

Ch 7 Structural Organisation in Animals Module 2

7.2 ORGAN AND ORGAN SYSTEM

7.3 EARTHWORM



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- **Basic tissues (Epithelial, Connective, Muscle and Neural Tissues) organise to form organs which in turn associate to form Organ Systems in the multicellular organisms.**
- **Such an organisation is essential for more efficient and better coordinated activities of millions of cells constituting an organism.**
- **Each organ in our body is made of one or more type of tissues. E.g., our heart consists of all the four types of tissues, i.e., epithelial, connective, muscular and neural.**

- **Complexity in organ and organ systems shows certain discernible trend. This discernible trend is called evolutionary trend.**
- **Let's learn more about morphology & anatomy of three organisms: Earthworm, Cockroach and Frog representing invertebrates and vertebrates, at different evolutionary levels to show their organisation and functioning.**
- **Morphology refers to study of form or externally visible features. In the case of plants or microbes, the term morphology precisely means only this. In case of animals this refers to the external appearance of the organs or parts of the body.**
- **Anatomy is used for the study of morphology of internal organs in the animals.**

7.3 EARTHWORM

- Earthworm is a reddish brown terrestrial invertebrate & a member of Phylum *Annelida*.
- It inhabits in the upper layer of the moist soil. During day time, it lives in burrows made by boring and swallowing the soil.
- In the gardens, it can be traced by its faecal deposits known as worm castings.
- The common Indian earthworms are *Pheretima* and *Lumbricus*.

7.3.1 Morphology

- 1. Body:
- Earthworms have long cylindrical body.
- It is divided into more than hundred short segments which are similar (*metameres* about 100-120 in number).
- The dorsal surface of the body is marked by a dark median mid dorsal line (dorsal blood vessel) along the longitudinal axis of the body.
- The ventral surface is distinguished by the presence of genital openings (pores).

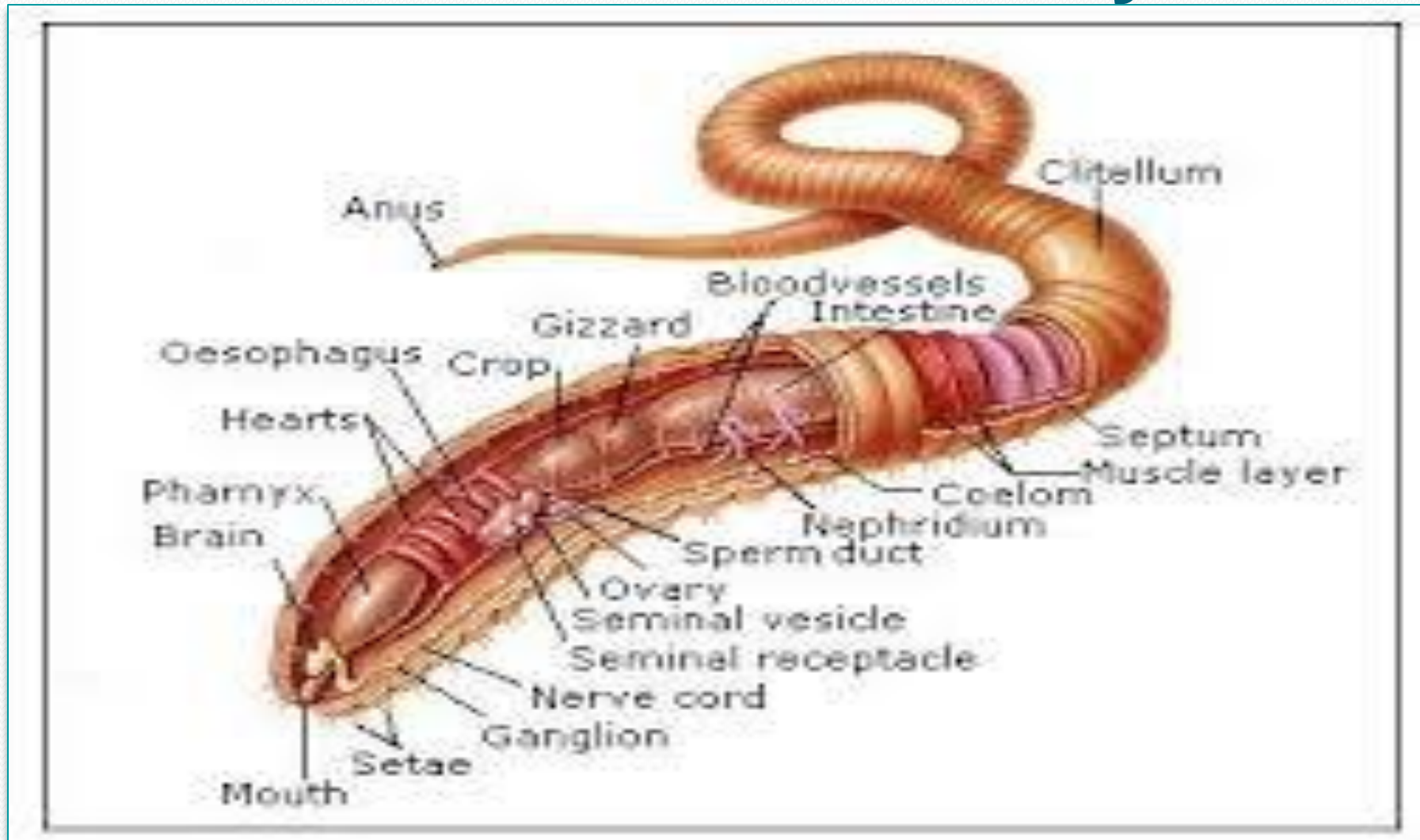
- 2. Anterior end consists of the **mouth** and the **prostomium**, a lobe which serves as a covering for the mouth and as a wedge to force open cracks in the soil into which the earthworm may crawl.
- Prostomium is sensory in function.
- 3. The first body segment is called the **peristomium** (buccal segment) which contains the mouth.
- 4. In a mature worm, segments 14-16 are covered by a prominent dark band of glandular tissue called **clitellum**.
- Thus the body is divisible into **three prominent regions** - preclitellar, clitellar and postclitellar segments.

- 5. Four pairs of **spermathecal apertures** are situated on the ventro-lateral sides of the inter-segmental grooves, i.e., 5th -9th segments.
- 6. A single **female genital pore** is present in the mid-ventral line of 14th segment.
- A pair of **male genital pores** is present on the ventro-lateral sides of the 18th segment.
- 7. Numerous minute pores called **nephridiopores** open on the surface of the body.
- 8. In each body segment (except the first) last and clitellum, there are rows of S-shaped **Setae**, embedded in the epidermal pits in the middle of each segment. Setae can be extended or retracted. Their principal role is in locomotion.

7.3.2 Anatomy

- i. The **body wall** of the earthworm is covered externally by a thin non-cellular cuticle below which are the epidermis, two muscle layers (*circular and longitudinal*) and an innermost coelomic epithelium found.
- ii. The **epidermis** is made up of a single layer of columnar epithelial cells that contains secretory gland cells.
- iii. The **alimentary canal** is a straight tube and runs between first to last segment of the body.
- A terminal mouth opens into the buccal cavity (1-3 segments) which leads into muscular pharynx.

Earthworm: Anatomy



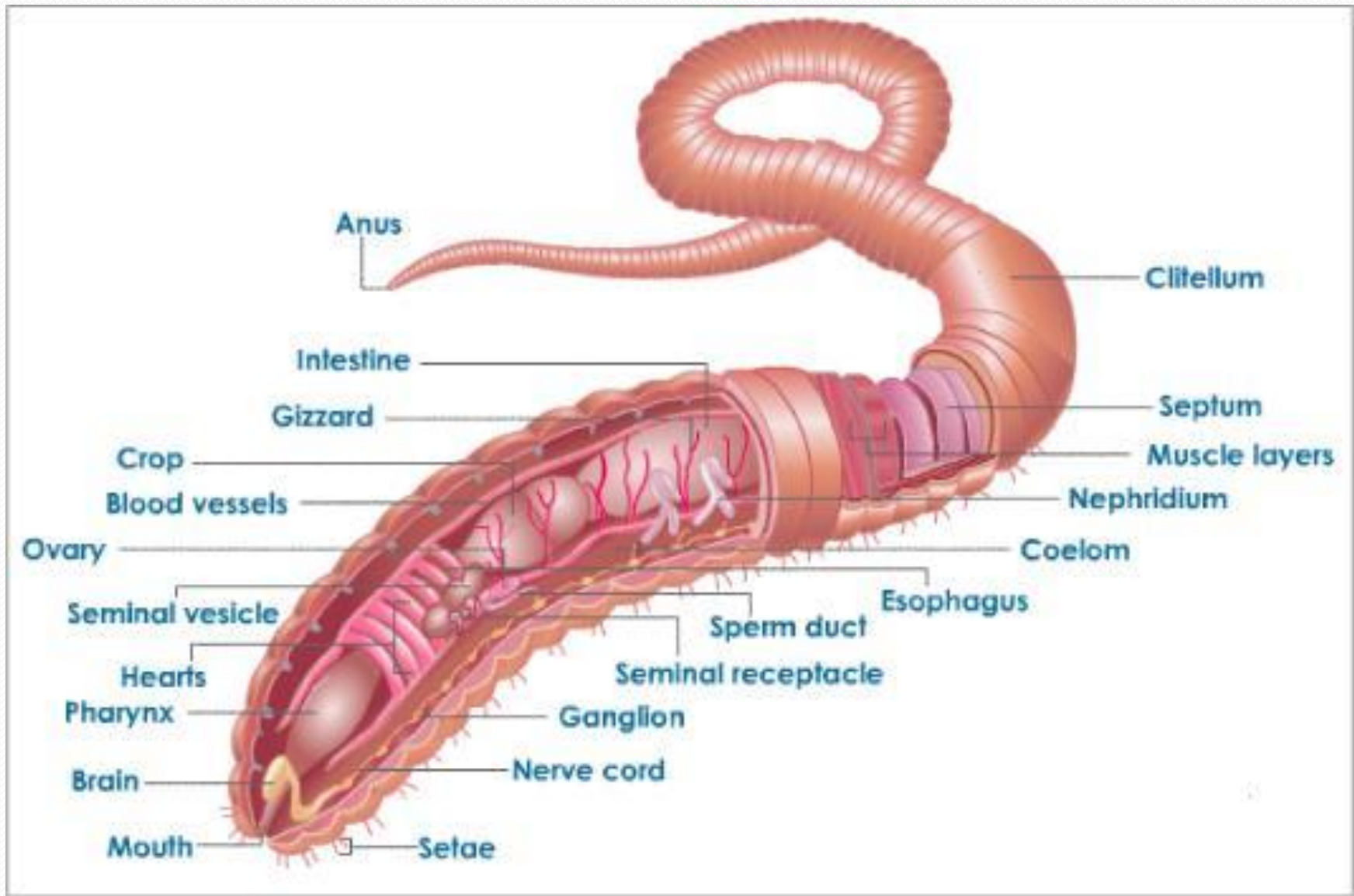
- A small narrow tube, oesophagus (5-7 segments), continues into a muscular gizzard (8-9 segments). It helps in grinding the soil particles and decaying leaves, etc.
- The stomach extends from 9-14 segments. The food of the earthworm is decaying leaves and organic matter mixed with soil. **Calciferous glands**, present in the stomach, neutralise the humic acid present in humus.
- iv. Intestine starts from the 15th segment onwards and continues till the last segment.
- A pair of short and conical intestinal caecae project from the intestine on the 26th segment.

- v. The characteristic feature of the intestine between 26-35 segments is the presence of internal median fold of dorsal wall called **typhlosole**. This increases the effective area of absorption in the intestine.
- vi. The alimentary canal opens to the exterior by a small rounded aperture called anus. The ingested organic rich soil passes through the digestive tract where digestive enzymes breakdown complex food into smaller absorbable units.
- These simpler molecules are absorbed through intestinal membranes and are utilised.

- *v. Pheretima* exhibits a closed type of blood vascular system, consisting of blood vessels, capillaries and heart. Due to closed circulatory system, blood is confined to the heart and blood vessels.
- Contractions keep blood circulating in one direction. Smaller blood vessels supply the gut, nerve cord, and the body wall.
- Blood glands are present on the 4th, 5th and 6th segments. They produce blood cells and haemoglobin which is dissolved in blood plasma.
- Blood cells are phagocytic in nature.
- vi. Earthworms lack specialised breathing devices. Respiratory exchange occurs through **moist body surface** (skin) into their blood stream.

- vii. The excretory organs occur as segmentally arranged coiled tubules called nephridia (sing.: *nephridium*). They are of three types:
 - a. Septal nephridia, present on both the sides of intersegmental septa of segment 15 to the last that open into intestine,
 - b. Integumentary nephridia, attached to lining of the body wall of segment 3 to the last that open on the body surface and
 - c. Pharyngeal nephridia, present as three paired tufts in the 4th, 5th and 6th segments.

- These different types of nephridia are basically similar in structure.
- Nephridia regulate the volume and composition of the body fluids.
- A nephridium starts out as a funnel that collects excess fluid from coelomic chamber.
- The funnel connects with a tubular part of the nephridium which delivers the wastes through a pore to the surface in the body wall into the digestive tube.



- viii. Nervous system is basically 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.
- The cerebral ganglia along with other nerves in the ring integrate sensory input as well as command muscular responses of the body.

- ix. **Sensory system** does not have eyes but does possess light and touch *sensitive organs* (receptor cells) to distinguish the light intensities and to feel the vibrations in the ground.
- Worms have specialised *chemoreceptors* (taste receptors) which react to chemical stimuli.
- These sense organs are located on the anterior part of the worm.

- x. Earthworm is *hermaphrodite* (bisexual), i.e., testes and ovaries are present in the same individual.
- - There are two pairs of testes present in the 10th and 11th segments.
- - Their *vasa deferentia* run up to the 18th segment where they join the prostatic duct.
- - Two pairs of accessory glands are present one pair each in the 17th and 19th segments.
- - The common prostate and spermatic duct (*vasa deferentia*) opens to the exterior by a pair of male genital pores on the ventro-lateral side of the 18th segment.

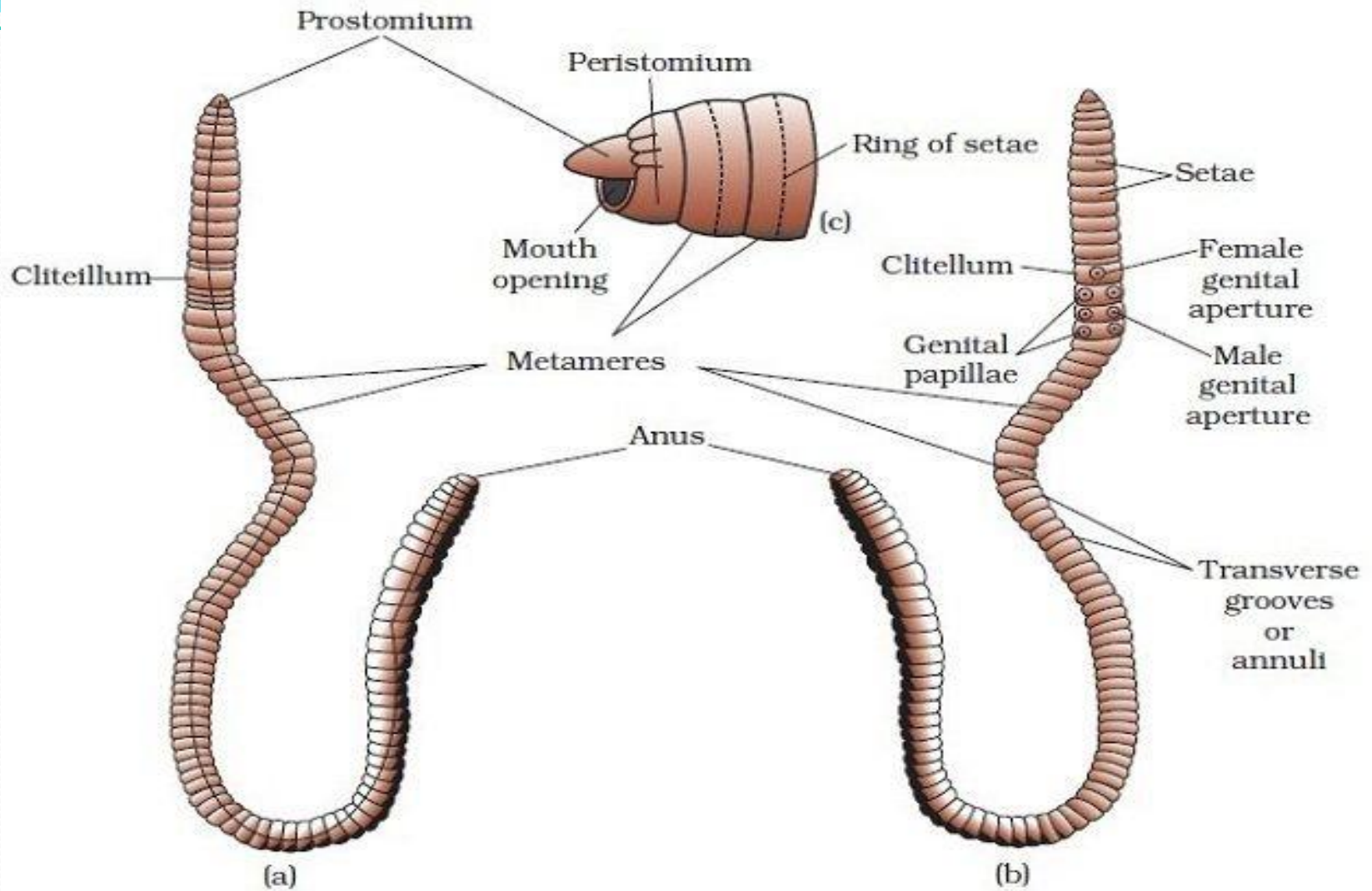


Figure 9. Body of earthworm : (a) dorsal view (b) ventral view (c) lateral view showing mouth opening

- - Four pairs of spermathecae are located in 6th-9th segments (one pair in each segment). They receive and store spermatozoa during copulation.
- - One pair of ovaries is attached at the inter-segmental septum of the 12th and 13th segments. Ovarian funnels are present beneath the ovaries which continue into oviduct, join together and open on the ventral side as a single median female genital pore on the 14th segment.
- A mutual exchange of sperm occurs between two worms during mating. One worm has to find another worm and they mate juxtaposing opposite gonadal openings exchanging packets of sperms called spermatophores.

- Mature sperm and egg cells and nutritive fluid are deposited in cocoons produced by the gland cells of clitellum.
- Fertilisation and development occur within the cocoons which are deposited in soil.
- The ova (eggs) are fertilised by the sperm cells within the cocoon which then slips off the worm and is deposited in or on the soil. The cocoon holds the worm embryos. After about 3 weeks, each cocoon produces two to twenty baby worms with an average of four.
- Earthworm's development is direct, i.e., there is no larva formed.

Earthworm: Segment-wise contents

- | | |
|---|---|
| <ul style="list-style-type: none">• Segment 1 to 4• Segment 4 to 6• Segment 5 to 7• Segment 5 to 9• Segment 8 to 9• Segment 9 to 10• Segment 9 to 14• Segment 14• Segment 15 onwards• Segments 14 to 16• Segment 18• Segment 26• Segment 26 to 35 | <ul style="list-style-type: none">• Mouth (Buccal Cavity) and Prostomium• Blood glands• Oesophagus• Spermathecal apertures• Gizzard• Testes• Stomach• Female genital pore• Intestine continues till the last segment• Clitellum• Male genital pore• Intestinal Caecae• Typhlosole |
|---|---|

- Earthworms are known as friends of farmers because they make burrows in the soil and make it porous which helps in respiration and penetration of the developing plant roots.
- The process of increasing fertility of soil by the earthworms is called vermi-composting. It is rich in Nitrates and minerals (P, Mg, Ca & K).
- Various Species of earthworm are used in this like *Eisenia fetida*, *E. andrei*, *Dendrobaena veneta*, *D. hortensis*, *Eudrilus eugeniae*, etc.
- They are also used as bait in game fishing.
