Metazoans

Metazoa is a major kingdom in the tree of life that encompasses all multicellular, eukaryotic organisms that are heterotrophic (they obtain energy by consuming organic material). This group represents a diverse and complex lineage of life forms characterized by their ability to move at some stage of their life cycle, specialized tissues such as muscles and nerves. They exhibit various body symmetries (radial, bilateral, or asymmetrical), and the development of body plans through embryonic stages.

Metazoa is divided into various phyla based on body structure, development, and evolutionary relationships. The major groups within Metazoa, based on their evolutionary and structural features, are classified into several phyla, including:

1. Phylum Porifera (Sponges)
2. Phylum Cnidaria (Coelenterates, e.g., jellyfish, corals)
3. Phylum Ctenophora (Comb jellies)
4. Phylum Platyhelminthes (Flatworms)
5. Phylum Nematoda (Roundworms)
6. Phylum Annelida (Segmented worms, e.g., earthworms – type study species)
7. Phylum Arthropoda (Insects, crustaceans, spiders)
8. Phylum Mollusca (Snails, clams, squids)
9. Phylum Echinodermata (Sea stars, sea urchins)
10. Phylum Hemichordata (Acorn worms, a link between invertebrates and chordates)
11. Phylum Chordata (Vertebrates and related species, e.g., fish, amphibians, reptiles, birds, mammals).

1- Phylum Porifera

Porifera, commonly known as **sponges**, is a phylum of simple, aquatic animals that are among the earliest multicellular organisms in the evolutionary history of life. The name "Porifera" means "pore-bearing," reflecting their porous body structure, which is crucial for their filter-feeding lifestyle.

Characterizations of Porifera:

1. **Body Structure**:
   - Sponges have a porous body with an internal canal system for water circulation.
   - They lack true tissues and organs but have specialized cells, such as choanocytes (collar cells) for feeding and amoebocytes for nutrient transport.
2. **Symmetry**:
   - Mostly asymmetrical, though some species exhibit radial symmetry.
3. **Skeleton**:
   - Their body is supported by a skeleton made of spicules (made of calcium carbonate or silica) or spongin (a protein).

4. **Feeding**:
    - Sponges are filter feeders, drawing water through their pores and trapping food particles using choanocytes.
5. **Reproduction**:
    - Can reproduce both sexually (via gametes) and asexually (by budding or fragmentation).
6. **Habitat**:
    - Mostly marine, though a few species are found in freshwater.
7. **Ecological Role**:
    - Sponges contribute to aquatic ecosystems by filtering water, providing habitats for microorganisms, and participating in nutrient cycling. Examples: *Sycon, Euplectella, Spongilla and Euspongia*.

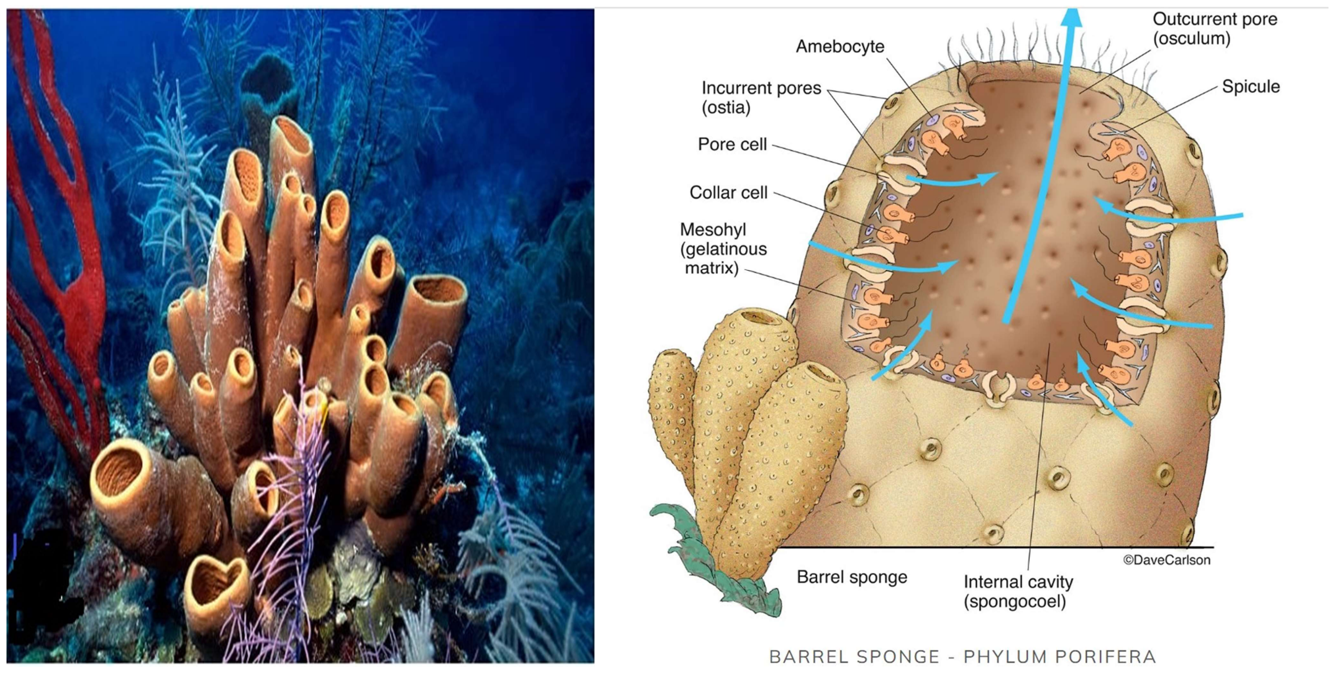

Figure 01 : Barral sponge – Phylum Porifera

2- Phylum Cnidaria

Phylum Cnidaria is a diverse group of animals that includes well-known species such as jellyfish, corals, sea anemones, and hydras. These animals are primarily marine, though some species are found in freshwater. Cnidarians are characterized by their radial symmetry, tentacles, and the presence of specialized cells called cnidocytes, which contain stinging organelles called nematocysts.

Characterizations of of Cnidaria:

- **Body Structure:** Cnidarians have a simple body structure, consisting of a soft, gelatinous body and two main body forms: the polyp (sessile, tube-like) and the medusa (free-swimming, umbrella-shaped). The most distinctive feature of cnidarians is the presence of cnidocytes, specialized cells located on their tentacles and other parts of the body.
- These cells contain nematocysts, which are stinging organelles used for defense and capturing prey. When triggered, nematocysts eject a sharp, venomous thread that can paralyze or immobilize prey.

- **Body Layers:** Cnidarians have a two-layered body (diploblastic structure), with an outer epidermis and an inner gastrodermis surrounding a gelatinous mesoglea (middle layer). They lack complex organs but have a nerve net for simple coordination of movements and responses.

- **Symmetry:** Most cnidarians exhibit radial symmetry (e.g., jellyfish and sea anemones), meaning their body parts are arranged symmetrically around a central axis. Some species, like Hydra, have bilateral symmetry during certain life stages.

- **Digestive System:** Cnidarians have a single opening that serves both as a mouth and an anus, leading to a gastrovascular cavity where digestion occurs. They are incomplete digestive systems, as food enters and waste exits through the same opening.
- **Nervous System:** Cnidarians have a simple nerve net, a decentralized nervous system that allows for basic coordination of body movements. Some species have more developed sensory structures such as ocelli (simple eyes) and statocysts (balance organs).
- **Reproduction:** Many cnidarians can reproduce by budding, where new individuals grow from the body of the parent (common in polyps). Cnidarians also reproduce sexually through the release of eggs and sperm into the water, forming larvae that develop into new individuals.

- **Habitat:** Cnidarians are predominantly marine animals, with a few species in freshwater environments. They can be found in a range of habitats, including coral reefs, open ocean, shallow waters, and deep sea.

Examples: *Physalia, Adamsia,Hydra .*

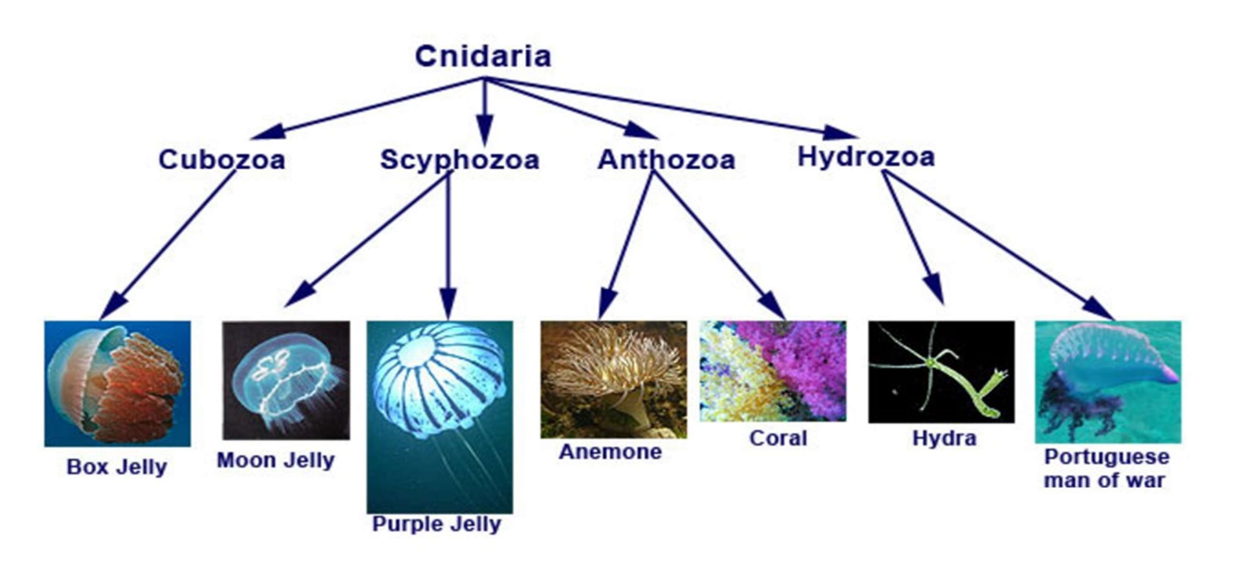

Figure 02: Different Classes of Cnidaria

3- Phylum Ctenophora

Phylum Ctenophora, commonly known as comb jellies, is a group of exclusively marine, gelatinous animals renowned for their unique mode of locomotion using rows of cilia and their often bioluminescent appearance. Despite their jelly-like consistency and superficial resemblance to jellyfish, they differ significantly from members of the phylum Cnidaria.

Characterizations of of of Ctenophora

1- Body Structure:

- Gelatinous, transparent, and soft-bodied animals.
- Most are oval, spherical, or ribbon-like in shape.
- Characterized by eight rows of ciliary plates (ctenes), which are used for swimming.
- The body is organized with biradial symmetry, meaning it is symmetrical along two planes.

2- Locomotion: Locomotion is achieved using the ctenes, which are bands of fused cilia. They are the largest animals to rely entirely on cilia for movement.

3- **Feeding:** Ctenophores are mostly carnivorous, feeding on plankton, small crustaceans, and fish larvae. Many have tentacles with specialized adhesive cells called colloblasts, which secrete a sticky substance to trap prey. Some are "gulpers" and directly swallow prey.

4- **Nervous System:** They have a simple nerve net, with no centralized brain.
A specialized organ called the statocyst helps them maintain balance and orientation in the water.

5- **Digestive System:** The gastrovascular cavity serves both digestive and circulatory functions. They have a simple digestive system with a mouth and anal pores, making them more advanced than Cnidarians, which have only one opening.

6- **Reproduction:** Most ctenophores are hermaphroditic (having both male and female reproductive organs). They reproduce sexually by releasing eggs and sperm into the water, and fertilization is typically external. They can also reproduce asexually in some cases.

7- **Bioluminescence:** Many species exhibit bioluminescence, producing light in the dark, which serves as a defense mechanism or to attract prey.

8- **Habitat:** Found in all marine environments, from shallow coastal waters to the deep sea.
Most are planktonic (floating in the water column), though a few species can be benthic (living on the seafloor).

Examples:

- *Pleurobrachia* (commonly called the sea gooseberry).
- *Mnemiopsis leidyi* (Known for its invasiveness, particularly in the Black Sea.)
- *Pleurobrachia bachei* (Often called the "sea gooseberry," this is a common and well-studied species.)
- *Beroe ovata* (A predatory ctenophore that feeds on other ctenophores.)

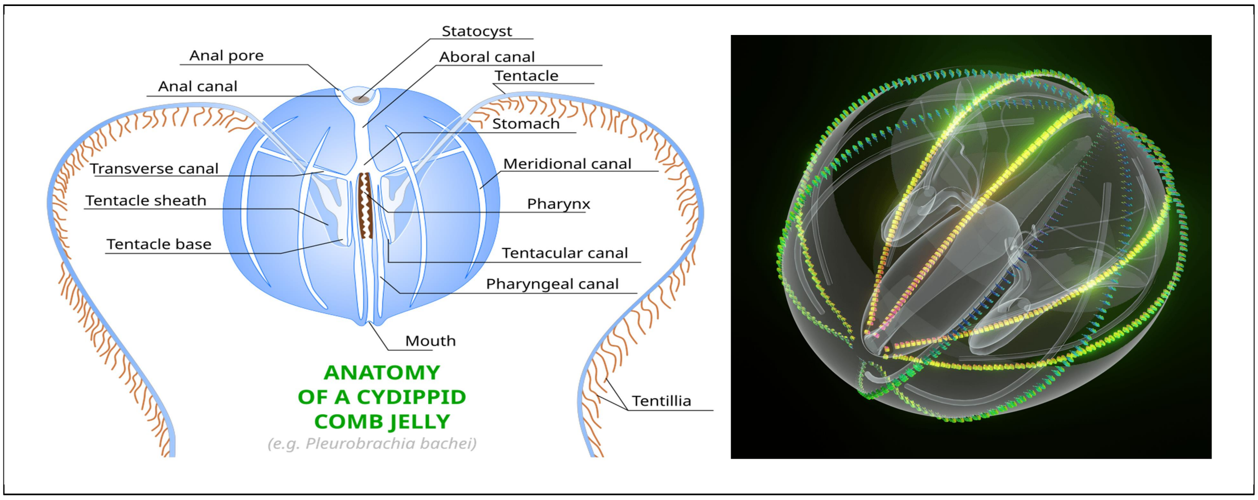

Figure 03 : *Pleurobrachia bachei* of Ctenophora

4- Phylum Platyhelminthes

hylum Platyhelminthes, commonly known as **flatworms**, is a group of simple, bilaterally symmetrical, and unsegmented invertebrates. They are among the earliest organisms to exhibit cephalization (the development of a head region) and a triploblastic body structure (three embryonic germ layers). This phylum includes both free-living and parasitic species.

Characterizations of Platyhelminthes

1. **Body Structure**:
    - Flatworms have a **dorsoventrally flattened body**, which is why they are called "flatworms."
    - Their body is **bilaterally symmetrical**, with distinct anterior (head) and posterior (tail) ends.
    - They are **triploblastic**, having three germ layers: ectoderm, mesoderm, and endoderm.
2. **Digestive System**:
    - They have an **incomplete digestive system** with only one opening that serves as both mouth and anus.
    - In parasitic species, the digestive system is often reduced or absent, as they absorb nutrients directly from their host.
3. **Nervous System**:
    - Flatworms have a simple nervous system with a pair of **cerebral ganglia** (primitive brain-like structures) and longitudinal nerve cords.
    - Free-living species possess **ocelli** (light-sensitive eyespots) for detecting light.
4. **Excretory System**: Platyhelminthes have a unique excretory system called **protonephridia**, which consists of flame cells (specialized cells that filter waste).
5. **Reproduction**:
    - **Hermaphroditic**: Most species possess both male and female reproductive organs.
    - Reproduction can be **sexual** (cross-fertilization) or **asexual** (through regeneration or fission).
6. **Locomotion**:
    - Free-living flatworms move using **cilia** on their ventral surface or by muscular contractions.
    - Parasitic species rely on their hosts for transportation.
7. **Habitat**:
    - Free-living species are found in **aquatic habitats** (marine and freshwater) and moist terrestrial environments.
    - Parasitic species live inside their hosts.
8. **Parasitism**:
    - Many flatworms are **endoparasites** (living inside the host) or **ectoparasites** (living on the host).
    - They have adaptations such as hooks, suckers, and a highly reduced digestive system for parasitic life.

Examples: *Fasciola hepatica* (liver fluke); *Echinococcus* (hydatid tapeworm); *Taenia solium* (pork tapeworm)

Planaria	*Taenia saginata*	*Echinococcus*
Class Turbellaria (Free-living Flatworms)	Class Cestoda parasitic flatworms	Class Cestoda parasitic flatworms

Figure 05: Examples of Platworms

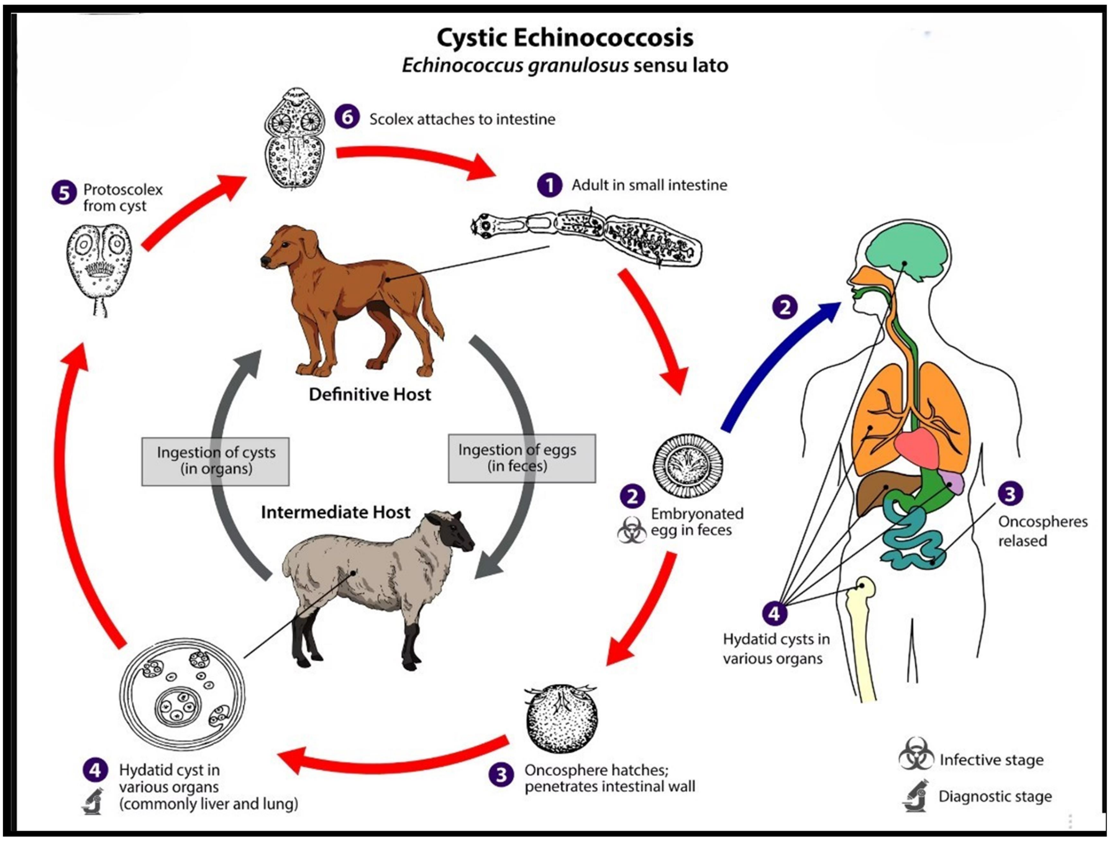

Figure 06: Life cycle of a hydatid tapeworm

5- Phylum Nematoda

Phylum Nematoda, commonly known as **roundworms**, includes a wide range of cylindrical, unsegmented worms. These organisms are abundant and diverse, inhabiting virtually all environments. Nematodes can be free-living or parasitic, and they are known for their tough outer cuticle and pseudocoelomate body structure.

Characterization of Nematoda

1. **Body Structure**:
   - Roundworms are **cylindrical**, **elongated**, and **tapered at both ends**.
   - They exhibit **bilateral symmetry** and are **triploblastic**.
   - The body cavity is a **pseudocoelom**, which serves as a hydrostatic skeleton.
2. **Digestive System**:
   - Nematodes have a **complete digestive system** with a separate mouth and anus.
   - They feed on organic matter, microorganisms, or host tissues (in parasitic species).
3. **Cuticle and Molting**:
   - Covered by a **tough, flexible cuticle** that provides protection and support.
   - The cuticle is periodically shed during growth (molting).
4. **Nervous System**:
   - A simple nervous system consisting of a **nerve ring** around the pharynx and longitudinal nerve cords.
   - They have chemosensory organs for detecting environmental cues.
5. **Reproduction**:
   - Most nematodes are **dioecious** (separate sexes), though some are hermaphroditic.
   - Reproduction is sexual, with internal fertilization. Females are often larger than males.
6. **Movement**:
   - Move using **longitudinal muscles**; they exhibit a characteristic thrashing motion due to the lack of circular muscles.
7. **Habitat**:
   - Found in **soil**, **water**, and inside host organisms (parasitic species).
   - They are incredibly adaptable and can survive in extreme environments.
8. **Parasitic Nematodes**:
   - Many are important parasites of plants, animals, and humans.
   - Examples:
     - *Ascaris lumbricoides* (human roundworm)
     - *Wuchereria bancrofti* (causes elephantiasis)
     - *Trichinella spiralis* (causes trichinosis)

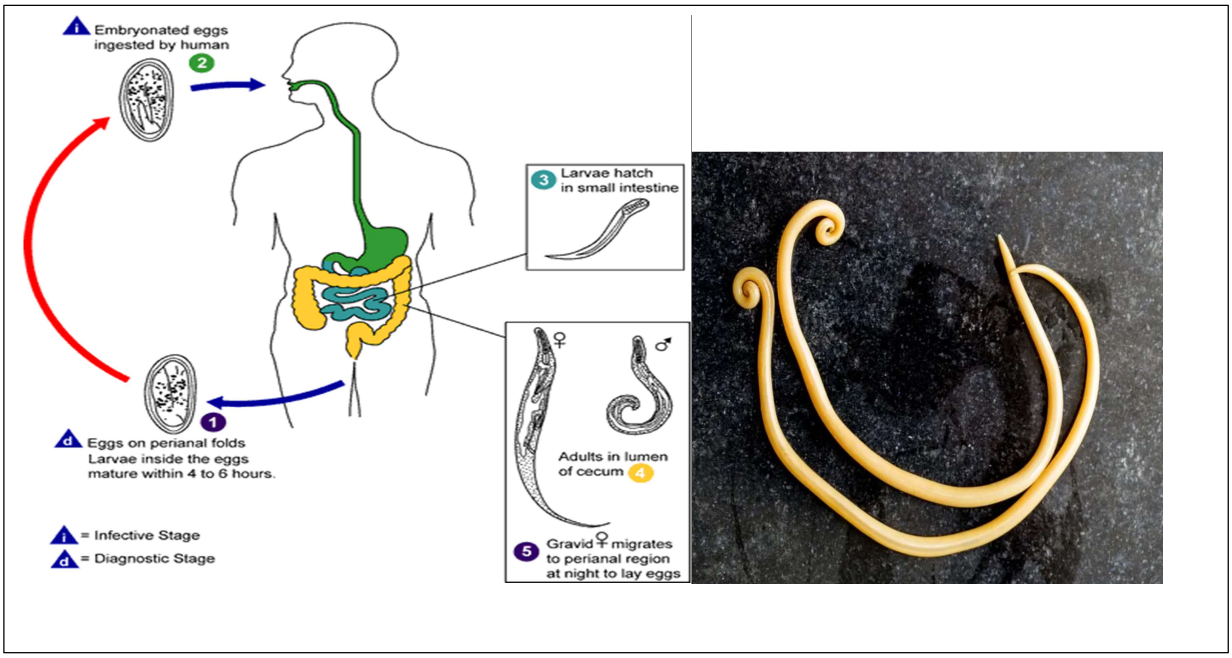

Figure 07: Life cycle of *Ascaris lumbricoides* (human roundworm)

6- Phylum Annelida

Phylum Annelida, known as **segmented worms**, includes organisms with a segmented, coelomate body. This phylum is highly diverse and includes species like earthworms, leeches, and marine worms. Annelids are known for their segmented bodies and advanced organ systems.

<u>Characterization of of Annelida</u>

1. **Body Structure**:
    - Annelids are **bilaterally symmetrical** and **triploblastic**.
    - Their bodies are divided into **segments (metameres)**, with internal partitions (septa).
    - They have a **true coelom**, which acts as a hydrostatic skeleton.
2. **Digestive System**:
    - They possess a **complete digestive system** with specialized organs like the pharynx, crop, gizzard, and intestine.
3. **Circulatory System**:

- Annelids have a **closed circulatory system** with blood confined to vessels.
- Some have hemoglobin or similar respiratory pigments for oxygen transport.

4. **Nervous System**:
   - They have a **centralized nervous system**, with a pair of cerebral ganglia (brain) and ventral nerve cords.
5. **Excretory System**: Excretion is carried out by paired **nephridia** in each segment.
6. **Reproduction**:
   - Annelids can be **hermaphroditic** (e.g., earthworms) or **dioecious** (separate sexes).
   - Reproduction can be **sexual** or **asexual** (e.g., regeneration).
7. **Locomotion**: Movement is achieved through the use of **longitudinal and circular muscles** working in conjunction with **chitinous bristles (setae)**.
8. **Habitat**:
   - Annelids are found in **terrestrial**, **freshwater**, and **marine** environments.
   - They occupy diverse ecological niches as decomposers, predators, and parasites. **Example:** *Lumbricus terrestris* (common earthworm).

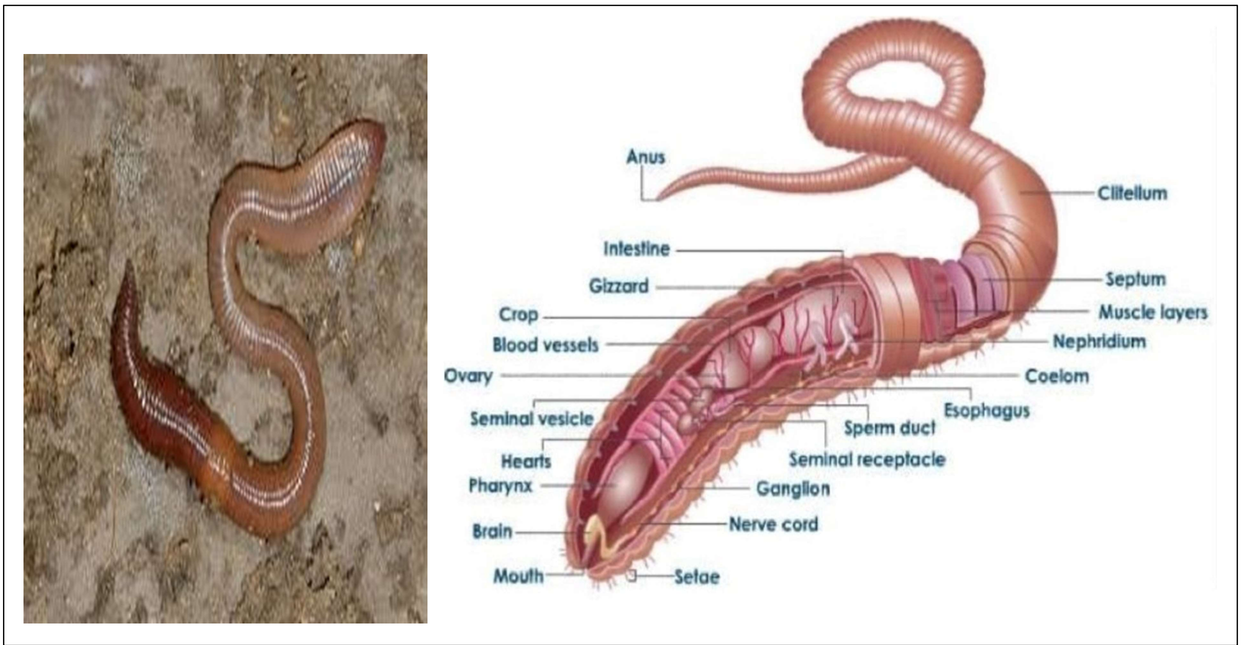

Figure 08: *Lumbricus terrestris* (common earthworm)