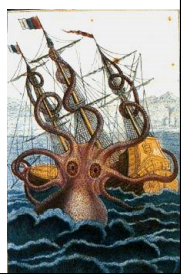
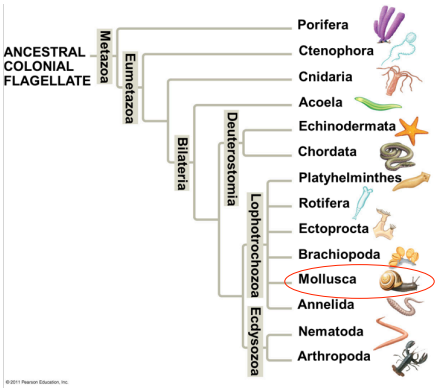
## An Introduction to the Invertebrates: Phylum Mollusca

Reference: Chapter 33



## Yet More Relationships




## Molluscs - Overview

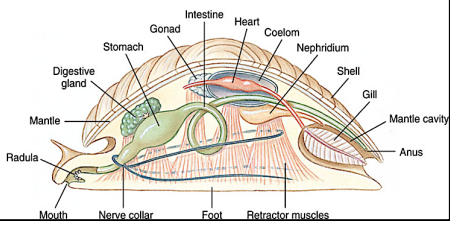
- Mollusca – "the soft things" (Aristotle)
- Phylum Mollusca includes snails and slugs, oysters and clams, and octopuses and squids
- Molluscs have adapted to a very wide variety of habitats
  - Most are marine and can be found in all ocean habitats
  - Many species of gastropod are freshwater and terrestrial
- Molluscs have evolved an array of highly diverse body plans

## Mollusc Overview

- Video, molluscs (~15 min): http://shapeoflife.org/video/phyla/molluscs-survival-game

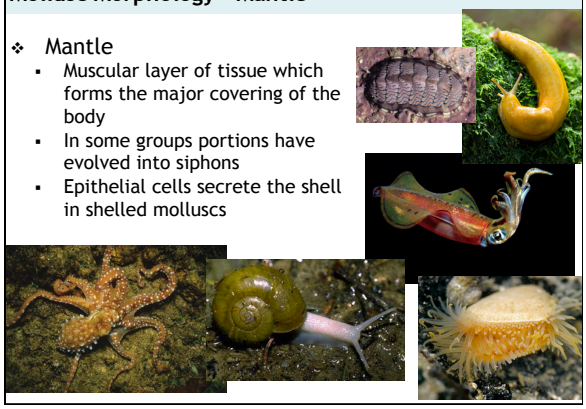
## Mollusc Morphology – Basic Body Plan

- Triploblastic, bilaterian, eucoelomate, lophotrochozoan protostomes
- All molluscs have a similar body plan with **three main parts:**
  1. **Mantle**
  2. **Muscular foot**
  3. **Visceral mass**



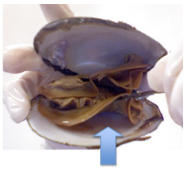

## Mollusc Morphology - Mantle

- Mantle
  - Muscular layer of tissue which forms the major covering of the body
  - In some groups portions have evolved into siphons
  - Epithelial cells secrete the shell in shelled molluscs



## Mollusc Morphology - Mantle Cavity

- Mantle Cavity
  - Internal cavity generated by folds in the mantle
  - NOT the coelom (which is much reduced)
  - Encloses respiratory organs in most
  - Lined with epidermal cells and exposed to external environment

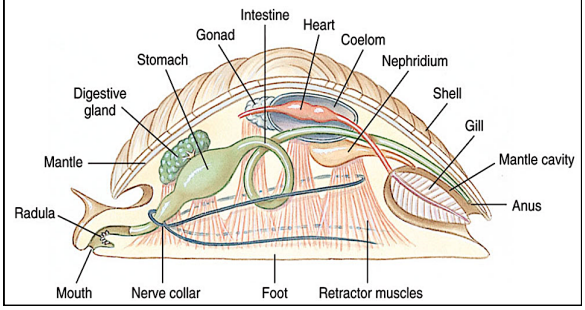



## Mollusc Morphology - Muscular Foot

- "Base" of the mollusc body
- Contains statocysts
  - Sensory cells that assist with balance
  - May function as "ears" for some
- Adapted in various ways
  - Locomotion in gastropods
  - Tentacles in cephalopods
  - Burrowing in bivalves

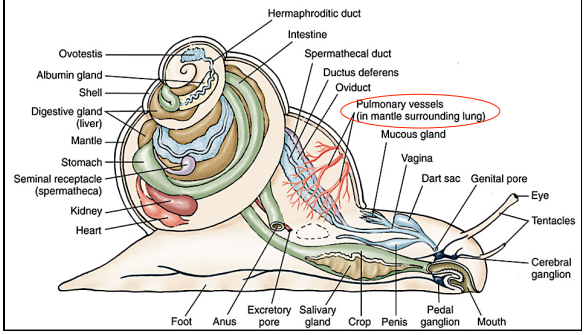
## Mollusc Morphology - Visceral Mass

- Internal organs, arranged in various ways within the body
- Coelom is reduced to open space surrounding heart and gonads



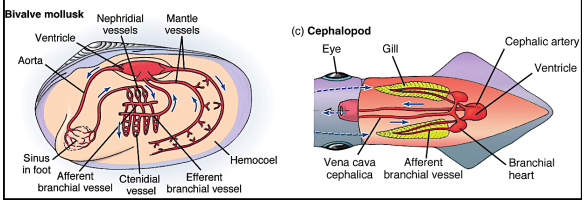

## Mollusc Morphology - Respiration

- Aquatic species have gills enclosed within the mantle cavity
- Terrestrial snails and slugs have a modified lung



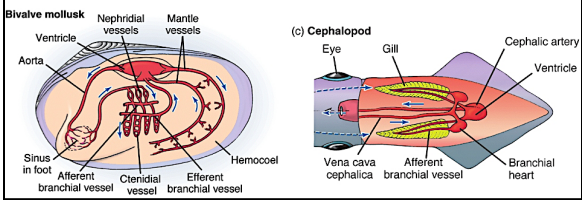

## Mollusc Morphology - Circulation

- Circulatory system
  - Open (except in cephalopods)
    - Open circulatory system is one in which blood is released directly into organs and body cavities (hemocoel)
    - No clear distinction between blood and interstitial fluid – Blood is known as hemolymph
  - Hemolymph contains **hemocyanin** to transport oxygen; appears blue when exposed to air



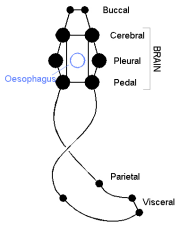

## Mollusc Morphology - Circulation

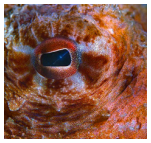
- Circulatory system includes beating heart
  - When relaxed, oxygenated hemolymph flows into the heart
  - Hemolymph is pushed out of the heart through the veins during contractions

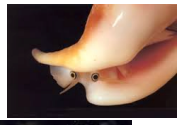


## Mollusc Morphology - Nervous System

- Nervous System
  - Two nerve cords and a brain (more or less)
  - Some groups have well-developed eyes

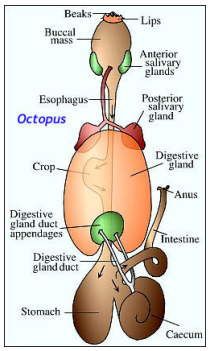




## Mollusc Morphology - Digestive System

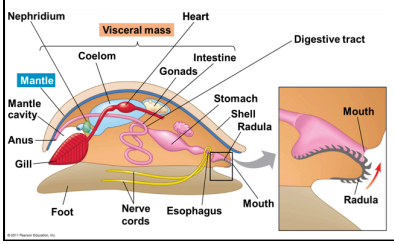
- Digestive System
  - Radula (surrounded by beak in some)
  - Complete gut
  - Well-developed digestive gland in most




Video- What the vampire squid really eats (~5 min)
https://www.youtube.com/watch?v=X8oWnbcLI40

## Mollusc Morphology - Digestion

- Digestive System consists of a complete gut
  - Mouth, stomach, intestine, anus
  - Various mucous and digestive glands
  - Some groups have pouches (cecum)
  - Much of the lining of the gut is ciliated




- Radula
  - Stiff, serrated structure
  - Adapted for scraping or grabbing
  - Used to inject venom in some groups

## Mollusc Morphology - Excretion

- **Excretory system - heart and nephridia ("little kidneys")**
  - The heart filters waste from hemolymph and releases it into coelom as urine
  - The nephridia reclaim usable material from the urine, inject more wastes into it, and eject it into the mantle cavity for excretion into the environment
  - Example of mollusc "multi-tasking" - using organ systems for more than one purpose

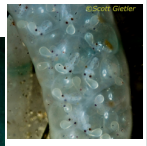
## Mollusc Morphology - Support

- Hemocoel(s) can function as **hydrostatic skeleton**
  - Can be filled with water or gas and exert pressure that provides structure and support to the body
- Shells
  - Calcium carbonate with protein
  - Secreted by the mantle
  - Sometime internal (cuttlefish)

## Mollusc Morphology –Reproduction

- **Reproduction**
  - Some groups maintain separate genders (cephalopods); some are hermaphroditic (gastropods)
  - Fertilization internal or external, depending on group

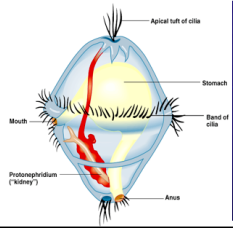


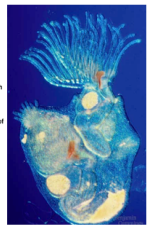
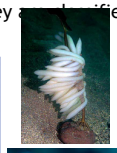



- Octo-mom video (~5 min): https://www.youtube.com/watch?v=lFCQltYMLQk

## Mollusc reproduction

- Most molluscs have separate sexes with gonads located in the visceral mass, but many gastropods are hermaphrodites
- All groups lay eggs
- The life cycle of many molluscs includes a ciliated larval stage called a **trochophore** (this is why they are classified as lophotrochozoa!)

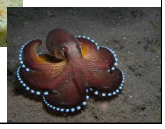



## Mollusc Taxonomy

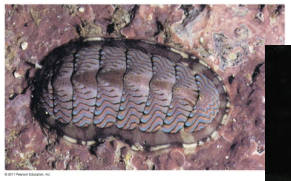
- Four major classes of molluscs are
  - **Polyplacophora** (chitons)
  - **Gastropoda** (snails, nudibranchs and slugs)
  - **Bivalvia** (clams, oysters, and other bivalves)
  - **Cephalopoda** (squids, octopuses, cuttlefish, and chambered nautiluses)



## *Polyplacophora - Chitons*

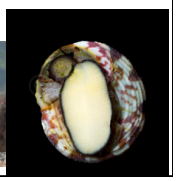
- Chitons are oval-shaped marine animals encased in an armor of eight dorsal plates
- They use their foot like a suction cup to grip rock, and their radula to scrape algae off the rock surface



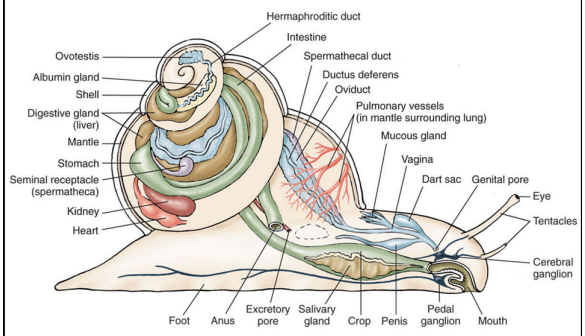

## *Gastropoda – "stomach foot"*

- About three-quarters of all living species of molluscs are gastropods – only insects have more
- Most gastropods are marine, but many are freshwater and terrestrial species
- Most gastropods have a single, spiraled shell
- Slugs lack a shell or have a reduced shell

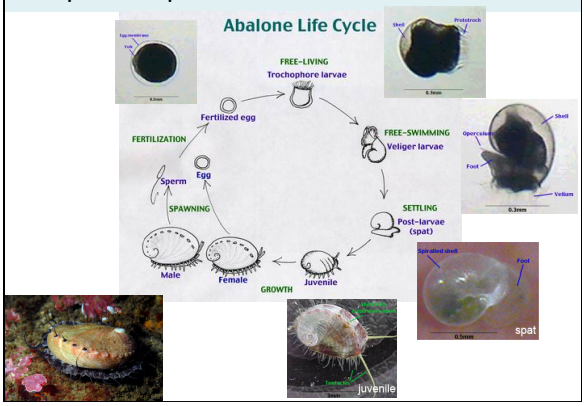




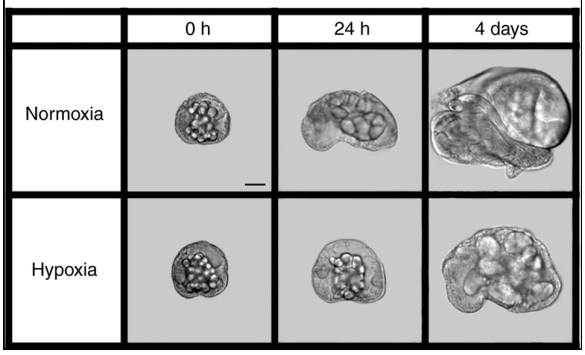
2
5




## Gastropod Development

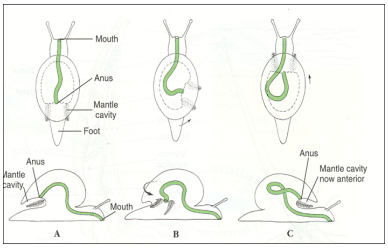



## Snails need oxygen to develop properly!



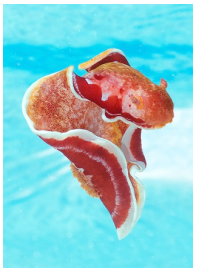

## Gastropod Development - Torsion

- **Torsion**
  - Occurs during development (veliger stage)
  - Visceral mass rotates 180 degrees relative to head
  - causes the animal's anus and mantle to end up above its head
- Pro's
  - Protection
  - Balance
- Con's
  - Animal dispels wastes on its head




## Gastropoda - Nudibranchs

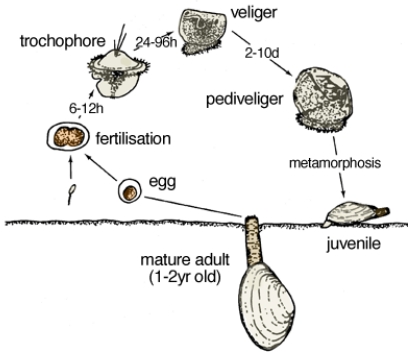
- Special case – secondary **detorsion**
  - Restores "normal" gut morphology
- Some species are strong swimmers

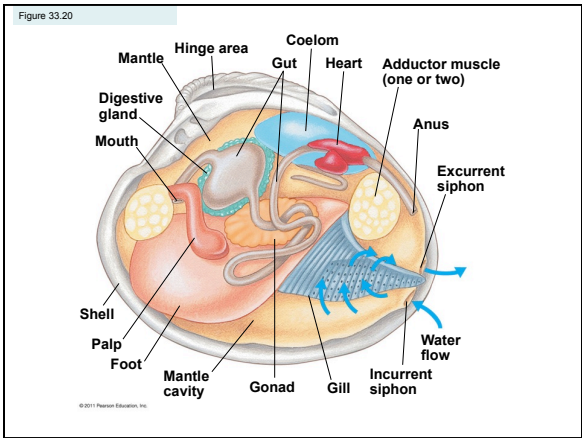


## *Bivalvia*

- Bivalves are marine and include many species of clams, oysters, mussels, and scallops
- They have a shell divided into two halves drawn together by adductor muscles
- The mantle cavity of a bivalve contains gills that are used for feeding as well as gas exchange
- **Incurrent/excurrent siphons** move water across the gills
- The foot is adapted for burrowing in sediment
- Some bivalves have eyes and sensory tentacles along the edge of their mantle

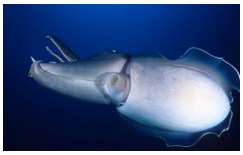

## Bivalve reproduction/development



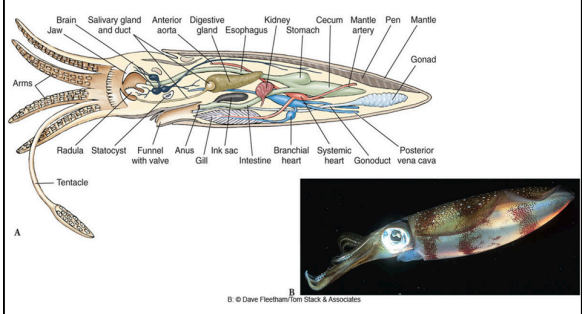

## *Cephalopoda – "head foot"*

- Cephalopods have a body plan greatly modified from the basic mollusc body plan
  - The muscular foot has been modified into tentacles
  - The mouth is equipped with a hinged, chitin beak
    - Some groups have greatly reduced radula
  - Most cephalopods use a **siphon** for locomotion, a specialized structure that pumps water through the body and propels the animal backwards through the water



## *Cephalopoda – "head foot"*

- Cephalopods have a closed circulatory system, well-developed sense organs, and a complex brain
- Nautilus retains a shell
- Cuttlefish retain an internal shell
- Most cephalopods have distinct sexes




True facts about the octopus:
https://www.youtube.com/watch?v=st8-EY71K84

## Molluscs behaving badly - PSP

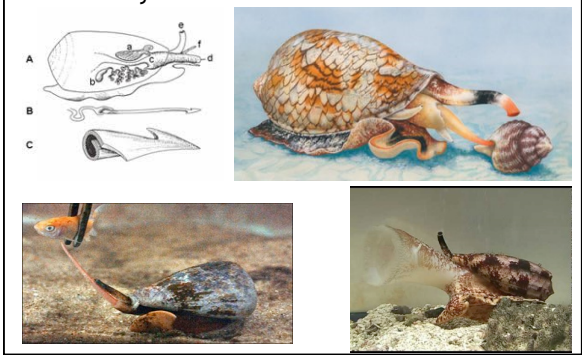
- Seasonal influx of nutrients cause phytoplankton populations to soar
  - Pigmented algae can cause the water to turn color – red tides, yellow tides, etc.
- Dinoflagellates and other algae can produce powerful neurotoxins – saxitoxin is the most common
- Suspension feeding molluscs concentrate toxins in their tissues
- When ingested, can result in PSP – paralytic shellfish poisoning
  - Severe illness
  - Can be fatal


## Molluscs behaving badly – Humboldt Squid

- Eastern Pacific – South America → Alaska
  - Most common in southern portion of range
  - Generally passive and curious, but can be extremely aggressive if disturbed while feeding
  - Tentacles have "teeth" on suckers that cause serious lacerations

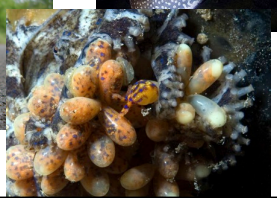

## Molluscs behaving badly – Cone Snails

- Extremely venomous



## Love amongst the molluscs

- Molluscs have some of the most bizarre courtship and mating rituals known
- Love darts
- Color patterns in cuttlefish
- Parental Care

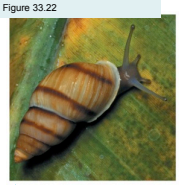


Love darts:
https://www.youtube.com/watch?v=VTV23B5gBsQ

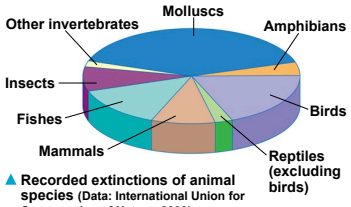
## Protecting Freshwater and Terrestrial Molluscs

- Molluscs are the animal group with the largest number of recent extinctions
- The most threatened groups are
  - Freshwater bivalves, including pearl mussels
  - Terrestrial gastropods, including Pacific island land snails
- These molluscs are threatened by habitat loss, pollution, and non-native species
- Other species are threatened by climate change
  - Ocean acidification and warming – Humboldt Squid

Figure 33.22



▲ An endangered Pacific island land snail, *Partula suturalis*




▲ Recorded extinctions of animal species (Data: International Union for Conservation of Nature, 2008)

◀ Workers on a mound of pearl mussels killed to make buttons (ca. 1919)

## Summary of Relationships