Bivalves: Mollusks that Matter

Objective

Students will understand the anatomy and physiology of mussels, and understand why they may pose health risks to humans.

National Science Education Standards

Content Standard C: Life Science
- Structure and Function in Living Systems (5-8)
- Organism Regulation and Behavior (5-8)
- Diversity and Adaptation of Organisms (5-8)
- Behavior of Organisms (9-12)

Warm-Up

Bring in, or ask students to bring in any seashells they have found, or go on a short preliminary field trip to collect them. Ask them to note which ones are bivalves, or those that have (or look like they had) two shell halves hinged at the top. Using identification keys, have students identify the shells by their common and scientific names.

Introduction

Bivalves are aquatic mollusks (Phylum Mollusca) that belong to the Class Pelecypoda (or Bivalvia), meaning "hatchet-foot." Mussels, clams, scallops and oysters are examples of bivalves, which have two shells (valves) covering the left and right sides of the body. There are many different types of both freshwater and marine bivalves, and their shells come in a wide variety of sizes, shapes, and colors. They may range in size from 2 millimeters to over four feet (the giant clam of the South Pacific).

Mussels attach themselves to rocks with bundles of tough threads called "byssal threads" so that they can remain stable in intertidal areas. The narrow end of the mussel points toward the breaking waves to protect the animal. Some examples of mussels are the Blue mussel (*Mytilus edulis*), which is common along the east coast, and the California mussel (*Mytilus californianus*), which is found on the west coast in exposed rocky intertidal zones.

Clams are another type of bivalve and include the Northern quahogs (*Mercenaria mercenaria*), also called "littlenecks" or "cherrystones," which make popular meals for seafood lovers. An example of a West Coast clam is the Razor clam (*Siliqua patula*) named for its sharp shell and resemblance to an old-fashioned straight razor.

Scallops have a variety of shell colors, with 17-20 ribs on the exterior. Scallops lie on the seabed and move by rapidly opening and closing their shells, ejecting water out. Most kinds have a series of brightly colored eyes that are sensitive to minor changes in light intensity. The

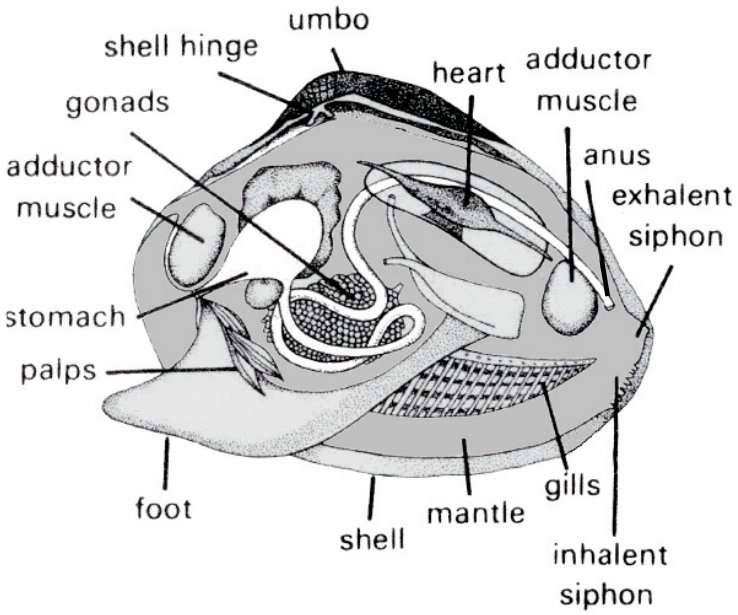
Atlantic Deep-sea Scallop (*Placopecten magellanicus*) forms the basis of the largest scallop fishery in the United States and one of the most important fisheries in the New England area.

Oysters are reef-forming animals, and these reefs or "beds" often provide structured habitats for many other species. Shell size usually ranges from four to eight inches, and is rough and irregularly shaped. Oysters are born as males, but may change into females if environmental conditions are favorable and food is plentiful. Some species of oyster are known for their pearls, which are formed if a particle becomes lodged inside the shell. The Eastern oyster (*Crassostrea virginica*) is most likely the species served if you are enjoying seafood on the East Coast. The Pacific Oyster (*Crassostrea gigas*) is the most common oyster grown on the west coast.

Anatomy

Different types of bivalves will vary somewhat in their anatomy, so the figure below should be used only as a general reference. The two halves (valves) of a bivalve's shell are hinged at the top by an elastic ligament, and are opened and closed by two **adductor muscles** on the inner surfaces of the valves. The top portion of the shell (where it is hinged) is the oldest part of the shell, called the **umbo**, and it is from this area that the animal extends as it grows. Some bivalves must be able to close their shells tightly when exposed at low tide so that they can retain water and keep their gills moist. Within the shell is a soft layer of tissue called the **mantle**, which secretes the three layers of the shell: the outer layer (organic periostracum), the middle (calcareous prismatic) layer, and the pearly, inner (nacreous) layer. Pearls are formed when a foreign particle finds its way into the shell, and the animal deposits nacreous layers around it.

General Bivalve Anatomy



Bivalves have a muscular "**foot**" at their front end that is used for movement such as burrowing, or in some bivalves like the razor clams, for swimming. In the blue mussels mentioned above, the foot is primarily used to create byssal threads. Bivalves have two **siphons** at the rear of the body which are used for the inflow (inhalant) of water and outflow (exhalant) of water and wastes. Sometimes the two siphons are joined into one "neck." The animal can extend these siphons if it needs to hide under the sediment to avoid predators.

Feeding

Bivalves consume the phytoplankton and other tiny organic matter that flows through their **gills**. Gills function both in respiration and in straining out food particles. Two small organs called **palps** help carry food to the mouth. Mussels are extremely efficient feeders, and can filter 10-15 gallons of water per day.

Reproduction

Bivalve reproduction takes place externally when eggs and sperm from the **gonads** are released into the water, and a female may spawn millions of eggs in her lifetime. Once fertilized, tiny, free-swimming larvae are formed. This planktonic stage usually lasts a few days, and the larvae settle and attach themselves to a hard surface, where they then begin to form a shell.

Student Activities

1. Bivalves are one of many species that absorb and retain pollutants such as heavy metals and toxic chemicals in their bodies. This process is called bioaccumulation. When humans or other animals higher up the food chain eat the mussels, they are also ingesting the toxins in the mussel's tissue, which may cause undesirable health effects. Find out if mussels are monitored in your region, and what, in particular, they are tested for. Have there been any shellfish consumption warnings in the past year? If so, what prompted the warnings?

2. Color the clam, oyster and scallop online at:
http://www.enchantedlearning.com/painting/Bivalves.shtml

Assessment

1. Complete the Worksheet on General Bivalve Anatomy
2. Using the internet and other resources, have students create an illustration of a food chain which involves mollusks and demonstrates the process of bioaccumulation.
3. Using what they've learned about bivalve anatomy and doing additional research if necessary, ask students to list and explain three adaptations of mussels to their environment.

Additional Resources

Man and Mollusk Resource Site
http://www.manandmollusc.net/advanced_introduction/moll101pelecypoda.html

National Oceanographic and Atmospheric Administration
Blue mussel: http://www.csc.noaa.gov/lcr/nyharbor/html/gallery/sgmytilu.html
Northern quahog: http://www.csc.noaa.gov/lcr/nyharbor/html/gallery/sgmercen.html

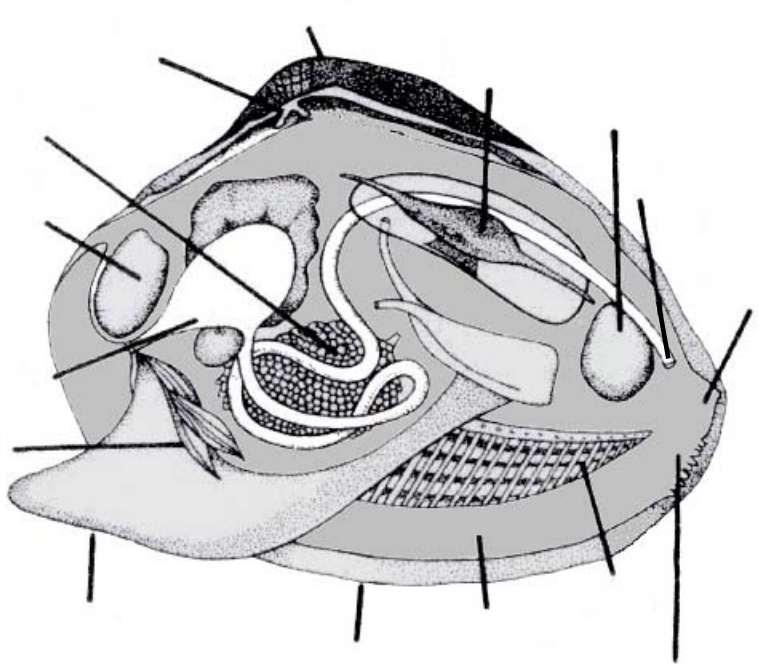
Scallop Eyes
http://www.iac-usnc.org/Methods/scallop/eyes.html

Freshwater Mussels
http://www.inhs.uiuc.edu/~ksc/MusselGenera.html
http://www.bio.umass.edu/biology/conn.river/fwmussel.html

Bivalve Slide Show
http://nighthawk.tricity.wsu.edu/museum/ArcherdShellCollection/SlideShows/Bivalve_Slide_Show2.html

Oyster Anatomy
http://www.mdsg.umd.edu/oysters/anatlab/
http://www.wsg.washington.edu/oysterstew/cool/oyster_diagrams.html

Student Worksheet
General Bivalve Anatomy



1. Label the parts of the bivalve above.
2. Explain the functions of the following:

    Inhalant Siphon:

    Exhalant Siphon:

    Foot:

    Palps:

    Adductor Muscles:

    Umbo:

    Mantle:

    Gills: