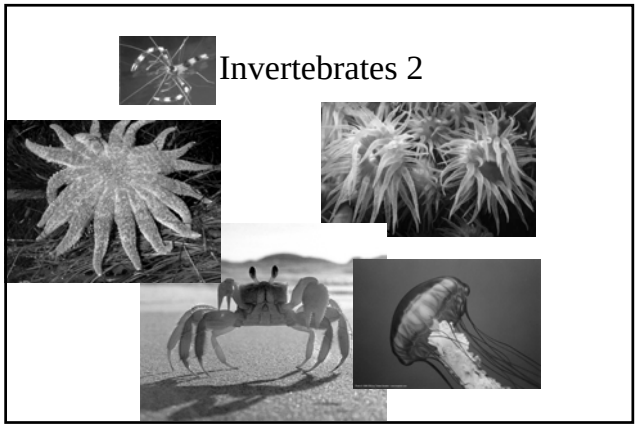
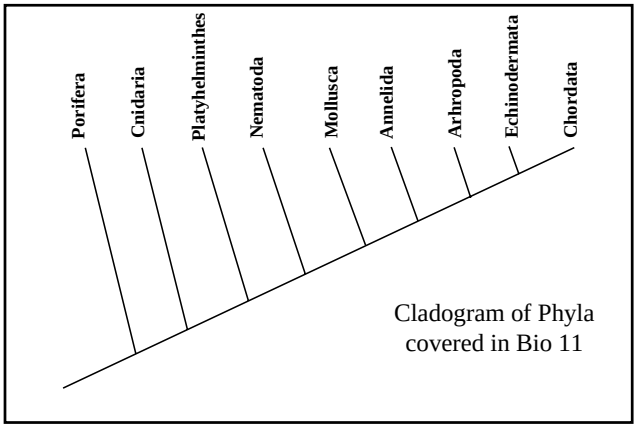




Cladogram of Phyla covered in Bio 11

Cladograms

Cladograms are constructed using a method known as '**cladistics**'. This method analyzes a collection of **heritable** character data compiled by a researcher (morphology and/or DNA). This method groups taxa based on the number of characters that they share with one another.

Cladograms

Cladograms are evolutionary tree diagrams that show relationships based on synapomorphies (shared-derived characters).

Shared-derived characters

Synapomorphies

Homologous characters

characters that are shared by two or more groups which originated in (and were derived from) their immediate (last) common ancestor.

Cladograms

Cladograms are evolutionary tree diagrams that show relationships based on synapomorphies (shared-derived characters).

NOT:

Homoplasy

Analagous characters

characters that look similar or have similar fucnctions, but are not derived from a common ancestor.

Cladistics example

Fly	Fish	Wolf	Gorilla	Human
Heterotroph	Heterotroph	Heterotroph	Heterotroph	Heterotroph
Chitin	Vertebrae	Vertebrae	Vertebrae	Vertebrae
Antenae	Eye	Eye	Eye	Eye
Compound eye	Fins	Hair	Hair	Hair
6 legs	Scales	5 toes	5 toes	5 toes
	eggs	4 legs	2 legs+2 arms	2 legs+2 arms
			Opposable thumb	Opposable thumb

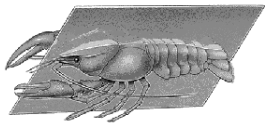
Homoplasy
Analogous characters

General Characteristics

1. Body Symmetry
2. Cephalization
3. Type of Gut
4. Type of Body Cavity
5. Segmentation

Body Symmetry and Cephalization

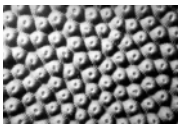
Radial – body parts are arranged regularly around a central axis. (example: sea anemone)

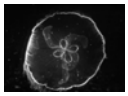


Bilateral – right half and left half are mirror images.
Anterior/Posterior – head/tail
Dorsal/Ventral – back/stomach

Examples of Body Symmetry

Radial



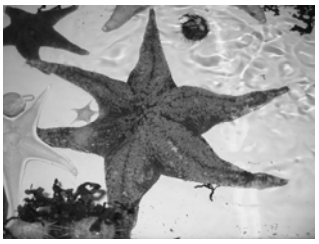


Bilateral

Echinoderm symmetry

What about sea stars and sea urchins?

As adults they have pentameral symmetry which is a form of radial symmetry, but their larvae show bilateral symmetry and molecular data indicates that their ancestors had bilateral symmetry. So we consider them to be bilaterians.

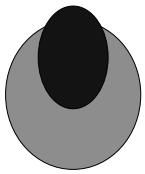


Cephalization

Bilateral organisms have developed a head in the anterior (front) end. This may have been favorable when moving forward and being able to detect and eat what's in front of them. Many sensory and nerve cells have become concentrated in the head.

Types of Guts

Sac-like Gut

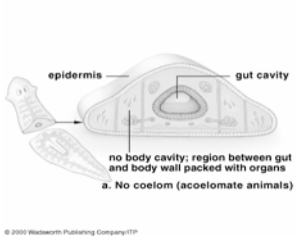


Single opening for ingesting food and excreting wastes.

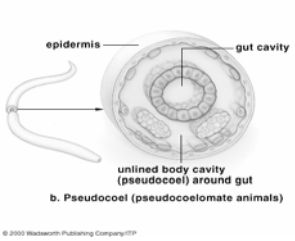
Tube-like Gut

Complete gut with mouth and anus. Food travels one-way through the organism.

Types of Body Cavities in Animals



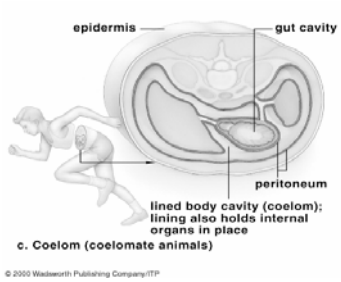
Acoel - no body cavity



Pseudocoel - unlined body cavity

Types of Body Cavities in Animals

Coelom - Lined body cavity



Segmentation

Repeating series of body units that may be quite different.

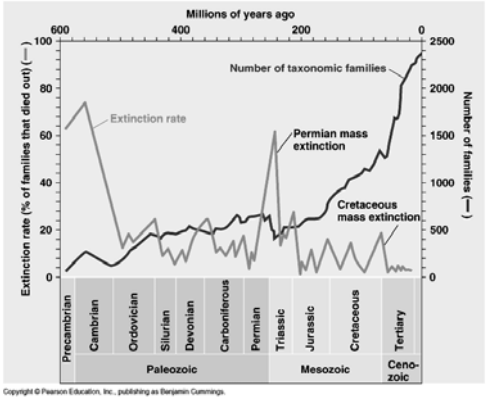
Examples:

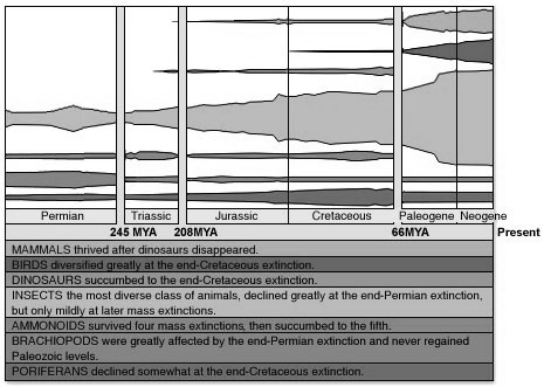
Segments of an earthworm are similar.

Segments of a crustacean are different (lobster, insect).

Fossils

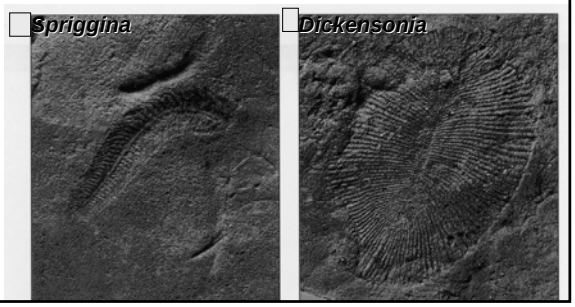
Fossile evidence has provided a greart deal of information about the origins of extant taxa.





Ediacaran Fossils

600-542 million years
Also called "Vendian"
South Australia



Ediacara Hills, Australia

Ediacaran Assemblage

Burgess Shale

- *Yoho National Park*
- *Canadian Rockies*
- *~540 mya*

Burgess Shale

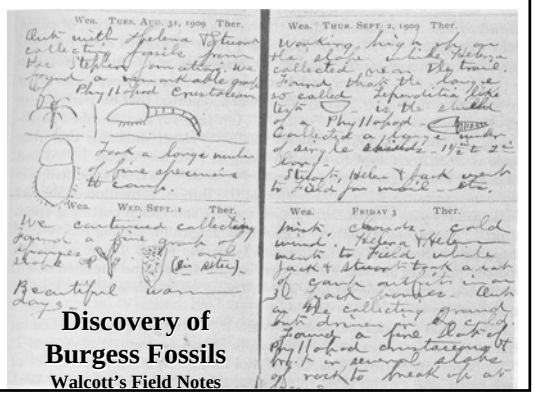
View from the Quarry

Working the Burgess Shale

Charles Walcott in his seventies

Helena Walcott & family, ca. 1910?

Royal Ontario Museum camp, August 2000, near Walcott's campsite



Discovery of Burgess Fossils

Walcott's Field Notes

Burgess Shale

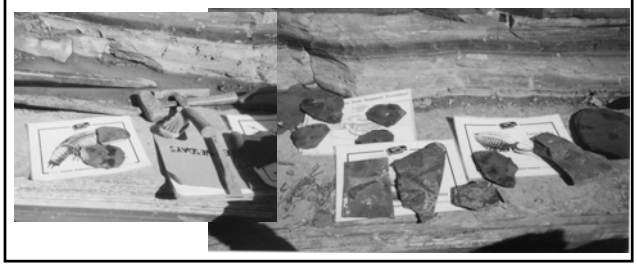
Edge of the Quarry

Burgess Shale

Slabs Ready to Split for Fossils

Burgess Shale

Freshly Exposed Fossils



Prepared Burgess Fossils

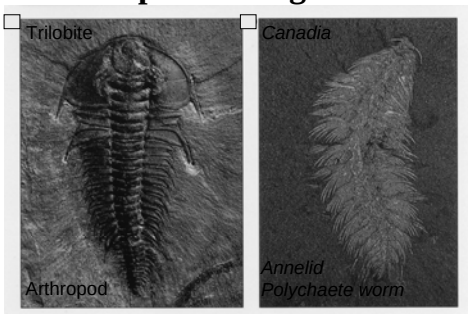
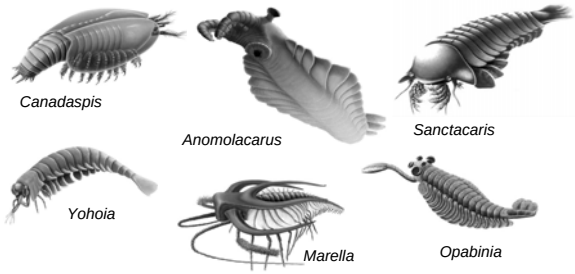
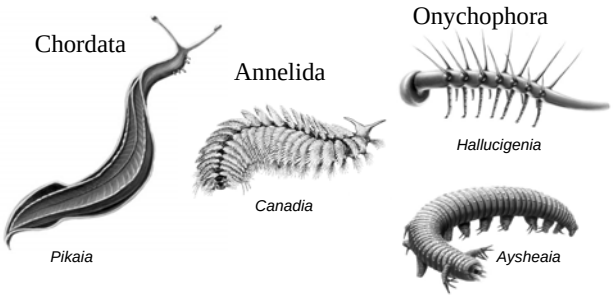


Figure from: Starr, C. (2000). Biology, Concepts and Applications. Brooks/Cole.

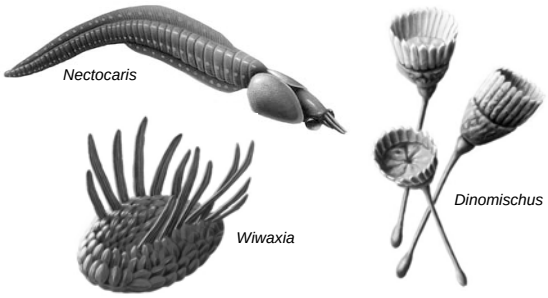
Burgess Animals Arthropoda



Burgess Animals



Burgess Animals
Weird Phyla



The Burgess Sea

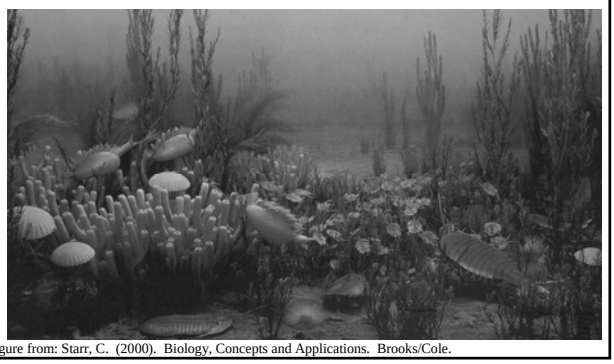
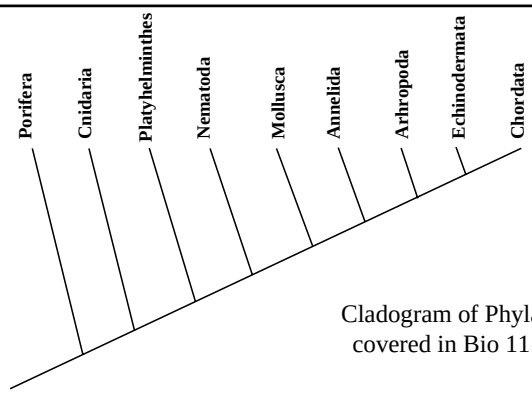


Figure from: Starr, C. (2000). Biology, Concepts and Applications. Brooks/Cole.



Cladogram of Phyla covered in Bio 11

Key Points for Each Phylum:

- **Recognize them**
- **Where they fall in the overall phylogenetic tree**
- **General Body Plan: symmetry, gut, coelom, skeleton**
- **General lifestyle**

Origin of Multicellularity

Animals

choanoflagellate-like protists

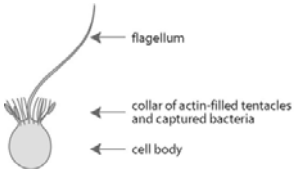
Two hypotheses

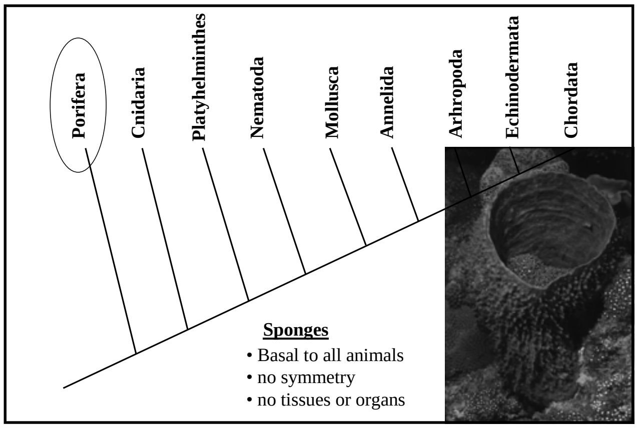
1. Ciliates

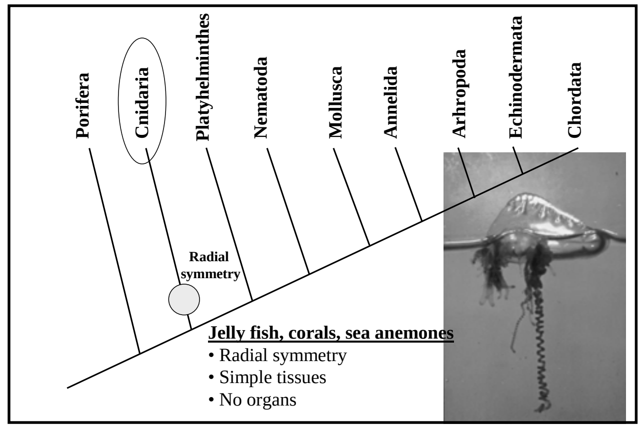
One cell, many nuclei

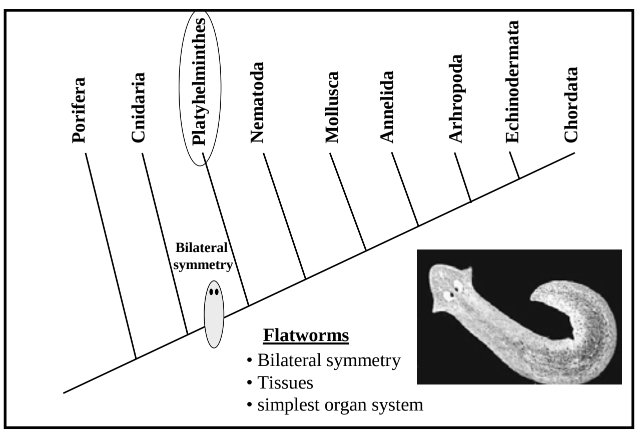
2. Colonies

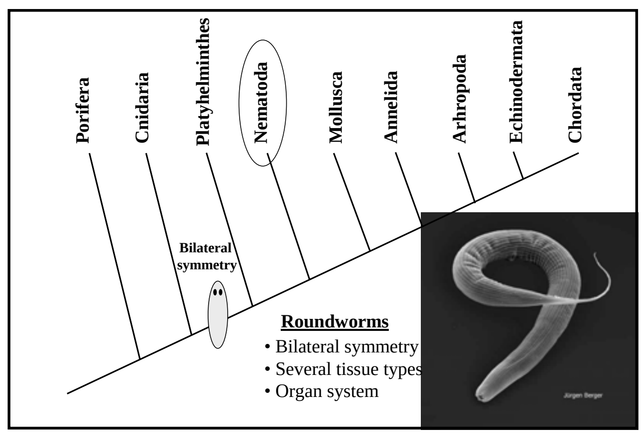
Colonies of cells that became specialized for certain tasks

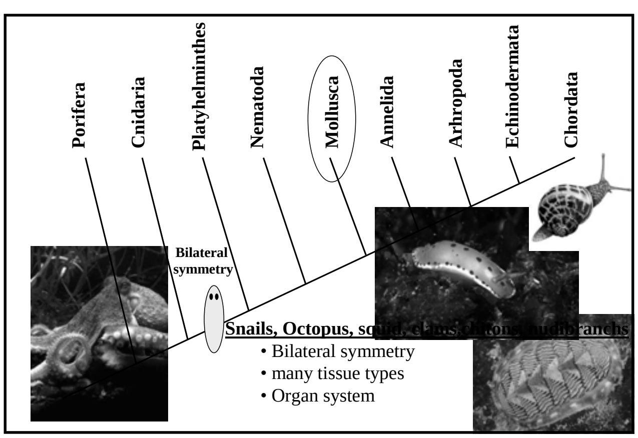


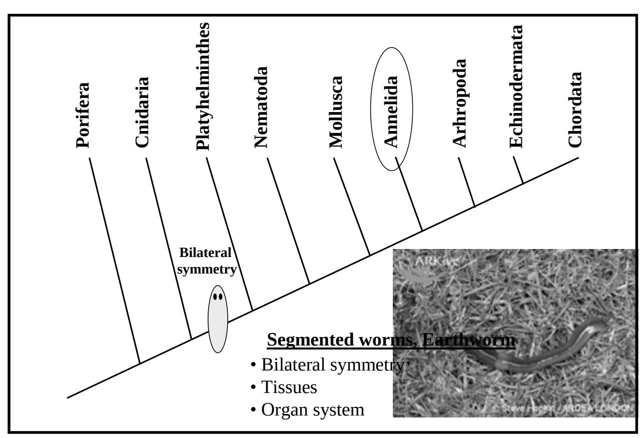

Porifera
Cnidaria
Platyhelminthes
Nematoda
Mollusca
Annelida
Arhropoda
Echinodermata
Chordata
Sponges
• Basal to all animals
• no symmetry
• no tissues or organs

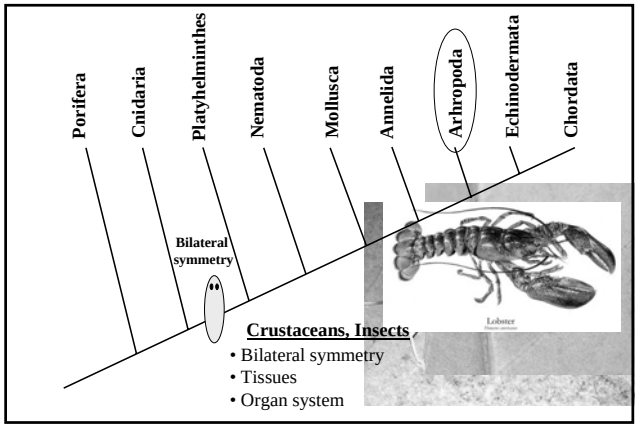

Porifera
Cnidaria
Platyhelminthes
Nematoda
Mollusca
Annelida
Arhropoda
Echinodermata
Chordata
Radial symmetry
Jelly fish, corals, sea anemones
• Radial symmetry
• Simple tissues
• No organs

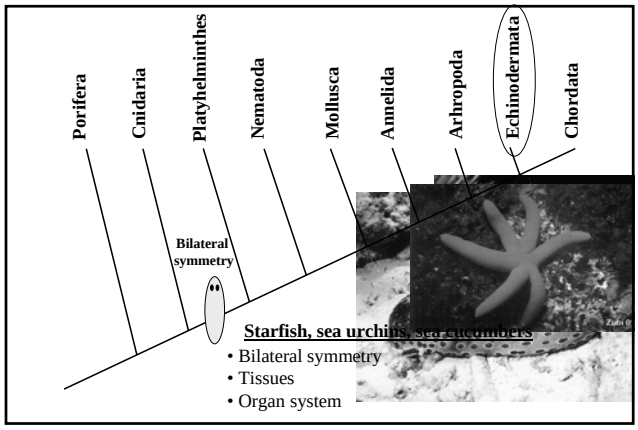

Porifera
Cnidaria
Platyhelminthes
Nematoda
Mollusca
Annelida
Arhropoda
Echinodermata
Chordata
Bilateral symmetry
Flatworms
• Bilateral symmetry
• Tissues
• simplest organ system

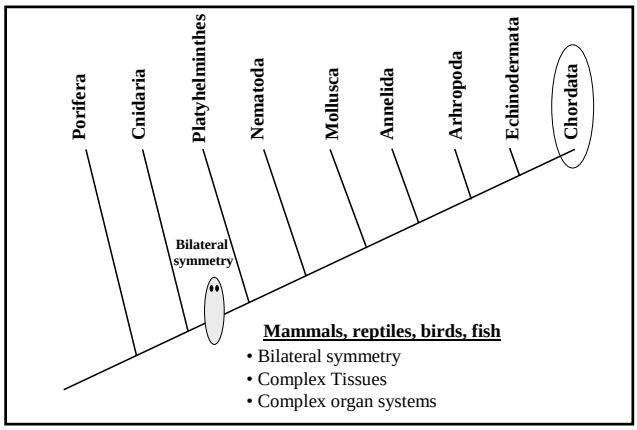

Porifera
Cnidaria
Platyhelminthes
Nematoda
Mollusca
Annelida
Arhropoda
Echinodermata
Chordata
Bilateral symmetry
Roundworms
• Bilateral symmetry
• Several tissue types
• Organ system


Porifera
Cnidaria
Platyhelminthes
Nematoda
Mollusca
Annelida
Arhropoda
Echinodermata
Chordata
Bilateral symmetry
Snails, Octopus, squid, clams, chitons, nudibranchs
• Bilateral symmetry
• many tissue types
• Organ system


Porifera
Cnidaria
Platyhelminthes
Nematoda
Mollusca
Annelida
Arhropoda
Echinodermata
Chordata
Bilateral symmetry
Segmented worms, Earthworm
• Bilateral symmetry
• Tissues
• Organ system



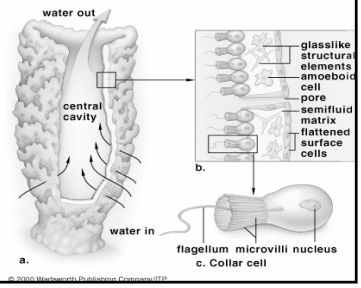




Porifera (Sponges)
Success in Simplicity

- **No symmetry, tissues, or organs**
- **Abundant since Precambrian**
- **8000 species today**
- **"Filter" food from the water**
- **Sessile adults**
- **Silica spicules**

•General lifestyle: Marine filter feeders



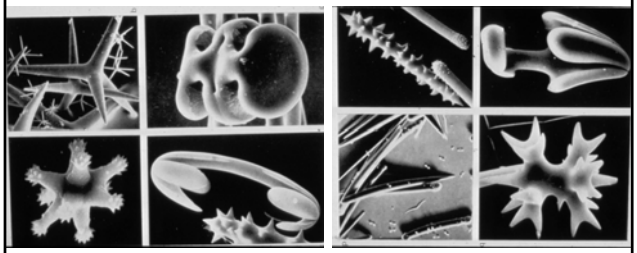
Porifera

A sponge releasing a cloud of sperm

- **Most live in coastal, shallow water marine environments**
- **Some deep ocean or fresh water**

- **Hermaphrodites that reproduce sexually (most species)**
- **Sperm in water, but eggs retained until fertilized**
- **Swimming larval stage**

Structural Elements of Sponges



Spicule types

Sponges – Skeletal Elements

Venus's flower basket *(Euplectella)*

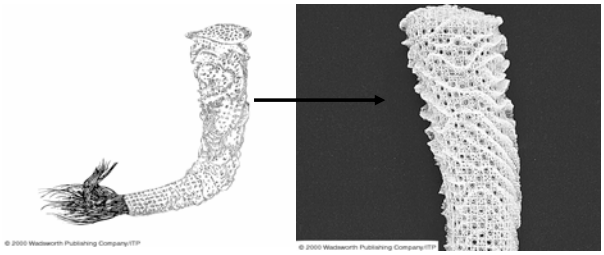
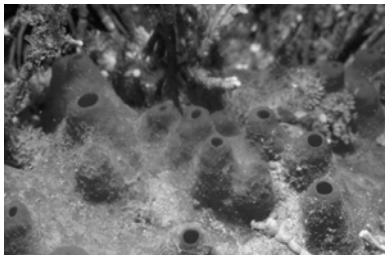


Figure 23.7 (c,d) from page 361 of your text

Sponges

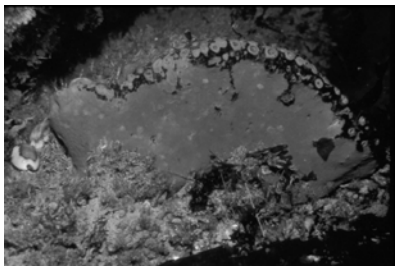
Tethya aurantia
puffball sponge

Sponges



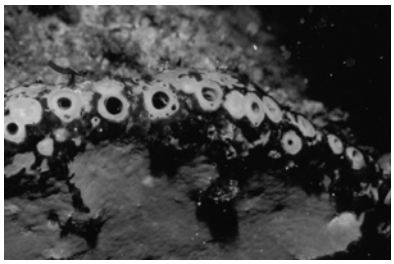
Acarnus erithacus
red volcano sponge

Sponges



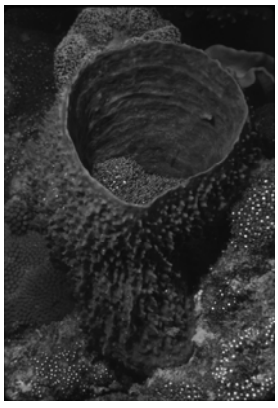
Spheciospongia confoederata
moon sponge

Sponges



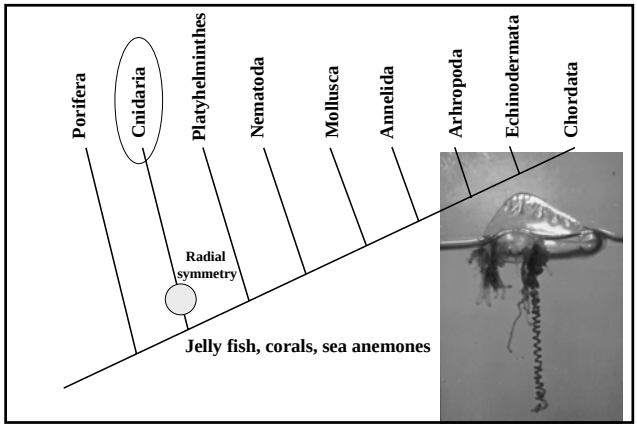
Spheciospongia confoederata close-up
moon sponge

Sponges



Coral Reef

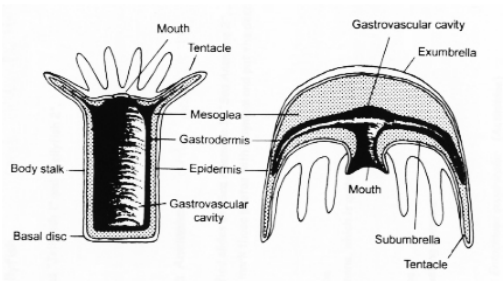
Vase Sponge



Phylum Cnidaria – anemones, corals, jellies

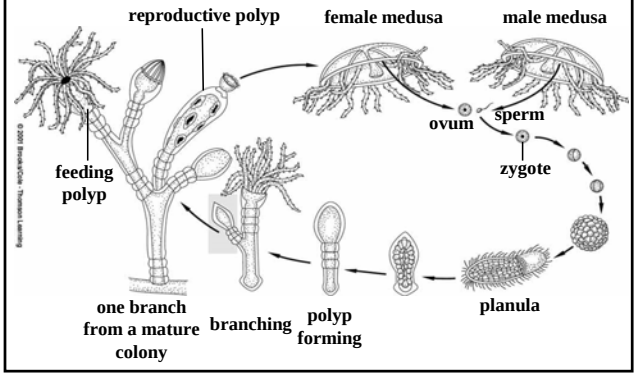
1. Key Innovations are radial symmetry and a tissue-level of organization (still no organs)
2. Diploblastic – have only two embryonic tissues (ectoderm and endoderm)
3. Have a sac-like gut
4. Two body forms – polyp and medusa
   polyp is sessile and benthic, medusa is planktonic
5. Carnivores with one gut opening
6. Reproduce sexually and asexually (budding)

Cnidarian Body Forms



polyp **medusa**

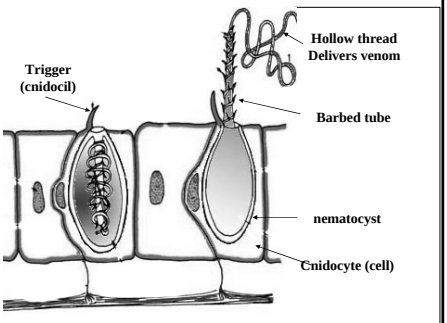
Cnidarian Reproduction



Phylum Cnidaria

Cnidocytes

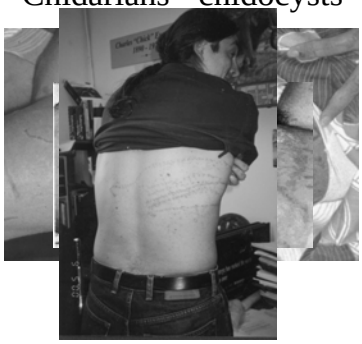
Cells containing a stinging structure (nematocyst).



Cnidarians

sea wasp warning

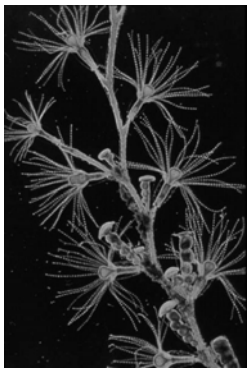
Cnidarians - cnidocysts



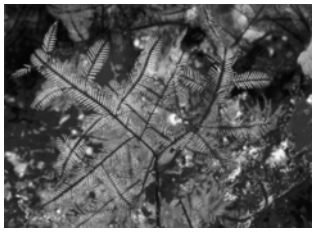
Jellyfish stings

Cnidarians

hydroid

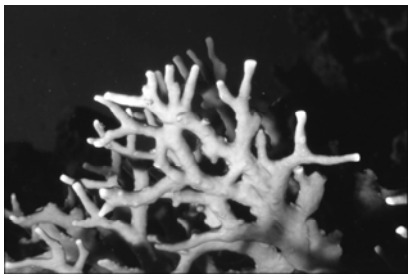


Cnidarians



Lytocarpus philippinus
stinging hydroid

Cnidarians

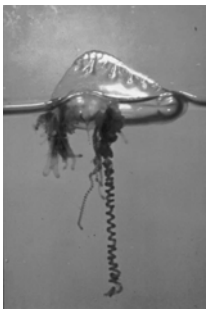


Millepora – fire coral

Cnidarians

Millepora – fire coral close-up

Cnidarians

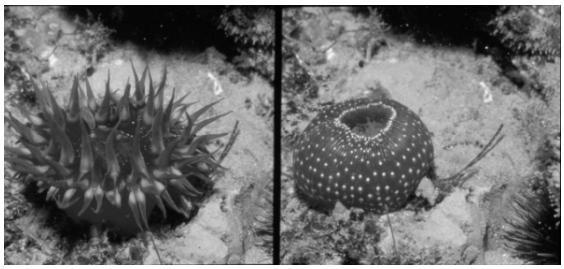


Portuguese Man O' War
(Physalia physalis)

Cnidarians

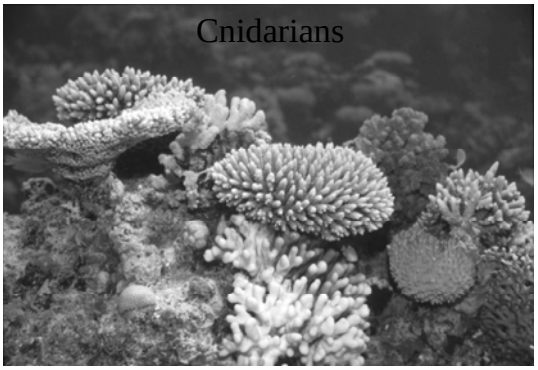
close-up of tentacles of
Portuguese Man O' War
(Physalia physalis)

Cnidarians



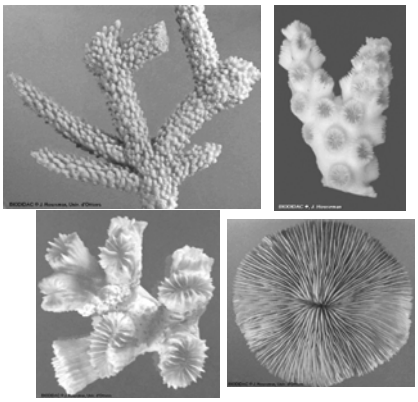
Urticina lofotensis
rose colored anemone

Cnidarians



corals from the Great Barrier Reef

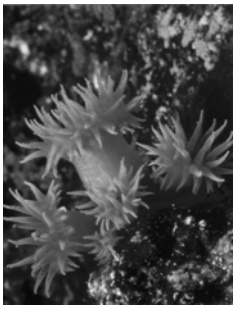
Cnidaria



coral
skeletons

Cnidarians

Tubastrea
tropical coral



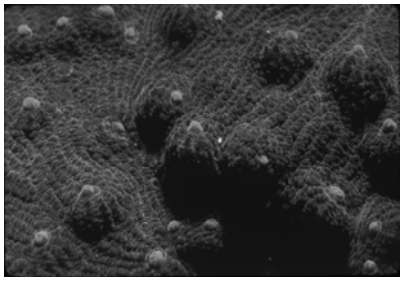
Cnidarians

cup coral close-up

Cnidarians

symbiotic zooxanthellae
(dinoflagellate) in coral tentacle

Cnidarians



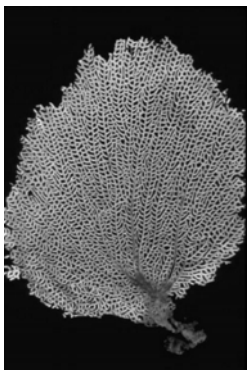
Echinophyllia aspera
(gray coral) close-up

Cnidarians

soft coral

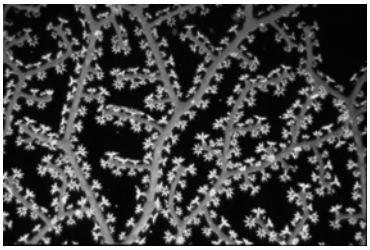
Cnidarians

gorgonian
(sea fan)



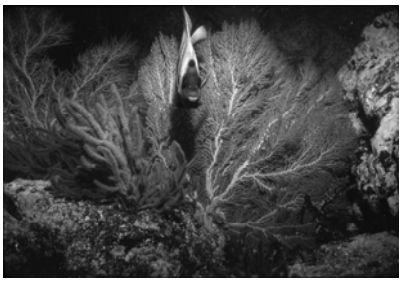
Cnidarians

notice
polyps



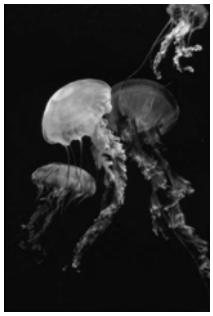
gorgonian close-up (sea fan)

Cnidarians



gorgonians (sea fans)

Cnidarians

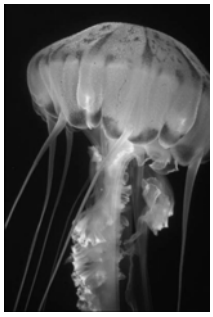


Chrysaora fuscescens
Sea nettle jelly

Cnidarians

Chrysaora fuscescens
sea nettle jelly

Cnidarians



Chrysaora (Pelagia) colorata
Purple-striped jelly

Cnidarians

Chironex fleckeri
sea wasp

Exam on Friday!

We will have fewer questions!

Review session tonight at 5:30 in 2301 Tolman.