Chapter 27 **Worms and Mollusks** **Name ________________**

Lab Features of a Clam

Background Information

Mollusks are a large and diverse group of animals. They include the chiton, clam, oyster, snail, slug, squid, chambered nautilus, and octopus. Most of the 110,000 plus species of mollusks are marine, but there are also many freshwater species, as well as several species that have adopted a terrestrial life style. Phylum Mollusca has four primary classes; Cephalopoda, Bivalvia, Gastropoda and Polyplacophora.

Members of this phylum have soft, unsegmented bodies, which usually are enclosed by a thin, fleshy layer called the **mantle.** The mantle usually secretes a hard shell. In some of the more specialized mollusks, the shell has been lost or reduced, or has become embedded in the soft tissue.

Mollusks are triploblastic, coelomates, as are the annelids and all other higher animals, including the chordates. The coelom is the principal internal body cavity in most of these groups and is completely lined by mesodermal tissue. The coelom arises during embryonic development as a cavity within the developing mesoderm. In most higher animals, the coelom expands greatly to become the principal internal cavity. Among the coelom's typical functions are to provide space for the development of internal organs, to serve in the temporary storage of metabolic wastes, and to provide space for gametes. In soft-bodied animals, the coelom can act as a **hydrostatic (water) skeleton** to facilitate the movements and burrowing of soft-bodied animals. In modern mollusks, however, the coelom is reduced largely to the cavities surrounding the heart, gonads, and excretory organs (nephridia).

The mollusk's body typically consists of three major parts: an anterior **head**, a **ventral foot**, and a dorsal **visceral mass**. These basic parts are modified in different mollusks, and clearly illustrate the remarkable diversity that can be achieved by alterations of a simple body plan. Because of the great diversity of form in the Phylum Mollusca, there is no "typical" mollusk.

Purpose

In this laboratory you will become acquainted with a clam's many different features.

Materials (per group)

Dissecting tray	Preserved clam
Dissection kit	Hand lens or dissecting scope

Procedure

Part A. External Structures

1. Thoroughly rinse a preserved clam to remove excess preservative. **CAUTION:** *The preservative used on the clam can irritate your skin. Avoid touching your eyes while working with this specimen.* Place the clam in a dissecting tray. Observe the bivalve shell. Notice the hinge ligament.

2. Locate the small, pointed area near the hinge ligament. This is the **umbo**, which is the oldest part of the clam. Note that the umbo is on the dorsal side toward the anterior end of the bivalve. Notice the concentric growth lines. They represent alternating periods of slow and rapid growth.

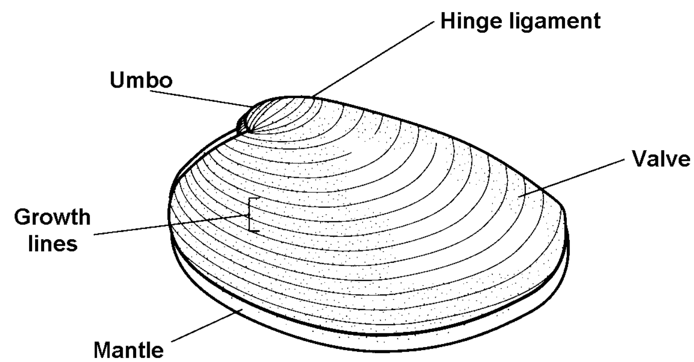


Figure 1

3. Locate the posterior, anterior, dorsal, and ventral surfaces of the clam shell. Hold the shell with the anterior end up and the hinge facing toward you. Locate the hinge, right valve, and left valve of the clam shell. See Figure 1. Label the diagram of a clam shell in **Observations**. Use the following terms: umbo, dorsal, ventral, anterior, and posterior regions.

4. Obtain a specimen, note that it has been pegged to give access to the internal structures. Locate the following external structures. The two valves are joined along the dorsal surfaces by an elastic hinge ligament. Observe the concentric lines of growth on the exterior surface of the shell, which are formed as the mantle secretes new material at the edge of the shell.

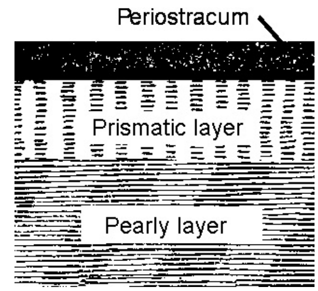


Figure 2

5. The shell consists of three layers, the exterior **periostracum**, a middle prismatic layer**,** and an inner pearly layer (see Figure 2). The exterior **periostracum** is made up of a protein which retards dissolution of the shell by the slightly acidic waters in which freshwater clams are typically found. The middle **prismatic layer** consists of crystalline calcium carbonate ($CaCO_3$) and provides strength. The inner **nacreous layer** ("mother-of-pearl") consists of numerous layers of $CaCO_3$. Near the anterior end of each valve is a raised portion, the **umbo**, which represents the oldest part of the valve.

6. At the edge of the shell, between the valves, you may be able to observe the incurrent siphon (lower) and the excurrent siphon (upper), two openings between the edges of the mantle.

7. Bivalves usually come from the supplier with the valves "pegged" open. Locate the position of anterior and posterior adductor muscles that are holding the valves closed. See Figure 3. Slip a scalpel between the mantle and the left valve. Cut each adductor muscle at its point of attachment to the shell. When both muscles are cut, loosen the mantle over the entire area of the left valve and open the valves.

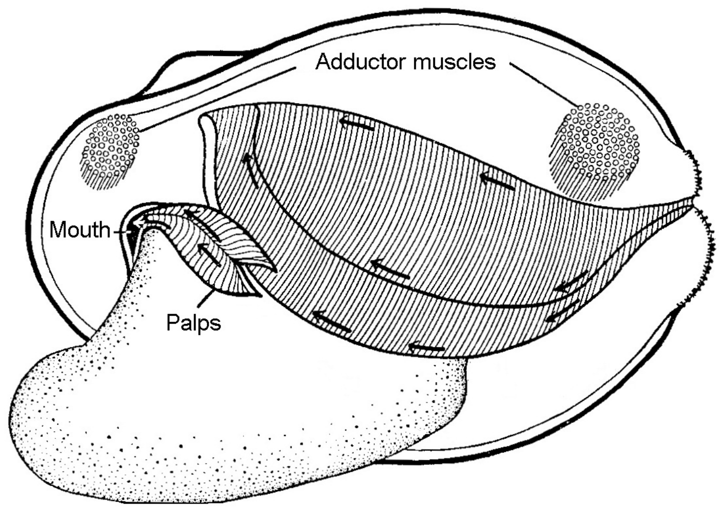


Figure 3

Part B. Internal Structure (See Figure 4)

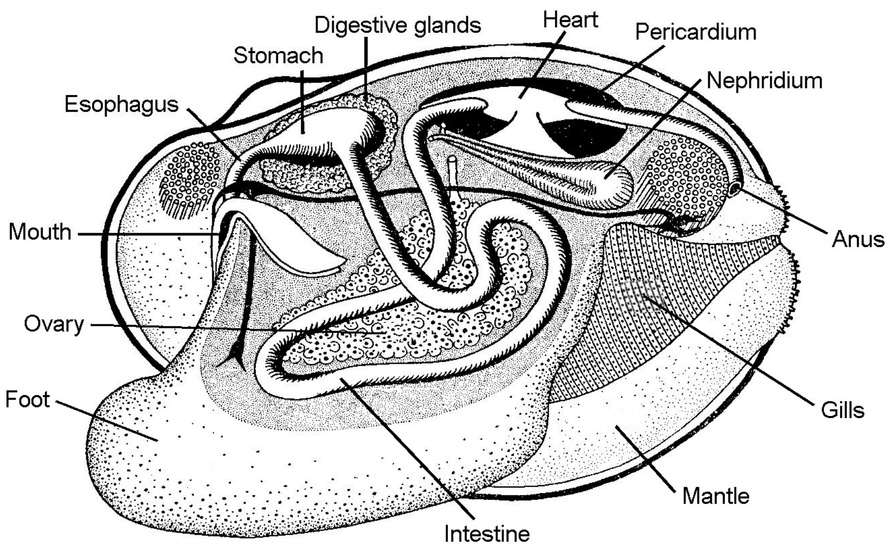
1. Examine the inner surface of the empty valve and the **mantle** covering the body of the bivalve. Just below the hinge, the mantle covers the **pericardial sac** and the **heart**. These structures are very delicate. Be careful not to disturb them until directed to do so. Examine the adductor muscles that you cut to opening the bivalve and their points of attachment on the empty shell. The adductor muscles have a "catch" mechanism that allows them to remain contracted for long periods with little energy expenditure. When the adductor muscles relax, elasticity of the hinge ligament forces the valves open. Next to each adductor muscle is a smaller **retractor muscle** that brings the foot into the shell. Find the retractor muscles and their points of attachment on the shell. Below the anterior adductor muscle is the anterior protractor muscle that helps extend the foot.

2. A thickening at the margin of the mantle, the **pallial muscle** attaches the mantle to the shell. The pallial line on the shell marks a line of attachment for this muscle. The pallial line arches between the points of attachment of the adductor muscles. The mantle of the left and right valves comes together posteriorly to form **incurrent** and **excurrent siphons** that allow water to enter and leave the mantle cavity. Water enters through the ventral incurrent aperture and leaves through the dorsal excurrent aperture. After a bivalve has burrowed into the substrate, the siphons can be extended for gas exchange and filter feeding.

3. Observe an empty shell. Just below the hinge are tongue-and-groove modifications of the shell called **teeth** that prevent twisting. Your teacher may have some broken pieces of a shell in the lab. If so, use a dissecting scope and examine a cross section of the shell. There are three layers in all mollusk shells (see Figure 2).

4. The space between the mantle and the body is the mantle cavity. Lift the mantle to expose the visceral mass and the foot. The muscular, wedge-shaped **foot** is located at the ventral surface of the body. The soft tissue making up the bulk of the body is the **visceral mass.** At the anterior margin of the visceral mass, note the flap like **labial palps**. Labial palps surround, and direct food toward the mouth. Water coming in from the in-current siphon reaches the ventral surface of the gills and passes dorsally through the gills into a space above the gills formed by the attachment of the gills to the mantle on one side and the visceral mass on the other. Once in this chamber**,** water is directed posteriorly and out of the mantle cavity through the excurrent siphon. In the process, suspended food particles are filtered and gas exchange occurs. Food particles are transported by cilia to **food grooves** along the ventral margin of the gills. Cilia in the food grooves transport food to the labial palps.

Figure 4



5. The circulatory system of bivalves is an open system. A heart is enclosed by the **pericardium** and located dorsal to the visceral mass. The pericardium is a thin membrane covering the top of the visceral mass. Carefully remove the pericardium to see the heart. The heart wraps around the **intestine** where the intestine emerges from the visceral mass. The intestine is running posteriorly to empty at the excurrent siphon. The heart consists of two parts, a thick-walled **ventricle** surrounding the intestine and two thin-walled **auricles** attached at either side of the ventricle. If you were careful in removing the pericardium, you should see both.

6. Blood leaves the ventricle through the anterior and posterior aorta and goes to the hemocoel for exchange of nutrients, gases, and wastes. Blood in the posterior aorta goes to the mantle and then returns to the auricles. Blood in the anterior aorta goes to the visceral mass and the foot. This blood returns to the auricles via the nephridia and the gills.

7. The excretory system consists of a pair of dark **nephridia** lying below the pericardial sac. Nephridia remove metabolic waste products from the blood and release the waste into the mantle cavity near the excurrent aperture.

8. Use your scalpel to make a sagittal section of the foot and visceral mass. Within the visceral mass note the cut sections of intestine. The yellowish tissue surrounding the intestine are gonads. Anteriorly you will have cut through a greenish digestive gland.

9. Sexes in bivalves are separate, but difficult to distinguish. Gonads are within the visceral mass and gametes are released in the vicinity of the excurrent aperture. Fertilization is usually external, with swimming larval stages. In freshwater bivalves, fertilization occurs within the mantle cavity of the female, and zygotes develop into **Glochidia** (see Figure 5) within the gill chambers. Glochidia have tiny valves with teeth that are used in attaching to the gill filaments, fins, or skin of a fish. Each glochidium lives as a parasite for several weeks, then drops off to take up adult life.

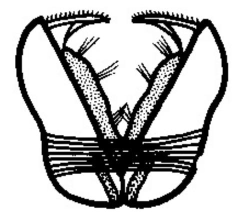
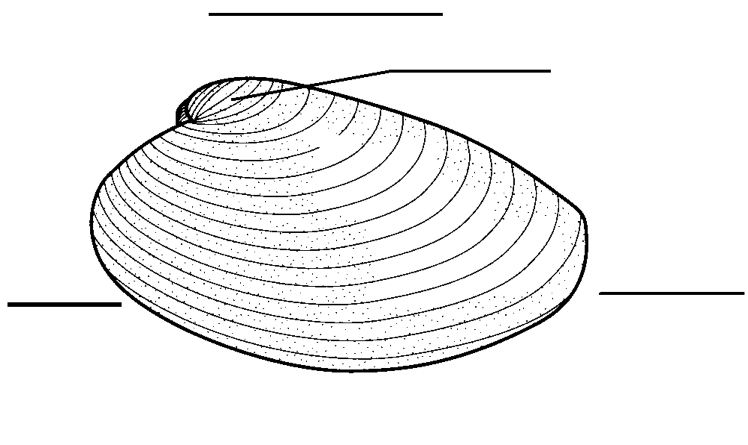


Figure 5

Observations

1. Label the clam shell below. Use the terms anterior, posterior, dorsal, ventral, and umbo.



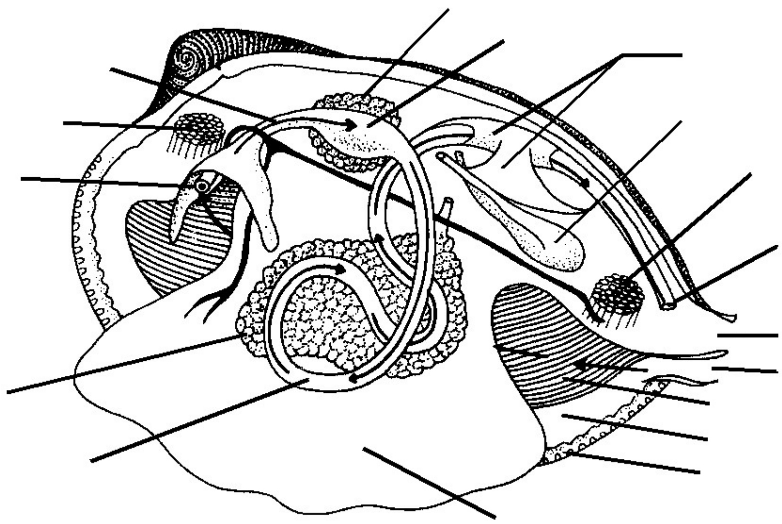
2. Did the clam shell have one or two umbos?

3. What is the function of the periostracum?

4. What structure is responsible for the formation of the two valves?

5. Does each growth ring on the clam's shell represent a years growth?

6. Using the following terms, label the illustration below: anterior adductor muscle, anus, digestive glands, esophagus, excurrent siphon, foot, gills, heart, incurrent siphon, intestine, mantle, mouth, nephridium, posterior adductor muscle, gonads, and valve (shell).



Analysis and Conclusion

1. What are the three regions of the body of a mollusk?

2. What is an open circulatory system?

3. How would you characterize members of class Bivalvia?

4. What would be an advantage of the glochidium's early parasitic life style?

Critical Thinking and Application

1. The nervous system of a clam is very simple. Describe the basic nervous system of a clam.

2. List one advantage and one disadvantage of the shell surrounding a clam.

3. The hinge ligament and the adductor muscles of the clam are said to be antagonistic to each other. What does that mean?

4. Marine clams reproduce by releasing eggs and sperm into the water. Would you expect clams to release large or small numbers of eggs and sperm? Explain your answer.

5. Why are fossils of mollusks more abundant than those of the worms?

6. Describe the feeding method used by clams.

7. Would torsion be an appropriate term to describe the development of a clam?