Dissection of the California mussel *(Mytilus californianus)* and the venus clam *(Venus mercenaria)*

Each student should accomplish the following during the lab for the *Mytilus* and *Venus* dissection:

1. Sketch the external anatomy of your animal (shell, ligament etc.)
2. Sketch the generalized internal anatomy of your animal (making sure to label all relevant features)
3. Sketch and label the internal markings of the valve (shell).
4. Compare features and anatomy between the *Venus mercenaria* and *Mytilus californianus*

Introduction

Your first reaction to this lab might be: "Ugh--bivalves. All they do is filter feed seawater". That's quite true--that's pretty much all they do most of the time. But the extreme adaptations to filter - feeding one sees in bivalves are part of what makes them such fascinating objects of study. And even though all bivalves utilize basically the same food source, they inhabit a variety of habitats. The forms you will study today--the mussels and the venus clam -- inhabit places as different as night and day: the mussel, the wave swept mid - tidal zone: the venus clam, the sand or mud of quiet bays. As you go through this lab, keep comparing/ contrasting the two animals in the light of their different habitats and lifestyles, but don't lose sight of the fact that they are built on the same basic plan. Once you identify the elements in this plan, it will be easier for you to get a handle in the modifications each form has undergone.

A Little Background

In bivalves, or pelecypods ("knife-foot" in Latin) the mantle has become greatly enlarged, and covers the head. The gills are highly modified for filter feeding; because the food particles they eat are so small, bivalves have no need for the scraping radula and muscular buccal (mouth) apparatus seen in most other mollusks.

Today you will be looking at typical representatives of the two largest bivalve groups: the Pteriomorphia, which have adapted themselves primarily to living attached to a substrate, and the Heterodonta, which are mainly burrowers in mud or sand. Pteriomorphs have a comparatively weak hinge area, without true teeth, and they draw sea water in and out through a simple opening in a fused region of the mantle rather than trough true inhalant and exhalant siphons, as heterodonts do.

Life Histories

Unlike its relatives, the oysters and rock scallops, which attach their lower shell valve to the substrate, *Mytilus* attaches itself with elastic byssal threads. You can see these threads protruding from the valves of your specimens.

Like most bivalves, *Mytilus* feeds by drawing water, by means of ciliary currents over the gills. Food particles are captured in a mucus sheet overlying the gills, and beating cilia propel the mucus sheet to the mouth. *Mytilus* does not have much of a head -- at least you will find no tentacles or eyes around the mouth. In many bivalves, the mantle edge has taken over the main sensory functions; the mantle edge of *Mytilus* is extremely sensitive to touch, and can also detect changes in light intensity. (Some bivalves, notably scallops, even have eyes or long tentacles on the mantle edge.)

Venus , in contrast to *Mytilus* , never settles down. Its foot remains relatively large and powerful throughout its life, and the clam uses it to burrow through sand or mud. One of *Venus*'s most notable adaptations to its burrowing lifestyle is its siphons, which can protrude slightly from the shell. Since, unlike *Mytilus* it is largely sheltered from food - bearing currents or wave action, its water - pumping mechanism should be much more powerful than the mussel's. But once it takes water into the mantle cavity, it feeds in a manner quite similar to the mussel.

Pre Lab Questions *(Answer in complete sentences)*

1. Compare the habitats of the mussel and the clam.

2. List three modifications found in bivalves that are not found, or are different than those in other mollusks.

3. Which animal in today's lab is the Pteriomorph and which is the Heterodont?

4. *Mytilus* like its relatives, the oysters and rock scallops, attaches itself permanently to the substrate. How does *Mytilus's* attachment method differ from that used by these other organisms?

5. Describe how most bivalves feed.

6. After reading the life histories for both the mussel and the clam make a prediction for how the foot of each organism and the siphons would compare to each other.

Getting started

Two group members should dissect a clam while the others dissect a mussel. At each stage, look at each other' s work and note the similarities/ differences between the two forms you are revealing as a team.

Once you've gotten your clam or mussel, get oriented: with the beak (umbo) of the clam pointing left, the clam's left end is the anterior end (where the mouth is); the right end is posterior (siphons and anus); the top (hinge area) is dorsal; the opposite edge (bottom) is ventral.

For the mussel, with the hinge pointing right, and the beak (umbo) up, the hinge area (upper right) is dorsal; the lower left edge is ventral; the upper left (to the left of the beak) is anterior, and the lower right is posterior.

External Anatomy: The Shell

The molluscan shell is secreted by the mantle. While *Mytilus* 's shell is much thinner than *Venus's*, it's structure and composition make it resilient. One might think of it as a lacquer bowl.

Questions:

1. What factors do you think could account for the different shell thickness and structure of the two forms? Environmental forces? Lifestyles? Predators?

2. Which of these factors do you think would have the most influence in each form? Explain.

To answer this question completely one other thing must be taken into account. The shell is an external skeleton. Muscles are attached to it. Depending on muscle size, configuration, and attachment points, as well as shell configuration, very different results may be achieved. "Results" can mean many things: the forces the animal can exert, both to its environment and to its own shell, and how much force it can withstand (for instance, wave shock, or the force of something trying to open the shell). In *Venus*, the powerful adductor muscles, which close the valves, may place a limit on how thin the shell can be. If you barely crack *Venus*'s shell, these muscles exert enough force to cave in the shell completely. The shell could not be much thinner than it is, or else it would collapse under the force of the animal's muscles.

The position the animal assumes in its environment, and where it lives in the intertidal zone, are useful information not only in comparing shell thickness, but also shell shape. The mussel attaches itself to the substrate with its anterior end usually facing the ocean. In this position a streamlined surface faces the oncoming wave.

Questions:

3. How might it help the mussel to have the streamlined surface of the shell pointed towards the incoming waves?

The clam, which lives in comparatively calm, low-intertidal areas, buries its anterior end in the sand or mud so that water only passes over the extreme posterior end, where the siphons are located. As it buries itself, the narrow ventral edge of the shell encounters the sand first. In cross-section, its shell is shaped like a wedge, an efficient shape for burrowing.

Notice the concentric grooves, or growth lines on the shell. They are much more distinct in the clam than in the mussel, giving the clam's shell a rigid surface. The mussel’s shell is quite smooth in comparison. The growth lines originate from the beak, or umbo, which curls anteriorly.

Once you have removed the animal's soft parts, you can examine the internal hinge area. (You might want to come back to this, after you have dissected the internal portions of the clam and mussel). Notice that the hinge ligament in both animals is outlined by a calcareous border.   At the inner edge of the beak the mussel also has minute "denticles", which aid in fitting the valves together accurately.

The clam"s "interlocking mechanism" is much more sophisticated than the mussel's. Anterior to the ligament are three pairs of large interlocking teeth. The entire ventral edge of the shell meshes tightly when closed.

4. Why do you think *Venus* and its burrowing heterodont relatives need such an efficient locking mechanism, while *Mytilus* and most of its pteriomorph relatives do not?

Inside a cleaned-out shell, you can see the chalky-white pallial line running parallel to the shell margin; this represents the connection between the mantle and the shell. Tiny muscles originating from the inner marginal fold of the mantle attach here. Also noticeable in both forms are adductor muscle scars: two roughly equal ones in Venus, one anterior and one posterior; one large and one very small on (near the beak) in *Mytilus* .

Internal Anatomy

Compare the adductor musculature between *Venus* and *Mytilus* . The basic pattern is the same, but the sizes and shapes of the muscles and foot are quite different. The posterior adductor dwarfs the anterior adductor, which lies just left of the beak.

Below *Mytilus* 's anterior adductor lies the brown, finger-like foot. The mussel's byssal threads emerge just below the foot. Embedded in the tissue at the base of the foot is the opaque white thread-producing byssal gland. Notice also the groove running down its upper surface.

Now trace *Mytilus* 's other (shiny) muscles back from where they attach to the foot and byssal area. You will find a single pair of long, cord-like anterior byssus retractors running anteriorly from the byssal gland and attaching to a small shelf just to the right of the beak. Besides pulling on the byssal threads, the contraction of these muscles cause the foot to move forward.

Drawings to include:

You will need to include 4 drawings total (one half page for each drawing)   For all drawings be sure to indicate the following: (anterior, posterior, dorsal, and ventral)

Mussel drawings:

1. External drawing :
    - o Byssal threads
    - o Umbo (beak)
    - o Hinge

2. Inside of valve (shell)
    - o Palial muscle scar
    - o Hinge teeth
    - o Posterior and anterior adductor scar

Clam drawings:

1. External drawing
    - o Umbo
    - o Growth rings
    - o Siphons (if visible) location if they are not

2. Inside of valve drawing:
    - Ligament
    - Posterior adductor scar
    - Anterior adductor scar
    - Cardinal teeth
    - Pallial line
    - umbo

On the mussel and clam internal anatomy handouts label and color the following:

Mussel Internal drawing:

- Mantle
- Foot
- Gills
- Labial palps
- Mouth (location)
- Anterior adductor muscle
- Posterior adductor muscle
- Byssal gland
- Anus location
- Ventricle (heart)
- Stomach (location)

Clam Internal drawing:

- Anterior adductor
- Posterior adductor
- Foot
- Gills
- Exhalant siphon
- Inhalant siphon
- Mantle
- Labial palps
- Mouth (location)
- Anus (location)
- Stomach (location)

Questions :

These answers should be in complete sentences to receive full credit.

5. List the functions of the following organs: valves, hinge ligament, muscular foot, hinge teeth, anterior adductor muscle, posterior adductor muscle, incurrent siphon, excurrent siphon, gills, labial palps, mouth, esophagus, stomach, intestine, and heart.

6. List any structures you think have a high surface-area-to-volume ratio and give possible explanations for this. How is this increased surface area beneficial to both the clam and mussle? *You should have at least two examples/organs.*

7. List and explain 3 pieces of evidence that show how both of these organisms are adapted to their environment.