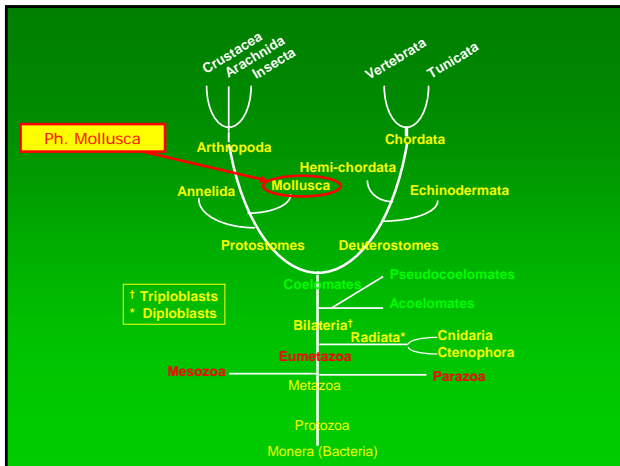


Ph. Mollusca



Lecture 16 – Chapter 20
102109



Phylum Mollusca ~ 93,195 species

- 93,000 living mollusc species; estimated 46,500 yet to be described
- an additional 70,000 known fossil molluscs
- one of the most morphologically diverse animal groups
- microscopic bivalves to giant clams (1m) & giant squids (>20m)
- all share an unmistakable body plan



Class Gastropoda
Order Nudibranchia
Family Flabellinidae
Species *Flabellina iodinea*

Phylum Mollusca ~ 93,195 species

Body Plan:

1. Bilateral symmetry (or secondarily asymmetrical)
2. Unsegmented, Protostomes, Coelomate (coelom limited to small spaces around heart, nephridia, part of intestine)
3. Gut complete – w/ specialization, & large digestive ceca

Class Gastropoda
 Order Nudibranchia
 Family Discodorididae
 Species *Anisodoris nobilis*



Phylum Mollusca ~ 93,195 species

Body Plan:

4. Head
5. Muscular foot – large, well-defined, often w/ flattened creeping sole
6. "Visceral mass" - dorsally concentrated



Aplysia californica
 Class Gastropoda
 Order Nudibranchia
 Family Aeolidiidae
 Species *Aeolidia papillosa*

Phylum Mollusca ~ 93,195 species

Body Plan:

7. Radula – in buccal region; rasping, tongue-like strap used in feeding.

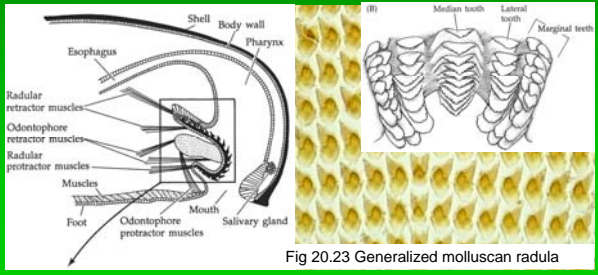
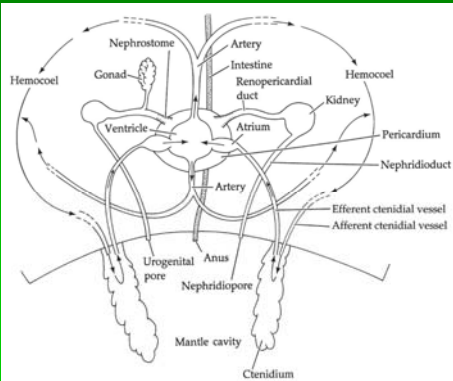


Fig 20.23 Generalized molluscan radula

Phylum Mollusca ~ 93,195 species

Body Plan:

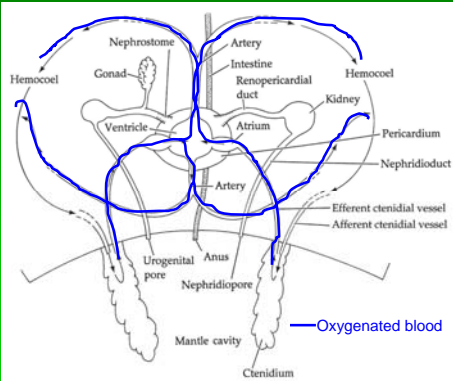
- 8. Hemocoel – open circulatory system
- 9. Heart – lies in pericardial chamber



Phylum Mollusca ~ 93,195 species

Body Plan:

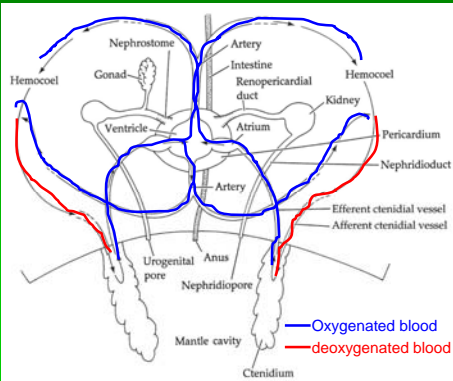
- 8. Hemocoel – open circulatory system
- 9. Heart – lies in pericardial chamber



Phylum Mollusca ~ 93,195 species

Body Plan:

- 8. Hemocoel – open circulatory system
- 9. Heart – lies in pericardial chamber



Phylum Mollusca ~ 93,195 species

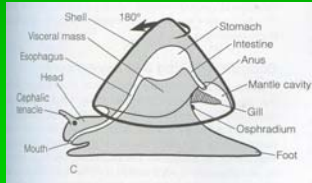
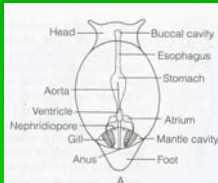
Body Plan:

- Nervous system = dorsal cerebral ganglion + circumcentric nerve ring + two pairs of longitudinal ladder-like nerve cords + several paired ganglia showing various degrees of fusion.
- Fertilization: external OR internal; one or two distinct trochophore larval stages

Phylum Mollusca ~ 93,195 species

Body Plan:

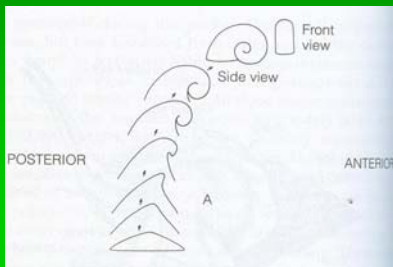
- Elongation of shell & visceral mass – the evolution of larger molluscs required the elongation of the shell & smaller aperture size.
- Flexure of gut – Gut and associated viscera moved away from longitudinal head-foot axis
- U-shaped gut - gut arching up into the cone, but mouth and anus remaining outside of the cone.



Phylum Mollusca ~ 93,195 species

Body Plan:

- Planispiral coiling – evolution of shell from flat, limpet-like form to shell coiling over head.
 - accommodated larger body size
 - easier to move
 - maintained ability to retract into shell

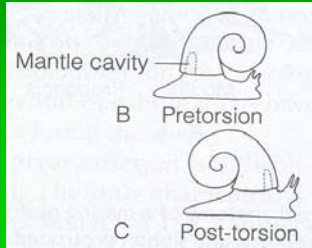


Evolution of planispiral shell
from Ruppert & Barnes text

Phylum Mollusca ~ 93,195 species

Body Plan:

19. Torsion – a counterclockwise rotation (from above) of the visceral mass and its overlying mantle and shell as much as 180° with respect to the head and foot.



Evolution of planispiral shell
from Ruppert & Barnes text

Phylum Mollusca ~ 93,195 species

Body Plan:

19. Torsion – a counterclockwise rotation (from above) of the visceral mass and its overlying mantle and shell as much as 180° with respect to the head and foot.



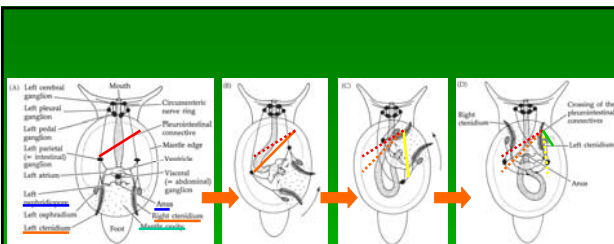


fig 20.18

A two-step process during larval development:

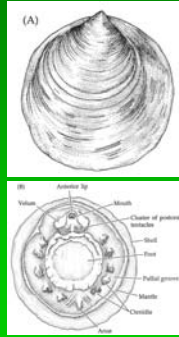
1. → An asymmetrical foot retractor muscle develops
 - extends from the shell (on the right) dorsally over the gut
 - attaches to the left of the head & foot.
 - contraction causes 90° counterclockwise twist [in min to a few hours]
2. Differential tissue growth pulls viscera the remaining 90° over a number of days

Phylum Mollusca ~ 93,195 species

Diversity: 7 classes

Class Monoplacophora (~25 species):

- "one plate", caplike shell, < 3cm
- foot = weak ventral muscular disc; 8 pairs of retractor muscles
- shallow mantle cavity around foot
- 3-6 pairs ctenidia
- w/ radula and distinct small head
- No eyes
- tentacles present only around mouth
- with crystalline style
- MOSTLY EXTINCT



Phylum Mollusca ~ 93,195 species

Diversity: 7 classes

Class Polyplacophora (~1000 species):

- "many plates"; 8 dorsal shell plates (=valves)
- Chitons; marine, intertidal to deep
- flattened, elongated,
- mantle forms thick girdle with calcareous or chitinous spines, scales, or bristles
- mantle cavity encircles w/ broad ventral foot
- w/ 6-80 pairs ctenidia
- No eyes, tentacles, or crystalline style



Mopalia muscosa

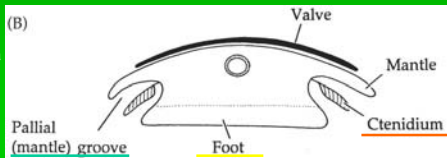
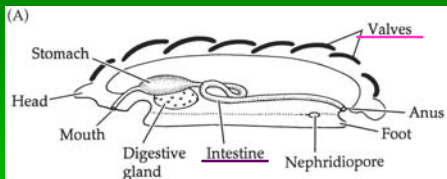


Katharina tunicata

Phylum Mollusca ~ 93,195 species

Modifications:

- Shell
- Foot
- Gut
- Ctenidia
- Mantle cavity



Class Polyplacophora
- A Chiton (A) lateral and (B) cross section

Body Plan:

- **Mantle:**
Gastropods have a single mantle cavity over head

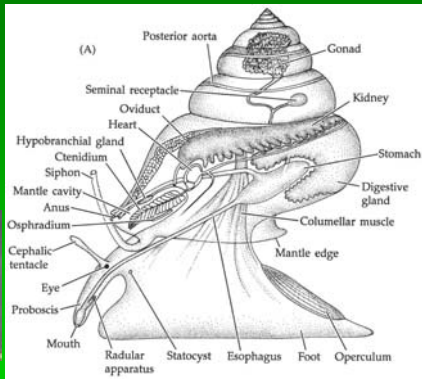


Fig 20.6 Generalized anatomy of a coiled gastropod snail (Class Gastropoda)

Phylum Mollusca ~ 93,195 species

Diversity: 7 classes

Class Gastropoda (~70,000 species):

Subclass Prosobranchia:

- largely shelled marine snails
- shell spirally coiled (sometimes cap-shaped or tubular)
- typically w/ operculum to close shell
- head w/ tentacles, bearing basal eyes
- radula variable or absent

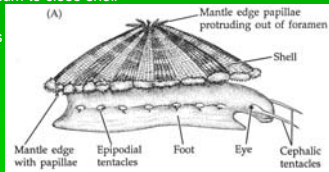


Fig 20.5 (A) Order Archaeogastropoda

Phylum Mollusca ~ 93,195 species

Diversity: 7 classes

Class Gastropoda (~70,000 species):

Subclass Opisthobranchia:

- marine slugs
- body variously detorted
- shell reduced and thin (external, internal or lost)
- ctenidia & mantle cavity reduced or lost
- without operculum (usually)
- head w/ 1-2 pairs of rhinophores or tentacles
- hermaphroditic

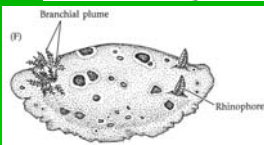
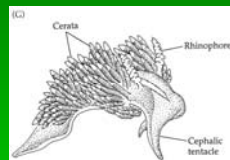


Fig 20.7 (F) & (G) Order Nudibranchia

Phylum Mollusca ~ 93,195 species

Diversity: 7 classes

Class Gastropoda (~70,000 species):

Subclass Pulmonata:

- terrestrial snails and slugs
- mainly terrestrial & freshwater forms (few marine)
- mantle cavity forms a **lung** w/ contractile opening (no ctenidia)
- body detorted to various degrees
- hermaphroditic
- highly concentrated nervous system



Phylum Mollusca ~ 93,195 species

Diversity: 7 classes

Class Bivalvia (~20,000 living species):

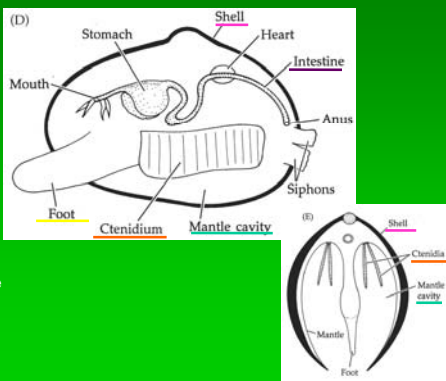
- Clams, oysters, mussels, etc.
- marine, freshwater
- laterally compressed
- shell typically of 2 valves, hinged dorsally
- head rudimentary, without eyes or radula (eyes & statocysts may occur elsewhere on body)
- foot typically laterally compressed (without a sole)
- 1 pair bipectinate ctenidia (used w/ labial palps in ciliary feeding)
- large mantle cavity
- mantle fused posteriorly to form inhalant & exhalant siphons



Phylum Mollusca ~ 93,195 species

Modifications:

- Shell
- Foot
- Gut
- Ctenidia
- Mantle cavity



Class Bivalvia – A clam (D) cutaway side view, and (E) cross section



"*Elliptio complanata* (eastern elliptio) of course; whenever there's zillions of them and you're in New England..."
Sean Werle, UMass Amherst Invertebrates Curator



Sean F. Werle is the current curator of non-insect invertebrate collections. Werle earned his B.Sc. in Zoology from the University of RI in 1995, an M.Sc. in Entomology in 2000, and a Ph.D. in Organismic and Evolutionary Biology in 2004, both latter degrees from the University of Massachusetts, Amherst. As curator he is interested in building up the invertebrate teaching collection, particularly in the area of aquatic invertebrates such as Unionoid mussels.



He also works with his wife Betsy Dumont in the Biology Department on 3-dimensional modeling of biological structures (bat skulls) and is hoping to expand this work into something more chitinous.





Christatella mucedo (a bryozoan) growing on a mussel

Phylum Mollusca ~ 93,195 species

Diversity: 7 classes

Class Scaphopoda (~900 living species):

- "shovel foot"; tusk shells
- shell one piece, tubular, usually tapering, open at both ends
- mantle cavity large
- No ctenidia, No eyes
- w/ radula, proboscis and crystalline style
- w/ paired clusters of clubbed contractile tentacles
- heart absent
- foot somewhat cylindrical

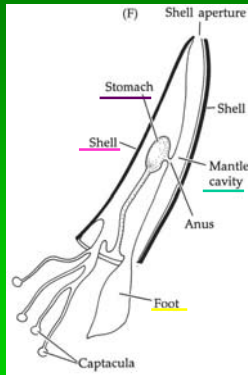


Gadila aberrans *Antalis entale*

Phylum Mollusca ~ 93,195 species

Modifications:

- Shell
- Foot
- Gut
- Ctenidia
- Mantle cavity



Class Scaphopoda –
A tusk shell (F) lateral view

Body Plan:

- Mantle:
 - bear a tapered, tubular shell.
 - Water, moved by ciliary action,
 - flushes over the mantle surface, site of gas exchange (no ctenidia)

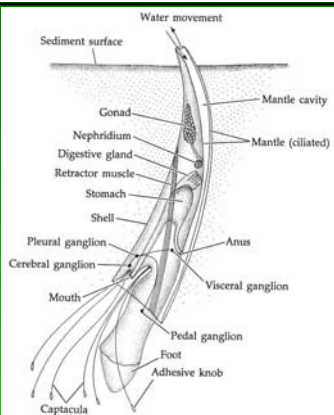


Fig 20.9 General anatomy of a tusk shell (Class Scaphopoda)

Phylum Mollusca ~ 93,195 species

Diversity: 7 classes

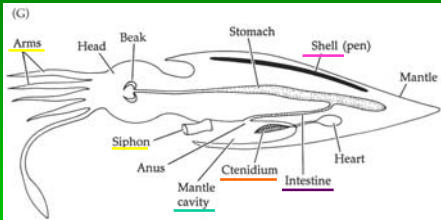
Class Cephalopoda (~900 species) :

- "head foot"
- Nautilus, squids, octopuses and cuttlefish
- w/ linearly chambered shell, usually reduced or lost
 - if external shell present (nautilus) animal inhabits last (youngest) chamber
- body cavity large, circulatory system closed
- head w/ large, complex eyes and circle of arms or tentacles around mouth
- w/ radula & beak
- w/ muscular funnel → forces water = jet propulsion

Phylum Mollusca ~ 93,195 species

Modifications:

- Shell
- Foot
- Gut
- Ctenidia
- Mantle cavity



Class Cephalopoda –
A Squid (G) lateral view

Body Plan:

- Mantle: innervated mantle muscles move water through mantle cavity

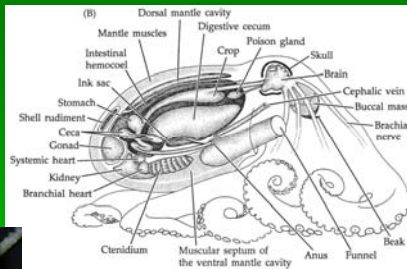


Fig 20.12 General anatomy of *Octopus*

Body Plan:
 • Mantle

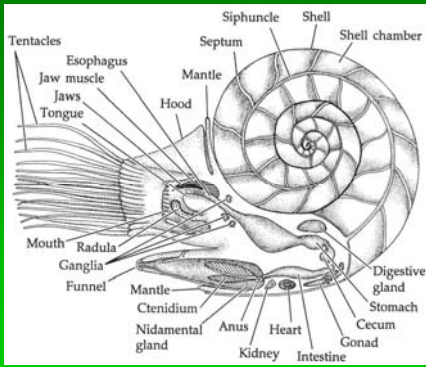
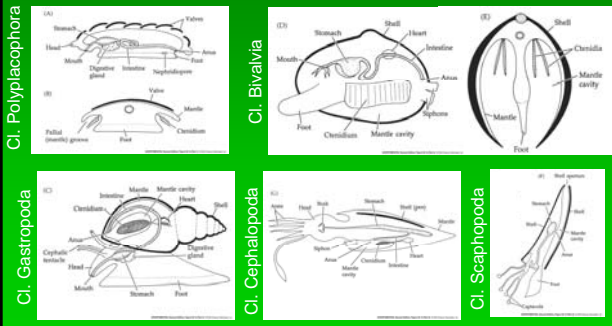


Fig 20.10 General anatomy of *Nautilus* (Class Cephalopoda)

Take-home Messages - 102109

Modifications of shell, foot, gut, ctenidia, & mantle cavity in 5 classes of Ph. Mollusca.



Study Questions - 102109

1. What are the common characters shared by all molluscs?
2. Explain torsion.
3. Describe the evolutionary pressures that resulted in coiling of gastropod shells.
4. Describe the functions of the gastric shield, style sac, crystalline style and protostyle, in food processing by molluscs.
5. Which molluscs are "heartless" and how do they carry on without one?
