References (Textbook - pages 526-530, Lab Manual pages 168-172)

Characteristics

1. Flatworms have bilateral symmetry and are the most primitive animals to possess this feature. This is the first phylum we have studied that has this trait. As such we could call flatworms the most primitive of bilateral animals. This type of symmetry is associated with animals that move in a single direction.

2. Most flatworms are triploblastic and have all three germ cell layers. The ectoderm, mesoderm, and endoderm. This is the first group to develop a true mesoderm.

3. The body is flattened dorso-ventrally. Hence the name flatworms.

4. Flatworms have a sac body plan

5. There are many parasitic forms

6. Most species of flatworms are hermaphroditic - that is both male and female sex organs are found in the same individual organism.

7. Flatworms lack a body cavity and are therefore acoelomate.

   - Review definitions or acoelomate, pseudocoelomate, and coelomate using handout of figure from textbook, page 530. If you have your book turn to that page.
   - acoelomate - digestive cavity only with no space or cavity between the gut and body wall.
   - pseudocoelomate - body wall and gut not lined completely with mesoderm
   - coelomate - Body cavity completely lined with mesoderm

8. As adults, flatworms have tissues organized into definite organs and organs working together in organ systems, such as those for excretion and reproduction.

9. Some species show a condition called cephalization.

   - this is an accumulation of sensory mechanisms and integrating structures of the nervous system into the head end of the organism.

10. Many species in this phylum are parasitic.

   - the outer "skin" or epithelial layer of parasitic forms are resistant to the digestive enzymes secreted by the host.
Classification

1. The phylum Plathelminthes is divided into three classes. These are:

   - Class *Turbellaria*
     - All are *free-living*, as opposed to *parasitic*
     - An example is the flatworm, Planaria

   - Class *Trematoda*
     - *All are parasitic*
     - Includes the *flukes*

   - Class *Cestoda*
     - *All are parasitic*
     - Includes the *tapeworms*

Class Turbellaria

Anatomy and Physiology (Planarian as representative)

1. We will study the anatomy and physiology of class Tubellaria using the planarian as an example. Please refer to the handout from page 171 of our lab manual.

2. Although some tubellarians occur in salt water, planarians live in freshwater habitats and occur on the undersurface of stones in springs, streams, and lakes.

3. Most are less than 10 mm long and the body is dorso-ventrally flattened.

4. They feed on dead and living small organisms.

   - Structure

     1. On the anterior end (head) are *eyes* (A-2)

     2. The anterior end also possesses lateral projections called *auricles* (A-3) which give the anterior end a triangular shape. The *auricles* are *tactile* and *chemoreceptors*.

     3. A *ciliated epidermal layer* covers the body, although in planarians only the *ventral surface* is ciliated.
4. A network of loosely connected cells called **mesenchyme** surrounds the gut and other organs and fills the interior of the body. There is **no body cavity** between the outer body wall and internal organs. What is the term for this? (acoelomate) 

- Is derived from the embryonic **mesoderm** as shown on the handout from figure 29A from page 530 of our textbook.

- **Locomotion**

  1. Planarians **swim** or **crawl** around in the bottom debris by **ciliary propulsion**.

- **Feeding and Digestion**

  1. Individuals feed on small invertebrates.

  2. The **mouth** (A-8) is an opening located on the mid-ventral line.

  3. Food is engulfed through the mouth and passes through the tube-like **pharynx** (A-7) and **opening of the pharynx** (A-9) into the **gastrovascular cavity**.

  4. The gastrovascular cavity is large and ribbon shaped. Digestion is **mostly intracellular** in the **cells lining** the **gastrovascular cavity**.

  5. When the animal feeds the **pharynx** is projected out of the mouth.

  6. Remember the body is a **sac** and there is **no anus**. Like in Coelenterates, undigested food particles are ejected through the mouth.

- **Excretion**

  1. The excretory organ consists of an interconnecting series of **excretory canals** (A-12) that run the length of the body on each side.

  2. Bulb-like structures containing cilia are found at the end of the side branches of these canals.

  3. These bulb-like structures are called **flame cells** or **protonephridia** (A-11).

  4. The beating of the cilia reminded biologists of a flame and therefore the name flame cell.
5. Although usually called excretory organs, flame cells and the excretory canals may be more important in maintaining water balance.

• Reproduction

1. Planarians reproduce asexually by transverse fission.
   - An individual constricts beneath the pharynx and splits apart. *(Draw on board)*
   - The two halves then regenerate the missing parts.

2. Planarians may reproduce sexually by copulation.
   - They are hermaphroditic, but normally practice cross fertilization.
   - The penis of one is inserted into the genital pore of another and fertilization occurs.
   - Fertilized eggs are enclosed in a cocoon and hatch in two or three weeks as tiny worms.

• Nervous System

1. The nervous system consists of two longitudinal nerves (A-5) that extend the length of each side of the body with enlargements at the anterior (head) end forming a simple brain (A-1).

2. There are a series of transverse nerves (A-6) attached to the longitudinal nerves.

3. Arrangement of longitudinal and transverse nerves give the appearance of rungs of a ladder and the system has been called a ladder type nervous system.

Review of Parasitism

1. Before we discuss the parasitic forms in Class Trematoda (the flukes) and Class Cestoda (the tapeworms) we need to review the concept of parasitism and how it relates to other interactions among species.
2. We need to first define **symbiosis**. **Symbiosis** is a relationship that occurs when two different species live together in a unique way.

- There are **three** types of **symbiotic relationships** based on whether the relationship is **beneficial** (+), **neutral** (0), or **detrimental** (-) to one and/or the other species.

- These three types are:

  1. **Parasitism**. A symbiotic relationship where one species (called the parasite) benefits in terms of growth and reproduction to the detriment of the other species (called the host).

     - Using our + and - symbols we could note this as (+, -).
     - Our tapeworms and flukes are examples of parasites.
     - What are some examples of hosts?

  2. **Commensalism**. A symbiotic relationship where one species is benefited, and the other species is neither harmed or benefited.

     - Using our symbols we would note this as (+, 0).
     - Example - cattle egrets (a bird) feeding near a herd of cattle. The movement of cattle flush insects that the birds eat.
     - In this example which species benefits and which is unaffected?

  3. **Mutualism**. A symbiotic relationship where both species benefit in terms of growth and reproduction.

     - We could note this as (+, +).
     - Often these species are not able to survive without each other.
     - Example - The relationship between bacteria and humans. The bacteria in our digestive tract and receive their nutrition from the contents of our intestines. In term the bacteria provide us with vitamins that we are not able to synthesize ourselves.
     - Another example is the protozoans that live in the gut of termites. The protozoans are able to digest cellulose and this allows the termites to eat and digest wood.
Class Trematoda

General Information

1. Flukes are usually named for the type of host organ they inhabit. For example there are blood, liver, and lung flukes.

2. Common hosts include birds and mammals, especially dogs and cats.

3. The body of flukes tends to be oval and elongate.

4. Like many parasites, their digestive system and nervous systems are reduced as compared to their free-living cousins. Why would you think this is the case?

Sheep Liver Fluke Life Cycle

As an example of the life cycle of a fluke and a parasite in general, we will look at the Sheep Liver Fluke. Refer to handout as we discuss this life cycle. As you will see the life history of a parasite can be unusual and complicated. A shortened version on p. 171 may be substituted.

1. Adult liver fluke lives in the liver of sheep (a).

2. Eggs are passed into the intestine and mix with feces (e).

3. Eggs passed with feces from sheep (d) and fall into water and develop into miracidium (e and f).

4. Miracidium penetrate an aquatic snail and become a sporocyst (g).

5. Inside the sporocyst, germinal cells develop and divide to form redia (h).

6. The sporocyst ruptures and redia are released into the water to form cercaria (k).

7. Cercaria attach to vegetation and become metacercaria (l,m, and n) which are eventually ingested by a sheep (o).

8. In intestinal tract of sheep, metacercaria mature into an adult fluke and infect sheep's liver (p and a).
Class Cestoda

General Information

1. Like flukes, tapeworms are endoparasites. That means they live inside their hosts.

2. The majority of tapeworms are adapted for living in the gut of vertebrates.

3. Like flukes, most tapeworms have complicated life cycles involving one to several hosts.

Anatomy and Physiology (Tapeworm as representative)

We will overview the structure and basic physiology of tapeworms using the handout of the diagram from our lab manual on page 171 and the handout showing entire body of tapeworm.

1. The anterior (head) end of a tapeworm is a region modified for attachment to the intestinal wall of its host. This area is called the scolex.
   - Near the top of the scolex is an area called the rostellum that includes the hooks (9).
   - The scolex also contains the suckers (10).
   - The hooks can be withdrawn into the scolex or extended to attach to the host.

2. A narrow neck region connects the scolex to the strobila.
   - The neck is an area where new proglottids are continually being formed and added to the body.
   - There fore the oldest proglottids are near the end of the strobila and are detached from the end as they die.
   - These are the immature buds shown on page 171 of our lab manual on the sketch of the scolex and neck of a tapeworm on the bottom left of the page.

3. The strobilia makes up the greater part of the tapeworm body.
   - The strobilia is made up of individual sections that are called proglottids. Proglottids are linear flattened.
   - Tapeworms average from 4 to 10 feet in length, although some may reach 40 feet.

4. The body is covered by a protective cuticle.
5. The **digestive system** is completely **lacking** and digested food of the **host** is directly absorbed through the tapeworms cuticle.

6. The **Reproductive System** takes up **most** of the **space** in each **proglottid**.

   - The **genital pore** (C-3) is a **common duct** for both **male** and **female** reproductive system and is located on **one edge** of each **proglottid**.

   - **Male** reproductive **organs** in each proglottid include the **testis** (C-2) and **vas deferens** (C-1).

   - **Female** reproductive **organs** in each proglottid include the **ovary** (C-4), **uterus** (C-6), and **yolk gland** (C-5).

   - Tapeworms are **hermaphroditic**.

   - **Sexual reproduction** usually occurs between the **proglottids of two different worms**, but can occur between different proglottids on the **same worm** and by **self-fertilization** within one proglottid.

7. Like the flukes, tapeworms have complicated life cycles. For an example refer to the life cycle of the Beef Tapeworm as outlined on page 172 of our Lab Manual.
PHYLUM - Platyhelminthes [flatworms]
CLASS - Trematoda (flukes)
See B on p.171 for "brief" life cycle.

PHYLUM - Platyhelminthes [flatworms]
CLASS - Cestoda (tapeworms)

CHARACTERISTICS
See p.171 + labeled drawing!

1. Gut of vertebrates [endoparasites]
2. Body form [scolex; neck; strobila] See p.171 C.
3. Formation + elimination of proglottids.
5. No digestive system.
6. Nervous system; Excretory system [length of strobila]
7. Reproductive System [many proglottids]
8. Examples: Pork & Beef tapeworms [overhead + p.172 lab manual; cystercercus]

PHYLUM - Nematelminthes [roundworms or nematodes]

CHARACTERISTICS
1. Tube within a tube body plan
2. Pseudocoel present
3. Bilateral Symmetry
4. Triploblastic
5. Non metameric [segmentation]
6. Complete digestive tract
7. Dioecious
8. Many parasitic forms
9. Cause millions of dollars in crop damage annually.
11. Range from microscopic to about 4" long. "Thread like" (nematodes)
12. Virtually all plants + animals are parasitized by one or more kinds of nematodes.
13. Tapering, cylindrical, spindle shaped worms
14. Use handout for examples
   Ascaris p.175