

PHYLUM MOLLUSCA (2nd largest, 100,000 spp)

Snails, slugs, clams, oysters, scallops, squid, octopods

[giant squid 18 m, 0.5 tons, giant clam 1.5 m, 0.25 tons]

Bilateral Symmetry

Triploblastic (ectoderm, endoderm, & mesoderm)

Eucoelous (true peritoneum)

Blastopore mouth, Spiral & Determinate cleavage

Schizocoelous

Complete Digestive Tract

Circulatory system (open)

Respiratory system

Mantle cells secrete a shell in most

Radula in most (not bivalves)

Muscular foot

Soft unsegmented body

Usually dioecous

Nervous system and sensory organs complex

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8 Classes, 6 will be emphasized

1. Monoplacophora (11 spp) e.g. Neopilina - very primitive, indications of segmentation
2. Polyplacophora (600 spp) Limpets - shell of 8 plates
3. Gastropoda (35,000+ spp) Snails, whelks, conch, limpets, slugs - Characterized by torsion
4. Bivalvia (8,000 spp) Clams, oysters - reduced head, hinged shells, no radula, blade-like foot
5. Scaphopoda (350 spp) Tusk shells - no gills
6. Cephalopoda (200 spp) Cuttlefish, squid, octopods -  
Foot tentacles, mantle + foot jet propulsion

ANCESTRAL MOLLUSC BODY PLAN

Muscular creeping foot

Modest cephalization

specialized cephalic sense organs

(tentacles - tactile, chemosensory; eyes; statoreceptors - gravity)

Osphradium - monitors incoming water

Mantle composed of:

Periostracum (outer layer)

Prismatic (middle layer)

Nacreous (inner layer) mother-of-pearl

Gills & anus in posterior mantle cavity

Nephridia (Metanephridia - open into coelom)

Radula & Odontophore

Stomach - style and digestive glands

Circulatory System - heart (ostia), open plan except Cephalopods

Reproductive

External fertilization in most

Gonads in coelom - gametes exit thru nephridium

Free-swimming larva (Trochophore larva) - Some molluscs have further larval development (e.g., veliger)

Class Gastropoda ("stomach foot")

Torsion (180° twist of body results in anus over head)

Reduced or absent right gill, nephridium, & auricle

Subclass Prosobranchia ("forward gill")

Contains species with anterior mantle cavity & torsion of internal organs

Subclass Opisthobranchia ("rear gill")

Contains species which have "de-torsioned" Reduction of mantle cavity & shell  
Gas exchange external - posterior gills, Cerata

Subclass Pulmonata ("lung")

Adapted for terrestrial habitats  
Mantle cavity (w/o gills) - exchange gases  
Opening to mantle cavity reduced to a pore (even a snorkel)  
Well developed head & eyes on tentacles  
FW types can tolerate pollution and low O<sub>2</sub> levels

Gastropod Evolution

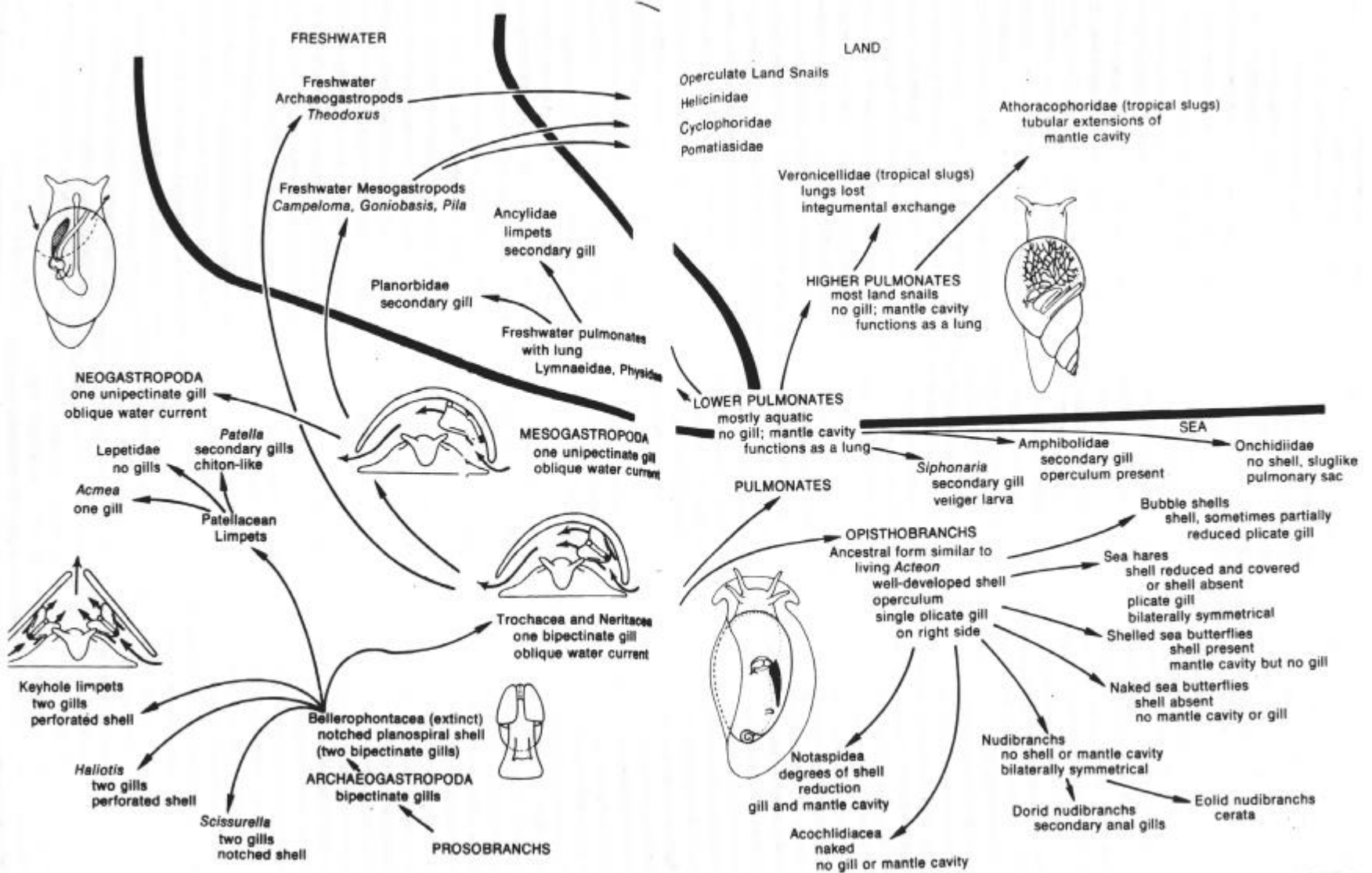
Primitive Body Plan (monoplacophora, limpets, abalone)

Proposed Evolutionary Steps: **See diagram on next page.**

1. Shell goes conical (paired pectinate gills)
2. Head develops
3. Shell coils
4. Torsion occurs
5. Right organs de-emphasized
  - 6a. Gills absent (pulmonates) terrestrial forms,  
including slugs (no shell)
  - 6b. Detorsion (opisthobranchs) nudibranchs (no shell, gills absent)

Locomotion - Foot

- 1) For movement (slime & cilia, wave action)
- 2) For adhesion (abalone, limpet)
- 3) Absent (worm shell - sessile)
- 4) For swimming - a fin or ripple flange (heteropod, sea hare)



## Nutrition

- 1) Particle feeders using radula
- 2) Carnivores, For examples:
  - Oyster borer - acid (1 mm/h) & extensible proboscis
  - Cone shell - radula like a harpoon + neurotoxin
  - Whelk - pull bivalves apart, use extension of shell as a wedge, insert proboscis
  - Nudibranchs - eat cnidarians, store nematocysts in cerata
- 3) Filter feeders, For example:
  - Sea butterfly - secretes a net of mucus
- 4) Ectoparasitic (near opening of bivalves or in body walls of starfish)

## Reproduction

Egg    Trochophore larva    Veliger larva (can clog pipes)

[similar to larvae of annelids -  
suppressed in many gastropods]

Egg    small snail (Direct Development)

Most species are dioecious, but opisthobranchs & pulmonates are hermaphrodites

External fertilization, or right nephridium converted to a duct + a penis from mantle tissue  
for internal fertilization. In pulmonates, one snail plays the \_ and another the \_.

## Class Monoplacophora ("single plate")

One living specimen was dredged up from 7,000 m in 1952. Last known member a fossil

from 400 million yr ago.

Has radula & style, eats diatoms and sponges

Metamerism (segmentation) weak - organs in repeating pairs (8 pr retractor muscles, 6 pr nephridia, 6 pr gills)

Trochophore larva and this metamerism shows a relationship with annelids

Class Polyplacophora ("many plates") Chitons (2 - 30 cm)

Indistinct head

No eyes or tentacles on head

Foot adapted for adhering to rocks with heavy wave action

Feed on algae and exhibit homing behavior

Class Bivalvia ("two valves")

Body flattened

Shell composed of two hinged valves

Head not well developed

Radula absent

Labial palps & gills

Subclass Protobranchia ("first gill")

One pair of unfolded, bipectinate gills

Most primitive bivalve condition

Bottom (deposit) feeders - preadapted for filter feeding

Foot - digging function usually

Adductor Muscle (large) for closing

Retractor Muscle (small) foot retraction

Suprabranchial cavity

Inhalant siphon (from mantle tissue)

exhalant siphon (from mantle tissue)

Labial palps - mucous, cilia

External fertilization (indirect development)

Subclass Lamellibranchia ("plate gills") - most species

Refolded bipectinate gills - increase surface area

Efficient filter feeders

Food grooves - mucous, style

Ecology

Soft-bottom Burrowers - e.g., goose neck clam - use foot to dig and long siphons to feed and respire (e.g., goose neck clams)

Attached Surface Dwellers - e.g., oyster - byssal secretions, foot absent

Unattached Surface Dwellers - e.g., scallops - sensory enhancement, swimming ability

Hard-bottom Burrowers - e.g., shipworms - highly modified shell to drill into sandstone, coral, limestone, wood

Reproduction

Mostly dioecious and external fertilization

Most freshwater species lack veliger larvae, have sub Glochidium larva instead

Class CEPHALOPODA ("head foot")

Foot tissue derives tentacles and funnel

Three basic groups

1. Nautilus - >90 arms, no suction discs

[e.g., chambered nautilus]

2. Decapods - 2 long tentacles (prehensile),

8 shorter arms - all w/ suction discs

[e.g., squid, cuttlefish]

3. Octapods - 8 arms w/ suction discs  
[e.g., octopus]

#### Shell

Nautilus - Present and exterior  
Decapods - Present, but interior (Pen)  
Octopods - Absent

#### Predatory adaptations

Smarts - Big brain and well developed sensory organs  
Speed - Well developed locomotion  
Horsepower - closed circulatory system, multiple hearts  
Capturing devices - Arms  
Killing devices - Beak & toxins (tetrodotoxin)  
Anti-predator devices - Ink, cryptic coloration

#### Reproduction

Dioecious - \_ has Hectocotylus arm for internal fertilization, Direct development, Parental care  
(e.g., octopus cleans, aerates, & defends eggs)

Many spp. mate once, then die (Optic gland)