Class Bivalvia

- **Bivalved molluscs** have two shells (valves).
- Mussels, clams, oysters, scallops, shipworms.
- Mostly sessile **filter feeders**.
- No head or radula.
Class Bivalvia

- Part of the mantle is modified to form **incurrent** and **excurrent** siphons.
  - Used to pump water through the organism for gas exchange and filter feeding.
  - Sometimes used for jet propulsion.
Class Bivalvia

- Shipworms can be destructive to wharves & ships.
- The valves have tiny teeth that act as wood rasps and allow these bivalves to burrow through wood.
- They feed on wood particles with the help of symbiotic bacteria that produce cellulase and fix nitrogen.
Class Bivalvia

• Native freshwater clams in the U.S. are jeopardized.
  – Of more than 300 species once present, 12 are extinct,
    42 are threatened or endangered and 88 more are of concern.
  – Sensitive to water quality changes, including pollution and sedimentation.
• Zebra mussels are a serious exotic invader into the Great Lakes Region.
Class Bivalvia

- Two shells are held together by a **hinge ligament** on the dorsal surface.
- The **Umbo** is the oldest part of the shell, growth occurs in concentric rings around it.
Class Bivalvia

- Like other molluscs, bivalves have a **coelom** and an **open circulatory system**.
- The mantle cavity of a bivalve contains gills that are used for feeding as well as gas exchange.
Class Bivalvia

- Pair of U-shaped kidneys is ventral and posterior to heart.
- Nervous system has three pairs of widely separated ganglia connected together.
- Sense organs are poorly developed.
  - Statocysts in the foot.
  - Osphradia in the mantle cavity (chemoreceptive).
  - Pigment cells on the mantle.
- Some mantle eyes have a cornea, lens, retina and pigmented layer.
- Tentacles may have tactile and chemoreceptor cells.
Bivalves are Typically Filter Feeders

- Food grooves in mucous string
- Position of hinge
- Mouth
- Left mantle
- External gill
- Foot
- Labial palp
- Shell
- Right mantle
- Sand and debris
- Incurrent siphon
- Excurrent flow
- Incurrent flow
Class Bivalvia

- Scallops have a row of small blue eyes along the mantle edge. Each eye has a cornea, lens, retina, and pigmented layer.
Class Bivalvia - Locomotion

• Bivalves move around by extending the muscular foot between the shells.

• Scallops and file shells swim by clapping their shells together to create jet propulsion.

http://www.youtube.com/watch?v=u_RfgvITEY&feature=related
http://www.youtube.com/watch?v=vmi_l8QW5eo
Class Bivalvia - Feeding

- Suspended organic matter enters incurrent siphon.
- Gland cells on gills and labial palps secrete mucus to entangle particles.
- Food in mucous masses slides to food grooves at lower edge of gills.
- Cilia and grooves on the labial palps direct the mucous mass into mouth.
- Some bivalves feed on deposits in sand.
Class Bivalvia - Reproduction

- Bivalves usually have separate sexes.
- Zygotes develop into **trochophore**, **veliger**, and **spat** (tiny bivalve) stages.
Class Bivalvia - Reproduction

- In freshwater clams, fertilized eggs develop into **glochidium** larvae which is a specialized veliger.
  - Glochidia live as parasites on fish and then drop off to complete their development.
Glochidium Larvae

http://www.youtube.com/watch?v=IDYTbJ0WHkU&feature=related
Class Cephalopoda

- **Cephalopods** include octopuses, squid, nautiluses and cuttlefish.
- Marine carnivores with beak-like jaws surrounded by tentacles of their modified foot.
  - Modified foot is a funnel for expelling water from the mantle cavity.
Class Cephalopoda

- Cephalopod fossils go back to Cambrian (570 mya) times.
- The earliest had straight cone-shaped shells.
- Later examples had coiled shells similar to *Nautilus*.
- Ammonoids were a very successful group, some had quite elaborate shells.
Class Cephalopoda - Shells

- Shells of Nautilus and ammonoid cephalopods are made buoyant by a series of gas chambers.
Class Cephalopoda - Shells

- Nautilus shells differ from those of a gastropod because they are divided into chambers. The animal lives in the last chamber. A cord of living tissue extends through each chamber.
Class Cephalopoda - Shells

- Cuttlefishes have a small curved shell, completely enclosed by the mantle.
Class Cephalopoda - Shells

- In squid, the shell has been reduced to a small strip called the **pen**, which is enclosed in the mantle.
Class Cephalopoda - Octopus
Class Cephalopoda - Locomotion

• Cephalopods swim by expelling water from the mantle cavity through a ventral funnel.
  – They can aim the funnel to control the direction they are swimming.
Class Cephalopoda

• Cephalopods have a **closed circulatory system**.

• Nervous and sensory systems are more elaborate in cephalopods than in other molluscs.
  
  – The brain is the largest of any invertebrate.
  
  – VIDEO
Class Cephalopoda

- Most cephalopods have complex eyes with cornea, lens, chambers, and retina.
Class Cephalopoda – Communication

- Visual signals allow cephalopods to communicate.
  - Movement of body and arms
  - Color changes effected by \textit{chromatophores} (cells in the skin containing pigment granules).

- Chromatophores can change shape alternately dispersing and concentrating pigment.
Class Cephalopoda

• Most cephalopods have an **ink sac** that secretes **sepia**, a dark fluid containing the pigment melanin.
  
  – When a predator tries to attack, the animal ejects the ink into the water where it hangs between the animal and the predator screening a quick escape.
Color & Morphology Changes for Camouflage
Class Cephalopoda - Reproduction

• Sexes are separate in cephalopods.
• Juveniles hatch directly from eggs – no free-swimming larvae.
• One arm of male is modified as an intromittent organ, the **hectocotylus**.
  – Removes a spermatophore from mantle cavity and inserts it into female.