Oyster Lesson Plan

The lesson plan's primary purpose is to demonstrate the importance of oysters to water quality; however, there are recommendations listed below to accommodate the six disciplines at The Harte Research Institute (e.g., Benthic Ecology, Ocean Health, Biodiversity and Conservation, Marine Policy and Law, Marine and Coastal Geospatial Sciences, and Socioeconomics).

Standards that were considered for the development of this lesson plan were taken from Ocean Literacy: The Essential Principles of Ocean Sciences K-12 (please see attached document). The majority of principles mentioned in the attached document can be applied towards how the lesson is specifically shaped.

Objectives:

Students will understand the ecological importance of oysters and oyster reefs.

Students will learn basic anatomy and physiology of the eastern oyster.

Students will be able to explain how oysters filter feed and cleanse the water.

Students will understand what species biodiversity is and why oyster reefs are important towards species biodiversity.

Students will learn what essential fish habitats are and why they are necessary.

Students will learn what ecosystem services are and how they pertain to oyster reefs.

Materials Needed:

Oyster reef and tank with filter

Water

Glitter (preferably green)

Colors (map pencils or crayons)

Additional/Recommended items

Artificial animals commonly found on oyster reefs (this can be used to show biodiversity on the reef)

Google Maps / Globe / Atlas

Introduction

When was the last time you ate seafood? Have you ever tried an oyster? Some people think oysters are not very appealing because of their appearance; however, oysters are actually very good for us. They have very low caloric values and are high in minerals. Oysters have been eaten since the earliest arrival of humans to the North American continent, thousands of years ago. Presently, they can usually be found at your local restaurant granted they are in season. So if humans eat oysters then what do oysters eat?

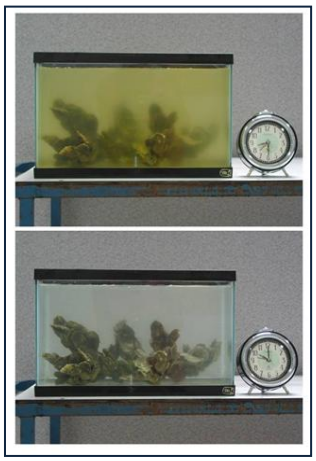


Figure 1 Photo courtesy of http://www.cosee-se.org

Oysters are stationary filter feeders. Interlace your fingers with your two palms facing you, bring your mouth to your fingers, and inhale. That is similar to how oysters feed except this is done underwater. Baby oysters do not have a shell, they float in the water column until they find a hard substrate where they will settle and glue themselves down for the rest of their lives. When many oysters get together they form a reef, where they continue to filter feed. An oyster can filter approximately 25 gallons of water in a single day. Imagine drinking 25 gallons of milk in one day. That's a lot of milk and a lot liquid. Additionally, if there is an entire reef of oysters all filtering together that can add up to a lot of water being filtered. You may be asking though what exactly is being filtered from the water.

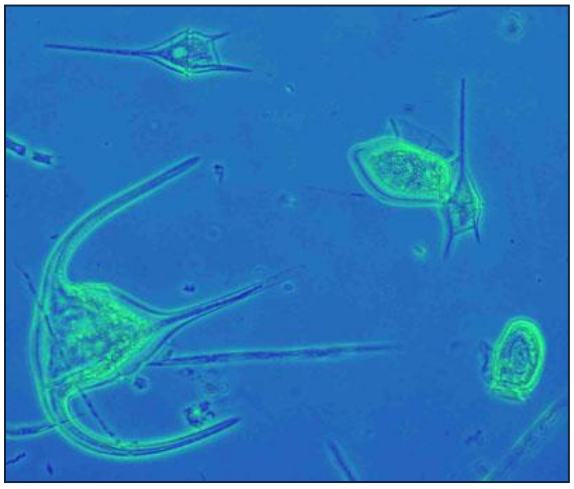


Figure 2 Photo courtesy of http://superfoodmarinephytoplankton.com

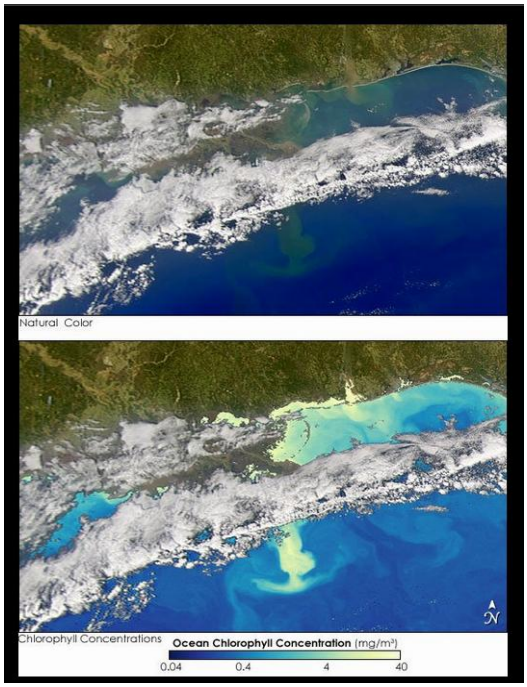


Figure 3 Photo courtesy of http://www.nasaimages.org/luna/servlet/detail/nasaNAS~10~10~68888~173898:Phytoplankton-Bloom-in-the-Gulf-of-

Well the answer is pictured in Figure 2. These are called marine phytoplankton. They are tiny plants that move around with the currents. The one on the very left side of Figure 2 is about the size of the period at the end of this sentence. That seems really small to feed not only all the oysters in the world but also some of the biggest animals in the world (whale sharks, blue whales, etc…), which also eat marine phytoplankton. Phytoplankton are capable of feeding all of these animals because they are very abundant. Figure 3 demonstrates this. The light blue/green streak alongside the bottom of the white cloud is a bloom of marine phytoplankton, and the land is Louisiana and part of Mississippi. Remember, this is only a small part of the world.

This lesson will primarily focus on the oyster's ability to filter food out of the water. Oysters build intertidal reefs that can be found within estuaries and coastal areas that are influenced by tidal fluctuations and watershed outflows (e.g., rivers, creeks, bays, etc…). Oysters are primarily filter feeders, meaning they take in water (rich in marine phytoplankton and algae) through their excurrent siphon and filter it across their gills. The water then is passed to their labial palps where smaller particles get eaten and larger particles pass out their excurrent siphon, as seen in Figure 4 (note this is a figure of a mussel and not an oyster but they feed similarly).

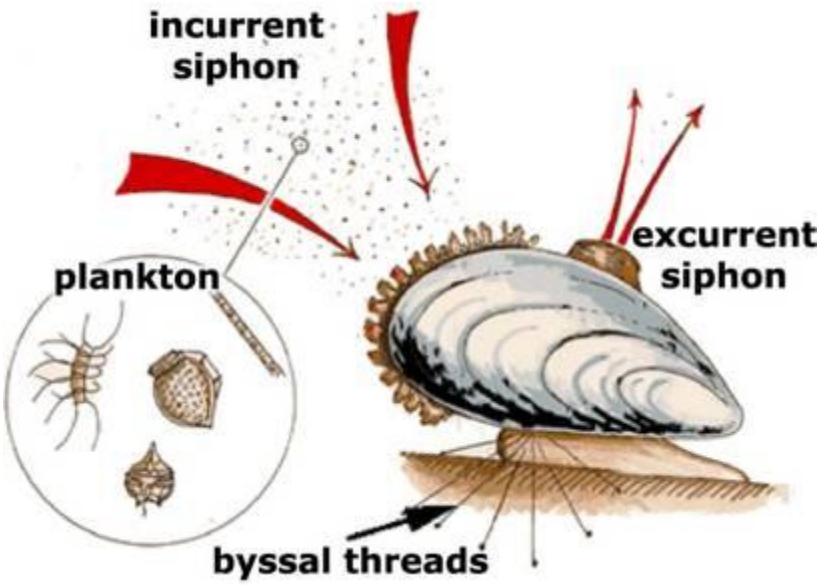


Figure 4 Photo courtesy of http://www.cabrillo.edu/~jcarothers/lab/notes/molluscs/FRAMES/MainFrame.html

If oysters are stationary and are constantly filtering water, what do you think would happen if someone were to pour something toxic in the water, like a pollutant? Well oysters are capable of filtering other things besides phytoplankton out of the water which can be a good and bad thing. Overtime, oysters can bio-accumulate chemicals (aka pollutants) and bacteria making the oyster inedible. Therefore, if there is pollution such as an oil spill or a toxin such as a harmful algal bloom, the commercial oyster industry will close. This is a large problem because the US harvests approximately 30 million pounds of oyster meat per year (~75% is the eastern oyster). In Rhode Island, oyster harvest has declined since the 1990s (see Figure 5) due to negative impacts on populations located in Narragansett Bay (e.g., effects of disease, environmental conditions, poor sets of new recruits, and heavy fishing pressure).

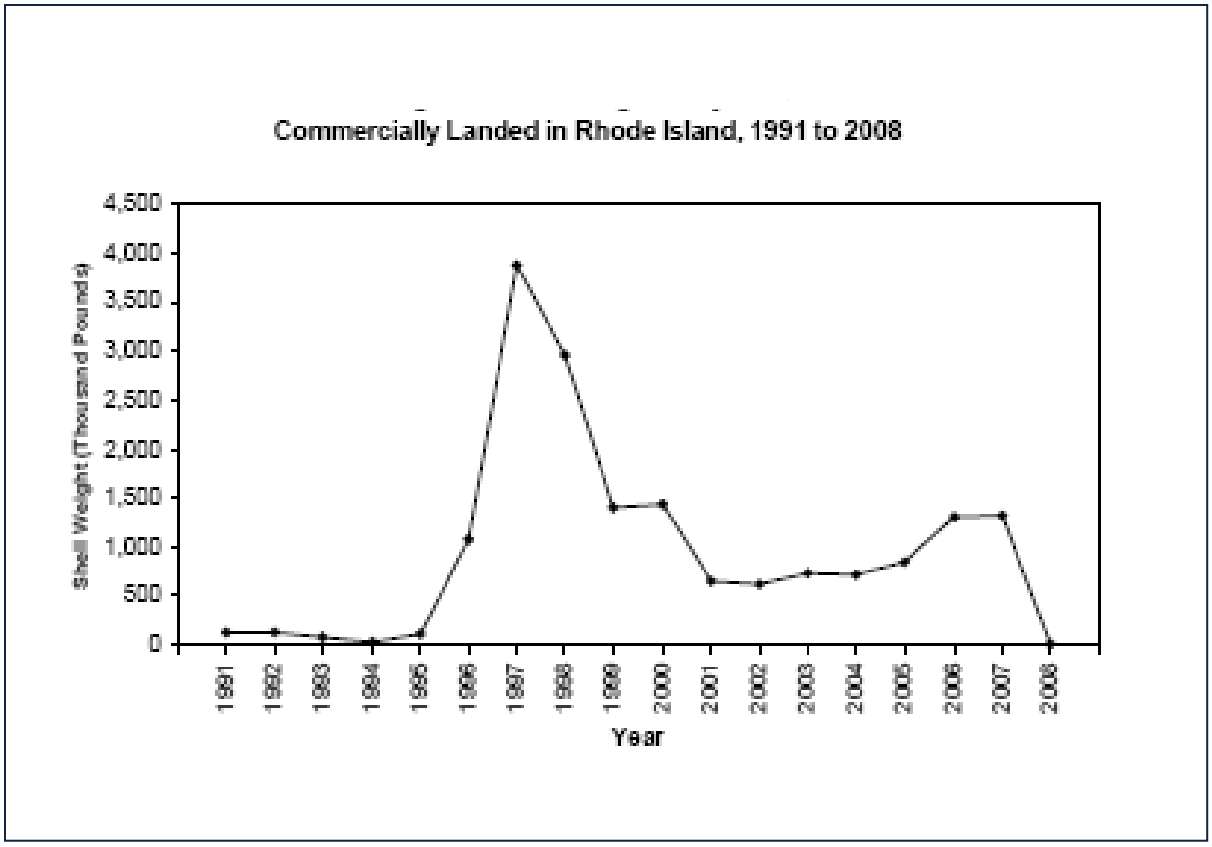


Figure 5 Graph courtesy of State of Rhode Island and Providence Plantations Department of Environmental Management 2010 Management Plan for the Shellfish Fishery Sector

Have your instructor set up the oyster demo. While this is running answer the following questions.

In the boxes below let each box represent the demo aquarium. At each time interval draw what your aquarium looks like. This will allow for you to be able to compare at the end of the lesson. *Hint: since there are certain features that will not change it might be easier to draw those features in each of the squares before beginning the demonstration.*

Beginning	5 minutes
10 minutes	15 minutes
20 minutes	25 minutes

30 minutes	35 minutes

40minutes

In between intervals answer the following questions

What does the green glitter represent?

What does the filter represent at the top of the tank?

Let's pretend that you have three live oysters in the tank, how many times would the water recycle in your 2 gallon tank in an hour? (Remember one oyster can filter 25 gallons per day or per 24 hours)

How many live oysters would be able to filter 100 gallons/hour?

Also, if your filter represents _____ oyster power (like horse power for a car) then how many times is the water going to be turned over in your tank? (Meaning how many times will 2 gallons get recycled/filtered/per hour)

So let's get know the oyster a little more. Below is a picture of an oyster. Please color and label the anatomy. *Hint: continue looking through the lesson to see if there are any clues to help you out labeling anatomical parts.*

Eastern Oyster – *Crassostrea virginica*

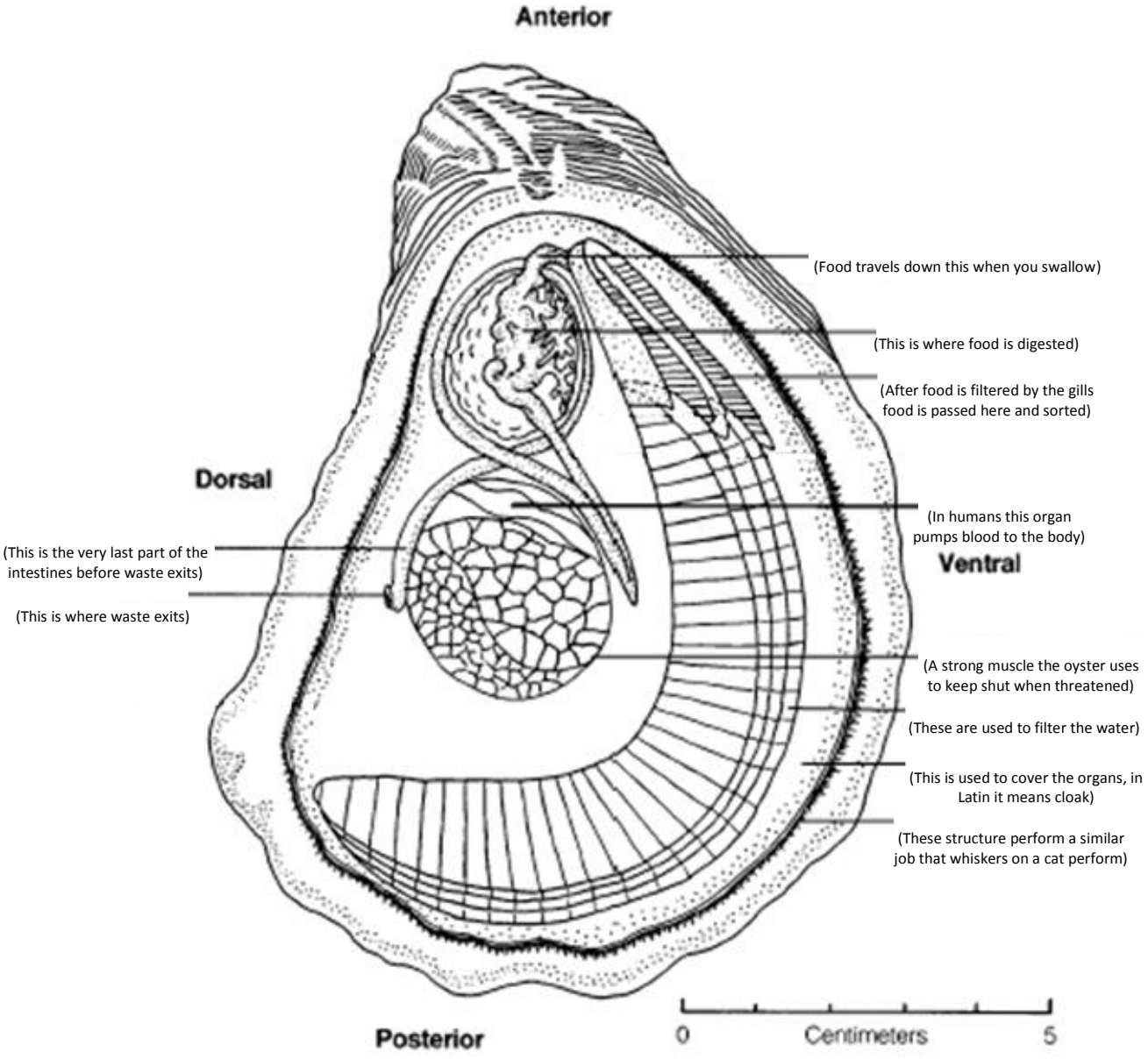


Figure 6 Photo courtesy of http://www.mdsg.umd.edu/store/books/oyster/sample/

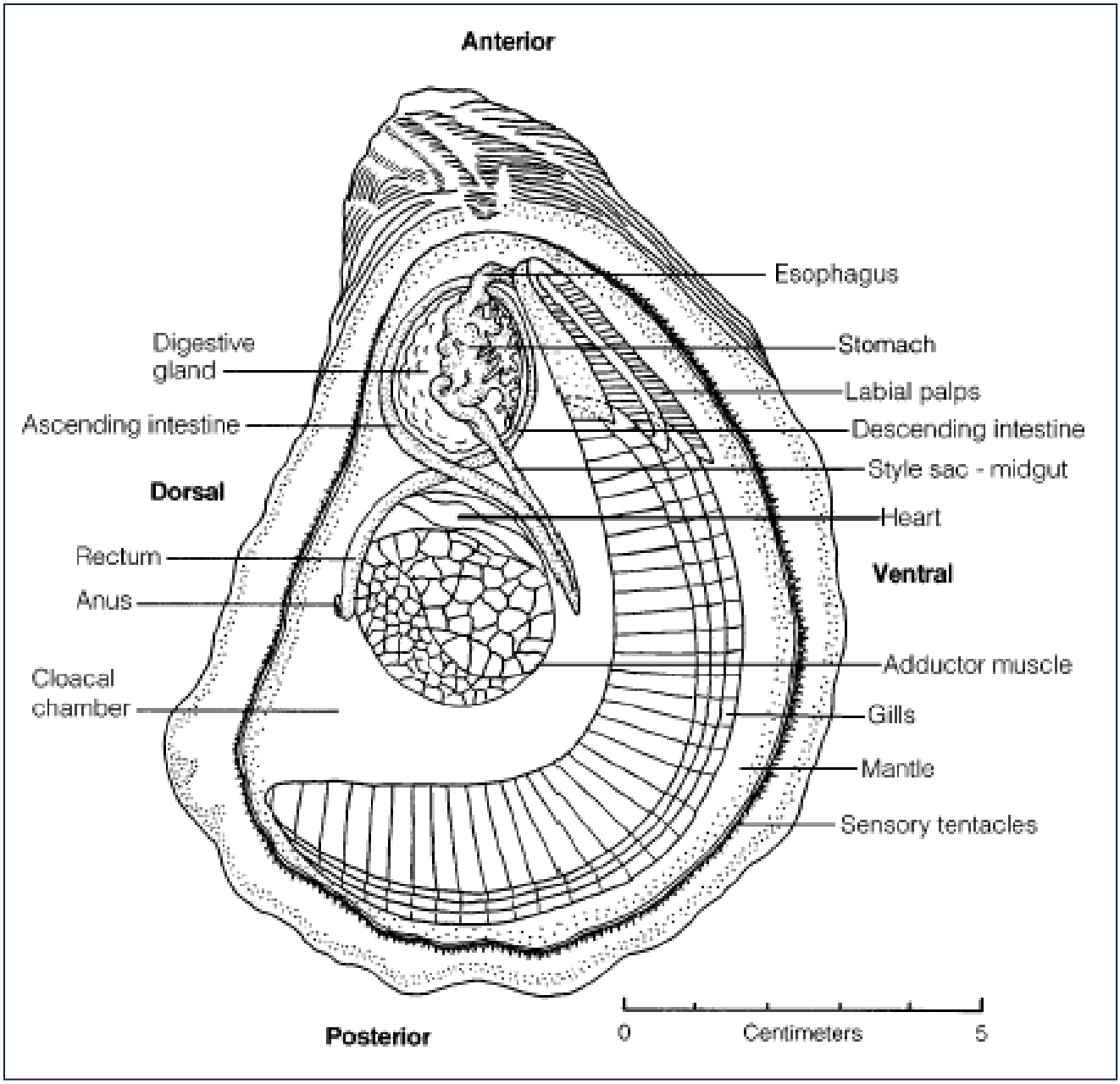
Below is a map showing the natural range of the eastern oyster. Areas that are in red illustrate where the eastern oyster has been documented. The yellow portions on the map are where there are undocumented findings of the eastern oyster.

Based on the map below are there eastern oysters where you are located? _____

(Circle your answer) Is the eastern oyster native to:

Alaska? – YES / NO
California? – YES / NO
Cuba? – YES / NO
Falkland Islands? – YES / NO
Yucatan Peninsula? – YES / NO

Figure 7 Photo courtesy from http://www.aquamaps.org/receive.php


Anterior
Esophagus
Digestive gland
Stomach
Labial palps
Ascending intestine
Descending intestine
Style sac - midgut
Dorsal
Heart
Rectum
Ventral
Anus
Adductor muscle
Cloacal chamber
Gills
Mantle
Sensory tentacles
Posterior
0
Centimeters
5

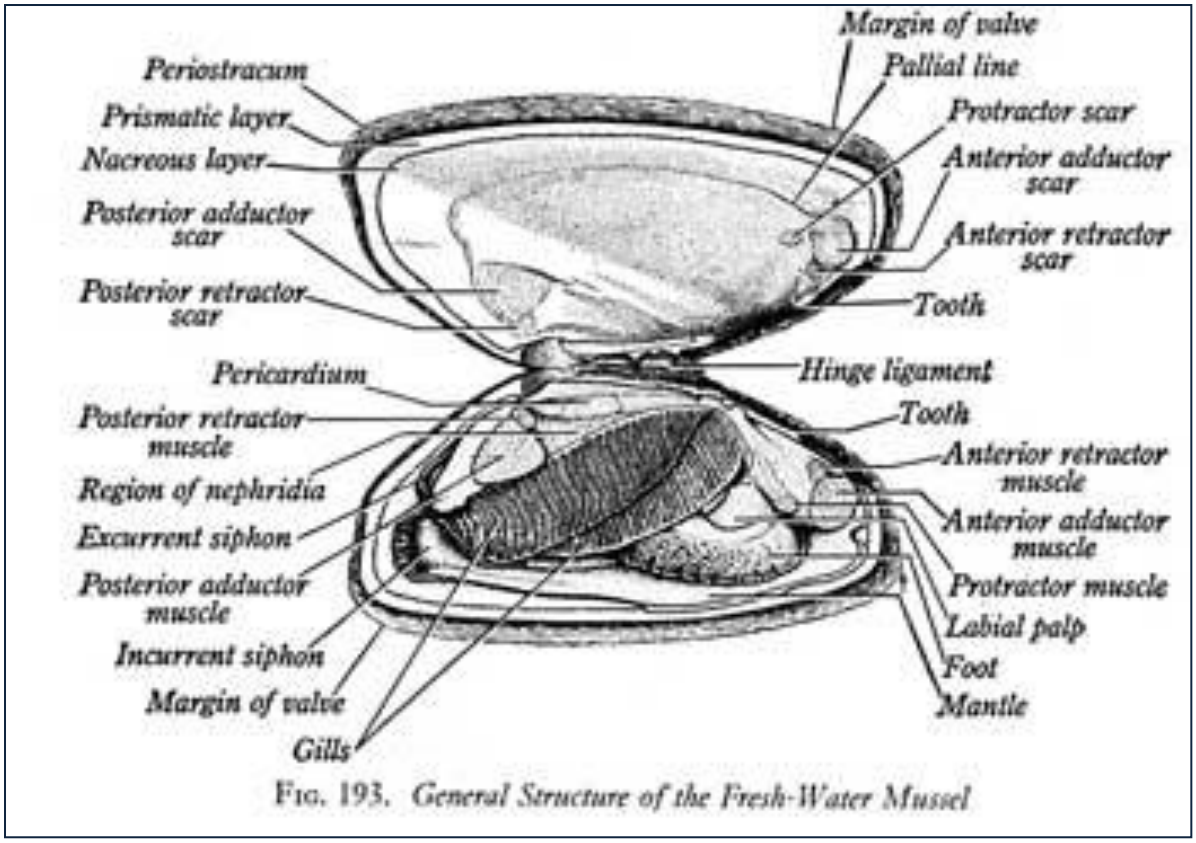


FIG. 193. *General Structure of the Fresh-Water Mussel*

Figure 8 Photo courtesy of http://www.sheppardsoftware.com/content/animals/animals/invertebrates/mussel.htm

Taxonomy

Taxonomy is the process scientists use to classify organisms. All organisms are classified into taxonomic levels including oysters and yourself. The levels of classification are Domain, Kingdom, Phylum, Class, Order, Family, Genus, and Species. Below is the taxonomic classification for humans. The taxonomic levels are analogous to identifying and locating someone on planet Earth. With your instructor's assistance complete the diagram below for the eastern oyster.

Example for Humans

Domain	Eukaryota
Kingdom	Animalia
Phylum	Chordata
Class	Mammalia
Order	Primates
Family	Hominidae
Genus	Homo
Species	sapiens

Fill in the blanks below least specific to more specific taxonomic levels	Below draw an upside down triangle to represent going from least specific to more specific levels	As you define each level, relate to addressing an mailed letter from less to more specific	Below fill out the information for yourself
		Country	
		State	
		City	
		Zip Code	
		Street	
		Street Number	
		Last Name	
		First Name	

If an organism is identified using the taxonomic classification they are then incorporated into a dichotomous key. Scientists use dichotomous keys to identify organisms when they find an unknown specimen. Sometimes it can be very difficult to tell some organisms apart; therefore, scientists will use morphological features (shape and structure) to tell them apart. In this next step we are going to practice using a dichotomous key to identify the animals your instructor placed into the aquarium. Some of you may have used a dichotomous key before while reading an adventure tale. Below is an example of an adventure dichotomous key.

1. a. If you feel brave and adventurous enter the cave……go to 2
   b. If you want to be safe turn around and go down the stairs……..go to 3
2. a. You've entered the cave and a bear is asleep keep walking quietly……go to 4
   b. You've entered the cave and the bear is awake…….go to 5
3. a. You begin walking down the stairs and find a piece of candy……..go to 6
   b. You begin walking down the stairs and you find no candy…….go to 7
4. You step on a twig and the bear wakes up and attacks and it's all over
5. The bear attacks and it's all over
6. You eat the candy and realize the bear set it there as a trap and it's all over
7. You continue to walk until you make it home and everything is okay

Dichotomous Key for the Aquarium Specimens (Note: all animals represent pseudo macroinvertebrates)

1. a. Animal has an elongated body with no paired appendages 2
   b. Animal does not have an elongate body, and has paired appendages 10
2. a. Animal has rings 3
   b. Animal has no rings 7
3. a. Rings are located anteriorly and posteriorly 4
   b. Rings are only located anteriorly 6
4. a. There are 60 rings on the posterior section
   BLUE GLITTER WORM
   b. There are 34 rings on the posterior section 5
5. a. Animal is reddish with bright blue glitter
   RED DOUBLE GLITTER WORM
   b. Animal is greenish with dull blue glitter
   GREEN DOUBLE GLITTER WORM
6. a. Animal is a bright neon orange/reddish
   SMALL NEON ORANGE WORM
   b. Animal is opaque white
   SMALL WHITE WORM
7. a. Slit on ventral surface of animal 8
   b. No slit on ventral surface of animal
   PURPLE QUEEN COCAHOE
8. a. Caudal fin (tail fin) has point(s) 9
   b. Caudal fin is flattened
   PURPLE BLACK-SPOTTED WORM
9. a. Gold strip running down lateral surface of the body
   GOLD STRIPED WORM
   B. No gold strip running down lateral surface of the body
   REDDISH BUG-EYE WORM

10. a. Animal has a elongated body with paired appendages 11
    b. Animal has a roundish body with paired appendages
    PEELER CRABS
11. a. Animal is large with paired appendages pointed and facing anteriorly
    DEVIL SILVER SPARKLE SHRIMP
    b. Animal is small with white eyes
    SILVER SHRIMP