29–1 Invertebrate Evolution

Origin of Invertebrates

Invertebrate fossils, dating between 575 and 543 million years ago, were discovered in the Ediacara Hills of Australia and in Chengjiang, China.

The Ediacaran fossils include some of the earliest and most primitive animals known.

The fossils:

- were flat and plate shaped
- were segmented
- had bilateral symmetry
- lived on the bottom of shallow seas
- were made of soft tissues
- absorbed nutrients from the surrounding water

Some of these animals may have had photosynthetic algae living within their bodies.

Some may have been related to soft-bodied invertebrates.

They were probably simple and had little internal specialization.

The animals of the Burgess Shale had many of the characteristics of modern day invertebrates including:

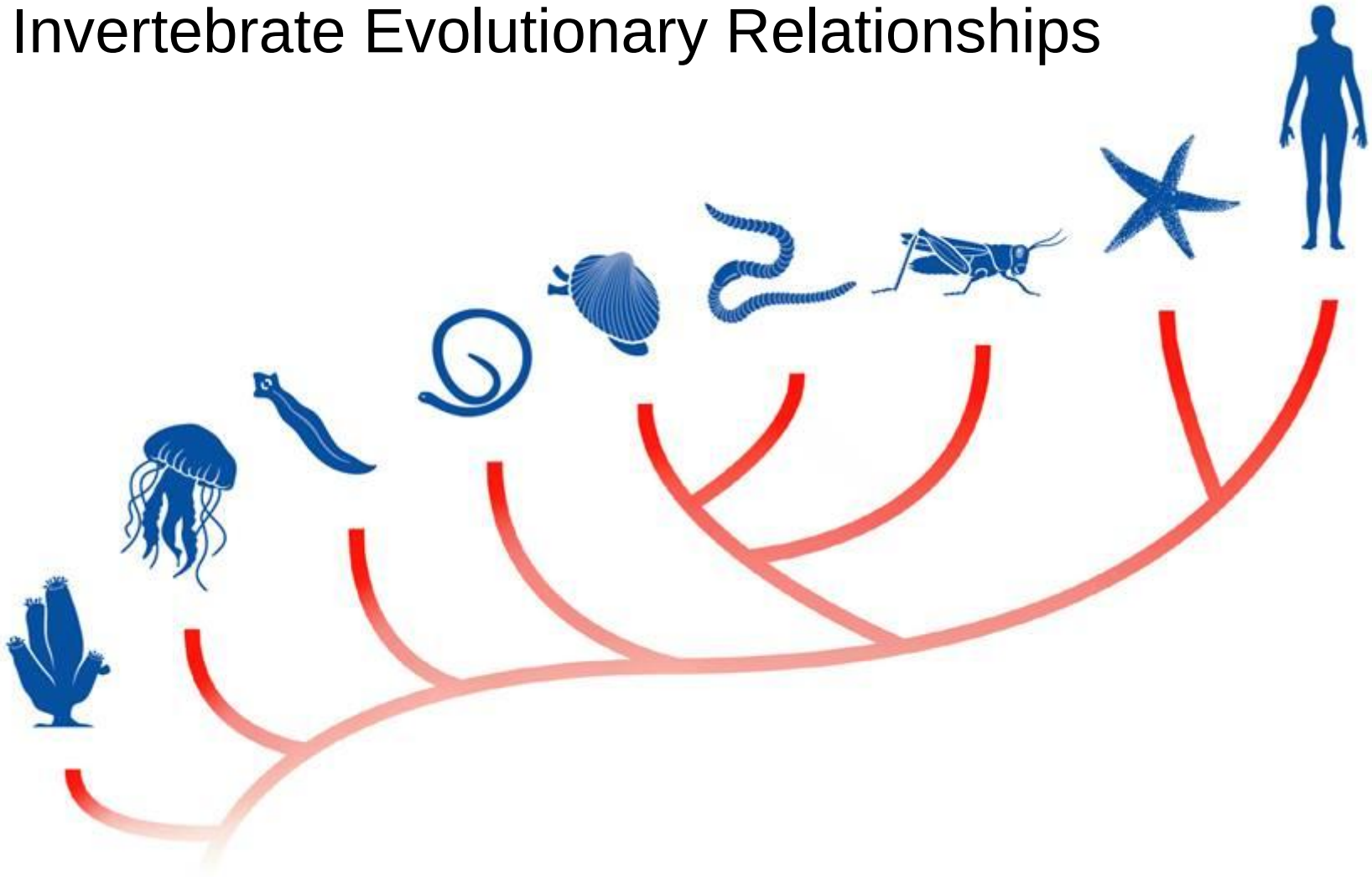
- body symmetry
- segmentation
- a skeleton
- a front and a back end
- appendages adapted for many functions

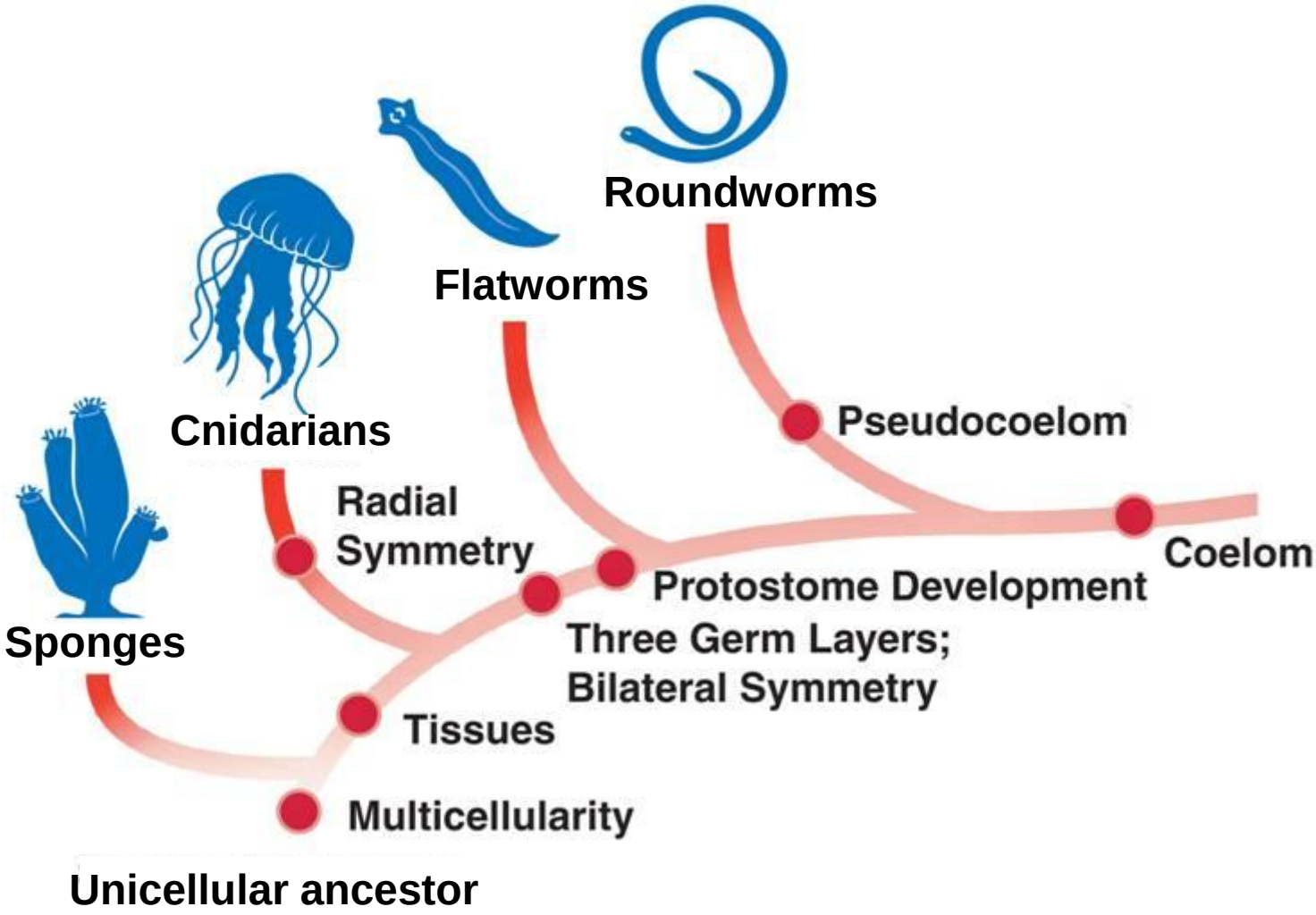
Invertebrate Phylogeny

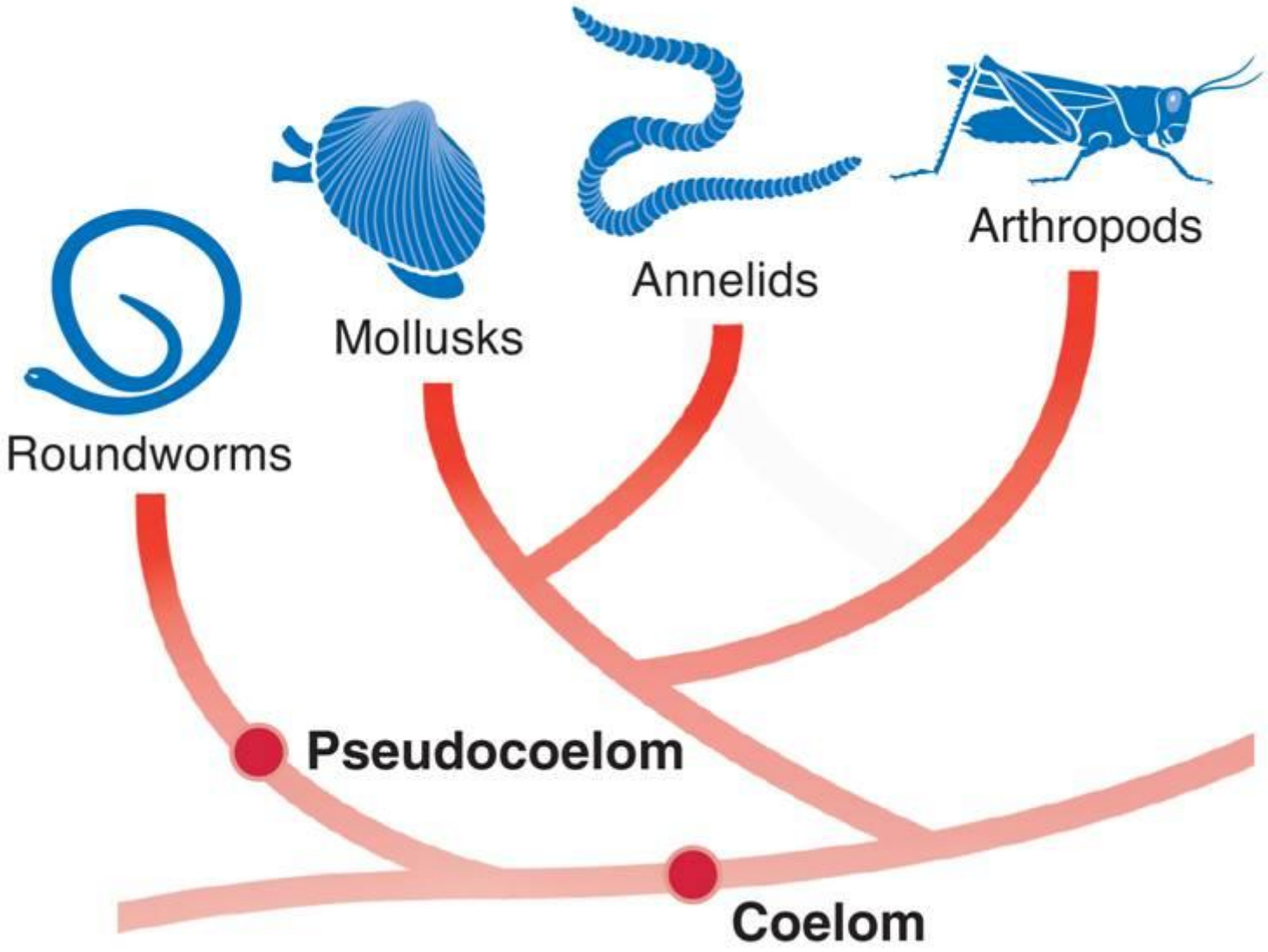
Many features of modern invertebrates evolved during the Cambrian period such as:

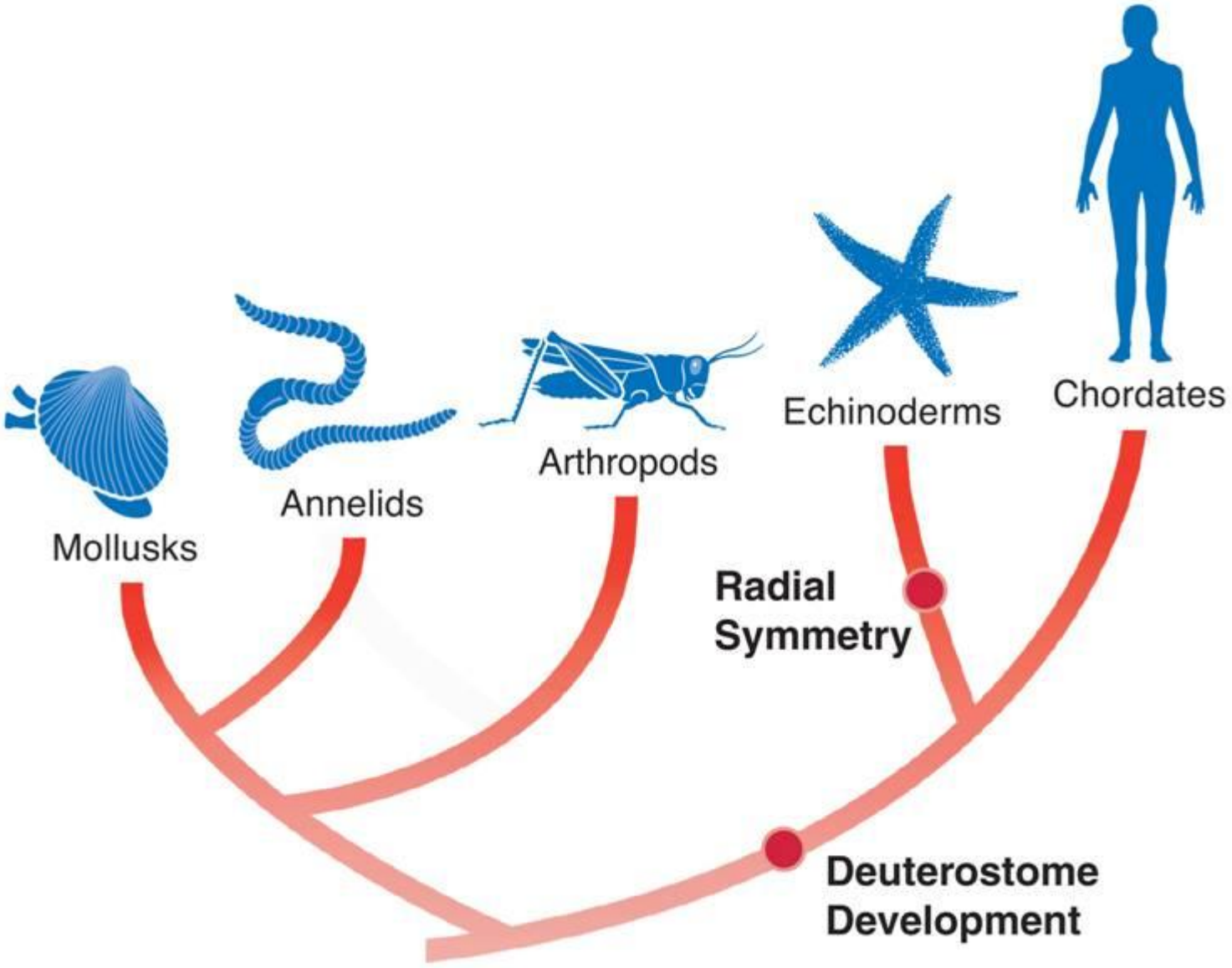
- tissues and organs
- patterns of early development
- body symmetry
- cephalization
- segmentation
- formation of three germ layers and a coelom

Invertebrate Evolutionary Relationships









What are the major trends in invertebrate evolution?

Evolutionary Trends

The appearance of each phylum in the fossil record represents the evolution of a successful and unique body plan.

Features of this body plan typically change over time, leading to the formation of many new traits.

Comparing Invertebrates

	Sponges 	Cnidarians 	Flatworms 	Roundworms 
Germ Layers	Absent	Two	Three	Three
Body Symmetry	Absent	Radial	Bilateral	Bilateral
Cephalization	Absent	Absent	Present	Present
Coelom	Absent	Absent	Absent	Pseudocoelom
Early Development	———	———	Protostome	Protostome

Comparing Invertebrates

	Annelids 	Mollusks 	Arthropods 	Echinoderms 
Germ Layers	Three	Three	Three	Three
Body Symmetry	Bilateral	Bilateral	Bilateral	Radial (adults)
Cephalization	Present	Present	Present	Absent (adults)
Coelom	True coelom	True coelom	True coelom	True coelom
Early Development	Protostome	Protostome	Protostome	Deuterostome

Specialized Cells, Tissues, and Organs

As larger and more complex animals evolved, specialized cells joined together to form tissues, organs, and organ systems that work together to carry out complex functions.

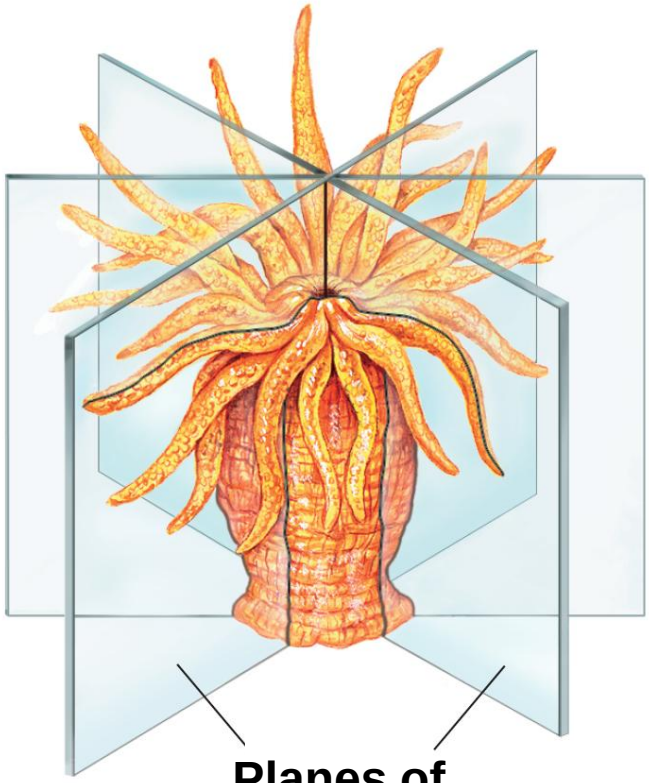
Flatworms have simple organs for digestion, excretion, response, and reproduction.

More complex animals, such as mollusks and arthropods, have organ systems.

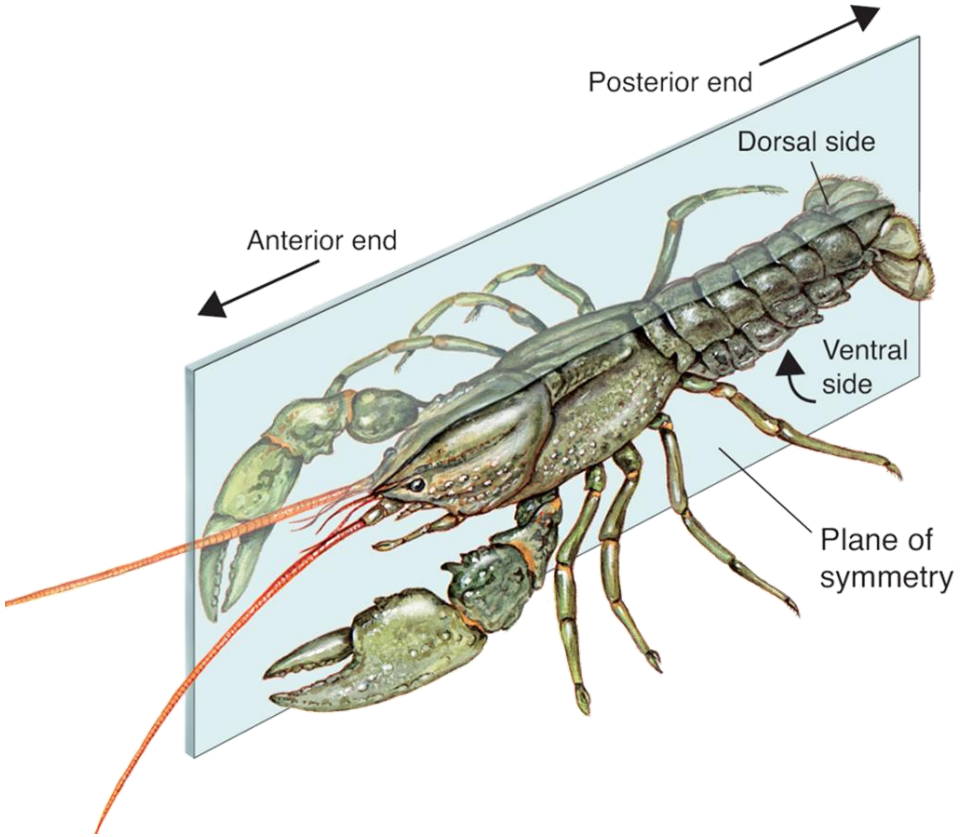
Body Symmetry

All invertebrates, except sponges, exhibit some type of body symmetry.

Cnidarians and echinoderms exhibit radial symmetry where parts extend from the center of the body.



Worms, mollusks, and arthropods exhibit **bilateral symmetry**, or have mirror-image left and right sides.



Bilateral symmetry

Cephalization

Cephalization is the concentration of sense organs and nerve cells in the front of the body.

Invertebrates with cephalization can respond to the environment in more sophisticated ways than can simpler invertebrates.

In most worms and arthropods, nerve cells are arranged in structures called ganglia.

In more complex invertebrates, nerve cells form an organ called a brain.

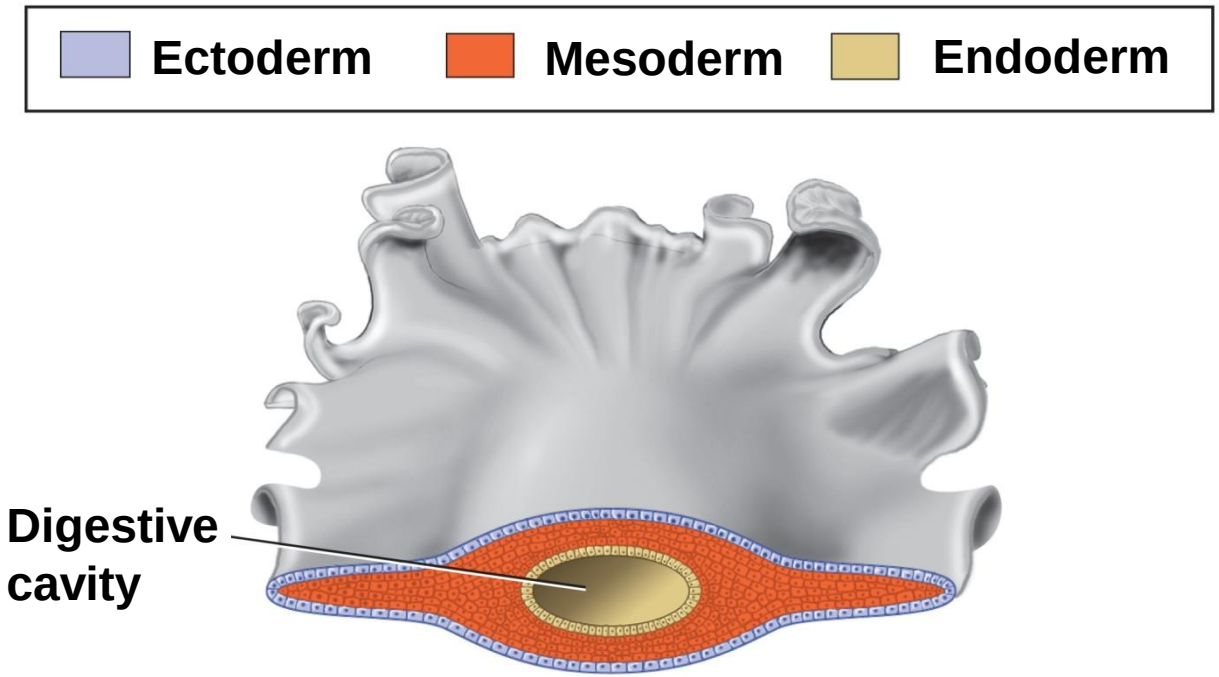
Segmentation

Over the course of evolution, different segments in invertebrates have often become specialized for specific functions.

Segmentation allows an animal to increase its size with minimal new genetic material.

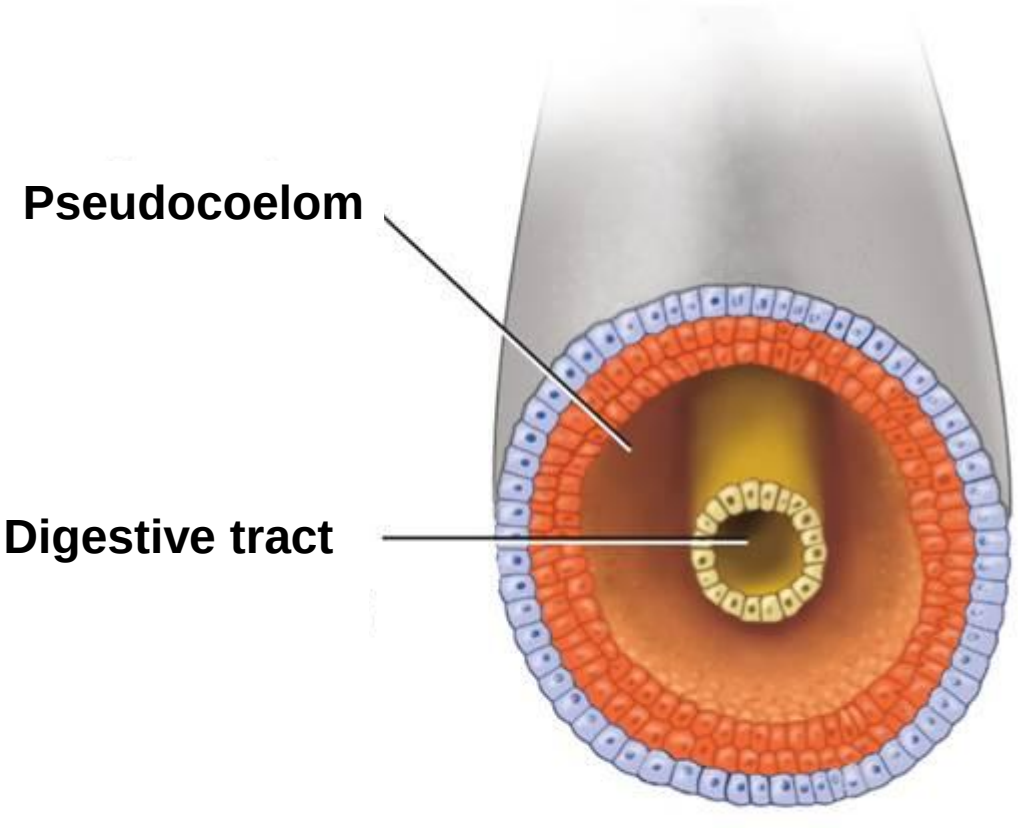
Coelom Formation

Flatworms are acoelomates. This means they have no coelom, or body cavity, that forms between the germ layers.



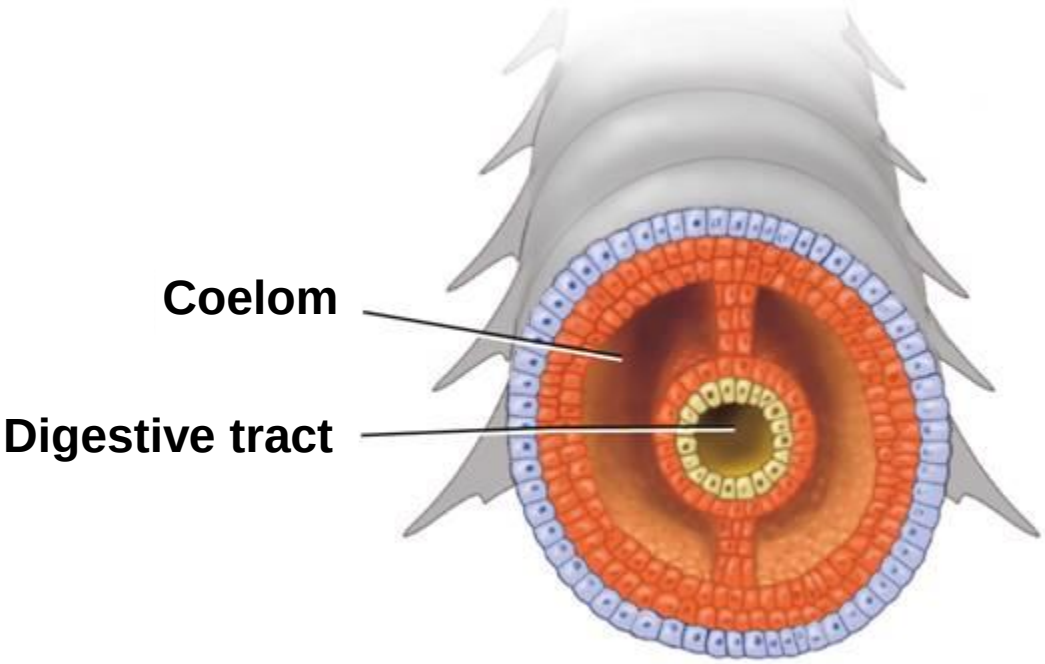
Acoelomate

Pseudocoelomates have a body cavity lined partially with mesoderm.



Pseudocoelomate

Most complex animal phyla have a true coelom that is lined completely with tissue derived from mesoderm.



Coelomate

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