Phylum Mollusca - Mollusks - includes snails, slugs, clams, scallops, oysters, cuttlefish, squid, octopus

Widespread and abundant in marine, freshwater and terrestrial habitats
Surpassed by only arthropods in terms of success on land
Includes some of the largest invertebrates: giant squid, and giant clam
Economically important as human foods, sources of pearls and other shell materials, some destructive to submerged wood, some introduced forms have caused ecological damage, some serve as intermediate hosts for human parasites, some can cause damage to crops
Seven classes of mollusks - Four classes covered here
Class Polyplacophora - chitons
Class Gastropoda - Snails, slugs, limpets
Class Bivalvia - Clams, oysters, scallops
Class Cephalopoda - Squids, octopus, cuttlefishes, *Nautilus*
Mollusk body plan: **head-foot, visceral mass, mantle**

**head-foot** - continuous muscular mass - with sensory and feeding structures associated with head, and foot for locomotion

**visceral mass** - contains organs of digestion, reproduction, circulation, excretion

**mantle** - covers visceral mass and secretes shell

mantle cavity contains gills, and ducts for reproduction and excretion
Basic body plan has been modified for different purposes in the different classes - Chitons closest to basic plan. Gastropods have twisted visceral mass. Bivalves have lost head, and gills are used for feeding. Cephalopods have modified foot into tentacles, and mantle is used for jet propulsion.
All mollusks except Bivalves possess a rasping, tongue-like, radula - composed of dozens of rows of chitinous teeth. Some gastropods scrape algae with radula, others use radula to tear apart prey or drill holes in shells of their prey.
Circulatory system is open in most
Heart collects blood from gills and pumps to sinuses that extend through body
Cephalopods have a closed system of vessels and auxiliary hearts
Coelom is primarily represented by small area around the heart

Nephridium for excretion- collects fluid from coelom and empties into mantle cavity - valuable solutes resorbed by walls of tubule
Reproduction
Most have separate sexes, some hermaphroditic, some change sex, most have internal fertilization, copulation between males and females (except in bivalves)
Mollusks dispersed through larval forms
Many have free-swimming trochophore larvae
A second free-swimming veliger stage may precede adult form
Class *Polyplacophora* - Chitons

Have oval bodies, and shell with eight overlapping plates
Very similar to basic body form
Chitons creep along on broad, flat foot
Foot surrounded by mantle cavity with series of gills
Most are shallow water herbivores that graze on algae
Class **Gastropoda** - Snails and Slugs
Primarily marine, with many freshwater and terrestrial forms
Most have shell, shell lost in slugs
Head possess paired tentacles that may have terminal eyes

Visceral mass asymmetrical because of torsion (twisting) during development
120° twist results in loss of right gill and positioning of anus to the right of the head
Coiling of shell due to one side of snail growing faster than other - not due to torsion
Varied feeding habits
Terrestrial herbivores can be serious garden pests
Oyster drills bore into other mollusk shells, kill and eat body
Cone shells are predators with harpoon-like radula
Some sea slugs (nudibranchs) eat cnidarian polyps and incorporate stinging cells

Terrestrial forms evolved a rudimentary lung under mantle
Air has much more oxygen than water - a lung is more efficient than a gill in air
Freshwater forms evolved from terrestrial forms and lack gills
Class **Bivalvia** - Bivalves
Includes clams, scallops, mussels, oysters

Have a single shell with two valves - hinged at top - held together by a ligament - closed by adductor muscles
Mantle covers entire body - secretes shells and ligament, often forms incurcurrent and excurrent siphons
Two pairs of gills are located under folds of the mantle - used for feeding and gas exchange
Foot is wedge-shaped - can be extended for crawling, burrowing, anchoring
Most forms are sedentary filter feeders
Food particles collected on gills and entangled in mucus - cilia on gills convey food to mouth

Planktonic larval stage (trochophore) allows dispersal
Scallops are unique, very mobile forms
swim by open and closing shell

Abundant in marine and freshwater habitats
Freshwater mussels distributed worldwide
More than 500 species live in lakes and rivers of North America
Larvae brooded in special pouch in gill chamber
Larvae are parasites on fish - larvae are called glochidia
Class Cephalopoda - Octopus, Squid and *Nautilus*
Active predators - most lack external shell (except *Nautilus*)
Foot has evolved into a series of tentacles
8 in octopus, 10 in squid, up to 90 in *Nautilus*
Tentacles snare prey, beaklike jaws bite, radula pulls prey into mouth
Have highly developed nervous systems
Rapid responses result from giant nerve fibers attached to mantle
Eyes are elaborate with retina similar to that in vertebrates
Exhibit complex behaviors and high level of intelligence
Take water into mantle and expel it through siphon for propulsion
Change direction of movement with siphon
May eject dark fluid to confuse predators

Most have closed circulatory system that provides more efficient circulation

Sexes are separate
Specialized tentacle in male transmits spermatophore to female
Eggs fertilized as they leave the oviduct
Extensive parental care in some
**Phylum Annelida** - Annelids - Segmented Worms

includes sandworms, fanworms, bristleworms, earthworms, leeches

most are marine, but they are also common on land and in freshwater
Segmentation is the key innovation for this group. Segments - modular structure - allows evolutionary and functional flexibility - slight modifications result in new functions.

Each segment is a relatively complete unit - each partitioned from the others by septa.

Each segment contains its own excretory organs, and nerve concentrations that control the actions of the segment called "ganglia".

Each segment can expand or contract independently - with circular and longitudinal muscles working around water-filled coelom.
Segments are specialized for specific functions.
Anterior segments for feeding and sensory input - one segment has a brain that can control ganglia of other segments - connected by two ventral nerve cords.
Other segments contain hearts that distribute blood through a closed circulatory system to all segments.

Excretion by segmental nephridia - empty coelomic fluid to outside and recover solutes.

Gas exchange occurs at body surface.
Three classes of Annelids

**Class Polychaeta** - marine worms - fan worms, feather worms, tube worms, bristleworms, sandworms, etc.

**Class Oligochaeta** - earthworms - both terrestrial and freshwater

**Class Hirudinea** - leeches - mostly freshwater, some terrestrial and marine
Class Polychaeta - Polychaetes -
“many bristles” - marine worms
Have well developed heads with
specialized sensory and feeding structures

Have paddle-like parapodia - for
locomotion and aid in gas
exchange - with many bristles
called “setae”
Separate sexes with external
fertilization -
Have trochophore larva - like
some mollusks
An important link in marine food
chains - many live in association
with sponges, mollusks,
echinoderms, crustaceans
Class Oligochaeta - “few bristles” - Earthworms

Usually burrow in soil - lack eyes - but have sensory systems that detect light, touch, and moisture

Have fewer setae than polychaetes - important in burrowing for anchoring segments in burrow

Eat soil and organic debris - muscular gizzard grinds food - castings deposited at surface - increase soil aeration and porosity

Hermaphroditic - individuals meet - clitellum of each forms mucus ball around partners - exchange sperm - eggs deposited into mucus ball - dries into “cocoon” - no larvae - fertilized eggs hatch as small immature worms
Class Hirudinea - Leeches

Most are freshwater, some terrestrial and marine - most are predators or scavengers, some are parasites. Loss of septa between segments, most have no setae. Have suckers at both ends for prey capture, attachment, and locomotion. Hermaphroditic with mating similar to earthworms. Leeches appear to have evolved from earthworms.

Example: *Hirudo medicinalis*
the medicinal leech - a parasite - mouth has chitinous teeth, attaches, bites, secretes anticoagulant "hirudin" -

Leeches are used to remove blood from beneath skin after surgery and from some wounds. Hirudin is used to prevent clot formation during surgery.