

NEMATODES

General Characteristics

- Elongated, cylindrical, unsegmented roundworm
- Sexes are separate, dioecious
- Head: No sucker, no hook
- Alimentary canal complete
- Body cavity present

- They have **pseudocoelom=body cavity**. The pseudocoelom is filled with **hemolymph**. A fluid filled body cavity acts as a cushion (protection to the organs) and a skeleton.
- Nematodes have **separate sexes** (Dioecious); female is usually larger than male.
- Body is tapered at both ends. There is a copulatory organ posterior end of the male.

The body wall is composed of a thick **cuticle**, a **hypodermis** and a layer of longitudinal **muscle** only, there is no circular or diagonal muscle

Cuticle

- The body is covered with a noncellular, highly resistant coating called a **cuticle**. An elastic cuticle covers the body surface of nematodes; **it is periodically molted**
- Cuticle is secreted by hypodermis
- **The cuticle not only covers the entire external surface, but it also lines the buccal cavity, esophagus, rectum, cloaca, vagina, and excretory pore**
- Specialized structures such as **papilla** (spine-like or finger-like / oral-cervical-caudal), **vesicle**, **alae** (wing-like / cervical-caudal), **leaf crown** (external and internal), **plaque** (plate-like), **cordons** (cord-like), **bursal ray** and **copulatory bursa** may be present on the cuticle; these structures may be sensory

Hypodermis

- Hypodermis produce the cuticle layer
- Two lateral cords contain the **excretory canal** when these are present, while dorsal and ventral cords contain **longitudinal nerves**.

Muscle

- The cuticle, hypodermis, and somatic musculature make up the **body wall**
 - Within and closely associated with the hypodermis are one or more layers of **longitudinally arranged muscle cells** (somatic)
 - Locomotion/movement is effected by undulating waves of muscle contraction and relaxation.
 - The multiple longitudinal rows of muscle cells in each of four quarters of a circle is termed **polymyarian**, one with no more than 2 rows of cells is called **holomyarian**, and one with 2 to 5 rows is **meromyarian**

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Pseudocoelom=Body cavity

- A space within the body cavity allows for **the reproductive and digestive systems** to evolve more complex shapes and functions
- The pseudocoelom is filled with **hemolymph**. A fluid lined chamber offers protection to the gut and other organs; acts as a cushion
- The fluid filled body cavity acts as a skeleton - **hydrostatic skeleton**, providing support and rigidity for a soft bodied animal

Digestive System

Mouth opening
or buccal cavity

esophagus

intestine

anus

- Have digestive system. It is simple, complete and tubular
- Consists of an anterior **Mouth** (simple oral opening or large/small buccal capsule may contain teeth, cutting plates), **Oesophagus** (is of variable form, muscular and pumps food into the intestine), **Gut** (is tube whose lumen, contain a single layer of cells and microvilli, which increase the absorptive capacity of the cells), **Cloaca** (in males there is a cloaca which functions as an anus) or **Anus** (in females the intestine terminates in an anus).

- Ingested from mouth food enters muscular region- esophagus or pharynx
- This is pumping organ that sucks/pumps food into the alimentary canal and into intestine (**Because of the hydrostatic pressure of the pseudocoelum** which acts on the intestine, the nematodes require a muscular pharynx or oesophagus in order to feed).
- In the muscles of the esophagus have glands- digestive enzymes- amylase, proteases, pectinases, chitinases, anticoagulants.
- Food in parasitic nematodes is **blood, tissue cells, body/mucosal fluid, intestinal contents or cell debris.**
- Free living nematodes feed on **bacteria** etc.

Nervous System

- It is primitive. There are 2 major nerve centers in nematodes:
 1. The circumesophageal **nerve ring** or **a central ganglion**
 2. **Nerves** (dorsal, ventral longitudinal nerves)

Parasitic nematodes have sense organs (mechanoreceptors and chemoreceptors)

1. Mechanoreceptors; These receptors are papillae

- Located around the mouth are papillae of 2 types: **labial papilla** on the lips surrounding the mouth and **cephalic papilla** behind the lips
- Other papillae may be found at different levels of the nematode body, e.g. **caudal papilla**, observed in many males; aids in copulation
- **Cervical papilla**

2. Chemoreceptors;

- **Amphids** are chemoreceptors located in shallow anterior pits
- **Phasmids** are a set of chemoreceptors at the posterior end

Excretory System

- It is very primitive. The basic component is comprised of 1 or 2 **renettes**, large unicellular glands that empty through **longitudinal excretory canals** and an **excretory pore**
- The renettes and the excretory pore are usually located anteriorly
- This system has a function in the removal of wastes (It is osmoregulatory)

Reproductive System

- Reproduce with sexually (copulation)

Male

- One **testis**. Testis, location of sperm production
- **Vas deferens** (sperm duct) extends distally to the **cloaca**
- Vas deferens are evident before it enters the cloaca: the **seminal vesicle** (sperm storage) and the **ejaculatory duct**.
- Organelles in copulation: Male nematodes have with one or two copulatory **spicules** and cuticular structures. The spicules are important during copulation in that **they keep the female vulva open**, thus facilitating the **entry of sperm into the female reproductive tract** (Spicules are used to open the vulva for sperm deposition). Other accessory structure may be present, including a **gubernaculum** and in some species **telamon**; serves to guide the spicules when they are extended.
- In addition to, **caudal alae** or **copulatory bursa**. These structures embrace female during copulation.

Female Reproductive System

- Nematodes generally have 2 cylindrical **ovaries** and **uterus**. Ovary, location of egg production. Followed by **oviduct** and **uterus** terminating in a vulva. **Eggs mature in uterus**.
- The uteri unite to form a **vagina** that opens through a **vulva**, usually located near mid body. Vulva, **opening to the outside environment**.
- Fertilization becomes in **receptaculum seminis**
- The distal portion of the uterus, the **ovjector**, is a short muscular organ, which **assists to expel mature eggs**

Life cycle includes..

- Egg

- There have 4 larval stage (L1, L2, L3, L4).

Sometimes the sexually immature adult stages are called L5. Each larval stage ends with molting.

- Adult stage

- Egg produce

- Direct life cycle (generally). Nematodes generally live one or two types of life cycle; free-living or parasitic.

- Free-living nematodes live in environments.

- Parasitic nematodes live within a host. (The L3 stage is normally the infective stage for parasitic nematodes. 1st and 2nd stage are rhabditiform, 3rd stage is filariform)

- Each stages will be ended with molting process. After the final moult, the nematodes will differentiate into males and females. Females can then produce fertile eggs or larvae.

LARVAE TYPES



Microfilaria

It is parasitic larva living in the blood circulatory system.



Filariform larvae

Larva in parasitic cycle is filariform.



Rhabditiform larvae

Larva in pre-parasitic cycle is rhabditiform.

Strongylid type

Ascaridoid type

Oxyuroid type

Trichuroid type

Spiruroid type

EGG TYPES in NEMATODES