PRE-MEDICAL

ZOOLOGY

ENTHUSIAST | LEADER | ACHIEVER

STUDY MATERIAL

Earthworm

ENGLISH MEDIUM

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Professor K.N. Bahl

(Professor Karm Narayan Bahl) (1891-1954)

Karm Narayan Bahl completed his D.Sc. (1920) from Punjab University, Lahore and D.Phil (1921) from University of Oxford. His area of specialization was zoology. His carrier was largely at Lucknow University where he was Head, Department of Zoology from 1921-51 and Professor (1923-51). He subsequently served as Vice-Chancellor of Patna University (1951-52).

Academic and Research Achievements: Bahl worked on the nephridial system of earthworms and discovered, in the genus *Pheretima*, a new type of septal nephridia which, contrary to then extant belief, open into the intestine and not outside the body. In *Pheretima* he found three distinct kinds of nephridia: septal, pharyngeal and integumentary. His later research unrevealed the complicated nature, both anatomical and physiological, of the nephridia of earthworms from various parts of the world.

Other Contributions: As an Editor for the Zoological Society of India, Bahl pioneered a series of monographs: Indian Zoological Memoirs on Indian Animals.

EARTHWORM

01. INTRODUCTION

- **Introduction**
- **Morphology**
- **Anatomy - Digestion, Circulation, Excretion, Reproduction**

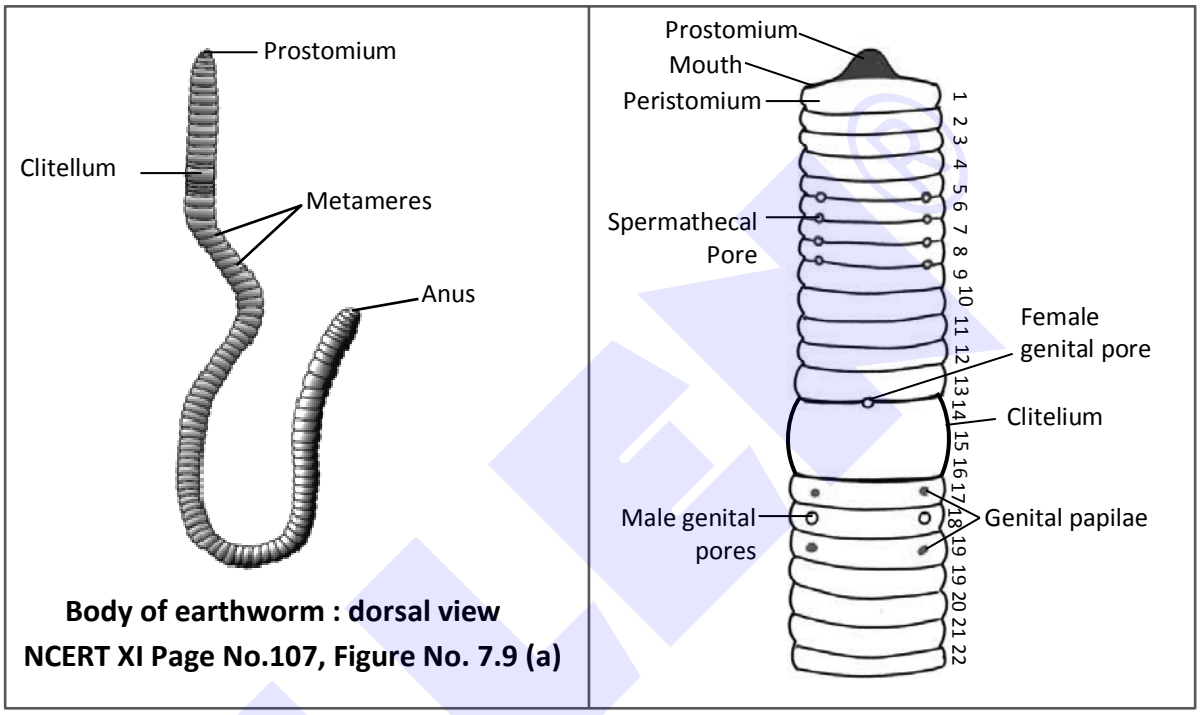
- ***Systematic Position :***
- ***Kingdom*** : Animalia
- **Phylum :** Annelida :
  - "Bilateral symmetry", "triploblastic".
  - Metamerically segmented body
  - Body cavity segmented like body wall.
  - Excretory organ - "nephridia".
  - Locomotion through "setae".
  - Non chitinous body wall.
- **Class** : Oligochaeta
  - Head, eye, tentacles - absent
  - Setae in body wall
  - Clitellum For "Cocoon formation.
  - Usually hermaphrodite and no free living larval stage.
  - Parapodia absent.
- **Order *:*** Terricola
  - Clitellum multilayered
  - Terrestrial animals
- **Genus** : ***Pheretima***
- **Common Species :**

  "***P. posthuma***" - North Indian earthworm; **discoverer** - K.N. Bahl
  Megascolex - longest, 3 m in length - South Indian earthworm
  Lumbricus - American and Europian earthworm.
- **Earthworm**
  - Fossorial (lives in burrows) animals.
  - Burrows found in moist soil, with more humus.
  - Cutaneous respiration through skin.
  - Absent in dry soil.
  - Maximum in garden soil, Nocturnal animals.

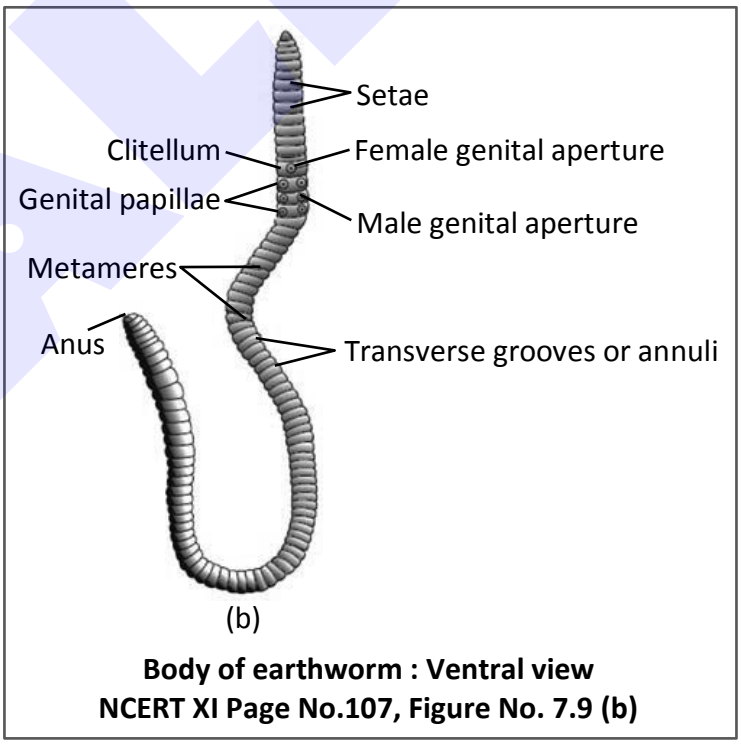
02. MORPHOLOGY

- **External Morphology** :
  - Body of ***Pheretima*** has "100-120" segments
  - Segments are known as ***metameres.***
  - First segment - **"Peristomium.** Peristomium bears a terminal slit like mouth.
  - A dorsal fleshy lobe like process overhanging the mouth like a hood called **prostomium.**
  - Prostomium helps in digging of burrows.
  - Photoreceptor also found in it.
  - Inter segmental groove present between every two segments.

- In each of the four intersegmental grooves between segments 5/6, 6/7, 7/8 and 8/9 there is a pair of ventro - lateral elliptical spermathecal pores.
- "14th, 15th and 16th segments have a pink coloured layer around them. This thick collar or girdle like thickning is known as **"cingulum"** or **clitellum**. This is made up of glandular cells.
- First segment of clitellum or 14th segment has a ***"female gonopore"*** or female genital pore is located at the mid-ventral line of this 14th segment.
- In 18th segment - on "Ventro-lateral" surface- 1 pair male gonopore present.
- In 17th and 19th segments - Pair of genital papilla present on ventro-lateral position.
- They helps in binding two *Pheretima* in ventro-lateral condition at the time of copulation.



Body of earthworm : dorsal view
NCERT XI Page No.107, Figure No. 7.9 (a)



Body of earthworm : Ventral view
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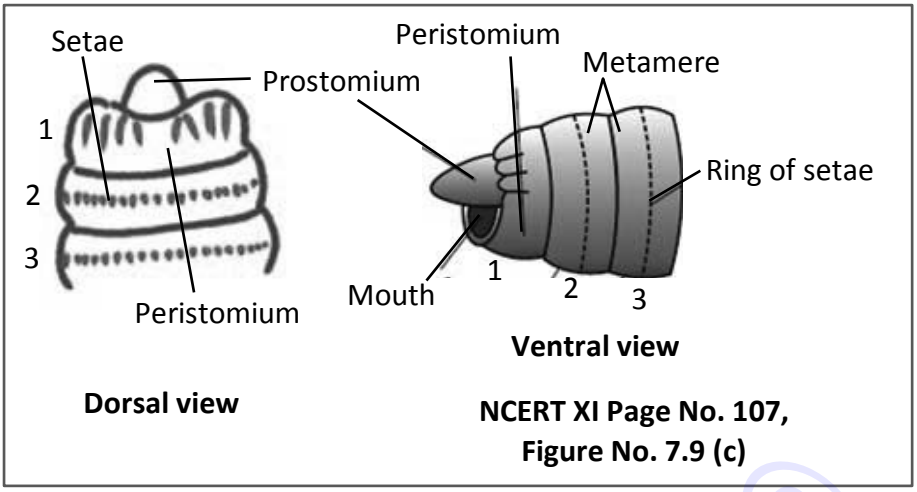

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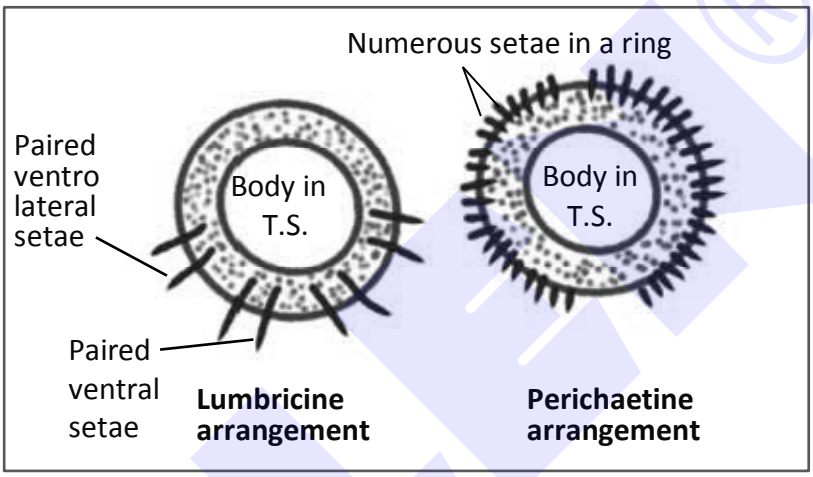


- **Setae :**
  - Each segment of body wall except first, last and clitellum bears an equatorial annular row (perichaetine arrangement) of about 80-120 minute S-shaped and yellowish setae (Chaetae).
  - Setae are half embedded in body wall and half projected backwards upon body surface.
  - They help in locomotion.
  - Young ***Pheretima*** - Setae present on clitellum also.
  - **Nephridiopores :** There are 200 to 250 minute pores of integumentary nephridia scattered upon the surface of each segment except the first two (3 to the last).
  - Upon clitellar segments their number is about 2000 to 2500.
  - **Mid - dorsal pores** are present in each intersegmental groove after 12^{th} segment.
  - Dorsal pores are absent in last groove.
  - Body-fluid - oozes out always from these pores.
  - This fluid moistens and smoothens the skin for cutaneous respiration.
  - When salt or alcohol is sprinkled on its body the fluid rapidly oozes out and causes its death.
  - A small and vertical slit like aperture at the end of last anal segment (Pygidium) known as anus.

BEGINNER'S BOX — INTRODUCTION & MORPHOLOGY

1. What is the function of prostomium in *Pheretima* ?

(1) Digging (2) Photoreceptor (3) Respiration (4) Both (1) & (2)

2. Pores present in *Pheretima* on ventro-lateral side of 5^{th} to 9^{th} segments, which are called ?

(1) Male genital pore (2) Spermatheca pore

(3) Female genital pore (4) Prostomium

3. In earthworm 2 pairs genital papilla present on :-

(1) Ventral side (2) Dorsal side

(3) Ventro-lateral side (4) Anterior side

4. Maxium number of nephridopores are present in earthworm on which area ?

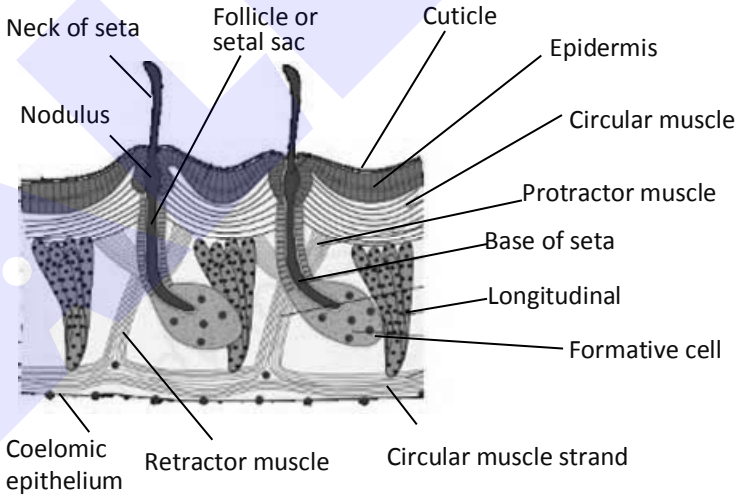
(1) Pygidium (2) Clitellum (3) Prostomium (4) Peristomium

5. In *Pheretima* anus is located at ?

(1) Pygidium (2) Prostomium (3) Peristomium (4) Clitellum

03. GENERAL ANATOMY AND PHYSIOLOGY

(1) BODY WALL



T.S. of body wall through setae

- **Body Wall :-** 4 main layers

  (A) Cuticle :- Thin and non cellular, It is outermost layer.

  (B) Epidermis :- It is second layers and made up of columnar epithelial cells, which contain gland cells. These thick gland cells are distributed here & there between supporting cells.

They are of two types :-

(i) Mucous Gland cell

- Numerous/many
- Mucous secreting, to moist and smoothens the body (moist and slimy)
- Also known as goblet cells
- Each goblet cell opens by a minute ductule upon body surface through a minute pore. The mucous keeps the walls of burrows smoother or lubricated.

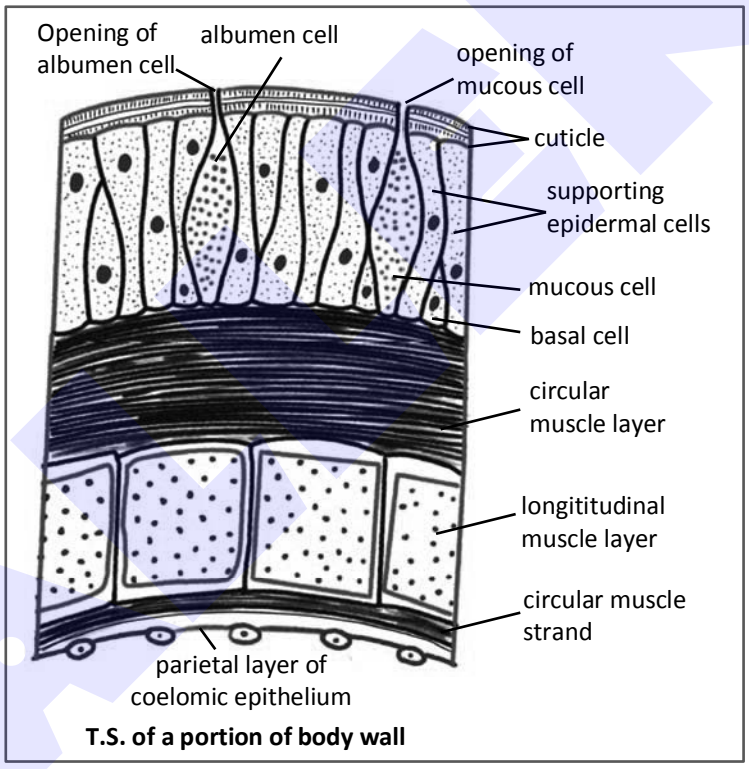
(ii) Albuminous cell

- Fewer (only in first 16 segment)
- It secretes nutritive substances in cocoons.

(C) Muscle layers :-

Outer = Circular muscle layer

Inner = Longitudinal muscle layer



T.S. of a portion of body wall

Circular muscle layer (Continuous layer around the body)

- Porphyrin pigment present in it.
- Brown colour of earthworm is due to this pigment. It protects from ultra violet rays. This is obtained by the decomposition of chlorophyll.

[Longitudinal muscle layer (discontinuous layer)**]**

- It is broken into several longitudinal strips or bands, separated from each other by thin connective tissue.

(D) Coelomic epithelium (Parietal peritoneum) :-

Inner most layers : found next to the longitudinal muscle layer.

Thin, membrane like, originated from mesodermal epithelial cells.

- **Fuction of body wall :**

(i) Provides fixed shape and size to the body

(ii) Provides protection, mucous prevents from harmful bacteria

(iii) Fluid moistens the body surface and facilitates in respiration.

(iv) Setae and muscles of body wall helps in locomotion.

(2) BODY CAVITY

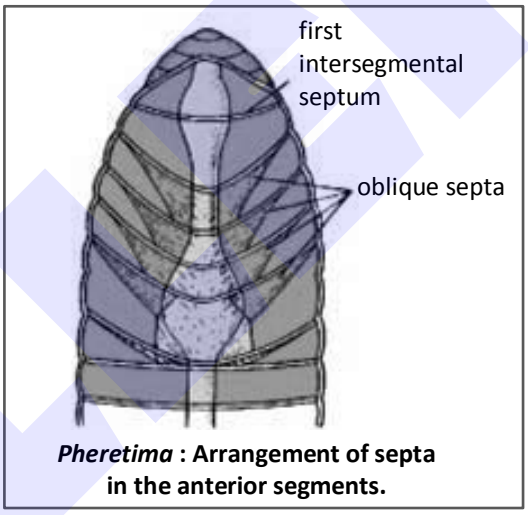
- **Body cavity** is **"True coelom"** (Schizocoelom)
- **Body cavity** is segmented.

Septa present between every two segments, which are known as **inter segmental septa**.

First intersegmental septa – present in between "4/5" segment.

9^{th} and 10^{th} segment do not have septa.

1^{st} septum is thin and straight.



Pheretima **: Arrangement of septa in the anterior segments.**

Next 5 septa - Thick and funnel shaped (5/6, 6/7, 7/8, 8/9 and 10/11)

Rest of all the septa - Thin.

- First 9 septa are - ***non porous***. All posterior septa - ***Porous***.

Each septa has ***"136 - pores"***, these pores are surrounded by ***Sphincter.***

Body cavity contains ***coelomic fluid*** which is - ***milky and alkaline fluid.***

Yellow cells or chloragogen cells present in coelomic fluid which are analogous to liver of higher animals. These cells perform liver like functions.

- **Funciton of coelomic fluid :**

(i) Works as hydrostatic skeleton, which facilitates locomotion.

(ii) The fluid helps in respiration because it oozes out from dorsal poors and makes moist skin.

(iii) Chloragogen cells helps in storage of food and excretion too.

(iv) Because of this fluid the body of earthworm is lustrous.

(3) LOCOMOTION IN EARTHWORM

(a) **Setae - fix the body to substratum**

(b) **Muscular layer of body wall.**

- C.M.L. (Circular muscle layer). It contracts than body become elongated & thin.
- L.M.L. (Longitudinal muscle layer). It contracts than body become shorten & thicker.
- Alternate contraction & relaxation takes place in both LML & CML during locomotion.
- In *Pheretima* contraction in 9 - segments takes place at one time.

(c) Body fluid – acts and hydraulic pressure.

(d) Mucous helps in locomotion on smooth surface. Speed = 25 cm/min.

BEGINNER'S BOX — BODY-WALL, BODY-CAVITY & LOCOMOTION

1. In *Pheretima* albuminous cells secrete nutritive substance in :-

(1) Cocoon (2) Spermathecae

(3) Septa (4) Stomach

2. Chloragogen cell of earthworm is analagous to our which body organ ?

(1) Stomach (2) Liver

(3) Spleen (4) Heart

3. Mucous secretion in earthworm helps in locomotion on :-

(1) Rough surface (2) Climb on wall

(3) Smooth surface (4) On trees

4. Circular muscle layer of earthworm help in :-

(1) Respiration (2) to make shorten the body

(3) Excretion (4) To make elongated body

5. Inter segmental septum absent between :-

(1) 9^{th} & 10^{th} segment (2) 11^{th} & 12^{th} segment

(3) 4^{th} & 5^{th} segment (4) 19^{th} & 20^{th} segment

(4) DIGESTIVE SYSTEM

It is a straight tube and runs between first to last segment of the body.

(a) **Mouth :** Present on peristomium.

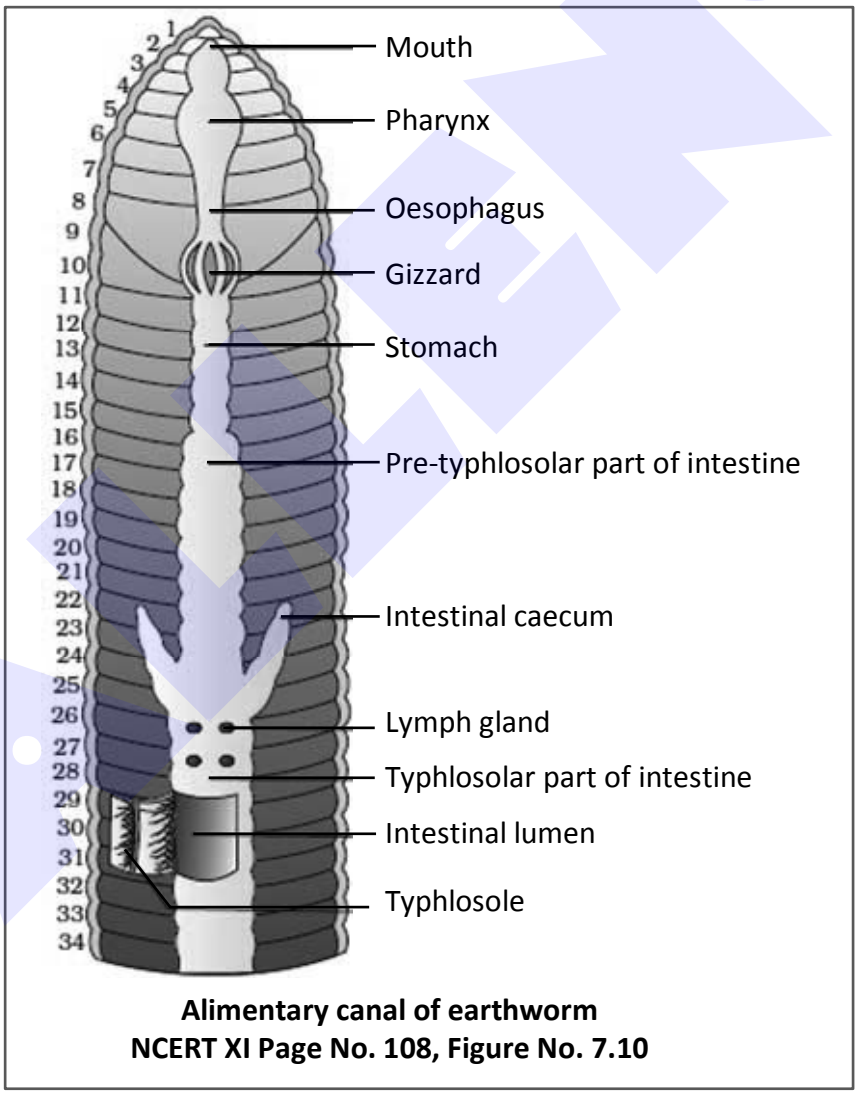
(b) **Buccal cavity :** In (1-3) segments. Because of radial muscle the buccal cavity evertible.

(c) **Pharynx :** Buccal cavity opens in muscular pharynx (4-5 segments). Saliva secreting cells are present in the dorsal part of pharynx. These cells are known as "chromophil cells".

(d) **Oesophagus :** It extends from 5^{th} segment to 7^{th} segment.

(e) **Gizzard :** Oesophagous opens into a thick walled "gizzard". This is located in 8^{th} - 9^{th} segment. It helps in grinding the soil particles and decaying leaves etc.

(f) **Stomach :** It extends from 9^{th} to 14^{th} segments. Sphincters present on both ends. Gland cell in the wall of stomach secretes ***"proteolytic" Enzyme.***



Alimentary canal of earthworm
NCERT XI Page No. 108, Figure No. 7.10

- In other earthworms (not in *Pheretima*) **"calciferous gland"** are found in wall of stomach.
- Calciferous gland - neutralize humic acid in humus by secreting lime.

(g) **Intestine** : Longest and widest part of alimentary canal.

- It starts from the 15th segment onwards and continues till the last segment. This is some what compressed by each inter-segmental septum.
- It has a beaded appearance.
- Wall of intestine is thin, highly vascular and glandular. It has internal longitudinal folds are called villi.
- Specially large and prominent internal median folds, called **typhlosole** hangs internally into the intestinal lumen from its mid-dorsal line. Beginning from the anterior end of **27th** segment and ending in front of the last **24** or **25** segments. Presence of typhlosole is characteristic feature of intestine in earthworm.
- Due to typhlosole, the alimentary canal is distinguished into **pretyphlosolar, typhlosolar** and **post-typhlosolar regions.**
- Last 20-25 segment contains rectum second longest part of alimentary canal.
- A pair of short and conical **"intestine caeca"** project from the intestine on the 26th segement. These are extended upto 22nd segement. It secretes digestive enzymes.
  Typhlosole & villi - increases the absorption area in intestine.

(h) **Anus :** The alimentary canal opens to the exterior by a small rounded terminal aperture called anus.

(5) FEEDING AND FOOD

- Earthworm is **"Omnivorous".**
- Food - Humus, dead insects, dead leaves and twigs.
- In feeding - Buccal cavity helps the most in feeding, while pharynx helps as a sucking organ.
- **Digestion :-** Starts in pharynx. Salivary secretion from salivary gland cells contains mucous, protein digesting enzyme is endopeptidase enzyme. This enzyme acts on protein and helps in the digestion of large protein molecules into smaller ones. Mucin lubricates the food and food passage.
- Gizzard - Performs grinding.
- Stomach - digestion same as in pharynx.
- Intestine - Maximum digestion takes place here.
- **Absorption** takes place in intestine mainly by the help of typhlosole.
- Absorption takes place after 26th segment .
- Blood distributes the digested food.
- **Defaecation :** the wall of rectum absorbs water from the undigested substances.
- Faeces - in form of dry pellets - "worm castings".

(6) RESPIRATION

"Cutaneous respiration"

- **Through skin**

Well adapted for cutaneous respiration, it is thin moist, highly vascular. A dense network of capillaries is present.

Normally - Aerobic respiration. But can also live without oxygen for 30 hrs.

(7) BLOOD VASCULAR SYSTEM [B.V.S.]

Closed type of blood Vascular system consisting of blood vessels, capillaries and heart.

True blood vessels present.

Blood - Red colour (haemoglobin present). Hb is dissolved in plasma.

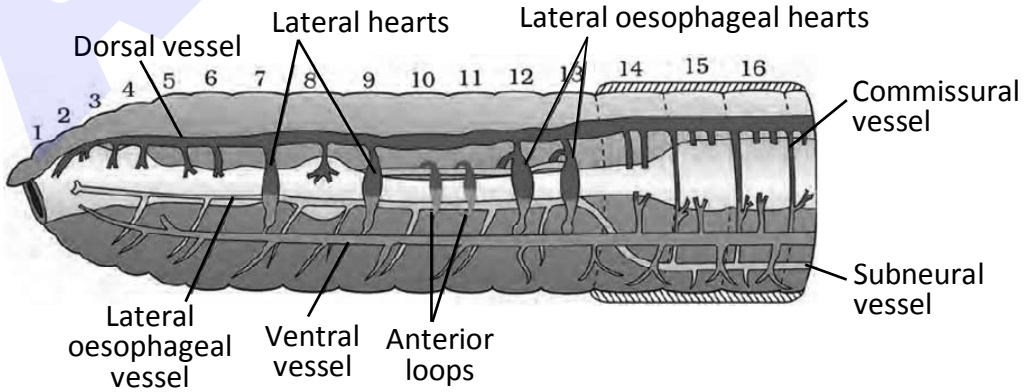
R.B.C. - absent (in nonchordates). This Hb knwon as **"erythrocruorin"** or "inter cellular" Hb.

(a) **Dorsal Vessel -** "Main blood vessel.

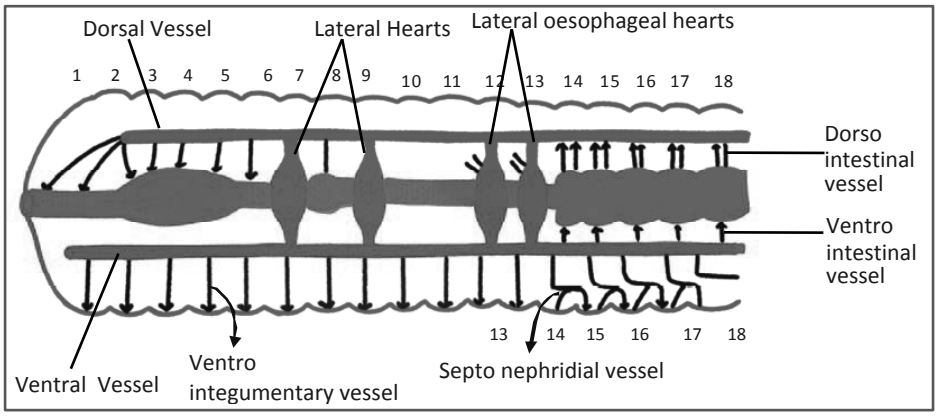
- From the 3rd to last segment at dorsal side of alimentary canal and it can be seen externally.
- Wall of dorsal vessel is muscular and lumen have valves. Flow of blood from posterior to anterior side.
- Dorsal Vessel in anterior part acts as collecting vessels from last segment to 14th segment.
- This collects blood from alimentary canal.
- dorsal vessel in anterior part acts as ***"distributing vessel"***.
- This supplies blood to the wall of alimentary canal of first to 13th segments.

(b) **Ventral vessel** - from second to last segment present on the ventral side of alimentary canal.

- Wall - non muscular and valve - absent.
- Blood flows from - anterior to posterior side.
- Ventral vessel acts as ***"distributing vessel"*** in its whole length.
- Ventral vessel in each segment supply blood to body wall and related structures. Septa, Septal nephridia, gonads, etc. get the blood supply.
- After 13th segment ventral vessel also supplies blood to alimentary canal. (14 to last).
- Ventral vessel receives blood from dorsal vessel through 4 pairs of lateral hearts.



Closed circulatory system
NCERT XI Page No. 109, Figure No. 7.11

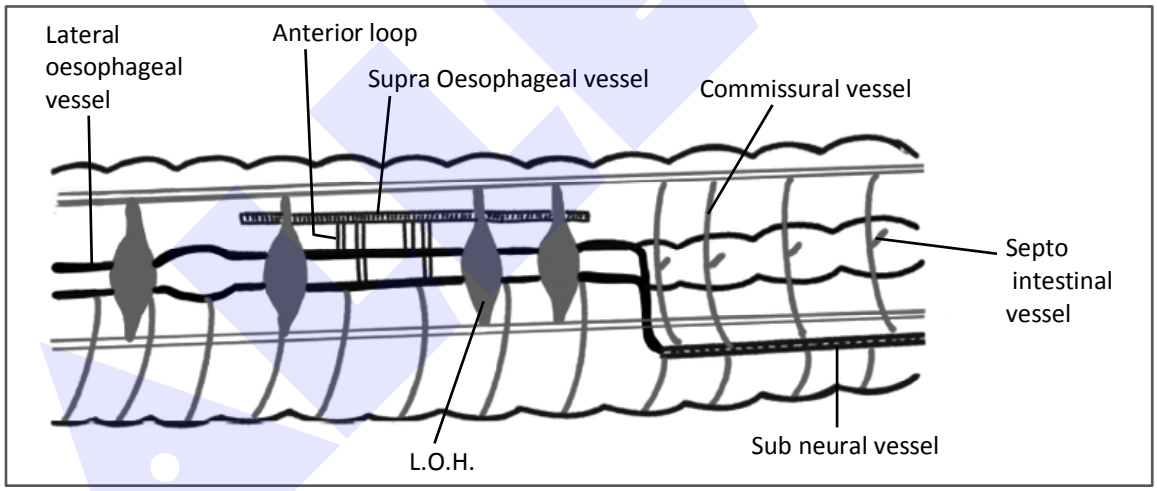


(c) **Heart** :

- Present in 7th, 9th, 12th, 13th segments (4 pairs).
- In 7th and 9th segment - "Lateral heart" is present.
- In 12th and 13th segment - "Lateral oesophageal heart" is present.
- The hearts are muscular and have valves.

(d) **Subneural vessel**

- This is present from last segment to 14th segment.
- Present on Ventral side of nerve chord.
- In 14th segments it forms branches into two parts. These are "lateral oesophageal vessel".



Both the branches are situated upto the 2nd segment in the lateral side of alimentary canal.

- S.N.V. and L.O.V. do not have muscular wall.
- They are without valves and blood flows from anterior to posterior.
- They act as "collecting vessel" along whole length.
- L.O.V. - Collects blood from walls of alimentary canal and body wall.
- S.N.V. - Collects blood only from body wall.
- S.N.V. - One pair of commissural vessel comes out in each segment. They supply blood to "***dorsal vessel***".

  From each commisural vessel comes out one "Septo - intestinal vessel". They supply blood to alimentary canal.

(e) Supra Oesophageal Vessel:

- It is situated in 9^{th}-13^{th} segments, on dorsal surface of alimentary canal i.e. on stomach.
- It collects blood from wall of Gizzard and Stomach.
- In 10^{th} and 11^{th} segment 2 pairs of "anterior loops" are situated which arise from SOV.
- They takes blood from LOV to SOV.
- Blood also reaches from LOV to SOV by a dozen of loop like ring vessels.
- Blood collected in SOV and reaches into lateral - oesophageal heart (LOH).
- From LOH the blood reaches to ventral vessel.

Blood glands :- 3 Pairs

- Situated in 4^{th}, 5^{th} and 6^{th} segments on dorsal part of alimentary canal. They produce blood cell (Phagocytic in nature) and Hb which is dissolved in plasma.

  WBC - Leucocytes

  Hb and blood cells are secreted in dorsal vessel.

Lymph glands :-

- They present on dorsal part of alimentary canal from 26^{th} segment to last segment.
- One pair in each segment
- They form phagocytes and pour them into body cavity.

BEGINNER'S BOX — DIGESTION, RESPIRATION & BLOOD VASCULAR SYSTEM

1. Find out the incorrect statement for *Pheretima* ?
(1) Buccal cavity present in 1^{st}–3^{rd} segment
(2) Oesophagus present in 5^{th} to 7^{th} segment
(3) Calciferous gland present in *Pheretima*
(4) Intestine is the longest part of alimentary canal

2. In earthworm, saliva is secrated by :-
(1) Chromophil cells (2) Clitellum (3) Cingulum (4) Calciferous gland

3. Intestinal caeca present on :-
(1) 26 to 27 segment (2) 26 to 23 segment (3) 25 to 28 segment (4) 22 to 26 segment

4. Valves present in :-
(1) Ventral blood vessel (2) Dorsal blood vessel
(3) Lateral blood vessel (4) Sub neural vessel

5. In *Pheretima* red blood due to presence of :-
(1) Haemoglobin (2) Heparin (3) Erythrocynin (4) Erythropoetien

6. Commissural vessel supply the blood to :-
(1) Alimentary canal and dorsal blood vessel.
(2) Alimentary canal and ventral blood vessel
(3) Only ventral blood vessel
(4) Dorsal blood vessel and body wall

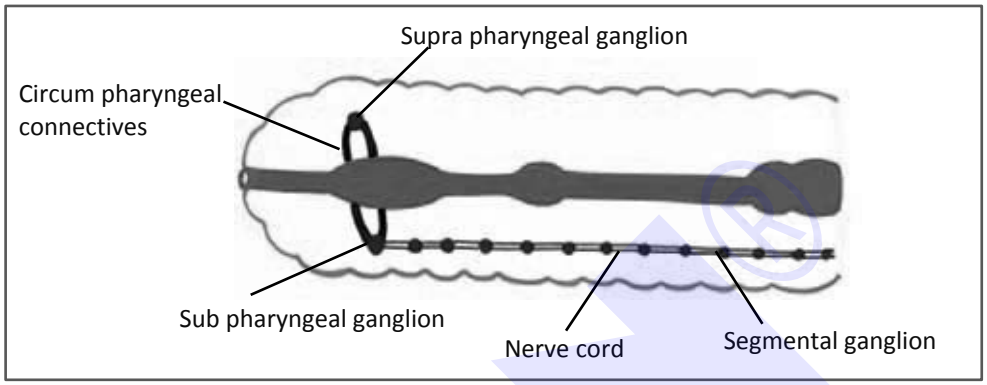
7. Among these in which of the blood vessel blood flow from posterior to anterior ?
(1) Dorsal blood vessel (2) Ventral blood vessel (3) Lateral blood vessel (4) All of them

(8) NERVOUS SYSTEM

(A) Central Nervous System :-

(i) Nerve ring

(ii) Nerve cord



- Nervous system is basically represented by ganglia arranged segmentwise 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 alongwith other nerves in the ring integrate sensory input as well as command muscular responses of the body.
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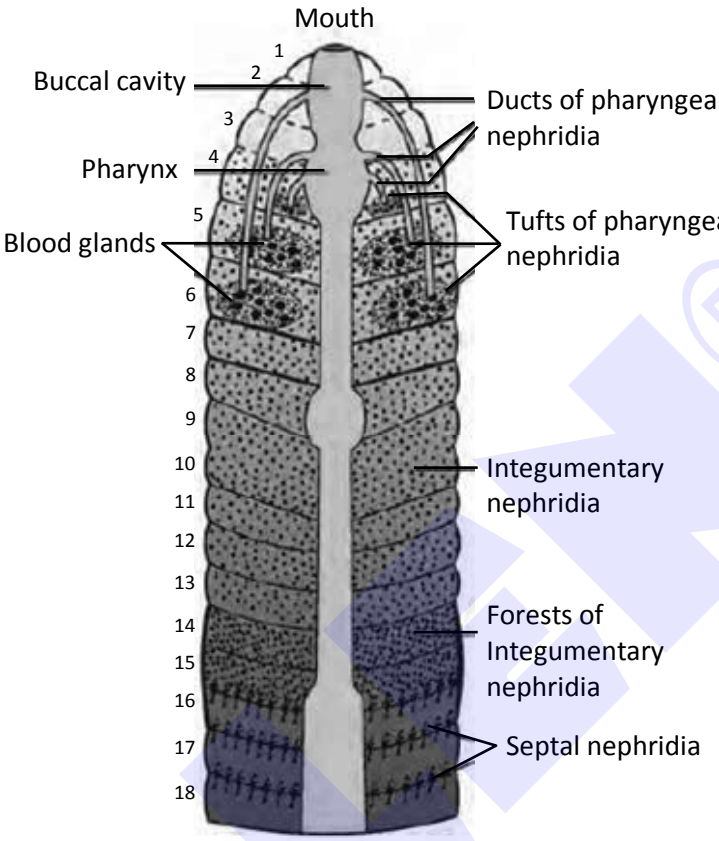
- The nerve cord in the anterior region (3rd and 4th segments) bifurcates, laterally encircling the pharynx and joins the cerebral ganglia dorsally to form a nerve ring. The cerebral ganglia alongwith other nerves in the ring integrate sensory input as well as command muscular responses of the body.
- 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.

(9) EXCRETORY SYSTEM

- **Excretory organ - nephridia**

The excretory organs occur as segmentally arranged coiled tubules called **nephridia.**



Nephridial system in earthworm
NCERT XI Page No.109, Figure No. 7.12

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 (endonephric).

(b) Integumentary nephridia, attached to lining of the body wall of segment 3rd to the last that open on the body surface (exonephric).

(c) Pharyngeal nephridia, present as three paired tufts in the 4th, 5th and 6th segments that open into alimentary canal (endonephric).

These different types of nephridia are basically similar in structure. 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 or digestive tube.

Pheretima - "Ureotelic"

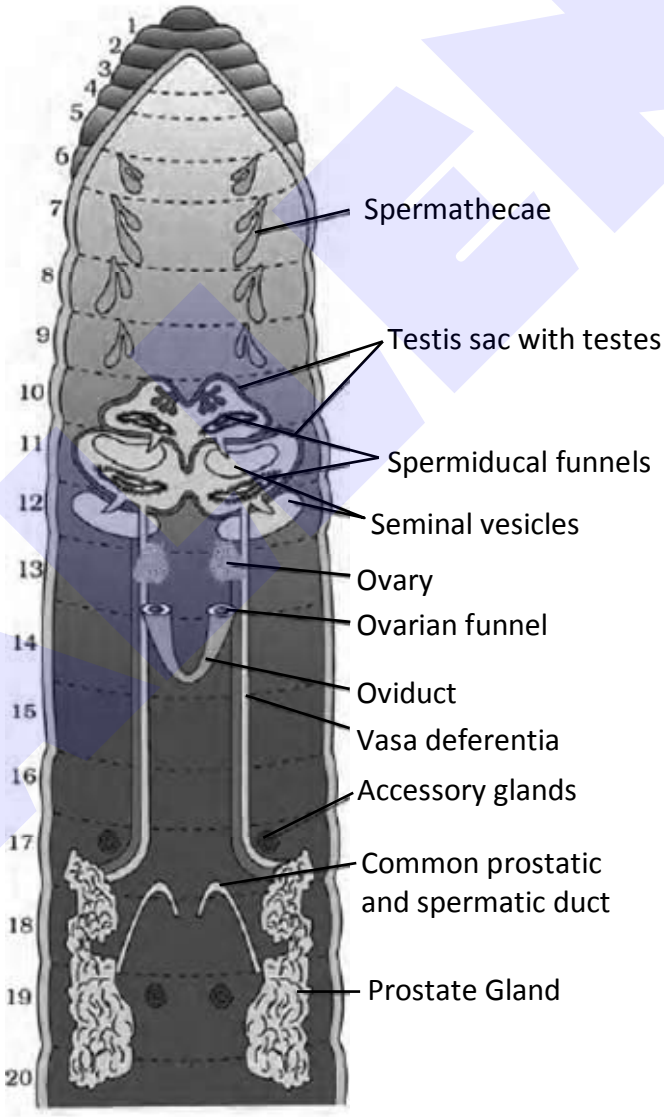
When moisture is more, then "Ammonotelic"

Functioning of Nephridia : Nephridia regulate the volume and composition of the body fluids, as they are abundantly supplied with blood vessels. they bear gland cells which can extract excess of water and nitrogenous wastes from the blood. Integumentary nephridia discharge waste material to the outer body surface through pores. Pharyngeal and septal nephridia discharge them into gut lumen from where they are eliminated with faeces. So, nephridia help in excretion and osmoregulation.

(10) REPRODUCTIVE SYSTEM

Earth worm is monoecious or hermaphrodite (bisexual) i.e. testes and ovaries are present in the same individuals.

Reproductive organs present on ventral side of alimentary canal.



Reproductive system of earthworm
NCERT XI Page No. 110, Figure No. 7.13

(A) Male Reproductive System :

(i) **Testes Sac :** 10^{th} & 11^{th} segment has testes sac. Testes sac formed by coelomic cavity.

(ii) **Testes :** Each testes sac has a pair of testes. Free end of testes is divided in 4 lobes. These lobes produce spermatogonia. Testes are mesodermal in origin.

(iii) **Seminal Vasicles :** A pair of seminal vasicles associated with each testes sac.

- 1 pair - 11^{th} segment
- 1 pair - 12^{th} segment
- Each seminal vesicle is connected to testis sac by a pair of tubules.
- Spermatogenesis completes in "Seminal Vesicle" while testes forms only spermatogonia.
- ***Monocystis*** endoparasite protozoan in earthworm, found in testes or seminal vesicle. They destroy the sperm and causes male sterility.

(iv) **Spermiducal Funnel :** There are two pairs of spermiducal funnels, one in 10^{th} segment and the other in 11^{th} segment. Each spermiducal funnel leads into a fine tube the vas deferens.

(v) **Vas Deferentia :** From each testes sac arises a pair of vas deferentia. They extends upto 18^{th} segment

(vi) **Prostate Gland :** A pair of prostate gland found from 17^{th} to 20^{th} segments.

- Vas deferentia along with duct of prostate gland open by male genital pore.
  So three ducts opens in male gential pore, two vas deferentia and one duct of prostate glands.
  Thus, male genital pore is a group of three pores.

(vii) **Accessary glands :** 1^{st} pair in 17^{th} and second pair in 19^{th} segment. These open outside the body at the apex of genital papilla. Its secretion helps to bind to ***Pheretima*** during copulation.

(B) Female Reproductive System :

(i) **Ovary :** One pair of ovary are located in 13^{th} segment and they are connected to ***Intersegmental septa.***

- The free end of ovary is divided into many lobes. In each lobe, eggs are found in rows.
- Eggs are arragned in acropetal order.

(ii) **Oviducts :** Two oviducts located beneath ovary.

- Both oviduct combine and open outside the body by female genital pore in 1^{st} cliteller segment

(iii) Spermathecae : from 6^{th} to 9^{th} segments, one pair in each.

- Each spermathecae has two parts :- Ampulla and Neck.
- A duct is associated with the neck this is known as diverticulum. After copulation sperms are stored in it.
- Ampulla secretes nutritive liquid, this provides nutrition to sperms.

(C) Copulation :

Breeding season - At night of rainy season the two ***Pheretima*** come closer to each other and tie in opposite direction. 18^{th} segment of one comes in contact with 5^{th} '6^{th} segment of other ***Pheretima***.

- A small tube (papilla) is formed around the male genital aperture. This is known as copulation tubes or copulation pegs.
- The copulation tube of one earthworm inserts into spermathecal pore of other.
- The transfer of sperms take place here.
- Spermathecae gets filled with sperms in one hour.

(D) Cocoon Formation :

- *Pheretima* shows protandrous condition.
- A slimy fluid is secreted by glandular cells of clitellum. This then comes in contact with air and forms a pouch around clitellum. This is known as **cocoon** (size 2.0-2.4 mm)
- The eggs comes out from female genital pores and get filled up in cocoon.
- Earth worm wringles back side and cocoon proceeds towards front side.
- When cocoons passes over the spermathecae the sperms gets filled in it.
- Nutritive fluid is given by albumin gland of epidermis.
- Pheretima completely wringles out from the cocoon. fertilization takes place in cocoon only. this is known as **"external fertilization".**

(E) Developement : "In 2-3 weeks"

- ***Pheretima*** gets fully developed and they come out by **hatching**. They do not have clitellum soon they develop clitellum.
- In young earthworm - Setae present in clitellur part.

After about three weeks, each cocoon produces 2 to 20 baby worms with an average of four.

Golden Key Points

- Neurohormone - Secreted from supra pharyngeal ganglion of *Pheretima*. These hormones control regeneration of injured tissue, developement of clitellum, and other accessory sexual organs, maturation of gametes, cocoon-formation and shedding of gametes etc.
- **Natural life cycle of *Pheretima* - 3.5 to 10.5 years**
- **Economic Significance of *Pheretima* & other earthworms -**
  (1) The burrows makes the soil (land) porous.
  (2) They are natural ploughmen of land. So they are friends of farmers.
  (3) They act as bait for fishing process.
  (4) ***Pheretima*** used to cure rheumatism, piles, asthma, pyorrhoea, impotency, ulcer, jaundice etc.
- **Harms caused by earthworms :-**
  (1) Increases soil erosion, ***Pheretima elongata*** - harms the roots of betal plant.
  Some earthworms also harms the plant of paddy and "elaichi plants - e.g. ***"Malabaria padudicola"***
  (2) Acts as hosts for transmission of some parasites (e.g. Gapeworm of chickens)
  (3) Some times they get burried with dead bodies thus they bring up the infection and harmful microbes with them on the surface.

BEGINNER'S BOX — NERVOUS, EXCRETORY & REPRODUCTION

1. Pretyphlosolar region in the intestine of earthworm extends from –
(1) 27^{th} segment to 95^{th} segment
(2) 15^{th} segment to 26^{th} segment
(3) 95^{th} segment to last segment
(4) 1^{st} segment to 15^{th} segment

2. Nephridia of earthworm which are enteronephric type include ?
(1) Pharyngeal nephridia
(2) Integumentary nephridia
(3) Septal nephridia
(4) Pharyngeal and septal nephridia

3. Flow of blood in lateral heart of earthworm is –
(1) Upwards
(2) Downwards
(3) Forwards
(4) Backwards

4. 8^{th} Segment of earthworms body contains which part of its digestive system?
(1) Stomach
(2) Oesophagus
(3) Gizzard
(4) Typhlosole

5. Which of the following blood vessels in earthworm is both collecting as well as distributing in nature ?

(1) Dorsal vessel (2) Ventral vessel

(3) Sub neural vessel (4) Lateral oesophageal vessel

6. A biology student has to distinguish the anterior and posterior end of *Pheretima* morphologically. For it, he/she can observe/locate –

(1) Movement (2) Eyes (3) Clitellum (4) Tentacles

7. In *Pheretima,* the dorsal surface is marked by a mid dorsal line, where as the ventral surface is distinguished by the presence of –

(1) Ventral blood vessels (2) Genital pores

(3) Absence of setae (4) Opening of nephridia

8. Which type of nephridia in earthworm are present on both the sides of intersegmental septa of segment 15 to the last and open into intestine?

(1) Pharyngeal (2) Septal (3) Integumentary (4) Both (2) & (3)

9. Mark the incorrect statement for *Pheretima* ?

(1) Fertilization and development takes place in cocoon

(2) Each cocoon produces two to twenty worms with an average of four

(3) There is no larval stage i.e. development is direct

(4) Mouth is placed in first segment called Prostomium

10. In *Pheretima* sperms belonging to same earthworm is stored in –

(1) Seminal vesicle (2) Diverticula of spermatheca

(3) Ampulla of spermatheca (4) Prostate gland

BEGINNER'S BOX — ANSWERS KEY

INTRODUCTION & MORPHOLOGY

Que.	1	2	3	4	5
Ans.	**4**	**2**	**3**	**2**	**1**

BODY-WALL, BODY-CAVITY & LOCOMOTION

Que.	1	2	3	4	5
Ans.	**1**	**2**	**3**	**4**	**1**

DIGESTION, RESPIRATION & BLOOD VASCULAR SYSTEM

Que.	1	2	3	4	5	6	7
Ans.	**3**	**1**	**4**	**2**	**1**	**1**	**1**

NERVOUS, EXCRETORY & REPRODUCTION

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	**2**	**4**	**2**	**3**	**1**	**3**	**2**	**2**	**4**	**1**

- Nocturnal animal.
- Metamerically segmented.
- 1st segment known as peristomium (Buccal segment).
- Last segment known as pygidium.
- Number of total segment is about 100 – 120 segment.
- Clitellum (cingulum) present in segment number 14th, 15th and 16th.
- Clitellum secretes cocoon.
- Between metameres intersegmental septa present.
- Body colour is Brownish due to presence of porphyrin pigment.
- At mid-dorsal surface dark line present which represent to dorsal blood vessel.
- In each body segment except the first, last and clitellum there are rows of s-shaped setae is present. (Help in locomotion).

BODY-WALL

- Cuticle Layer
- Epidermis Layer
  - Supporting cells
  - Glandular cells
  - Basal cells
  - Sensory cells
- Muscle Layer
- Coelomic Epithelium

DIGESTIVE SYSTEM OF EARTHWORM

Alimentary Canal
Intestine has typhlosole
Function-Absorption of digested food

Glands
- Pharyngeal glands with chromophil cell
  Function – Secrete mucus and proteases
- Calciferous glands present wall of stomach
  Function – Neutralizes acidity of soil

CIRCULATORY SYSTEM OF EARTHWORM

Blood vascular system
Dorsal blood vessels, Ventral blood vessels, Latteral oesophageal vessels, sub-neural blood vessels, supra-oesophageal blood vessel

Blood
Red colour with respiratory pigment which dissolve in plasma

Blood glands
Present in 4th, 5th & 6th segment
Function – Blood cell and haemoglobin formation

Heart
- **Lateral heart** present in 7th & 9th segment
- **Lateral oesophageal heart** present in 12th & 13th segment

EXCRETORY SYSTEM OF EARTHWORM

Septal Nephridia (Enteronephric)
Main role is water conservation

Pharyngeal Nephridia (Enteronephric)

Integumentory Nephridia (Exonephric)

Function – Osmoregulation and excretion.

- Earthworms are mainly ureotelic but planty of water present in surrounding ammonotelic

NERVOUS SYSTEM OF EARTHWORM

Nerve ring/Brain ring

- Brain present but no head
- Nerves are motor, sensory and adjustor type

Nerve cord
Double, ventral and solid

SENSE ORGAN OF EARTHWORM

Epidermal Receptor (Tango receptor)

Buccal Receptor (Gustatory & Olfactory)

Photo Receptor
Use to judge intensity and duration of light do not capacity of vision
(Because no eye)

REPRODUCTIVE SYSTEM OF EARTHWORM

Male

Testis – Two pairs (10^{th} and 11^{th} segment)
Seminal vesicles – (11^{th} and 12^{th} segment)
Accessory gland – (17^{th} and 19^{th} segment)
Genital papillae – (17^{th} and 19^{th} segment)
Male genital pore (18^{th} segment)
Prostate gland (17^{th} to 20^{th} segment)

Female

Ovary – One pairs (13^{th} segment)
Female genital pore (14^{th} segment)
Spermatheca 4 pairs (6^{th} to 9^{th} segment)

- Earthworm are monoecious or hermaphrodite
- No self fertilization in earthworm