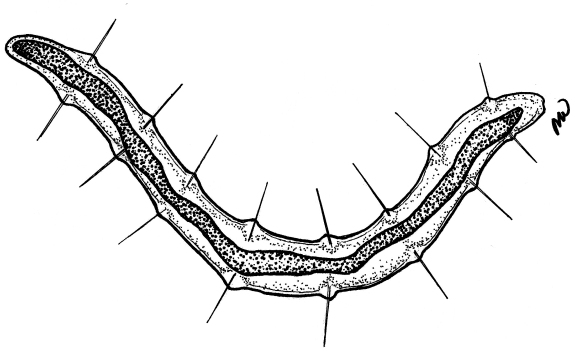
# phylum Annelids

## Metameric Segmentation

Annelids are one of only a few relatively distantly related groups that exhibit **metamerism**. Metameric segmentation is characteristic of the Panarthropoda, Annelida, and Chordata. Due to the distant relationships between these groups, it is most likely that metamerism evolved at least three times in the animal kingdom.

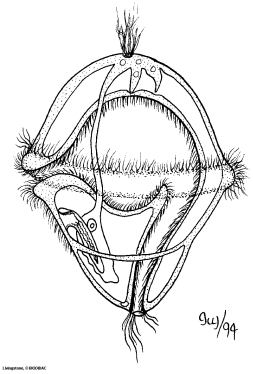
The division of the body into segments which contain repeated organs is advantageous for several reasons. Segmentation allows for more efficient modes of locomotion, due to the ability to have independent but coordinated muscular control of individual segments and limbs attached to those segments. It also allows for an independent hydrostatic skeleton in each segment. This allows for different parts of the body to move in different ways. Furthermore, segmentation allows the animal some degree of redundancy, since often, organs are repeated in multiple segments.



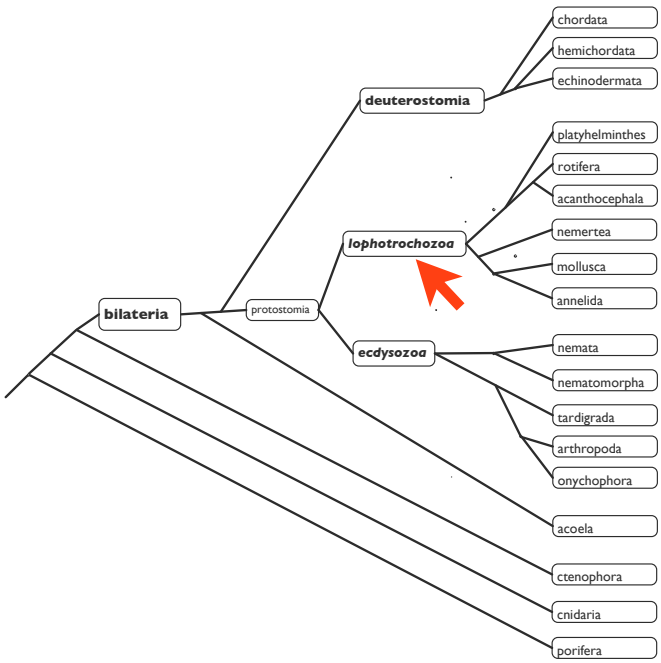
**Tagmatization** is a reduction in the number of segments due to the specialization of groups of segments to perform specific functions -- another advantage of segmentation. This evolutionary trend is especially evident in the diversity of arthropods. Annelids exhibit very little tagmatization, but they do exhibit some specialization of individual segments.

## Lophotrochozoa

The annelids are included in the clade Lophotrochozoa, which includes a large number of phyla that share either the presence of a **trochophore** larva or a feeding structure called a lophophore. The annelids and the molluscs are also part of the smaller clade Trochozoa, including just the phyla that possess a trochophore.



The trochophore larvae is found in most species of annelids, but is generally lost in the terrestrial species. The planktonic trochophore is wrapped in bands of cilia that are used for swimming.




## Organization

Annelids are triploblastic eucoelomates. They possess a true coelom, and a closed circulatory system. The fluid-filled coelom functions as a hydrostatic skeleton in the annelids. The outer layer of the body is covered in a tough proteinaceous cuticle, and muscles work in opposition to the independent hydrostatic pressure of each segment.

The body of an annelid demonstrates a large degree of cephalization, with most of the important structures concentrated on the anterior end of the body. The head of annelids is composed of two parts: the **prostomium** and the **peristomium**. The most posterior segment of the body is the **pygidium**. During development, new segments bud anteriorly from a growth section at the posterior of the body. Therefore, the newest segments of the body are the most posterior ones (not counting the pygidium). The body of most annelids is covered with chitinous bristles called **setae** (**chaetae**). Setae are used by annelids as anchoring devices and are also involved in locomotion in many species. In polychaetes, each segment possesses paired **parapodia** that often serve as gills or locomotor structures. Often the parapodia are covered with setae.

# Classification

Class Polychaeta - The largest group of annelids, in terms of species number and diversity. As the name suggests, polychaetes possess many setae. Large numbers of parapodia are common. Some are sessile tubeworms, others are burrowing suspension feeders, others are predatory. Some possess large jaws and venom for subduing prey. Often complex reproductive systems.

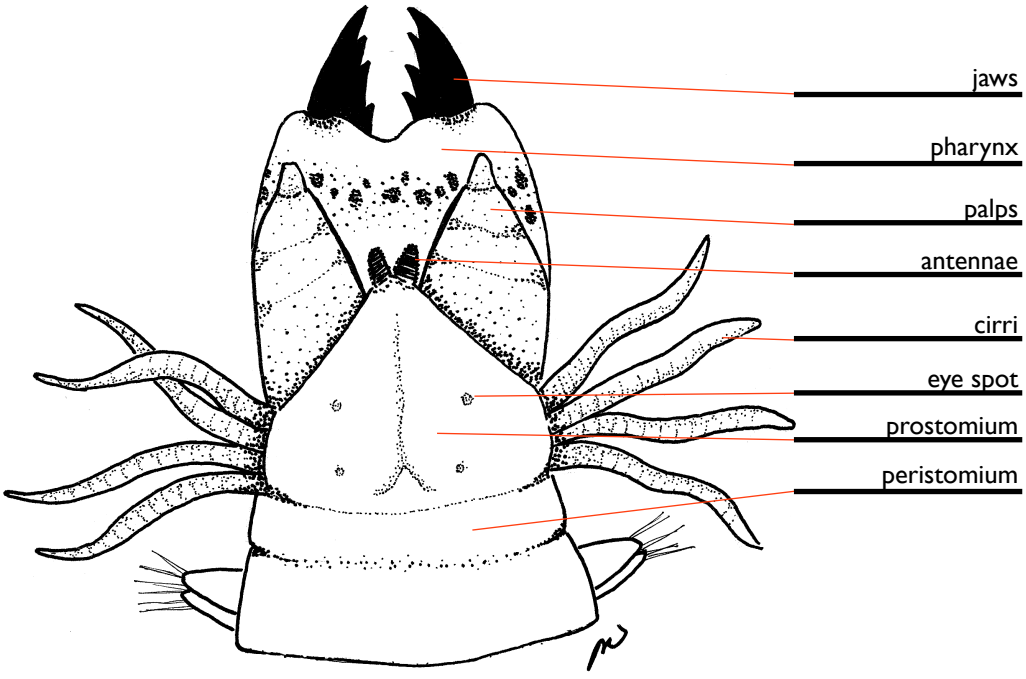
Clade Clitellata - members possess a clitellum.

Class Oligochaeta - Includes earthworms. Oligachaetes have very few setae, usually just on the ventral aspect of the body in terrestrial species. They have few external features and reduced cephalization.

Class Hirudinea - Leeches are fluid feeders, often ectoparasitic, but not always so. The leeches do not possess septa like the oligochaetes. The body of a leech contains fluid filled spaces called lacunae that transport materials throughout the body, often in lieu of a circulatory system.

# Polychaeta

## *Nereis sp.*




Clam worms, *Nereis sp.* are common coastal polychaetes that are both suspension-feeders and carnivores. While in its burrow, the clam worm produces mucus that traps phytoplankton, single-celled algae, bacteria, and fungi. At other times, the worm may leave its burrow and feed on other polychaetes, using its large jaws. The jaws are usually held inside the pharynx, but are everted while feeding. These jaws are not chitinous, but are composed of a protein matrix hardened by zinc and copper.

✱ Obtain a preserved *Nereis* specimen. Observe the anterior end of the body using a dissection scope.

Note the mouth of the specimen. Depending on the particular specimen, the pharynx may be everted or not. In some specimens, the anterior-most end of the animal may be the pharynx; in others, the **prostomial palps** may be the the most anterior structures.

The first segment of the head is the prostomium, and the second is the peristomium. The prostomium possesses a pair of palps that are sensory structures involved in chemosensation and tactile sensation. Medial to the palps are a pair of tiny prostomial tentacles (antennae). In the middle of the prostomium are two pairs of eyespots. These are not image forming eyes, but are photosensitive structures which allow the worm to sense the presence or absence of light.

The peristomium is posterior to the prostomium, and bears four pairs of sensory tentacles that are referred to as cirri.

✱Draw and label the anterior end of the *Nereis* preserved specimen. Label the following structures: **jaws (if visible), pharynx, antennae, prostomial palps, eye spots, peristomial tentacles, prostomium, peristomium, neuropodium, notopodium, setae**.

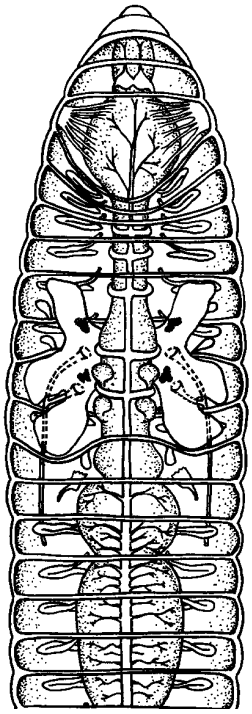
Sexual reproduction in *Nereis* happens through epitoky. The immature form of the worm is called an atoke. During breeding season, an individual develops into a sexually mature epitoke, which results in degeneration of the digestive tract, and a transformation of the body into a reproductive vessel. The parapodia become enlarged and flattened, serving as more efficient swimming structures. The epitoke swims to surface areas, where gametes are released, and fertilized eggs develop into trochophores. Note: The lab specimens provided are the atoke form.

✱ Observe any *Nereis sp.* prepared slides that are available.

✱ Observe the preserved polychaete specimens available (especially *Chaetopterus, for an example of how weird some of these polychaetes can look)*.

# Clitellata

The class Oligochaeta is recognized as being paraphyletic, and should include the Hirudinea. As a result, some have suggested combining these two classes in a class called the Clitellata. Clitellata is the name given to the monophyletic group that includes oligochaetes and leeches. These worms possess a structure called a clitellum that is a band of tissue that is used to produce the slime tube during reproduction. This structure is the most noticeable external structure in oligochaetes. The clitellum of leeches is only present during reproductive periods, and is not noticeable in the specimens in the lab. Other characteristics that are shared by the Clitellata include hermaphroditism, direct development, reduction in the number of chaetae, and lack of parapodia.




## *Oligochaeta*

Earthworm (*Lumbricus sp.*)

✱ Obtain a preserved earthworm specimen. Perform the dissection as described below:

The clitellum should be visible as a thick band on the anterior end of the body around segment 30. On the ventral aspect of the body, setae may or may not be visible. A dissection scope may help you find them. Tiny nephridiopores may also be visible near the chaetae.

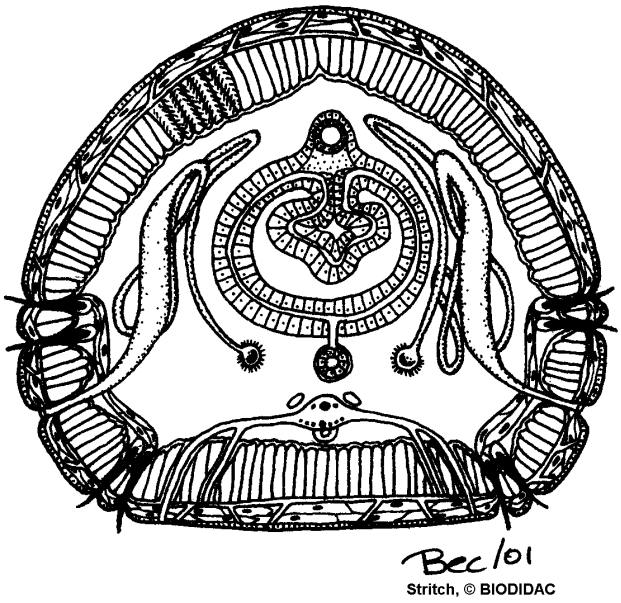
Make a shallow dorsomedial incision beginning at the anterior end and proceeding about halfway down the length of the body. Use dissection pins to retract the body wall to reveal the internal structures. It may help to use a scalpel to cut the septa away from the body wall as you spread the incision and pin back the body wall. Running down the center of the body is the digestive tract. The most anterior end of the digestive tract is the **pharynx**. The pharynx is covered with fibrous looking tissue, which is actually radial muscle which controls the shape of the pharynx.

The **esophagus** is more narrow than the pharynx and is surrounded by a group of 5 pairs of **aortic arches** ("hearts") that pump blood from the **dorsal vessel** to the **ventral vessel.**

Near the fifth pair of aortic arches there are two pairs of tiny **seminal receptacles**. These look like tiny white spheres on either side of the esophagus. The seminal receptacles receive sperm from the hermaphroditic partner during copulation. The two larger white structures posterior to the seminal receptacles are the **seminal vesicles**. There are actually three pairs of seminal vesicles, but they are all connected and may appear to be two very large structures with multiple lobes. Sperm mature in the seminal vesicles prior to being exchanged during copulation. The **ovaries** are just posterior and ventral to the seminal vesicles and are about the same size as the seminal receptacles.

Posterior to the seminal vesicles, the digestive tract becomes thicker. The first portion of the digestive tract in this region of the body is the **crop**. Posterior to the crop, the gut becomes thicker and more muscular. You should be able to feel this with your probe. This portion of the gut is the **gizzard**, where food particles are physically broken down to aid in digestion. The next section of the gut is the **intestine**, which continues to the anus.

On the ventral surface of each segment, on either side of the gut are two metanephridia. These excretory organs are repeated in each segment. Each **metanephridum** consists of a funnel shaped opening called a **nephrostome** in the septum anterior to the nephridium. From the nephrostome, a tubule runs posteriorly, loops, and then connects to an opening in the ventral body wall called a **nephridiopore**.




- Draw and label the following structures: **seminal vesicles, seminal receptacles, ovaries, pharynx, metanephridia, esophagus, aortic arches, crop, gizzard.**
- Observe the prepared *Lumbricus* CS slides.

In the cross section of the earthworm, the metanephridia may or may not be present. This will depend on whether the particular section happened to pass through the metanephridia or not. The outermost layer of the body is the cuticle. The layer of cells below the cuticle is the epidermis. Just interior to the epidermis is a layer of circular muscle. Circular muscles allow the earthworm to stretch out its body. Below the circular muscle is a layer of longitudinal muscle. Longitudinal muscles allow the earthworm to bend its body to one side or the other, and to shorten the body.

In the center of the cross section is the gut. The large dorsal blood vessel is attached to the dorsal aspect of the gut, and the ventral blood vessel is attached its ventral aspect. Just ventral to the dorsal blood vessel is an invagination of the wall of the gut called the typhlosole. The typhlosole increases the surface area of the gut to allow for more efficient absorption of nutrients.

## *Hirudinea (leeches)*

True leeches have 34 body segments. They lack setae and parapodia. Instead, they move by alternating attachment and detachment of **anterior** and **posterior suckers**. Leeches can also swim by undulation of the

body. Most leeches are aquatic, but a few tropical species are terrestrial. The body of a leech is not divided by septa as in the oligochaetes. Instead, the body really has only one fluid filled hydrostatic compartment. However, the coelom is divided by connective tissue into a system of spaces called **lacunae**. Lacunae are used to exchange nutrients much like a circulatory system.

Leeches are fluid feeders, often feeding on blood of interstitial fluid of various species. Although often thought of as parasitic, many are also predaceous, feeding on small invertebrates which they grasp with their anterior sucker. Leeches have a **proboscis** which they can evert to engulf small prey items. On either side of the **pharynx** are large **salivary glands** which produce anticoagulants and anesthetics which allow the leech to surreptitiously open a wound in its host and suck blood until it is engorged and drops off. The **intestine** of the leech are extensively branched with **caeca** extending into each of the body segments.

Leeches possess two "brains". The leech has a set of fused anterior ganglia and a set of fused posterior ganglia that act like brains. A double ventral nerve cord with 21 pairs of segmental ganglia runs between the two brains.

✱ Observe the live leech specimens. Note how they move.

# questions

## annelida

1. What is tagmatization?

2. Is the *Nereis* specimen you are looking at an atoke or an epitoke? How can you tell?

3. How can you tell the difference in the dorsal and ventral surface of an earthworm?

4. Give five characteristics of the clade Clitellata:

# Drawings

## *Nereis sp.* head

Kingdom: _____
Phylum: _____
Class: _____
Order: _____

# Drawings

## *Lumbricus sp.* dissection

Kingdom: _____
Phylum: _____
Class: _____
Order: _____