Exercise 1
Bivalve Evolution: Diversity of Form and Function

This exercise stresses the structure-function relationships in various species of bivalves. It emphasizes a) shell structure, b) bivalve diversity, and c) the diversity of habitat diversity in which bivalves occupy.

SUGGESTED ELEMENTS FOR AN INTRODUCTORY LECTURE

- Bivalves (Phylum Mollusca: Class Bivalvia) are a diverse group comprising 20,000-30,000 living species and contain rich fossil record.
- They occupy a diversity of habitats, including both freshwater and marine waters.
- Habitat types range from the intertidal, soft sediment, rock, wood substrata to the abyss.
- Species size range from 1 mm to 1 m.
- Most bivalves are filter feeders, but many are also deposit feeders and use siphons to feed on soft sediment.
- Some bivalves are epifaunal and produce byssal threads for attachment to rocks and shells.

ACTIVITIES
1. Examine shell morphology of 13 bivalve species.
2. Identify key features of each shell.
3. Sketch shell morphology.
4. Identify hinge tooth structure.

VOCABULARY

<table>
<thead>
<tr>
<th>Adductor muscle</th>
<th>Dimyarian</th>
<th>Isomyarian</th>
<th>Heteromyarian</th>
<th>Monomyarian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle scar</td>
<td>Auricle</td>
<td>Beak</td>
<td>Hinge</td>
<td>Ligament</td>
</tr>
<tr>
<td>Hinge tooth</td>
<td>Valve</td>
<td>Lunule</td>
<td>Pallial line</td>
<td>Pallial sinus</td>
</tr>
<tr>
<td>Umbo</td>
<td>Cardinal teeth</td>
<td>Lateral teeth</td>
<td>Sculpture</td>
<td>Taxodont</td>
</tr>
<tr>
<td>Edentulous space</td>
<td>Heterodont</td>
<td>Desmodont</td>
<td>Schizodont</td>
<td>Filter feeder</td>
</tr>
<tr>
<td>Deposit feeder</td>
<td>Siphons</td>
<td>Epifaunal</td>
<td>Byssal threads</td>
<td></td>
</tr>
</tbody>
</table>

MATERIALS FOR ALL PROCEDURES

Equipment
- Compound Microscope

Supplies
- Colored pencils
- Lab notebook
- Ruler

Organisms
- *Tridacna crocea*
- *Mercenaria mercenaria*
- *Tellina* sp.
- *Spondylus* spp.
- *Chama* sp.
- *Arca zebra*
- *Crassostrea virginica*
- *Pecten* spp.
- *Arctica* sp.
**SUPPLEMENTAL MATERIALS**


**VENDORS FOR MATERIALS**

Shells can be collected locally or ordered from Deltona shells, http://www.deltonaseashells.com

Field guides can be purchased at www.amazon.com
Bivalves (Phylum Mollusca: Class Bivalvia) are a diverse group comprising 20,000-30,000 living species and containing a rich fossil record. They occupy a diversity of habitats, including both freshwater and marine waters. Bivalve habitat types range from the intertidal to the abyss and species range in size from 1 mm to 1 m. Most bivalves are filter feeders, but many are also deposit feeders and use siphons to feed on soft sediment. Some bivalves are epifaunal and produce byssal threads for attachment to rocks and shells.

**LAB OBJECTIVES:**

1. To examine shell anatomy and be able to identify key morphological features
2. To examine bivalve diversity as it relates to form
3. To be able to relate shell morphology/diversity with function and habitat

In today’s lab you will examine some representative species of bivalves that exhibit a variety of form as it relates to function and habitat type. As you examine your shell species sketch the details of the shell, measure shell size and identify/label key morphological features using the textbooks, field guides and shell terminology below. Record notes on how the species differ morphologically. As you examine each species, use the guide books to determine their lifestyles (the habitat type each species is adapted for, feeding niche etc). How does the morphology of each species relate to its ecological niche?
BIVALVE SHELL TERMINOLOGY

**ADDUCTOR MUSCLE.** Muscle connecting the two valves of the shell and tending to draw them together. There are normally two adductor muscles in each animal.

- **Dimyarian**: A valve having two adductor muscle scars; one anterior and one posterior.
- **Isomyarian**: A dimyrian shell where two adductor scars generally equal in size.
- **Heteromyarian**: Dimyrian shell where the two adductors are of unequal size; usually the posterior scar is the larger of the two.
- **Monomyarian**: A shell having only one adductor scar; which is usually a centrally positioned posterior adductor scar.

**ADDUCTOR MUSCLE SCAR.** Impression on the interior of the shell where the adductor muscle was attached.

**AURICLE.** Earlike extension of the dorsal part of the shell, commonly separated from the body of the shell by a notch or sinus.

**BEAK (Umbo).** In bivalves, the tip of each valve, the oldest part of the shell, generally pointed and near the hinge.

**HINGE.** Collective term for structures of the dorsal region which function during opening and closing of the valves.

**HINGE PLATE.** Shelly internal platform bearing hinge teeth, situated below beak and adjacent parts of the dorsal margin.

**HINGE TOOTH.** Shelly structure (usually one of a series) adjacent to the dorsal margin and received into a socket in the opposite valve. Hinge teeth hold valves in position when closed.
LEFT VALVE. The valve on the left hand side when the shell is placed with the pallial sinus towards the observer, and the beaks uppermost.

LIGAMENT. Horny elastic structure or structures, joining the two valves of the shell dorsally and acting as a spring, causing the valves to open when the adductor muscles relax.

LIGAMENT PIT. Relatively broad depression in the cardinal area for the attachment of the ligament.

LUNULE. A depressed area present in some bivalves, situated in front of the beaks, in one or both valves, generally set off from the rest of the shell by a change in sculpture or color.

MUSCLE SCAR. Impression on the interior of the shell marking the former place of attachment of a muscle.

PALLIAL LINE. Line of mantle attachment

PALLIAL SINUS. An indentation in the posterior part of the pallial line where the siphons can be retracted.

POSTERIOR RIDGE. Ridge passing over or originating near the umbo and running diagonally towards the posteroventral part of the shell.

RETRACTOR MUSCLE SCAR. Insertion point of a muscle situated above the adductor muscle and attached to the foot.

UMBO (singular) - ONES (plural). Region of the valve surrounding the point of maximum curvature of the longitudinal dorsal profile and extending to the beak when not coinciding to it; normally convex.

TEETH. Projections from the hinge of a bivalve shell. See also cardinal teeth and lateral teeth.

CARDINAL TOOTH. Hinge tooth situated close to the beak.

LATERAL TOOTH. Hinge tooth in front of or behind the cardinal teeth and located some distance from the beaks.

SCULPTURE. Relief pattern on shell surface.

TAXODONT. The condition when numerous alternating small teeth and sockets occur along the hinge of a bivalve shell, some or all transverse to the hinge margin.

DENTITION

The two valves are held together by a hinge and hinge ligament. The hinge is composed of teeth and sockets known as dentition. The condition of the teeth varies taxonomically. The following describes the different types of dentition that exists. Cardinal teeth are located in the middle of the hinge and can be flanked by posterior and anterior lateral teeth.

Cardinal teeth: The teeth immediately below the beak.
**Lateral teeth:** The teeth extending laterally from the beak.

**Edentulous space:** Hinge region lacking teeth, usually present between the cardinal and lateral teeth.

**Taxodont dentition:** A series of small parallel to sub parallel teeth which are perpendicular to hinge line.

**Heterodont dentition:** having cardinal teeth and lateral teeth either in front and/or behind beak.

**Desmodont dentition:** having an internal ligament and a chondrophore (spoon-like depression in hinge supporting ligament), but usually lacking well defined teeth.

**Schizodont dentition:** having prominent bifurcating or diverging teeth.
REPRESENTATIVE SPECIES: Measure and sketch specimens below. List the key diagnostic features for each species.

*Arca zebra*

*Tridacna crocea*

*Tellina sp.*
Spondylus barbatus

Spondylus ducalis

Mercenaria sp.
Tellina sp.

Crassostrea sp.

Pecten spp.

Chama lazarus
Additional Bivalve Species

You will also be observing additional species including local species from the Chesapeake Bay and Atlantic Ocean. For each of these provide a sketch below labeling the anatomy of the shell. As in the previous section list diagnostic features and lifestyle using the guide books.