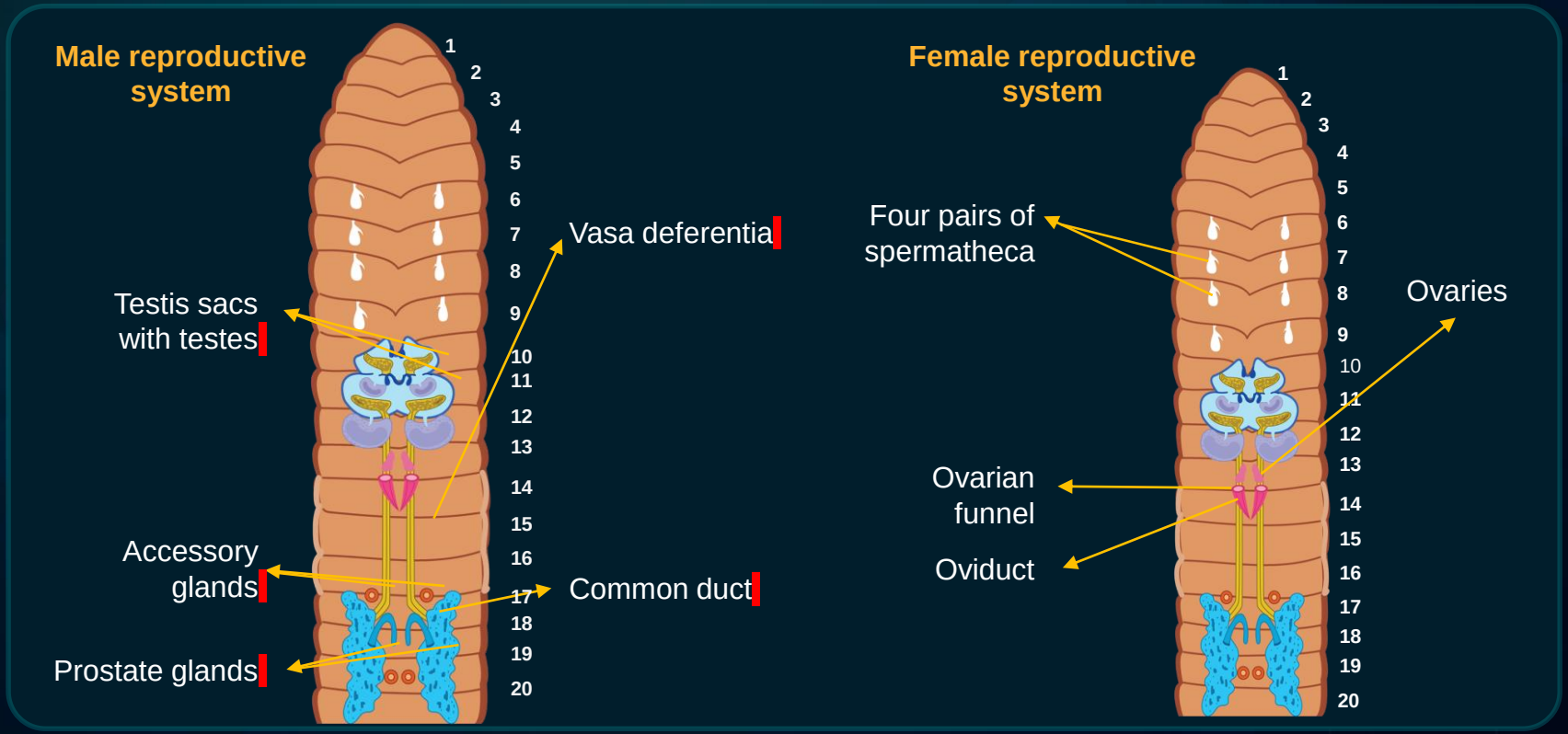
- Central nervous system (CNS) → Coordinates functions of entire body
- Peripheral nervous system (PNS) → Helps connect CNS to other body parts
- Sympathetic nervous system (SNS) → Helps body to respond involuntarily to dangerous situations

Reproductive system

- Male reproductive system → Produces sperms
- Female reproductive system → Produces ova
- Fertilisation → External
- Development → Direct

Summary

Reproductive system of earthworm



Summary

Cockroach

Characteristics

- Nocturnal
- Nutrition: Omnivorous
- Habitat: Damp places

Classification

- Phylum: Arthropoda
- Class: Insecta

Morphology

- Size: 0.6 cm - 7.6 cm
- Region: Head, thorax, abdomen

Summary

Blood vascular system
Open-type circulation, body cavity divided into three sinuses, heart used to pump haemolymph

Respiratory system
Exchange of gases takes place through diffusion from spiracles to trachea to tracheoles to cells

Excretory system
Excretion takes place through malpighian tubules that converts nitrogenous wastes into uric acid

- Pericardial sinus
- Perivisceral sinus
- Perineural sinus
- Anatomy
  - Alimentary canal
    - Divisions
      - Foregut
        - Mouth
        - Oesophagus
        - Pharynx
        - Crop and gizzard
      - Midgut
        - Hepatic caeca
        - Malpighian tubules
      - Hindgut
        - Ileum
        - Colon
        - Rectum

Summary

Anatomy

Cockroach

Body divisions

Head

- Triangular in shape, bent at right angle, flexible neck
- Head is made up of six segments, has compound eyes
- Biting and chewing type mouthparts

Thorax

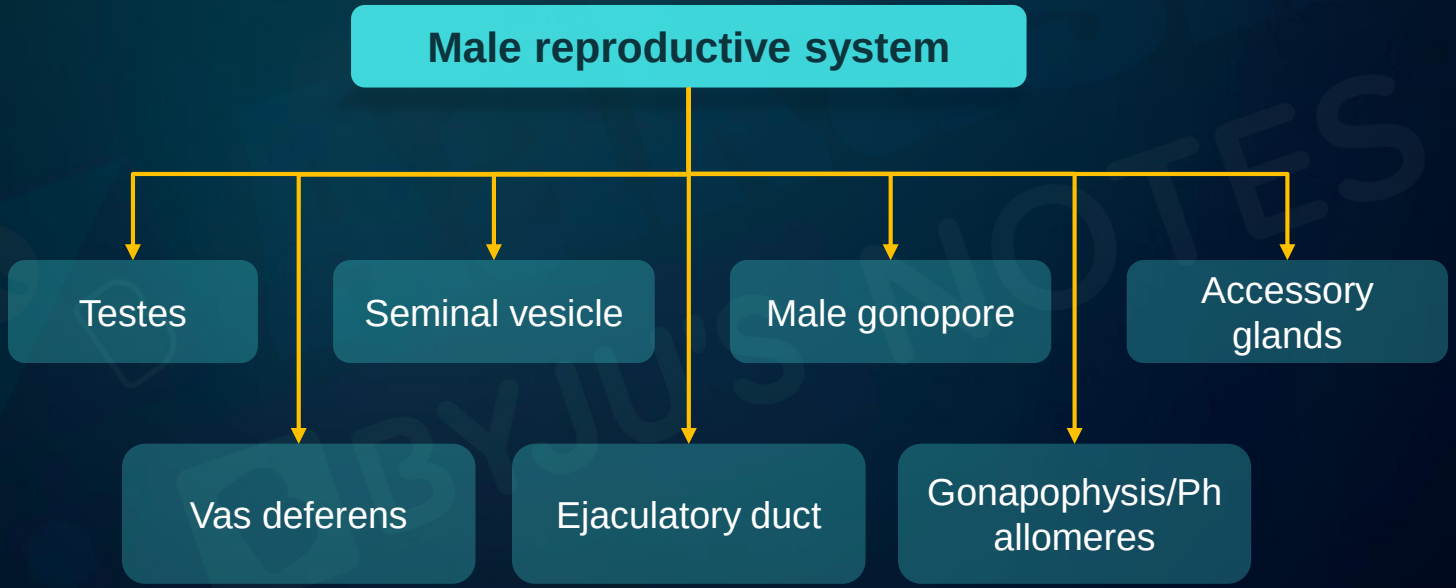
- Made up of three segments, i.e., prothorax, mesothorax, metathorax
- Bears two wings and six legs

Abdomen

- Contains genital pouch in males, genital pouch in females, and abdominal appendages

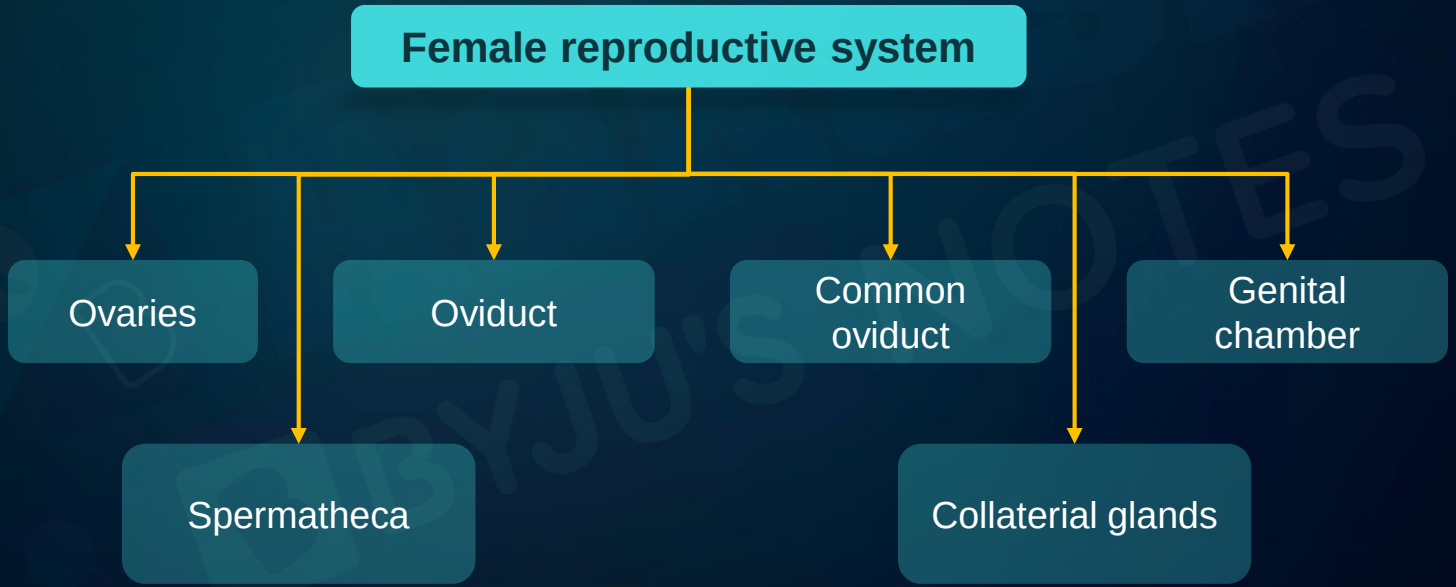
Summary

Cockroach



Summary

Cockroach



Summary

Frog

- **Anatomy of frog**
  - **Reproductive system**
    - **Male reproductive system**
      - Testes (Produce sperm)
      - Vasa efferentia
      - Bidder's canal
      - Ureters
      - Cloaca
    - **Female reproductive system**
      - Pair of ovaries
      - Oviduct
      - Cloacal chambers
  - **Excretory system**
    - Kidneys
    - Nephrons
    - Ureters
    - Bladder
    - Cloaca
  - **Endocrine system**
  - **Nervous system**
    - **CNS**
      - Brain
      - Spinal cord
    - **PNS**
      - Cranial nerves
      - Spinal nerves