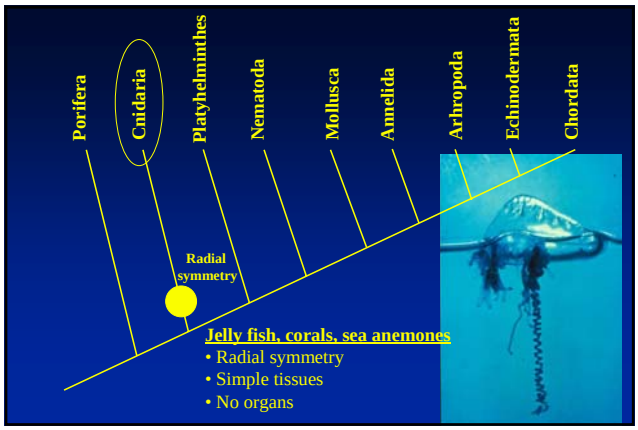
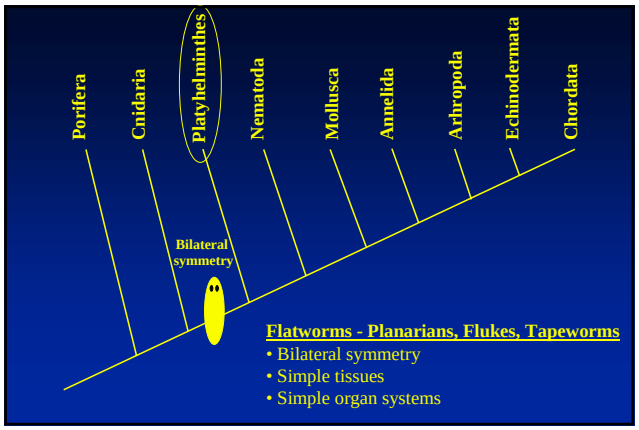
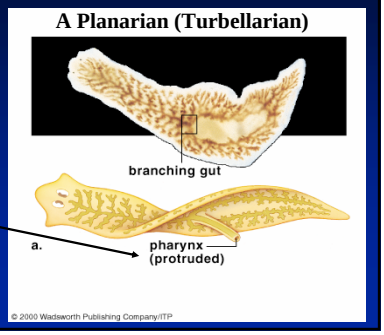




Platyhelminthes (Flatworms: Turbellarians, Flukes, & Tapeworms)

- ~ 15,000 species
- Bilateral
- Cephalized
- Flat bodies
- Simple organ systems
- acoelomate



Phylum Platyhelminthes

- planarians, flukes, tapeworms

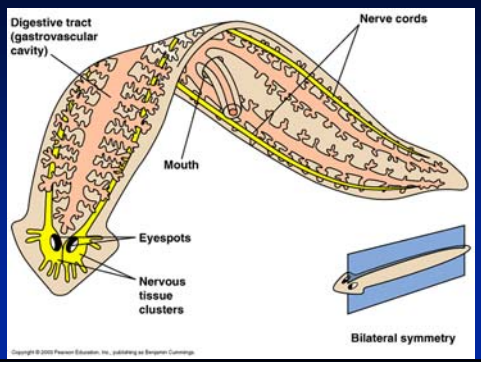
- Key Innovations - bilateral symmetry, triploblastic (ecto, endo, mesoderm - muscles!), cephalized (nonparasitic ones)
- Developed nervous, digestive, and excretory systems
- Flatworms are acoelomate
- Flatworms are very flat. No circulatory system so oxygen must diffuse through the body wall.
- They have a blind, sac-like (incomplete) gut, often with branchings.

General lifestyle:
Often parasitic
Why you should care:
Primitive bilaterians
Health hazards

Platyhelminthes

Dugesia planarian

Platyhelminthes



Platyhelminthes

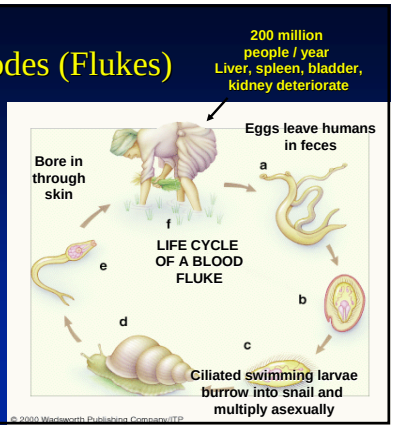
Trematodes (Flukes)

Parasitic worms

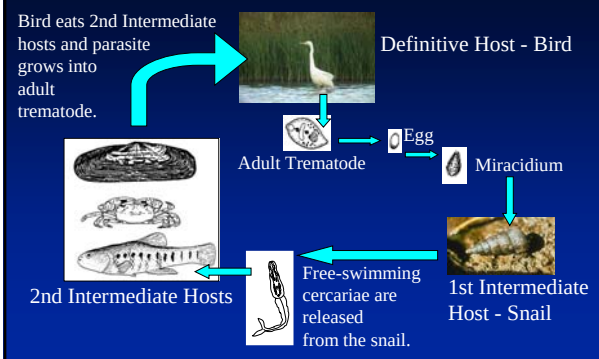
Sexual and asexual phases

Definitive host (parasite reaches sexual maturity)

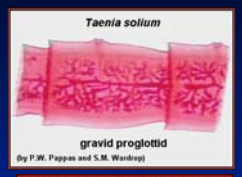
Intermediate host (immature stages)



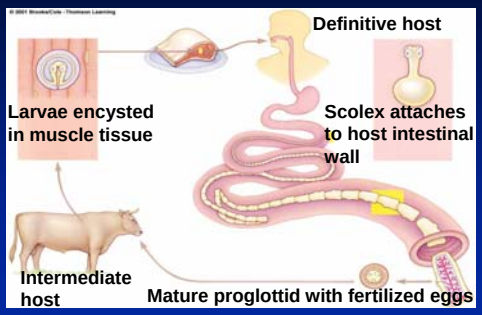
Life Cycle of Trematode Parasite



Platyhelminthes



Life Cycle of Tapeworm Parasite



Life Cycle of Tapeworm Parasite

Platyhelminthes

tapeworm scolex

Platyhelminthes

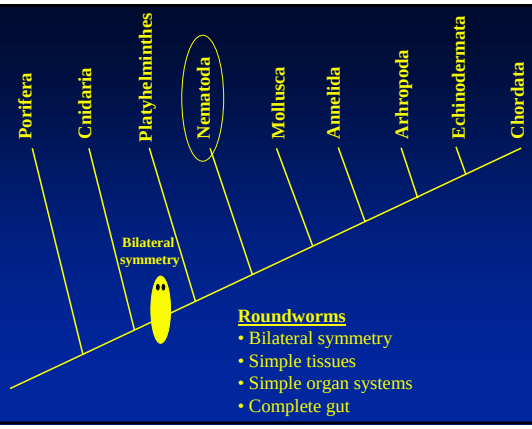
tapeworm scolex

Platyhelminthes

Tapeworm

Platyhelminthes

Tapeworm proglottids containing eggs

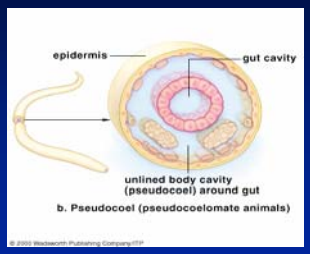


Phylum Nematoda (nematodes or roundworms)

- Nematodes are the most abundant and ubiquitous multicellular organisms on earth.
- Key Innovations: complete gut (has mouth and anus) and pseudocoel (fluid-filled, unlined body cavity packed with organs).
- Bilateral, cephalized (though not much), triploblastic (as all are from here on).
- Cylindrical worms with a thick, elastic cuticle on epidermis.
- Most are free-living, but many are parasites.

Nematoda

Pseudocoel
unlined body cavity



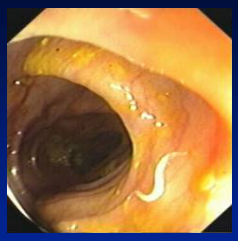
Nematoda

Complete digestive system

Nematoda - Trichinosis

ingest encysted juveniles
when eating undercooked pork

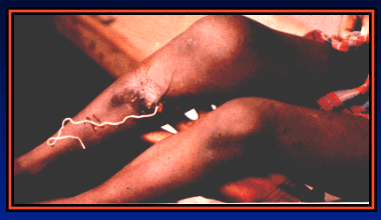
Nematoda - Pinworms



View inside
colon

Nematoda - Hookworms

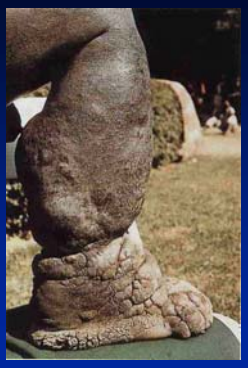
Nematoda - Guinea Worm



Warning!

If you thought the last slide was bad,
the next slide is REALLY gross!

If you're at all squeamish or easily offended,
please close your eyes.

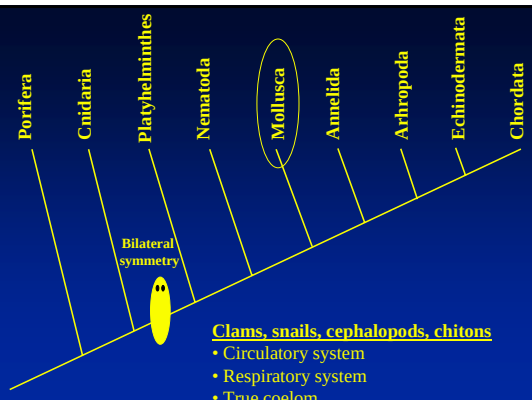


Nematoda

Elephantiasis
a filarial
worm disease

Nematoda

Elephantiasis



Phylum Mollusca - snails, chitons, bivalves, and cephalopods

Soft-bodied, usually with a hard shell

Key Innovations: circulatory system (open), respiratory structures, true coelom (reduced)

Bilateral, cephalized, small coelom, short, fleshy, soft body, muscular foot. Often have shell of $CaCO_3$ and protein. Mantle tissue secretes shell.

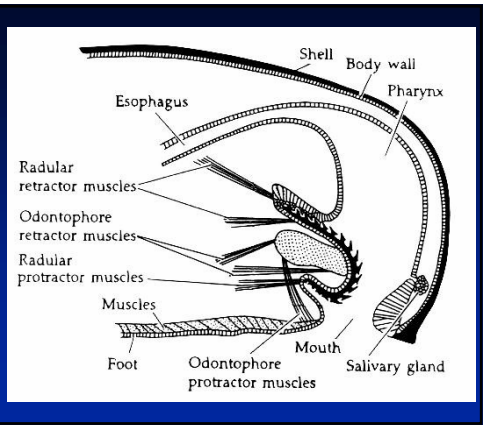
Many molluscs have lost their shell.

Mollusca

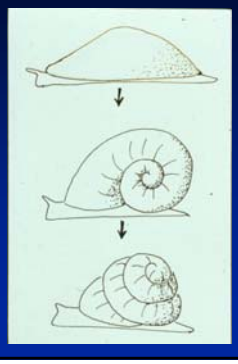
radula

Mollusca

radula



Mollusca



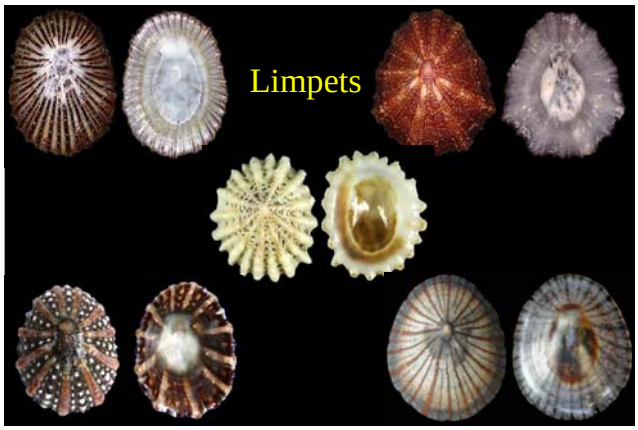
evolution of shell coiling

Mollusca

terrestrial snail

Mollusca

snail mating dance



Mollusca

snail laying eggs

Mollusca

Banana Slug

Mollusca

Cypraea spadicea
Chestnut Cowry

Cowries

Mate in pairs for life and some are endangered. Ironically, many "environmentalist" Wear them woven into headbands, belts and hair ties.

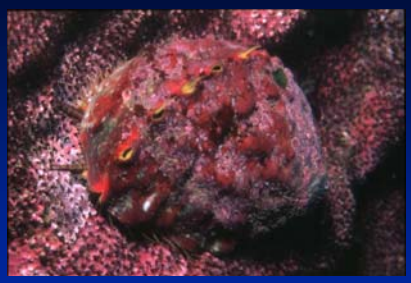
Cowrie jewelry

tsk tsk

Mollusca

veliger larva

Mollusca



Haliotis kamtschatkana
Pinto Abalone

Mollusca

sea hare

Mollusca

Anisodoris nobilis
sea lemon nudibranch

Mollusca

Phidiana hiltoni
nudibranch

Mollusca

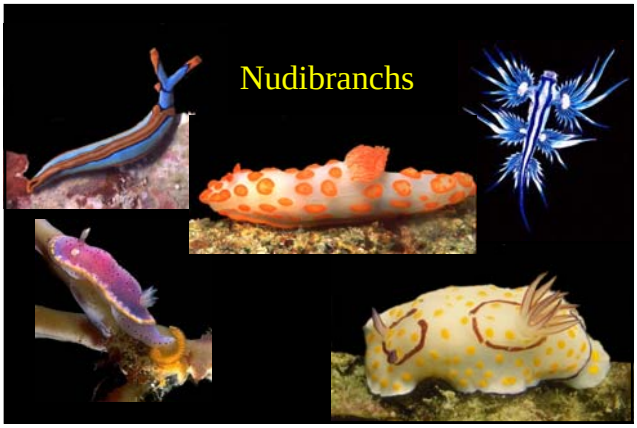
Phidiana crassicornis
nudibranch

Mollusca

Phidiana crassicornis
nudibranch

Nudibranch

Nudibranchs



Mollusca

dorsal view of chiton

Mollusca

ventral view of chiton

Mollusca

Tonicella lineata
lined chiton

Mollusca

Cryptochiton stelleri
gumboot chiton

Abalone

Mollusca

Crassedoma giganteum
rock scallop

Mollusca

Flame Scallop

Mollusca

Eyes of a scallop

Mollusca

Mytilus edulis
common mussel

Mollusca

Mytilus californianus
California mussel

Mollusca

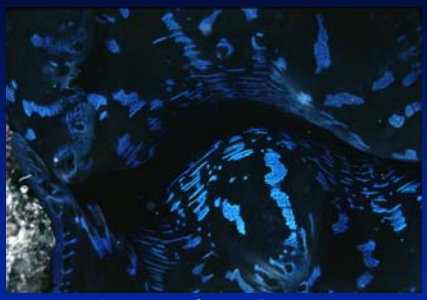
Giant clam

Mollusca

Mantle Tissue of Giant Clam

Giant Clam
in VLSB
UC Museum of Paleontology

Mollusca



Close-up of Mantle Tissue
of Giant Clam

Mollusca

Nautilus shell

Mollusca

Nautilus

Mollusca

Sepia
cuttlefish

Mollusca

cuttlefish

Mollusca

cuttlefish
internal shell

Mollusca

squid pen

squid

Mollusca

Architeuthis
Giant Squid

Mollusca

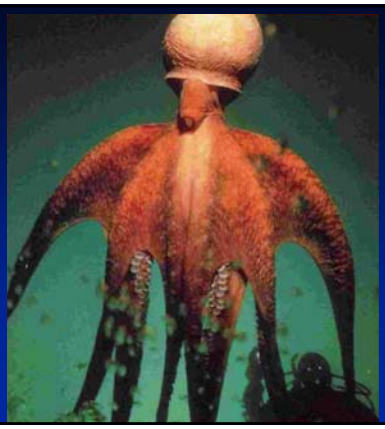
Octopus

Mollusca

Octopus

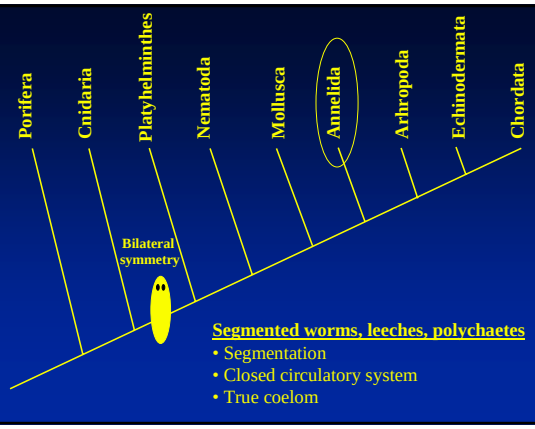
Mollusca

Octopus dofleini
Giant Octopus



Mollusca

Hapalochlaena
Blue-Ringed Octopus



Phylum Annelida - polychaetes, oligochaetes, leeches

Segmented worms including leeches

Key Innovations: segmentation, closed circulatory system

Polychaetes (marine worms) have many setae, parapodia

Oligochaetes (earthworms) have few setae, no parapodia

Leeches have no setae, no parapodia

Segmentation (repeated body units) allowed specialization and diversification

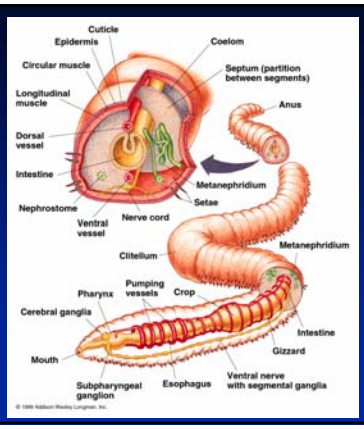
Blood contained in vessels and hearts

Nephridia, paired nerve cords

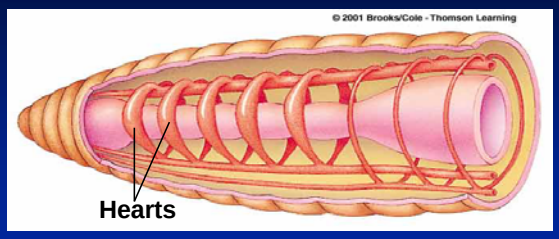
Annelida

Segmentation

earthworm



Annelida
Closed Circulatory System

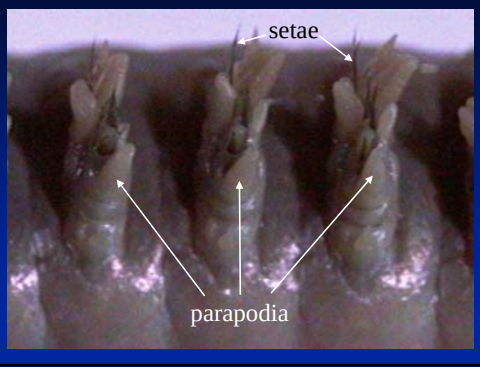


earthworm

Annelida

polychaete

Annelida - polychaete



Annelida

polychaete
trochophore
larva

Annelida

young
polychaete

fire worm

Annelida

Aphrodita
sea mouse

Annelida

spionid
polychaete

Annelida

Eudistylia polymorpha
feather duster worm

Annelida

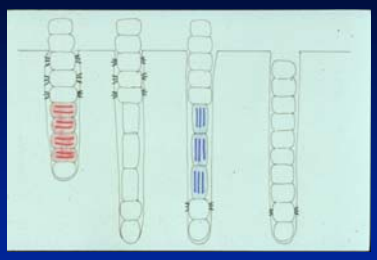
Spirobranchus giganteus
Christmas Tree Worm

Annelida

Oligochaete

Lumbricus
earthworm

Annelida



burrowing with circular and longitudinal muscles

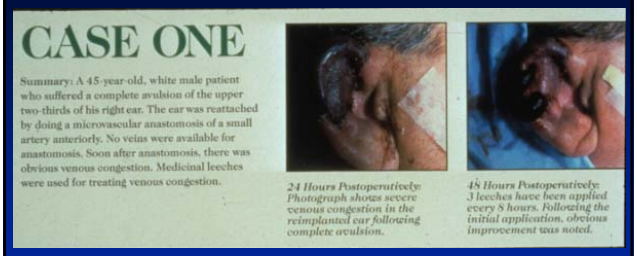
Annelida

earthworms mating

Annelida

giant oligochaete
worm
from Costa Rica

Annelida



CASE ONE

Summary: A 45-year-old, white male patient who suffered a complete avulsion of the upper two-thirds of his right ear. The ear was reattached by doing a microvascular anastomosis of a small artery anteriorly. No veins were available for anastomosis. Soon after anastomosis, there was obvious venous congestion. Medicinal leeches were used for treating venous congestion.

24 Hours Postoperatively: Photograph shows severe venous congestion in the reimplanted ear following complete avulsion.

48 Hours Postoperatively: 3 leeches have been applied every 8 hours. Following the initial application, obvious improvement was noted.

medicinal leeches

Annelida

72 Hours Postoperatively: 3 leeches have been applied every 8 hours for periods of 15 to 30 minutes. Marked improvement in color with decreased swelling and congestion was noted.

6 Days Postoperatively: The entire reimplanted ear was viable and healing well.

Two Months Postoperatively: Complete survival of reattached ear.

medicinal leeches

Annelida

CASE TWO

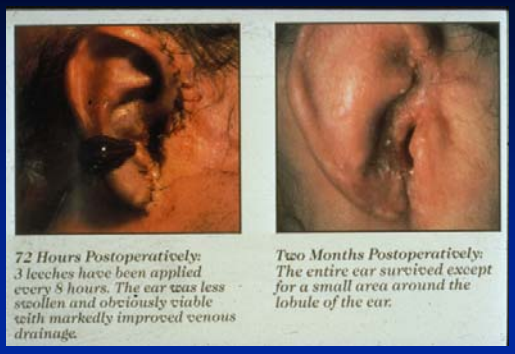
Summary: A 22-year-old male patient who suffered a severe crush injury to his right ear. Injury was caused by a concrete mixer resulting in almost complete avulsion of his right ear with multiple and extensive contusion crush-type lacerations. The ear was reattached. About 10 hours postoperatively, obvious venous congestion was noted. It was felt that medicinal leeches were required to salvage the ear.

16 Hours Postoperatively: Photograph shows severe venous congestion in the reimplanted ear following surgery.

48 Hours Postoperatively: 4 leeches have been applied every 8 hours. Definite improvement in venous congestion was noted.

medicinal leeches

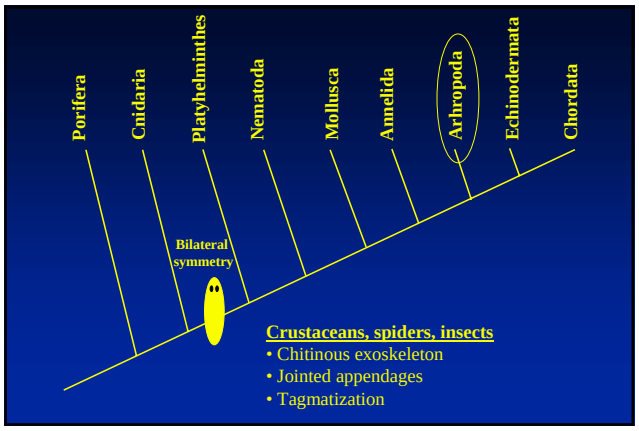
Annelida



72 Hours Postoperatively: 3 leeches have been applied every 8 hours. The ear was less swollen and obviously viable with markedly improved venous drainage.

Two Months Postoperatively: The entire ear survived except for a small area around the lobule of the ear.

medicinal leeches



Phylum Arthropoda - crustaceans, spiders, insects

Key Innovations: chitinous exoskeleton (completely enclosed) with jointed appendages. Must molt to grow. Truly terrestrial (not tied to water for reproduction). Tagmatization (specialization and fusion of segments).

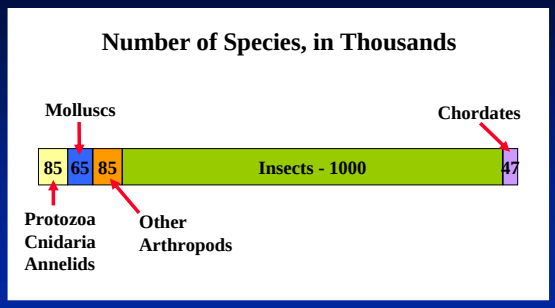
Open circulatory system, intricate eyes, gills or tracheal system for respiration.

Crustaceans – crabs, shrimp, barnacles, etc. Mostly marine.

Chelicerates – horseshoe crabs, spiders, scorpions. Have chelicerae (jaws) and pedipalps.

Uniramians – millipedes, centipedes, insects. Have unbranched legs. Insects have a head, thorax, abdomen. Some with wings.

Animal Diversity



Arthropoda

centipede
(predator)

Arthropoda

millipedes
(herbivores)

Arthropoda

isopods
pill bugs

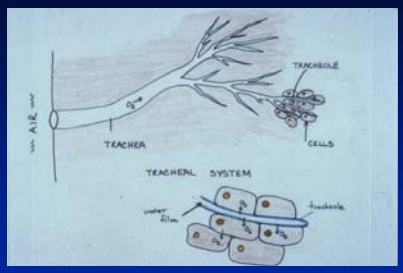
Arthropoda

jointed appendages

Arthropoda

spiracle
opening to tracheal system

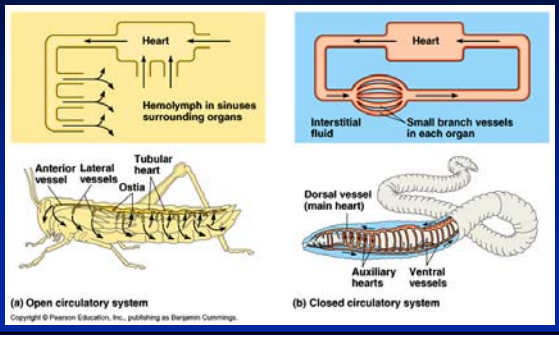
Arthropoda



tracheal system

Circulatory Systems

Arthropoda Annelida



Arthropoda

wing venation

Arthropoda

wing covers

Arthropoda

stomatopod
mantis shrimp

Arthropoda

stomatopod
(mantis shrimp)
appendages

Arthropoda

molting

Arthropoda

Extinct
Trilobites

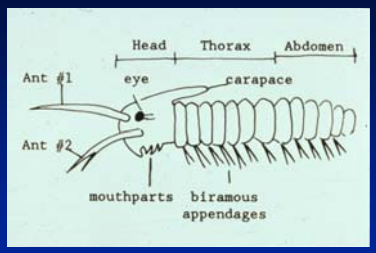
Arthropoda

Limulus
horseshoe crabs mating

Arthropoda

Panulirus interruptus
California spiny lobster

Arthropoda



arthropod segments

Arthropoda

krill (euphausiids)

Arthropoda

copepod
(zooplankton)

Arthropoda

zoea
larva

Arthropoda

male crab

Arthropoda

Uca
male fiddler crab

Arthropoda

hermit crab

Arthropoda

Orchestoidea
(amphipod)
beach hopper

Arthropoda

Ligula (isopod)

Arthropoda

Pollicipes polymerus
gooseneck barnacles

Arthropoda

barnacles mating

Arthropoda

FIGURE 41-10
The scorpion *Uroctonus mordax*, showing the characteristic pincers and segmented abdomen, ending in a sting, raised over the animal's back. White young scorpions cluster on this individual's back.

female scorpion
carrying eggs

Arthropoda

whiptail scorpion

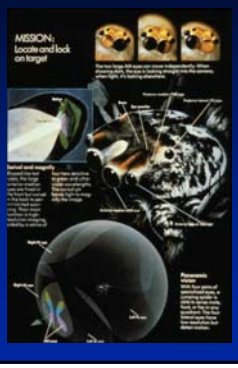
Arthropoda

spiders

Arthropoda

spider “face”

Arthropoda



multiple
spider eyes

Arthropoda

multiple
spider eyes

Arthropoda

spider eyes

Arthropoda

orb web

Arthropoda

spider web with
warning pattern

Arthropoda

spider spinnerets
producing silk

Arthropoda

size differences – sexual dimorphism

Arthropoda

mite

Arthropoda

mites on
reptile's eye

Arthropoda

dust mite

Arthropoda

empty and full ticks

Arthropoda

wasp segmentation

Arthropoda

beetle

Arthropoda

butterfly feeding

Arthropoda

weevil feeding

Arthropoda

housefly with sponge-like proboscis

Arthropoda

menacing jaws

Arthropoda

jaws

Arthropoda

wasp jaws

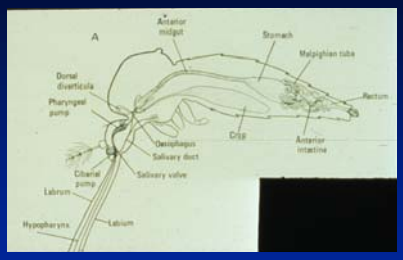
Arthropoda

jaws

Arthropoda

female mosquito
with red abdomen

Arthropoda



mosquito structures

Arthropoda

flea

Arthropoda

body louse

Arthropoda

parasitic wasp

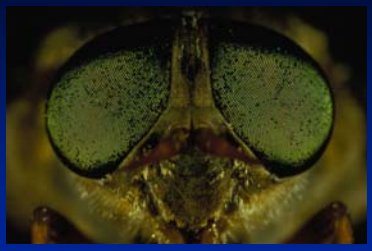
Arthropoda

compound eyes

Arthropoda

compound eyes

Arthropoda



compound eyes

Arthropoda

larva or caterpillar

Arthropoda

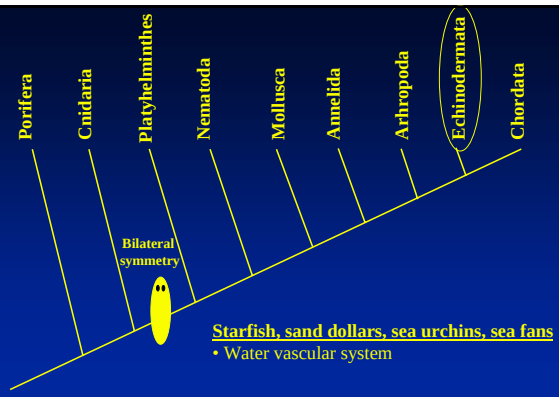
pupa or chrysalis

Arthropoda

butterfly emerging from chrysalis

Arthropoda

adult butterfly



Echinoderms

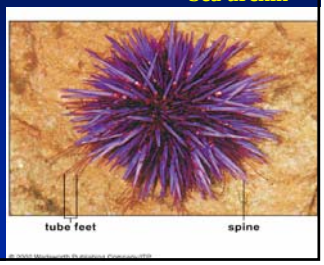
Echinoderms have spines, spicules, or plates in their body wall, and a water vascular system

General lifestyle:

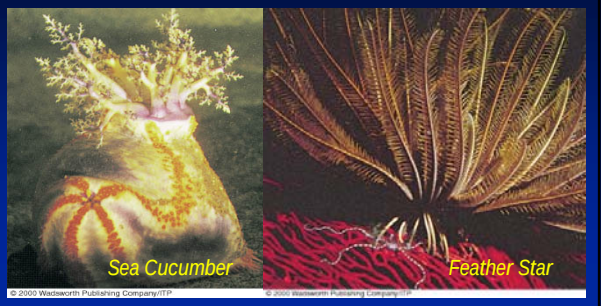
Marine predators

Sea stars, sea urchins, etc.

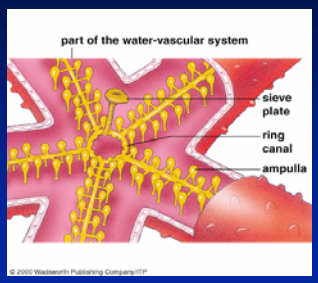
Sea urchin



The Echinoderms



Key Aspects of the Radial Body Plan of a Sea Star



Echinodermata

Tube feet

Echinodermata

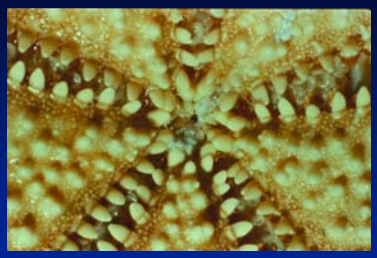
Echinodermata

Echinodermata

Echinodermata

Tube feet

Echinodermata



Echinodermata

Tube feet

Echinodermata

Echinodermata

Echinodermata

Echinodermata

Echinodermata

Sun star (*Heliaster kubiniji*)

Echinodermata

Regeneration

Echinodermata

Regeneration

Echinodermata

Crown of thorns

Echinodermata

Crown of thorns

Echinodermata

Ophioroid – Brittle star

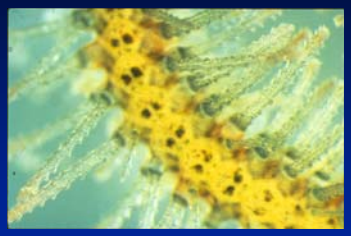
Echinodermata

Ophioroid – Brittle star

Echinodermata

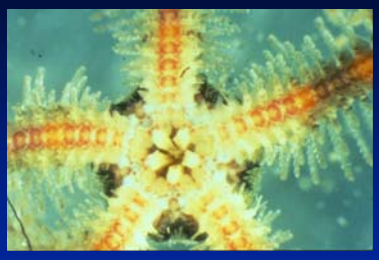
Ophioroid – Brittle star

Echinodermata



Ophioroid – Brittle star

Echinodermata

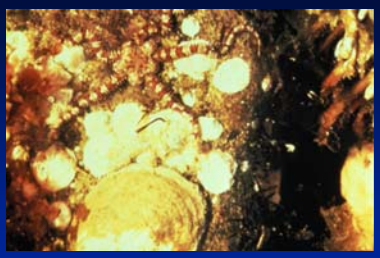


Ophioroid – Brittle star

Echinodermata

Ophioroid – Brittle star

Echinodermata



Ophioroid – Brittle star

Echinodermata

Basket star

Echinodermata

Sea urchins

Echinodermata

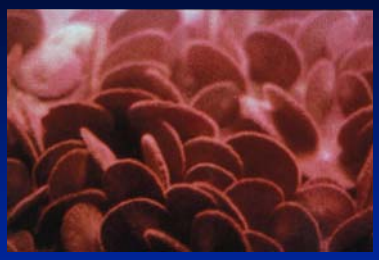
Sea urchin and tube feet

Echinodermata

Echinodermata

Sand Dollar - Dendraster

Echinodermata

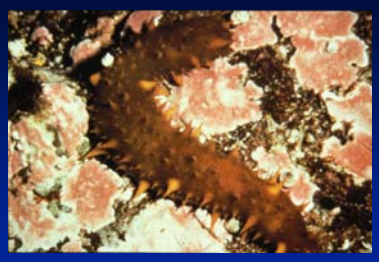


Sand Dollar - Dendraster

Echinodermata

Sand Dollar - Dendraster

Echinodermata



Sea cucumber - Cucumaria

Echinodermata

Sea cucumber - Cucumaria

Echinodermata

Sea cucumber - Cucumaria

Echinodermata

Sea cucumber - Cucumaria

Echinodermata

Feather star

Echinodermata

Feather star

Echinodermata

Feather star

Echinodermata

Feather star

Echinodermata

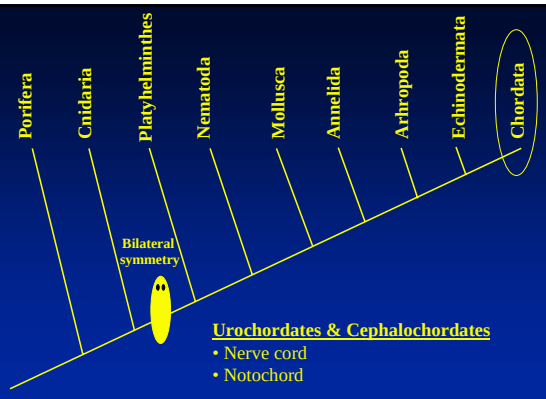
Feather star

Echinodermata

Feather star

Echinodermata

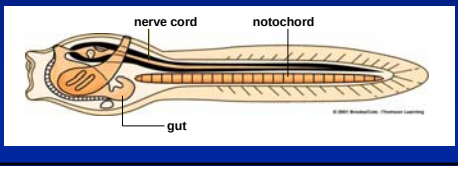
Echinodermata



Urochordates & Cephalochordates
- Nerve cord
- Notochord

Subphylum Urochordata

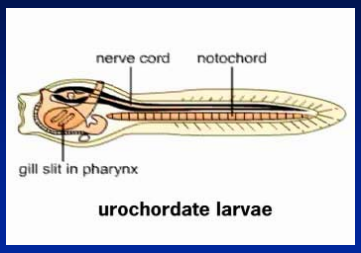
Most are “tunicates”- “sea squirts”
Larva is free-swimming filter feeder
Adult is sessile



Tunicate Life History

Larva undergoes metamorphosis to adult form

Tunicate Life History



Urochordates - Tunicates

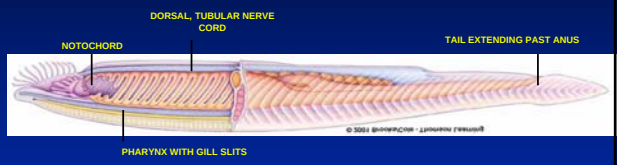
Urochordates - Tunicates

Urochordates - Tunicates

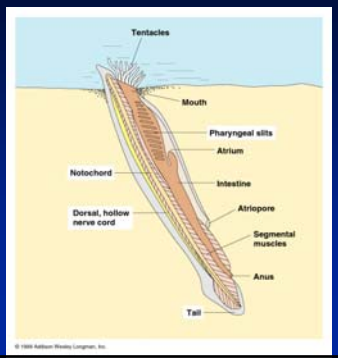
Subphylum Cephalochordata

- Lancelets, Amphioxus
- Fish-shaped filter feeders that lie buried in sediments
- Chordate characteristics of adult:
  - Notochord lies under dorsal nerve cord
  - Pharynx has gill slits
  - Tail extends past anus

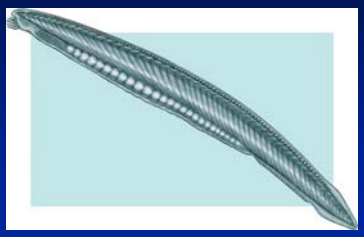
Lancelet Body Plan



Lancelet Body Plan



Amphioxus



Amphioxus

Amphioxus

Trends in the Evolution of Vertebrates

Shift from notochord to vertebral column

Nerve cord expanded into brain

Evolution of jaws

Paired fins evolved, gave rise to limbs

Gills evolved, gave rise to lungs