Animal Evolution and Diversity

Reading: Chap. 31 (More in chaps 32 & 33 if you'd like.)

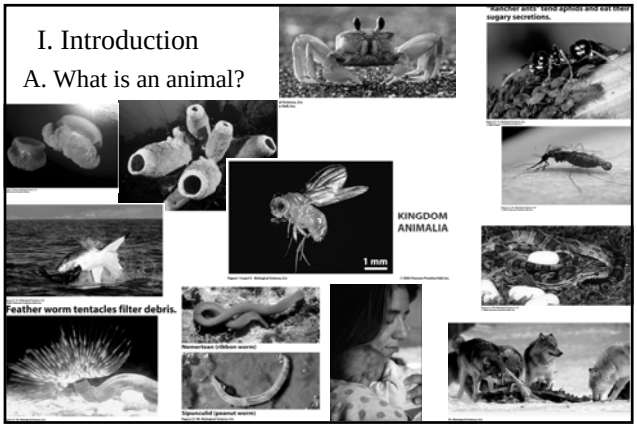
I. Introduction
- A. What is an animal?
- B. Why are animals important?

II. Animal evolution
- A. Comparative morphology
- B. Molecular vs. morphological phylogenies

III. Themes in animal diversification
- A. Feeding
- B. Movement
- C. Reproduction & life cycles

I. Introduction

A. What is an animal?



KEY CONCEPTS

Animals are a particularly species-rich and morphologically diverse lineage of multicellular organisms on the tree of life.

-Eukaryotes.

-Multicellular, contain several different types of cells.

-Heterotrophic, must eat preformed organic molecules.
- Most ingest organisms or detritus (dead organic matter) whole or in pieces.

-Lack cell walls. Cells held together by structural proteins, particularly collagen, and unique intercellular junctions composed of other structural proteins.

-Have nervous tissue (impulse conduction) and muscle tissue (movement). Tissues are integrated groups of cells with a common structure and function.

-Most reproduce sexually, with diploid stage dominating life cycle. Many have larvae (a sexually immature form, distinct from adult).

TABLE 31.1 An Overview of Major Animal Phyla

Group and Phylum	Common Name or Example Taxa	Estimated Number of Species
Protostomes: Lophotrochozoa		
Porifera	Sponges	5500
Cnidaria	Jellyfish, corals, anemones, hydroids, sea fans	10,000
Ctenophora	Comb jellies	100
Acoelomorpha	Acoelomate worms	10
Rotifera	Rotifers	1800
Platyhelminthes	Flatworms	20,000
Nemertea	Ribbon worms	900
Gastrotricha	Gastrotrichs	450
Acanthocephala	Acanthocephalans	1100
Entoprocta	Entoprocts	150
Gnathostomulida	Gnathostomulids	80
Sipuncula	Peanut worms	320
Echiura	Spoon worms	135
Annelida	Segmented worms	16,500
Mollusca	Mollusks (clams, snails, octopuses)	94,000
Phoronida	Phoronids	20
Ectoprocta	Ectoprocts	4500
Brachiopoda	Brachiopods; lamp shells	335

Table 31-1 part 1 Biological Science, 2/e
© 2005 Pearson Prentice Hall, Inc.

TABLE 31.1 An Overview of Major Animal Phyla

Group and Phylum	Common Name or Example Taxa	Estimated Number of Species
Protostomes: Ecdysozoa		
Nematoda	Roundworms	25,000
Kinorhyncha	Kinorhynchs	150
Nematomorpha	Hair worms	320
Priapula	Priapulans	16
Onychophora	Velvet worms	110
Tardigrada	Water bears	800
Arthropoda	Arthropods (spiders, insects, crustaceans)	1,100,000
Deuterostomes		
Echinodermata	Echinoderms (sea stars, sea urchins, sea cucumbers)	7000
Chaetognatha	Arrow worms	100
Hemichordata	Acorn worms	85
Chordata	Chordates (tunicates, lancelets, sharks, bony fish, frogs, reptiles, mammals)	50,000

Table 31-1 part 2 Biological Science, 2/e
© 2005 Pearson Prentice Hall, Inc.

Proportion of species in different animal phyla

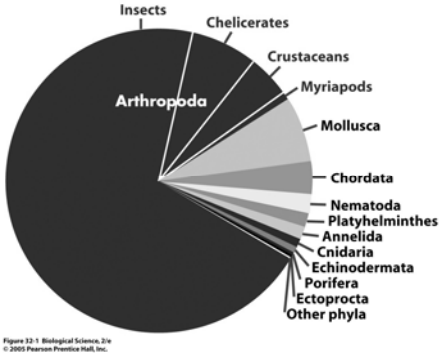
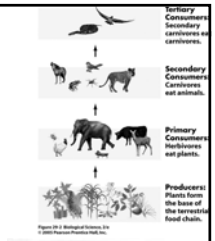


Figure 32-1 Biological Science, 2/e
© 2005 Pearson Prentice Hall, Inc.

B. Importance of animals

1. "Gee, they're neat."
2. Ecosystem roles
   Consumers: Ornaments or keystones?
3. Understanding evolution
4. Human cultural evolution: Food and work
5. Human biology & medicine
   - fruit flies, lab rats, primates



http//www.africanspicesafaris.com/images/masai-cattle.jpg

II. Animal evolution

KEY CONCEPT

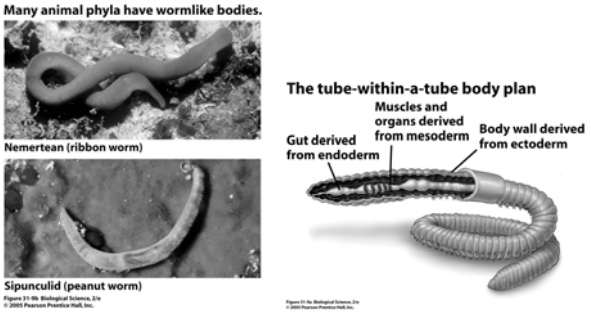
Major groups of animals are defined by the design and construction of their **basic body plan**, which differs in

- the number of tissues observed in embryos,
- symmetry,
- degree of cephalization,
- the presence or absence of a body cavity,
- the way in which early events in embryonic development proceed.

II. Animal evolution

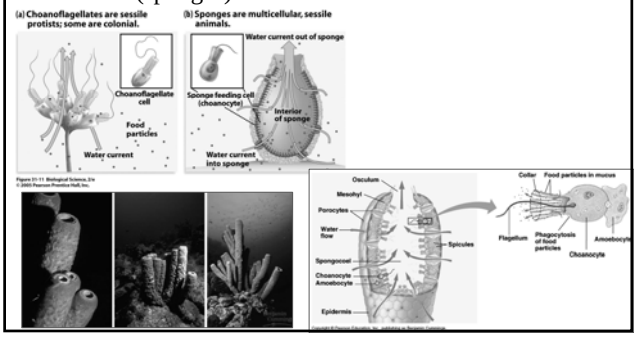
A. Comparative Morphology
1. Tissues
2. Symmetry and cephalization
3. Body cavity
4. Patterns of development

Why are there so many worms?



1. The Evolution of Tissues

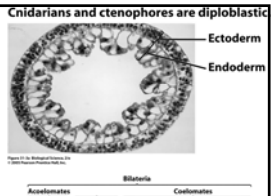
Parazoans (sponges) – no true tissues

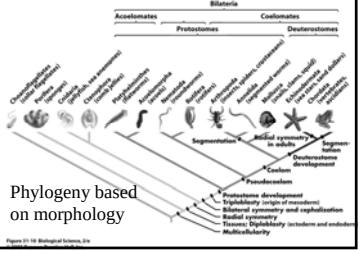


Eumetazoans – have true tissues; all other animals

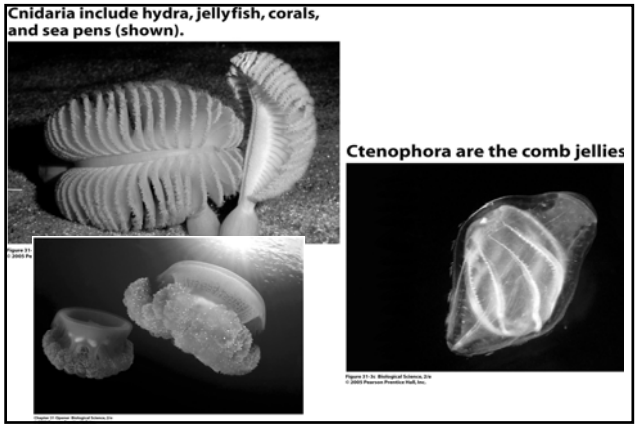
diploblasts – two tissue "germ" layers in embryo
- endoderm
- ectoderm

triploblasts – 3 tissue germ layers in embryo
- endoderm→gut lining
- ectoderm→skin, nerve tissue
- mesoderm → muscles, organs

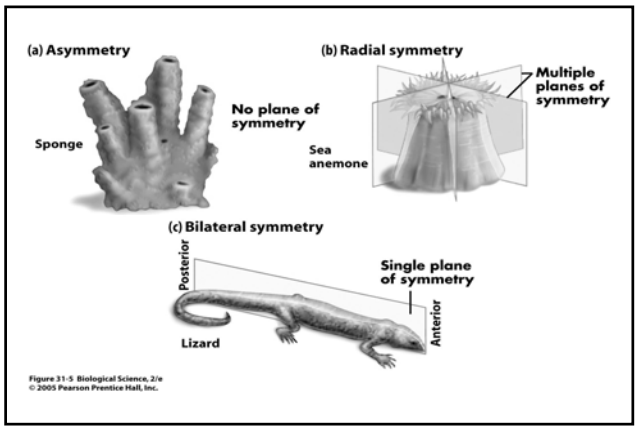


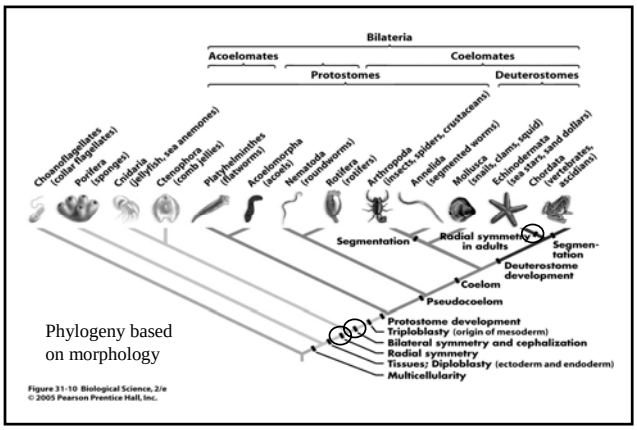


Phylogeny based on morphology



2. Symmetry and cephalization





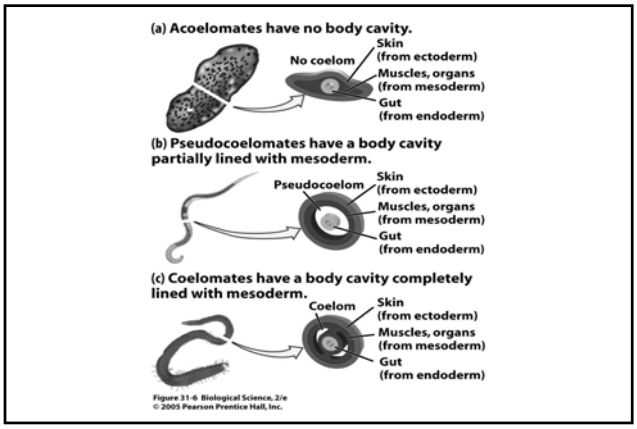
3. Body cavities

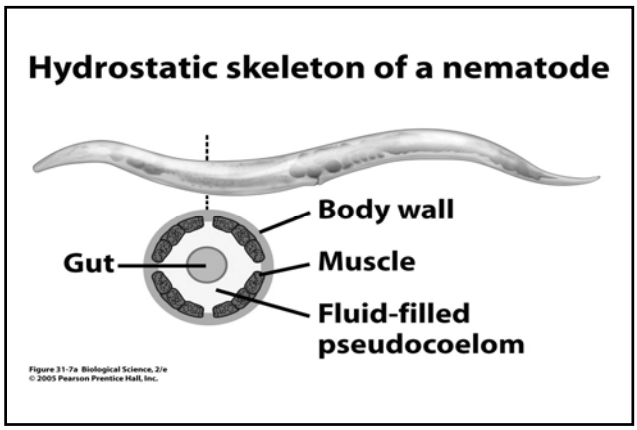
Coelem – internal fluid-filled cavity; protects internal organs, hydrostatic skeleton

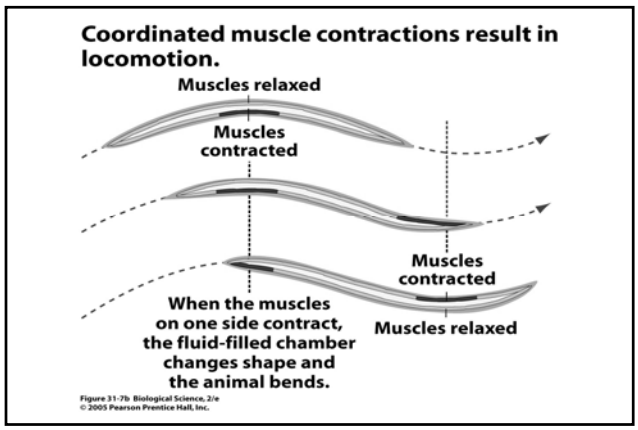
Acoelomates – no cavity

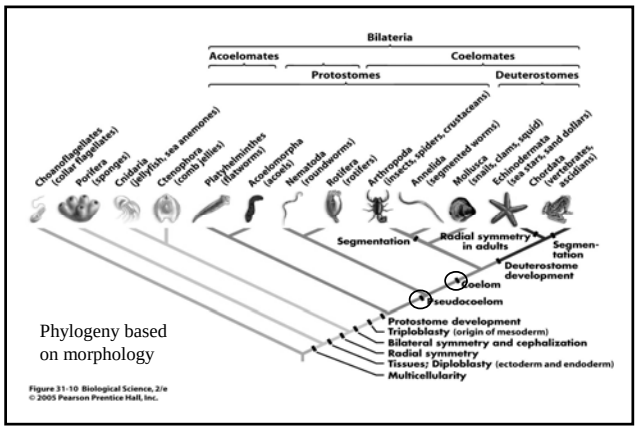
Coelomates – "True"

Pseudocoelomates – different developmental pattern, but still a "real" coelom





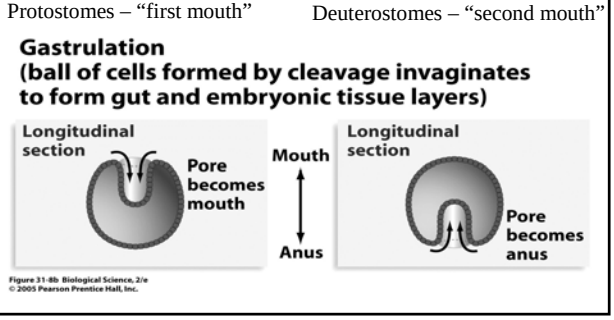


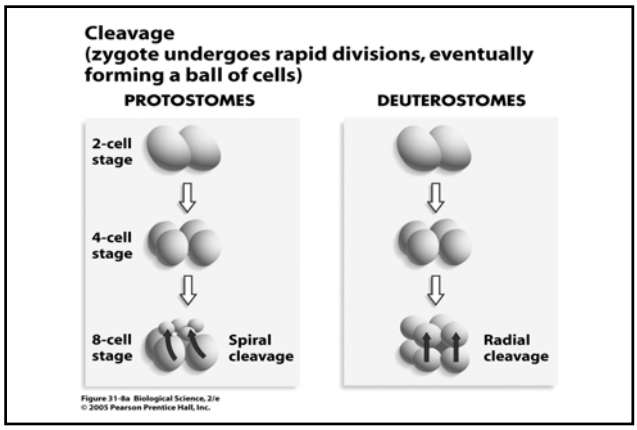


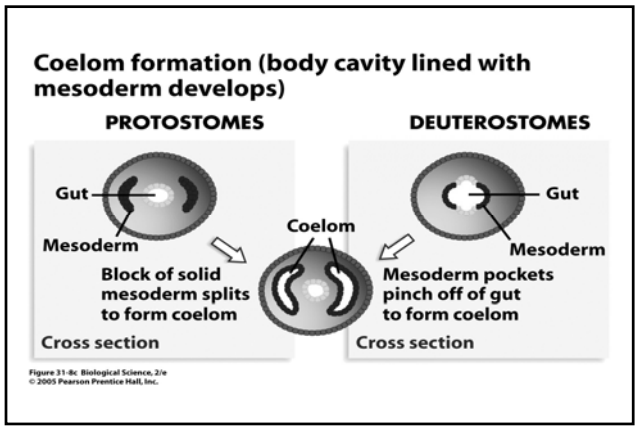
4. Patterns of development

Protostomes – "first mouth"

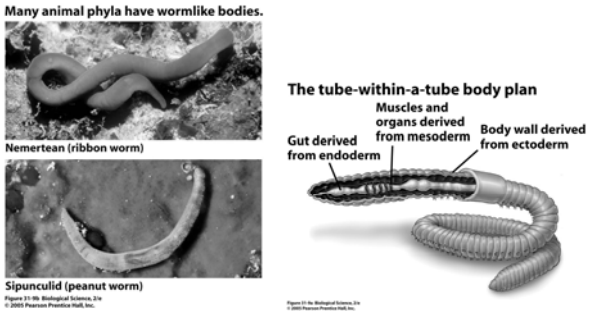
Deuterostomes – "second mouth"





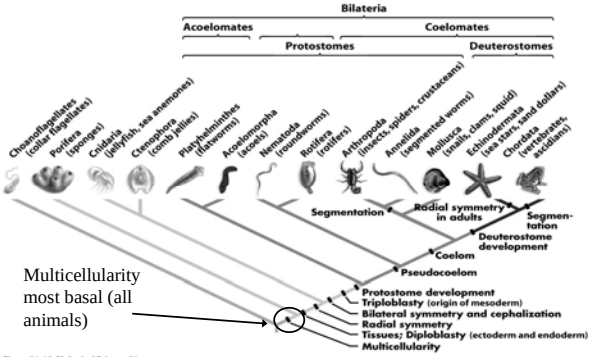


Why are there so many worms?

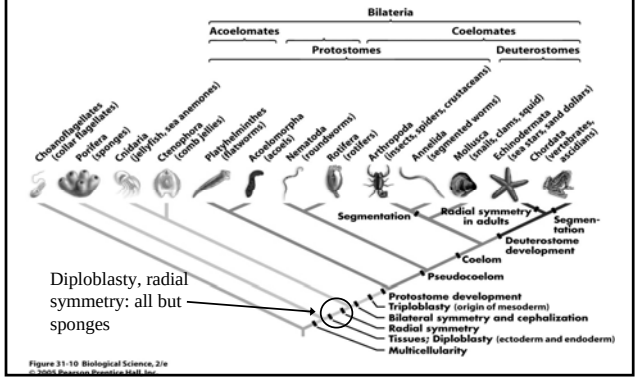


II. Evolution
B. Comparison of phyologenies

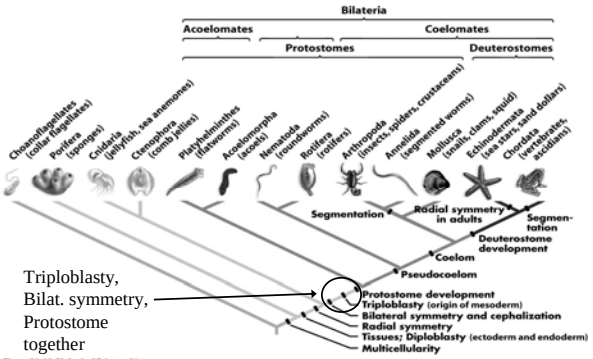
Phylogeny based on morphology



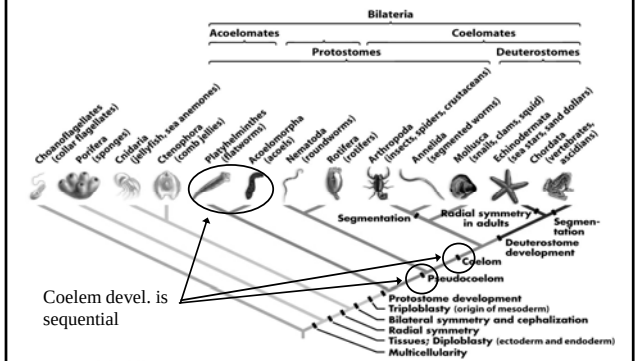
Based on morphology



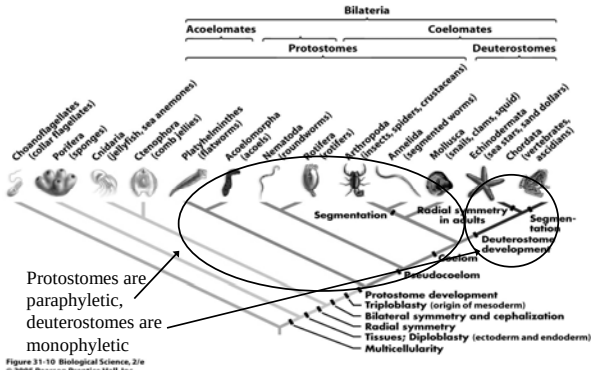
Based on morphology



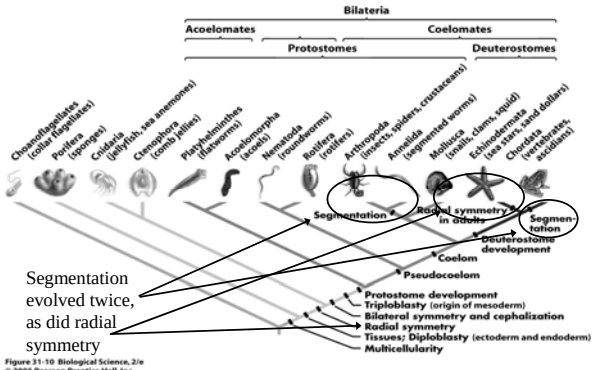
Based on morphology



Based on morphology



Based on morphology

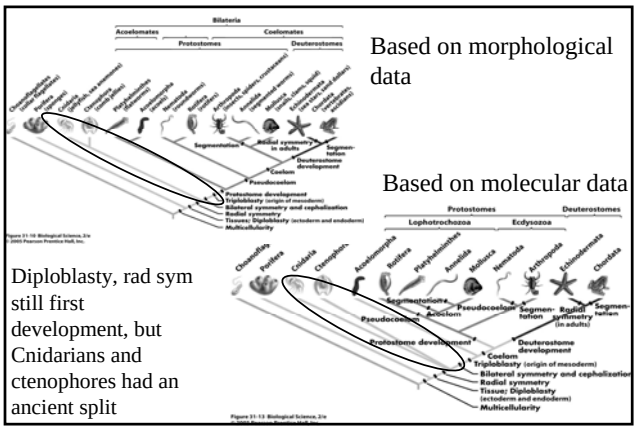


II. Evolution
B. Comparison of phyologenies
KEY CONCEPTS

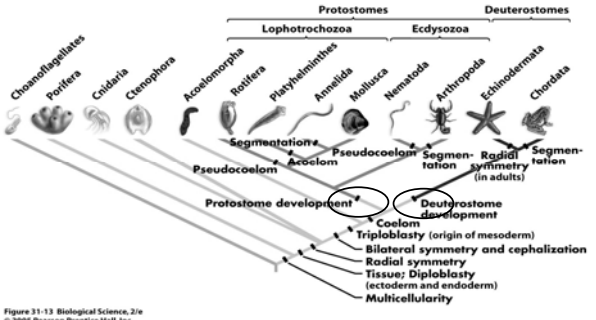
Recent phylogenetic analyses of animals using DNA have blown the morphological phylogeny out of the water.

A. there were three fundamental splits during animal evolutionary history:
1. protostomes are monophyletic
2. deuterostomes are monophyletic
3. two monophyletic protostome groups (Lophotrochozoa and Ecdysozoa)

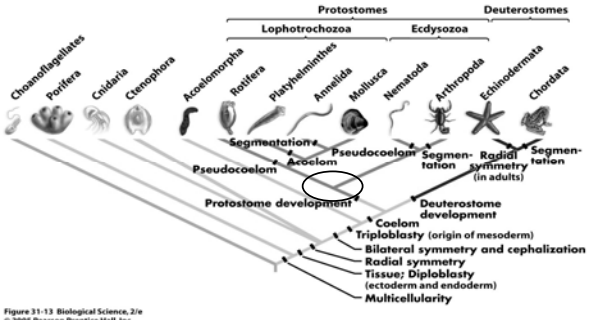
B. Well, at least these are the same:
- The most ancient animal group living today is the sponges.
- The closest living relatives to animals are choanoflagellates, a group of protists.

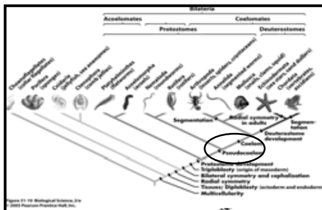


Based on molecular data



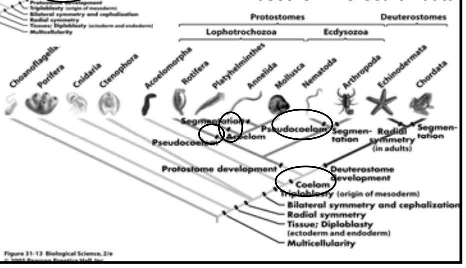
Based on molecular data

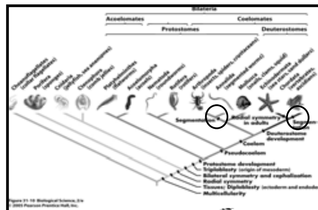




Based on morphological data

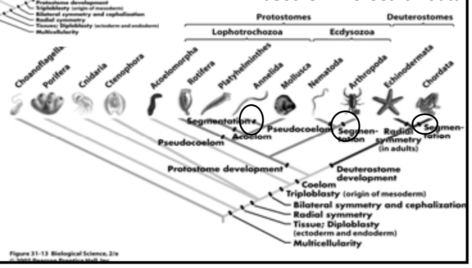
Based on molecular data

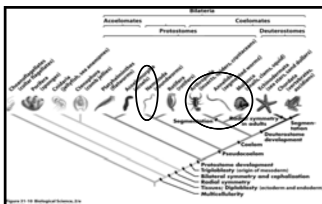




Based on morphological data

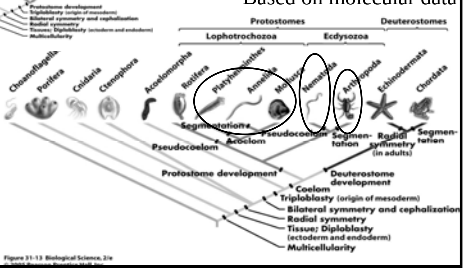
Based on molecular data





Based on morphological data

Based on molecular data



Who are the Lophotrochozoans and Ecdysozoans?

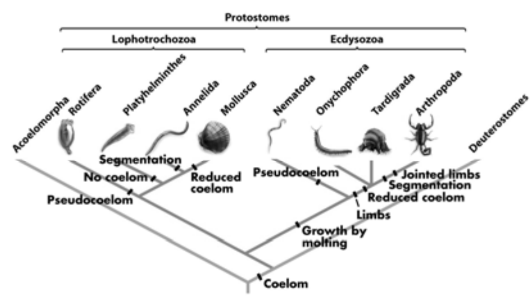
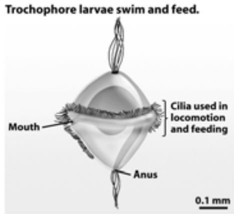


Figure 32-9 Biological Science, 2/e
© 2005 Pearson Prentice Hall, Inc.

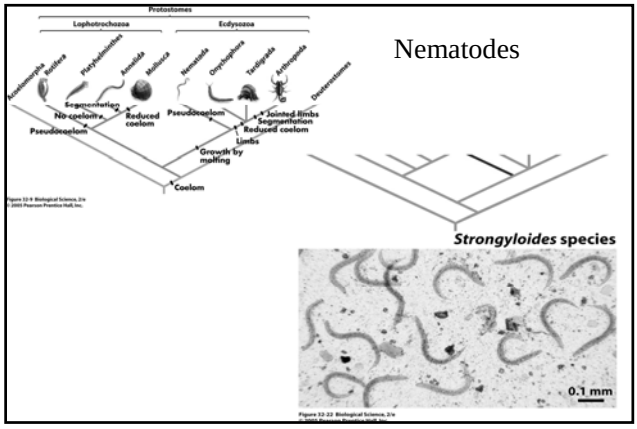
Who are the Lophotrochozoans?

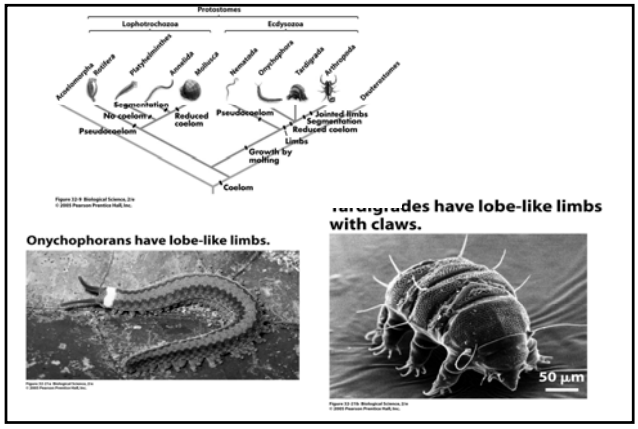
Lophophores function in suspension feeding in adults.

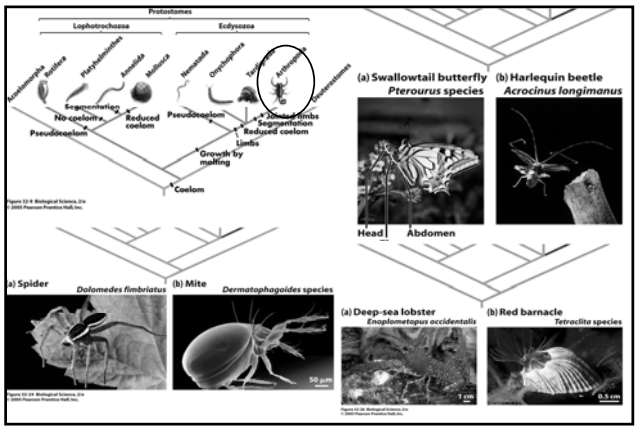
Trochophore larvae swim and feed.



Who are the Ecdysozoans?







III. Diversification of animals
KEY CONCEPTS

Within major groups of animals, evolutionary diversification was based on innovative ways of feeding and moving. Most animals get nutrients by eating other organisms, and most animals move under their own power at some point in their life cycle.

Questions

1. What are the five primary modes of animal feeding and examples of adaptations for each?
2. What is the difference between an ectoparasite and an endoparasite? What are some examples of each, including key adaptations?
3. What are some advantages of jointed limbs? In which group(s) are they found? What other kingdoms besides animals also have muscles, limbs and skeletons?
4. What type of life cycle is seen in animals? Be able to sketch it and know the different steps.
5. What are the differences between and advantages and disadvantages of holometabolous and hemimetabolous metamorphosis? What are some examples of each?