

## **Exercise 11**

# **INTRODUCTION TO MULTICELLULAR PARASITES**

### **and other microscopic invertebrates**

#### **Introduction**

When studying various types of natural infusions, students of microbiology often observe organisms not technically considered to be microbes. These organisms are eukaryotic, multicellular, are composed of multiple tissue layers and typically have internal organs for digestion, excretion, and reproduction. These organisms are usually studied in detail in Zoology or Biology classes and are considered here only briefly. The major Phyla are listed below with representative examples illustrated at the end of this exercise.

#### **A. Phylum *Cnidaria* or *Coelenterata* (Cnidarians or Coelenterates):**

Organisms in this group include the sea anemones, corals, jellyfish, and fresh water *Hydra*. Only the microscopic *Hydra* is common in fresh water.

#### **B. Phylum *Platyhelminthes* (flat worms):**

Flukes, tapeworms, and the free-living *Planaria* are representatives of this group. The parasitic forms are described in greater detail below.

#### **C. Phylum *Ashelminthes*, *Nemathelminthes* or *Nematoda* (round worms):**

Organisms in this group are commonly referred to as nemas or nematodes. They are found commonly in moist soils and water, and some forms are parasitic in plants or animals. Parasitic forms are described in greater detail below.

#### **D. Phylum *Annelida* (Segmented worms):**

Earthworms and leeches are annelids along with a number of marine forms and some microscopic fresh water species.

#### **E. Phylum *Arthropoda* (Joint-footed animals):**

Water fleas, ostracods, and copepods are small arthropods common in fresh water. A number of insect larvae (immature stages) may also be observed.

#### **F. Miscellaneous Phyla:**

Gastrotrichs, rotifers, and tardigrades are microscopic invertebrates belonging to different phyla. They are common in fresh water infusions and may be mistaken for large protozoa.

## Selected Parasitic Organisms

There are a number of invertebrate organisms that live as internal parasites of man or other animals. Most of these are either flatworms (phylum *Platyhelminthes*) or roundworms/nematodes (phylum *Aschelminthes*) and so are sometimes referred to as **Helminthes**.

The Helminthes are highly specialized for life inside a living host. They have reduced digestive systems (being able to obtain food by absorbing host nutrients), poorly developed nervous and muscular systems (cannot detect nor move to avoid predators or hunt prey), and often times greatly enlarged and highly specialized reproductive systems. Many forms are hermaphroditic or **monoecious**, having both male and female reproductive structures in the same individual.

Helminthes typically have rather complex life cycles involving a succession of different hosts. Humans or other vertebrates often serve as **definitive hosts** (those in which adult parasites exist and where sexual reproduction occurs) while a variety of invertebrates serve as **intermediate hosts** (those in which the larval or immature stages exist and asexual reproduction may occur). Because the reproductive stages of helminthes, eggs and larvae (immature forms) are microscopic, they fall within the realm of microbiology.

A number of specific parasitic forms are listed below.

### A. Phylum *Platyhelminthes*, Class *Trematoda* (flukes):

Flukes are typically named according to where they are found within the definitive host. Some examples include liver flukes, lung flukes and blood flukes. Fluke eggs are typically excreted by definitive hosts in vast numbers and hatch out in water or moist environments. The larval forms enter intermediate hosts such as snails, crayfish, crabs, or fish, and many pass through several stages. Eventually the parasites reenter their definitive hosts by being ingested or by burrowing directly into exposed individuals.

### B. Phylum *Platyhelminthes*, Class *Cestoda* (tapeworms):

Tapeworms are intestinal parasites that attach to the hosts intestinal mucosa via suckers and/or hooks located on their “head” region or **scolex**. Their bodies are composed of a series of segments called **proglottids** that are essentially highly specialized reproductive sacs. Tapeworm eggs released into the environment can be ingested by intermediate hosts (fleas, cattle, copepods, fish, etc.). The larvae migrate into host tissues and are later ingested by the definitive host.

### C. Phylum *Aschelminthes* or *Nematoda* (roundworms):

Nematode infections may be divided into two categories; 1) those in which the eggs are infective for the definitive host, and 2) those in which the larva are infective. Common roundworms such as *Ascaris* (ascariid worms) and *Enterobius* (pinworms) are infective as eggs and are typically ingested by their hosts. *Necator* and *Ancylostoma* (hookworms), *Dirofilaria* (heartworms), and *Trichinella* (causative agent of Trichinosis) are infective as larva. Some larva are free in the environment and attach to hosts directly (hookworms), some are ingested (*Trichinella*) and others require transport by an intermediate host such as a mosquito (heartworms).

**Note** - The eggs of many parasitic worms may be encountered during microscopic examination of various materials. These can sometimes be used to identify the organism present.

Other organisms including a variety of Arthropods are external parasites (ectoparasites) of man and other animals. These organisms transmit disease-causing agents (viruses, bacteria, protozoa or other multicellular parasites) from one host to the next, so are called **vectors**. Some typical examples are fleas, ticks, lice and mosquitoes.

**Procedure:**

A. Observe the prepared slides listed below and be able to identify the organisms indicated.

1. *Fasciola hepatica* (cercariae)
2. *Schistosoma japonicum, mansoni or hematobium* (redia and fork-tailed cercariae)
3. *Taenia pisiformis, saginata or solium* (tape worm scolex)
4. *Trichinella spiralis* (larva in muscle tissue)
5. *Necator americanus* or *Ancylostoma duodenale* (individual infective larvae)
6. *Onchocerca volvulus* (filarial larvae inside adult worms)
7. *Dirofilaria immitis* (filarial larvae in a blood smear)
8. *Dermacentor andersoni* (wood tick)
9. *Ixodes dammini* (deer tick)
10. *Sarcoptes scabiei* (itch mite)
11. *Pediculus humanus capitis* (head louse)
12. *Xenopsylla cheopis* (rodent flea)
13. *Culex pipiens* (Mosquito)

B. Observe the demonstration material provided:

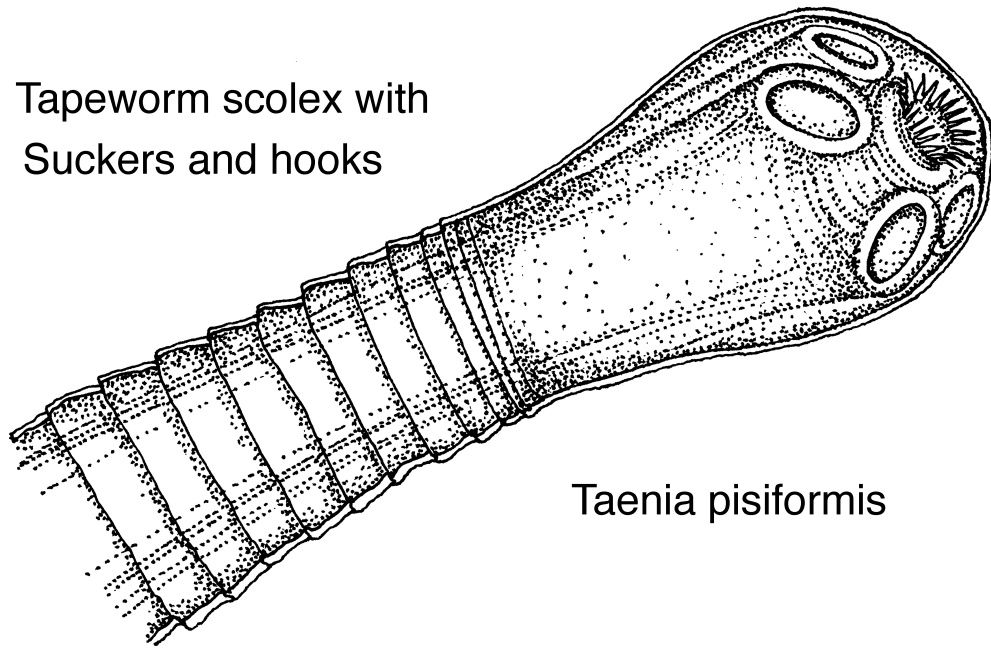
1. Tapeworms
2. *Ascaris lumbricoides* (roundworms)
3. *Dirofilaria immitis* (Canine heartworm adults in heart)

**Questions:**

1. Microscopic invertebrates are similar to protozoa and algae in that they are composed of \_\_\_\_\_ type cells.
2. What types of organisms fall into the category generally identified as helminthes?
3. Name two general types of flatworms (Platyhelminthes) that are known to infect humans.
4. What is an endoparasite; what is an ectoparasite, and which of the parasites listed falls into each category?

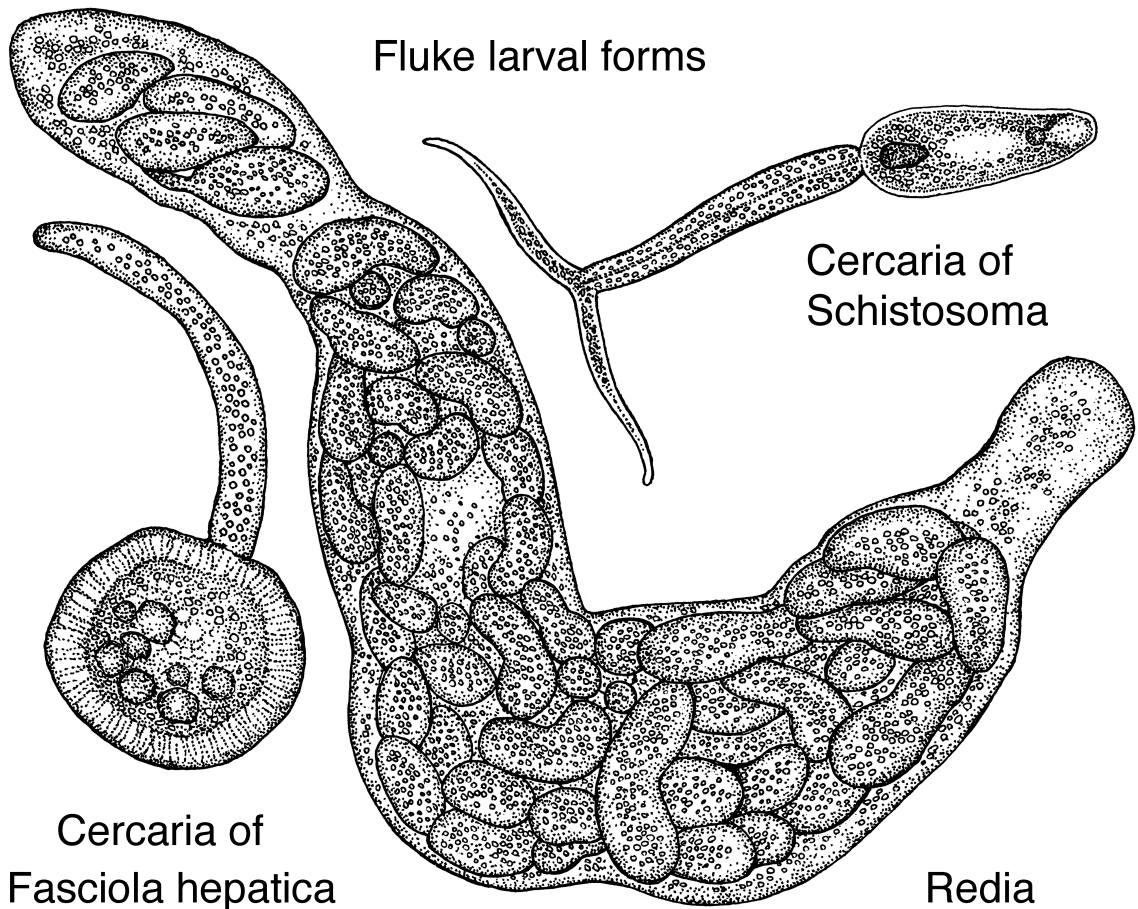


Tapeworm scolex with  
Suckers and hooks



*Taenia pisiformis*

Fluke larval forms

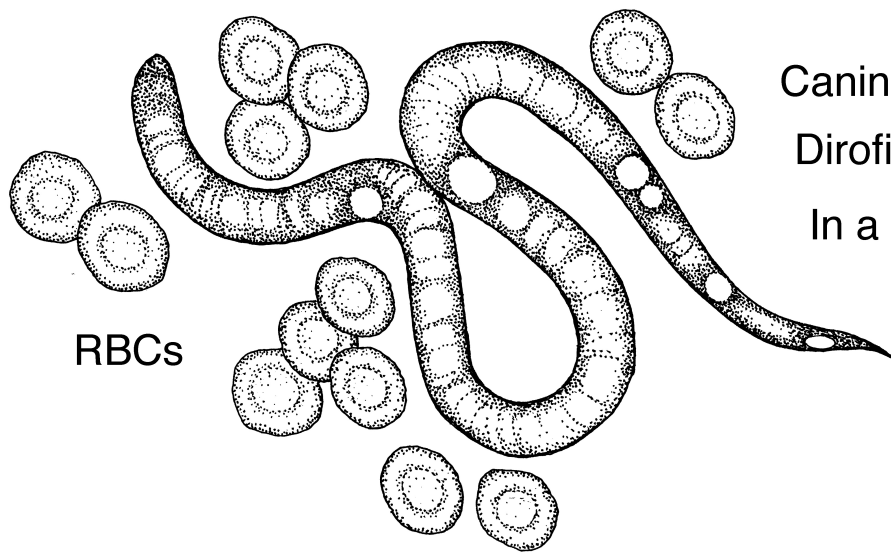


Cercaria of  
*Schistosoma*

Cercaria of  
*Fasciola hepatica*

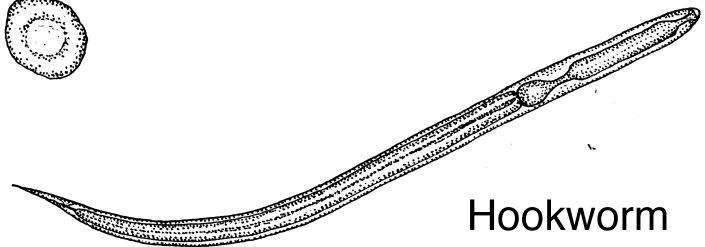
Redia

**Figure 11.2 – Some Representative Parasitic Flatworms (Platyhelminthes)**

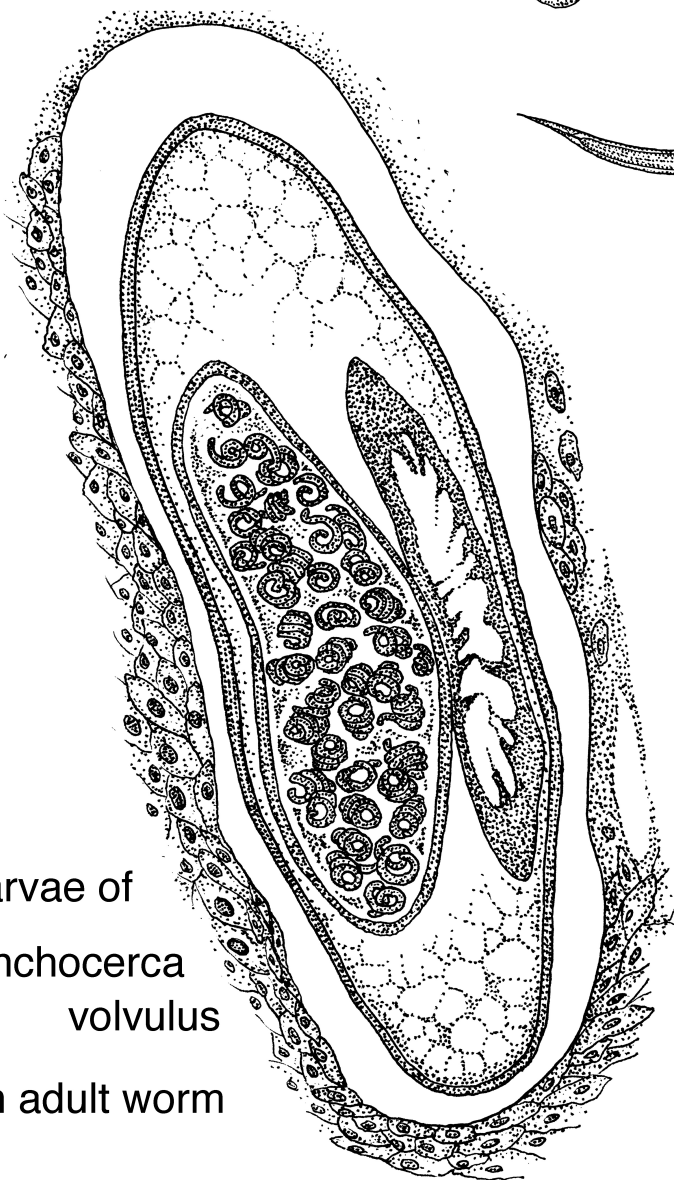


Canine Heartworm  
*Dirofilaria immitis*  
In a blood smear

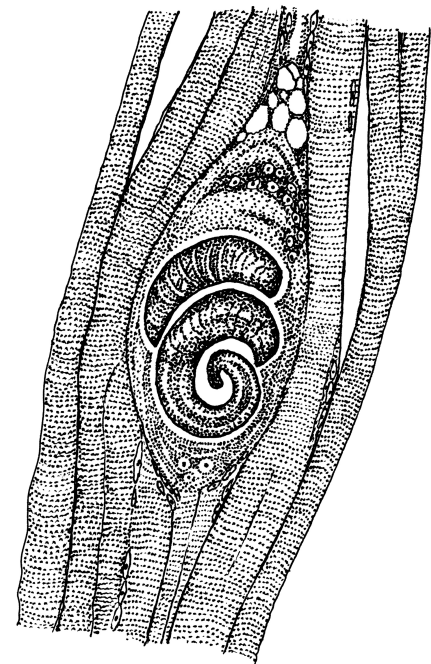
RBCs



Hookworm

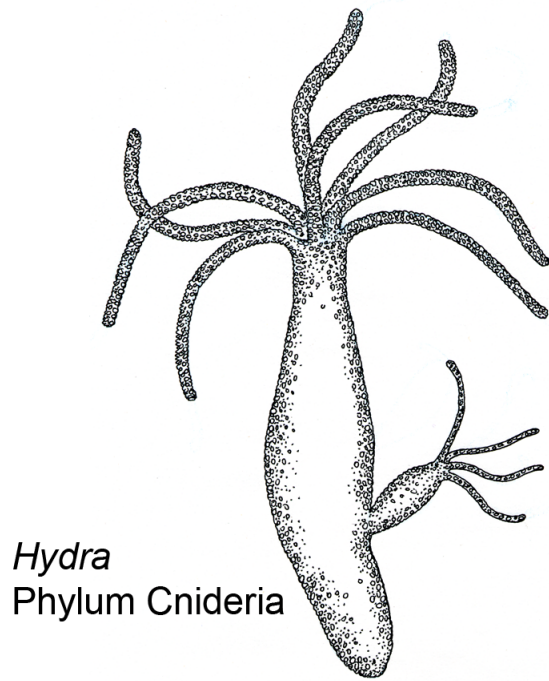


Larvae of  
*Onchocerca*  
*volvulus*  
In adult worm

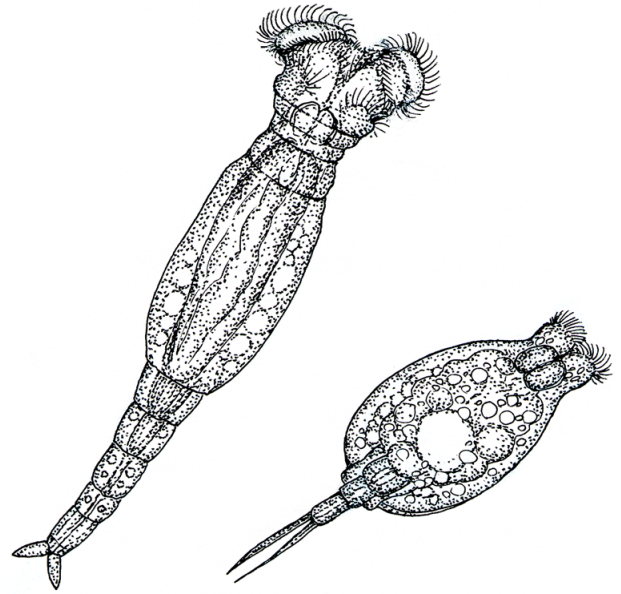


*Trichinella spiralis*  
Larva in muscle tissue

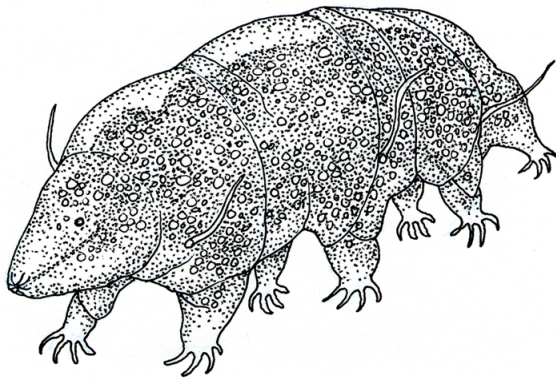
Figure 11.3 – Infective Larvae of Some Parasitic Roundworms (Aschelminthes)



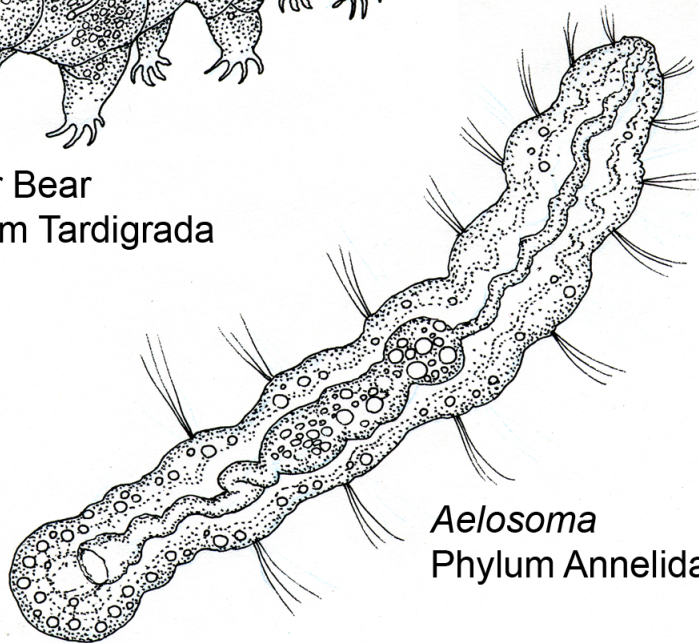
*Hydra*  
Phylum Cnidaria



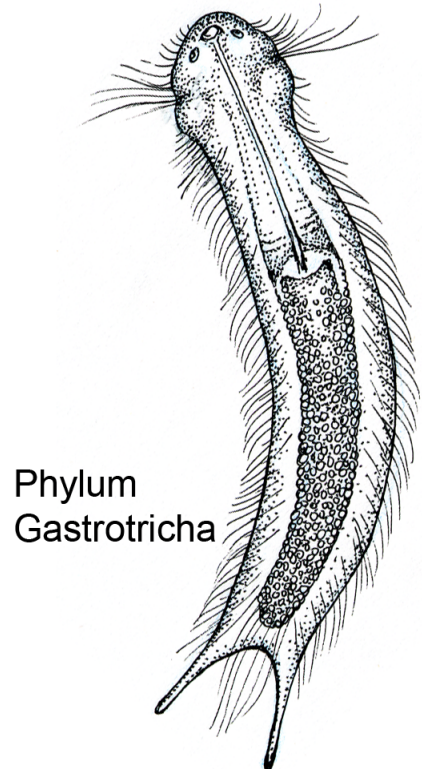
Phylum Rotifera



Water Bear  
Phylum Tardigrada



*Aelosoma*  
Phylum Annelida

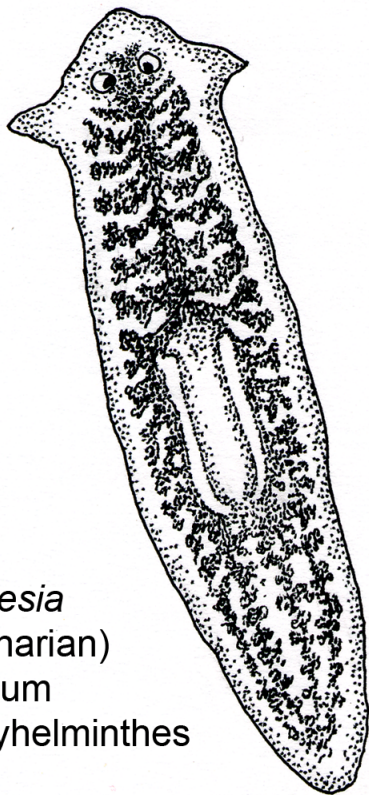


Phylum  
Gastrotricha

**Figure 11.4 – Representative Examples from Miscellaneous Invertebrate Phyla**



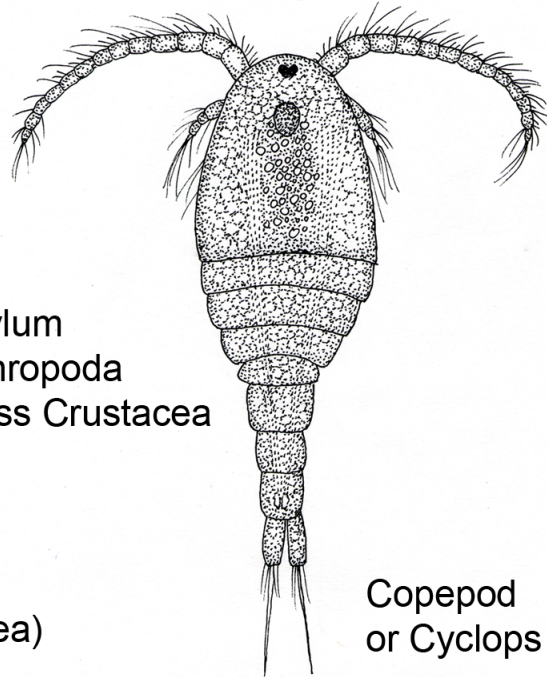
*Dugesia*  
(Planarian)  
Phylum  
Platyhelminthes



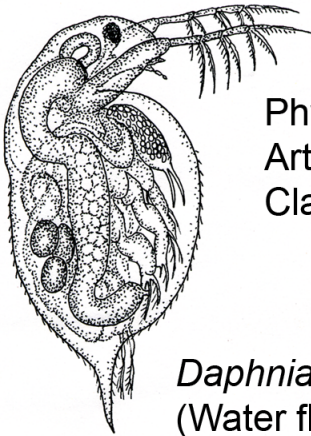
Nematode  
Phylum  
Aschelminthes  
or Nematoda



Phylum  
Arthropoda  
Class Crustacea



*Daphnia*  
(Water flea)



Copepod  
or Cyclops

Clam Shrimp

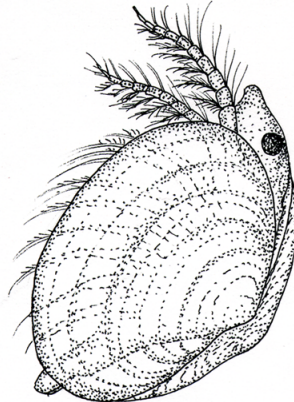


Figure 11.5 – Representative Examples of Non-parasitic Worms and Arthropods