Mollusks
Soft-bodied Invertebrates
Phylum Mollusca

- Very diverse - more species of molluscs than any other group in the ocean.
- Phylum includes:
  - Bivalves (2 shells); ex. Clam
  - Gastropods (1 shell, coiled); ex. Snail
  - Cephalopods (large head, tentacles); ex. Octopus
Phylum Mollusca

- Class **Bivalvia** (clams, mussels)
- Class **Gastropoda** (snails)
- Class **Cephalopoda** (octopus, squids)
Phylum Mollusca

- **Soft-bodies**
- Calcium carbonate **shell**
- **Mantle** (thin layer of tissue that covers the body)
  - Mantle secretes the shell
- **Bilateral** symmetry (most)
- Muscular **foot** (movement)
- **Head** with sensory organs
- Paired **gills** (O$_2$ exchange)
- **Radula** (tool used to feed, scrapes surfaces)
Bivalvia
clams, mussels, oysters, scallops

- Approx. 10,000 species
- Bodies are **bilaterally** symmetrical, laterally compressed
- Have head, foot, coiled visceral mass (internal organ)
- **Mantle**: membrane that lines the inside of the shell; contains glands that release calcium carbonate.
- Clams live **buried** in sand; intertidal and subtidal zones.
Bivalvia
clams, mussels, oysters, scallops

- Body is enclosed within a shell
  - 2 shells (valves)
  - Valves hinged at one end.
- **Umbo** is hump at dorsal (top) side of shells, near hinge
  - Umbo is the oldest part of the shell
  - Growth of shell is from umbo – growth lines/rings show on shell.
- No head, no radula
- Gills: exchange oxygen and filter food particles from water.
- Adductor muscles keep shells closed.
World’s Oldest Animal: a clam!

http://www.nbcnews.com/video/nightly-news/53547313#53547313
Shells are shut tight; only a small gap between them.

Siphon tube sticks out from gap to feed and breathe.

- **Incurrent** (IN) and **outcurrent** (OUT) openings
- Water moves IN (**food particles and O\(_2\)**)
- Water moves OUT (**waste from digestion and CO\(_2\)**)

Bivalves are filter feeders: water comes in through the siphon and washes over gills – **food particles** get stuck on gills and mantle and are then moved toward the mouth.
Bilvalve Breathing

- Breathe using gills: water flows over gills - O\textsubscript{2} comes in, CO\textsubscript{2} goes out
- Open circulatory system transports oxygen through a colorless blood.
Reproduction is **external**: eggs and sperm are released into the water.

**Temporary zooplankton**: larvae are planktonic.
- When shells are formed, they sink to the bottom and develop into adults.
Bivalve Diversity

- Not all bivalves burrow in sand
  - **Mussels**: use byssal threads (protein fibers) to attach themselves to rocks, other surfaces.
  - **Oysters**: cement themselves to shells of other oysters.
  - **Scallops**: some species swim by clapping their shells together (one very strong adductor muscle)
Clam – external features

- umbo
- exhalant (=excurrent) siphon
- growth ring
- inhalant (=incurrent) siphon
Clam – internal features
Phylum Mollusca

- Class **Bivalvia** (clams, mussels)
- Class **Gastropoda** (snails)
- Class **Cephalopoda** (octopus, squids)
Two-thirds of all mollusks are gastropods.
- 80,000-100,000 species (mostly marine)
- **Univalves**: one shell – it is usually spiral or coiled.
- **Gastropoda** means “**stomach-foot**”.
- Large muscular **foot** is used to move on surfaces.
- **Radula** is used to scrape food from rocks.
- Food is taken through the **mouth** and moves down a one-way digestive tract; waste is sent out through the **anus**.
Nutrients are transported using an open circulatory system:

- **Heart** pumps blood through tissue when it contracts.

- **Kidneys**: filter and send out waste from cells.

- **Operculum**: trapdoor over shell’s opening.

  - When not feeding or moving, snails close up into their shells.
Gastropods: snails and slugs.

Littorina obtusata, North Atlantic Ocean.
Some species have **separate sexes**.

Some species are **hermaphrodites** (both male & female).

**Internal** fertilization: egg is fertilized INSIDE the organism.

**External** development: fertilized eggs can be deposited into the water OR eggs may develop in an egg case.

Many snail larvae are **planktonic**.
Shell Morphology

- **APEX**: first part of shell formed; oldest.
- **WHORL**: one complete coil of the shell.
- **BODY WHORL**: last part of shell formed; youngest.
- **MOUTH**: opening of shell.
- **LIP**: thickened edge of mouth.
- **SPIRE**: all visible whorls, not including body whorl.
<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell</td>
<td>Protection</td>
</tr>
<tr>
<td>Muscular foot</td>
<td>Movement</td>
</tr>
<tr>
<td>Anterior antennae (eyes)</td>
<td>Vision</td>
</tr>
<tr>
<td>Posterior antennae</td>
<td>Sensitivity</td>
</tr>
<tr>
<td>Siphon</td>
<td>Water intake</td>
</tr>
<tr>
<td>Gills</td>
<td>Breathing/gas exchange</td>
</tr>
<tr>
<td>Radula</td>
<td>Feeding/ingestion</td>
</tr>
<tr>
<td>Mouth, stomach, intestines, anus</td>
<td>One-way digestion</td>
</tr>
<tr>
<td>Kidney</td>
<td>Filtration &amp; Excretion</td>
</tr>
<tr>
<td>Heart</td>
<td>Nutrient transport</td>
</tr>
</tbody>
</table>
Gastropod Morphology

- **APEX:** __________________________
  ____________________________________

- **WHORL:** ________________________
  ____________________________________

- **BODY WHORL:** __________________
  ____________________________________

- **MOUTH:** _________________________

- **LIP:** __________________________

- **SPIRE:** _________________________
  ____________________________________
<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Molluscs

http://shapeoflife.org/video/molluscs-survival-game

http://shapeoflife.org/video/geerat-vermeij-evolutionary-biologist-reading-shell%E2%80%99s-story
Phylum Mollusca

- Class **Bivalvia** (clams, mussels)
- Class **Gastropoda** (snails)
- Class **Cephalopoda** (octopus, squids)
Cephalopoda: squid, octopus, cuttlefish

- 800 marine species
- Prominent head and tentacles
- Cephalopoda means “head-foot”.
Swimming mollusks: swim by jet propulsion

- Streamlined body shape
- No external shell (shell is either lost or very reduced)
- Draw water into mantle and then contract mantle to send water out of the water jet/siphon – propels through water.
- Can direct themselves by changing the direction of the water jet (coordinated by a highly developed nervous system).

https://www.youtube.com/watch?v=eT8sNJp9yOw
“Foot” of Cephalopods is modified into arms & tentacles
- **Tentacles**: capture prey (fish, crabs)
  - Animal is killed with their beak.
  - Octopus also paralyzes with venom
- **Complex nervous system**.
- **One-way digestive tract** (mouth → anus)
- **Closed circulatory system** transports nutrients.
Cephalopoda: squid, octopus, cuttlefish

- **Squid:** long, thin internal shell (“pen”)
  - Fastest cephalopod; swims in **large schools** (gives protection)
  - 8 arms, 2 tentacles

- **Octopus:** no remaining shell (some may have vestigial remnants)
  - Solitary, efficient hunters (use beak, also venom in some sp.)
  - 8 arms

- **Cuttlefish:** internal shell (cuttlebone)
  - 8 arms, 2 tentacles
  - **solitary** organism

- **Nautilus:** large external shell
  - **solitary** organisms.
  - 60-90 short tentacles
Camouflage: adaptation to avoid predation.

- Special pigmented cells (chromatophores) change shape in skin and allow animal to blend in.

Ink: cephalopods use cloud of ink to confuse predators, allowing them to escape.

Highly developed brain and eye: help to avoid predation.

Cephalopoda: ADAPTATIONS
Cephalopoda: Chambered Nautilus

- Has a coiled external shell.
- Shell has multiple compartments, some filled with gas to help with buoyancy.
- Lives in deep, tropical waters.
- Feeds during the night in shallower waters.
You will be assigned 2 types of Cephalopods.

Go online and research the basic characteristics and life history of two chosen species.

Create a Valentine for each Cnidarian (you must choose a **specific species**).

- Make it cheesy and creative.
- Follow the rubric!

*This assignment will be worth a DOUBLE CW GRADE!*
https://www.youtube.com/watch?v=QMFqV4SJLWg
Cephalopoda: Cuttlefish

- Shell is internal – helps support the soft body.
- Lives on the bottom of the ocean, preys on invertebrates in the sand.
- Ten tentacles, 2 are very long.
Cephalopoda: Reproduction

- Breed in shallow water.
- Separate sexes: internal fertilization; external development.
- Male uses tentacle to deliver sperm to female (places it in mantle cavity).
  - Fertilized eggs are placed on rocks or algae: squid die after mating; octopus female cares for the eggs.
http://video.pbs.org/video/1778564635/
Squid Dissection

https://www.youtube.com/watch?v=OueQ9kU36io