Common characteristics of animals

By :

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6 Characteristics of the Animals

1. Animals are multicellular

Except for sponges, animal cells are arranged into tissues (a tissue is a group of cells alike in structure and function… such as muscle tissue or brain tissue). Tissues are necessary to produce organs and organ systems.

2. Animals are heterotrophs

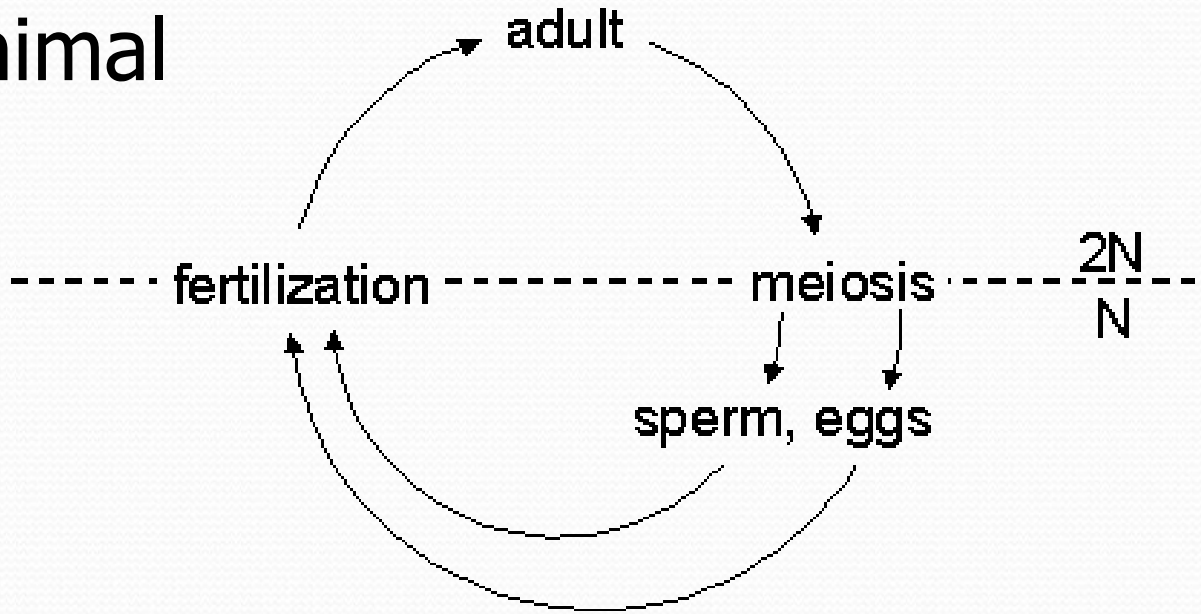
- Heterotrophs consume their organic food.
- Heterotrophs are not capable of making their own foods.

3. Animals are motile

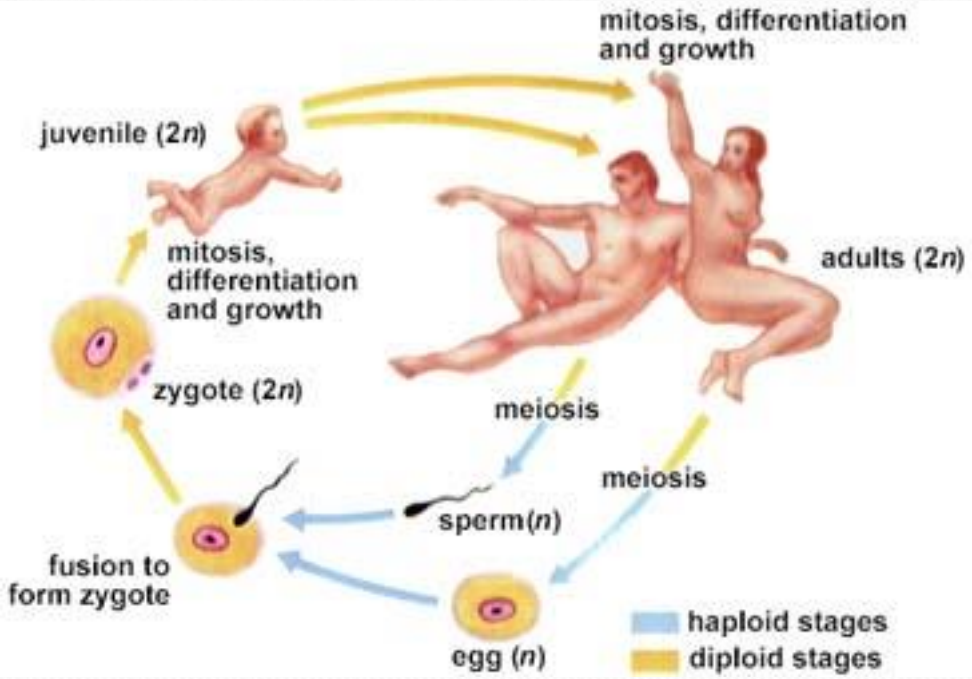
- Heterotrophy often requires motility to capture prey.
- Animals have motility during at least some part of their life cycle.

4. Animals are diploid

- The dominant generation in the life cycle is the diploid generation.
- Their gametes are heterogametes (different sizes); eggs are larger than sperm.
- Gametes are produced by meiosis.
- A typical animal life cycle:



Human Life Cycle



5. Animals have a period of embryonic development

During *embryonic development*, cells become specialized and form two or three layers of tissues.

6. Animal cells lack cell walls

Therefore a skeleton is necessary to support the tissues of large animals.

The key to the success of the Animals is their Diversity-

The Diversity of the Animals originates from the variations that occur in their:

- 1. Tissue Complexity
- 2. Body Symmetry
- 3. Cephalization
- 4. GastroVascular Cavity (GVC)
- 5. Coelom
- 6. Segmentation, and
- 7. Protostomes and Deuterostomes.

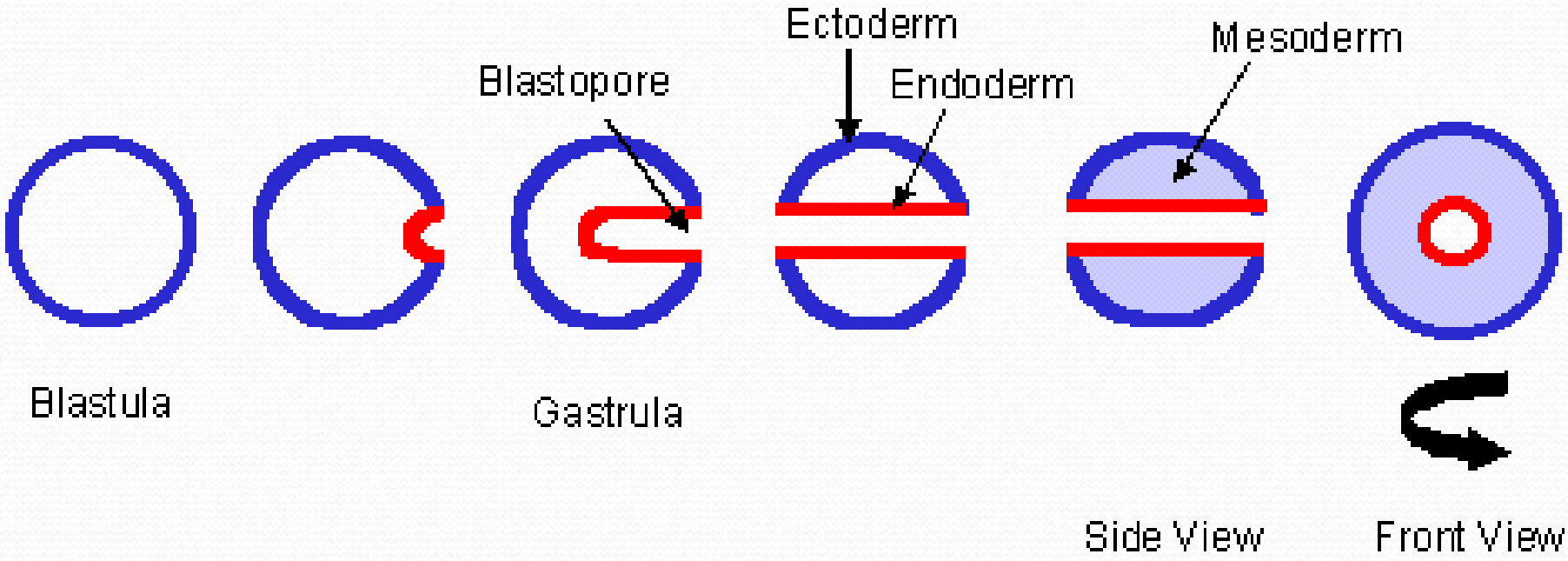
Tissue Complexity

- Most animals, collectively called the eumetozoa, have closely functioning tissues.
  - Diploblastic, have only two cell layers… like hydra and jellyfish.
  - Triploblastic and three cell layers.
  - The three "germ layers" are the ectoderm, mesoderm and endoderm.
- Another group of animals, the parazoa (sponges) are not organized into true tissues and lack organs.

Embryonic Germ Layers

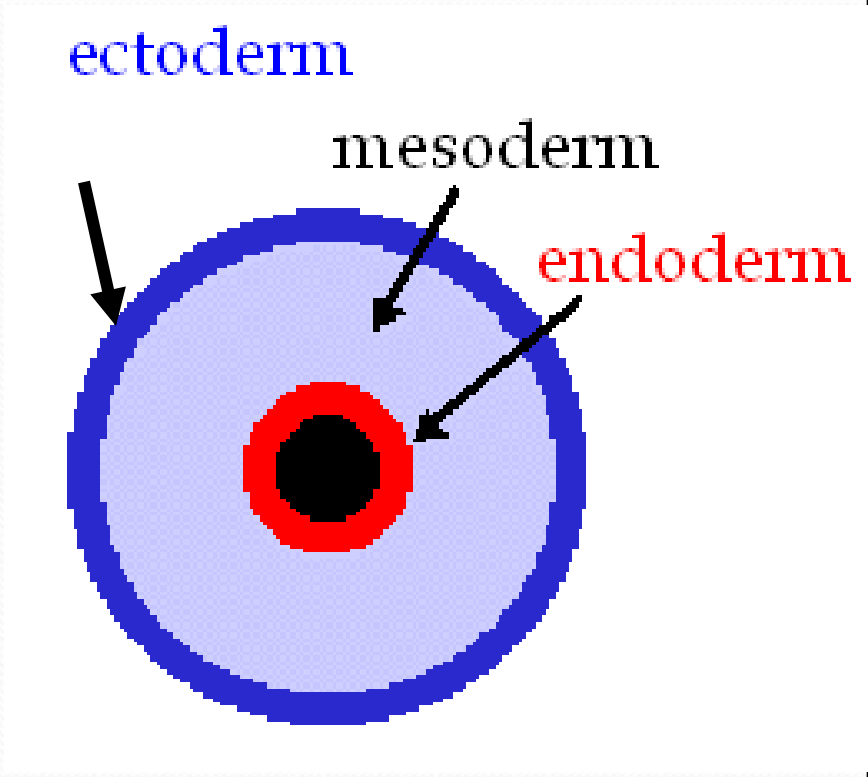
- The three layers of tissues that become established during early embryonic development are called germ layers.
- They give rise to the body tissues.
- These layers are *ectoderm*, *mesoderm*, and *endoderm*.

Embryonic Germ Layers



Embryonic Germ Layers

- The ***ectoderm*** forms from the outer layer of cells. It gives rise to the skin and nervous system.
- ***Mesoderm*** forms between the ectoderm and endoderm. It becomes the muscles, connective tissues, skeleton, kidneys, circulatory and reproductive organs.
- The ***endoderm*** is made of cells that form the tube-like structure in the gastrula. These cells will form the lining of the gut, and the major organs are derived from it.

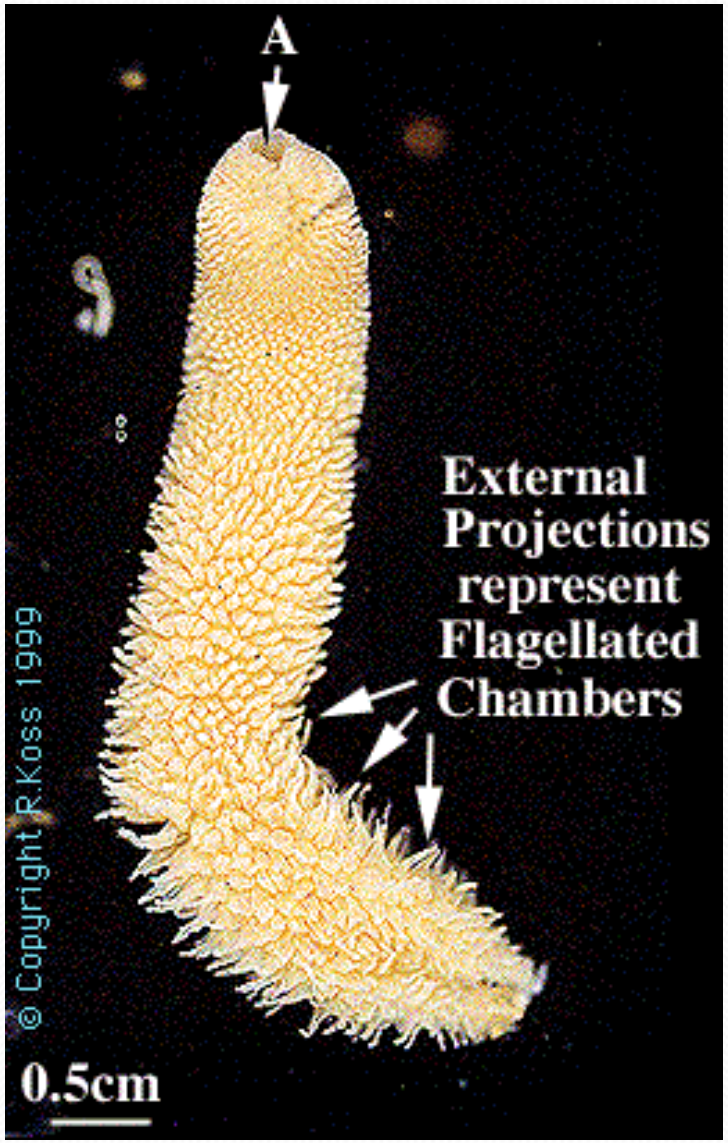


Types of Body Symmetry

Body Shapes

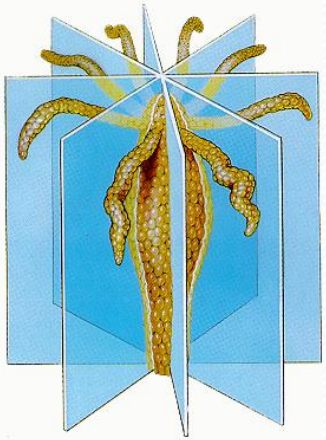
Asymmetry

- ***Asymmetrical*** animals have no pattern of symmetry.
- The simplest animals (sponges) are asymmetrical.



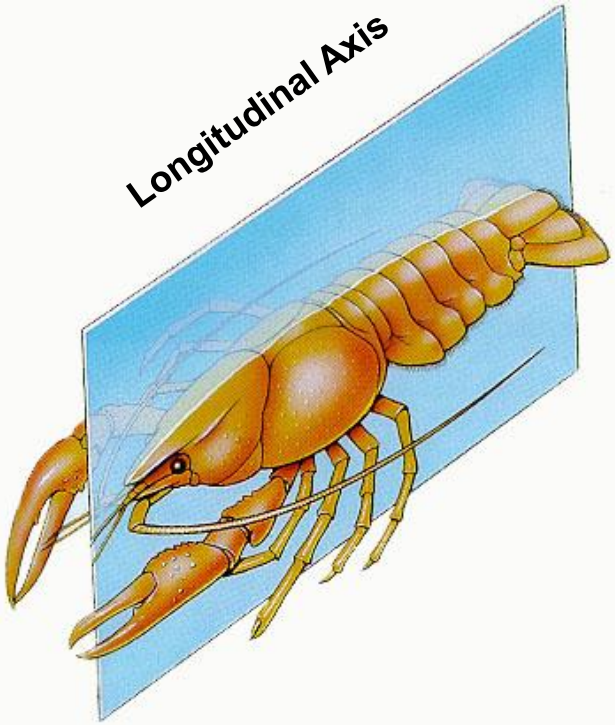
Radial Symmetry

- The body parts of a radially symmetrical animal are arranged around a central axis so that each part extends from the center.
- Animals that exhibit radial symmetry tend to be *sessile* (immobile). Radial symmetry allows them to reach out in all directions.



Bilateral Symmetry

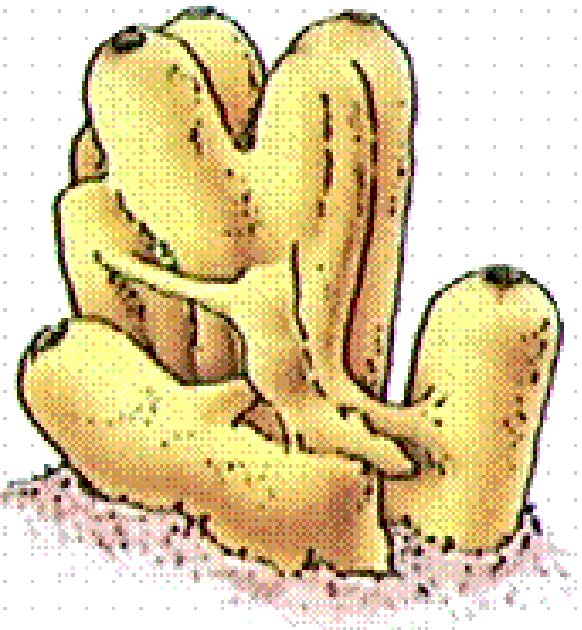
- One cut along the longitudinal axis will produce identical halves of a bilaterally symmetrical animal.
- Bilateral symmetry is best for motile animals.



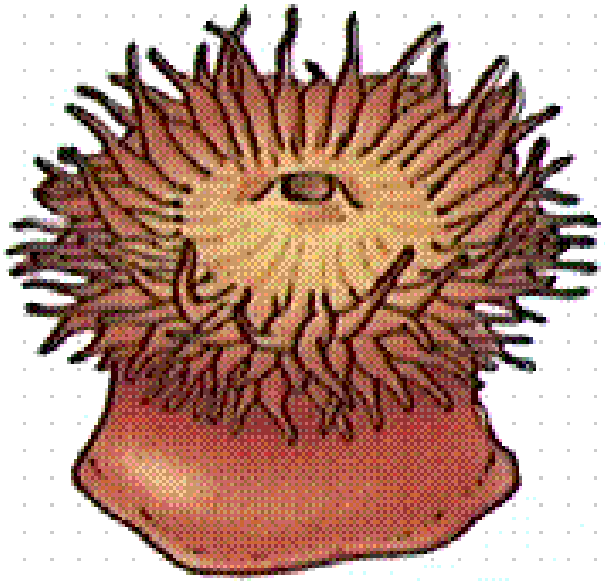
Body Plan Includes

- Anterior and Posterior Ends
- Dorsal and Ventral Surfaces
- "Right" and "Left" sides are mirror images

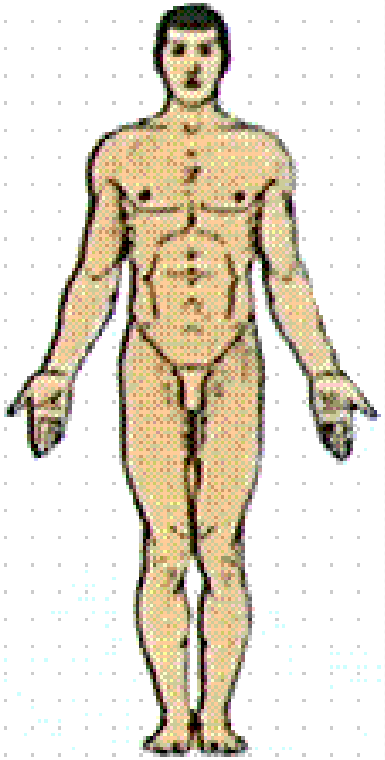
Asymmetrical



Radial

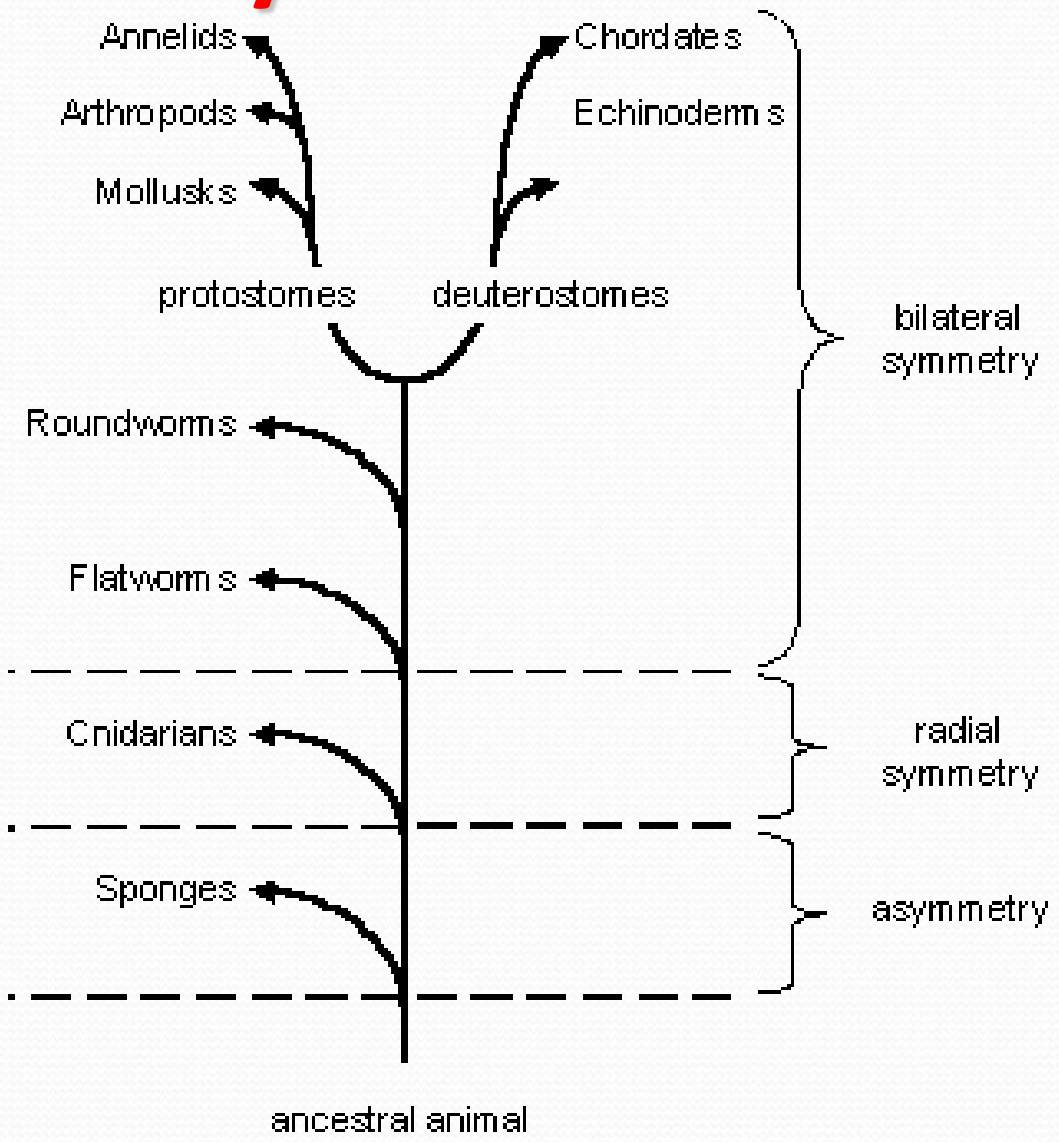


Bilateral



Evolution of Symmetry

The evolutionary sequence progressed from asymmetrical animals, to radial, and then to bilaterally symmetrical animals.



Evolutionary Changes in the Animal Body

1. Body Cavities

2. Cephalization

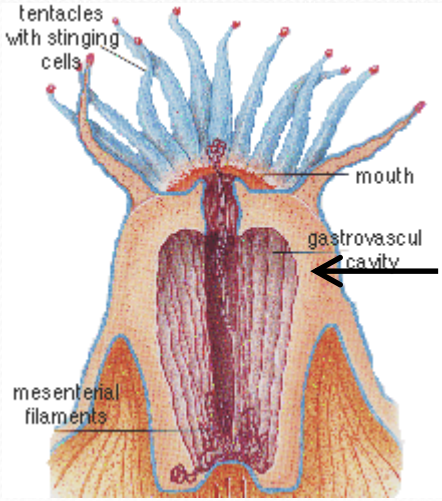
3. Segmentation

1. The Body Cavity

- The body cavity is a space that separates the gut and internal organs from the rest of the body.
- It isolates the internal organs from body-wall movements.
- It also bathes the internal organs in a liquid through which nutrients and wastes can diffuse.

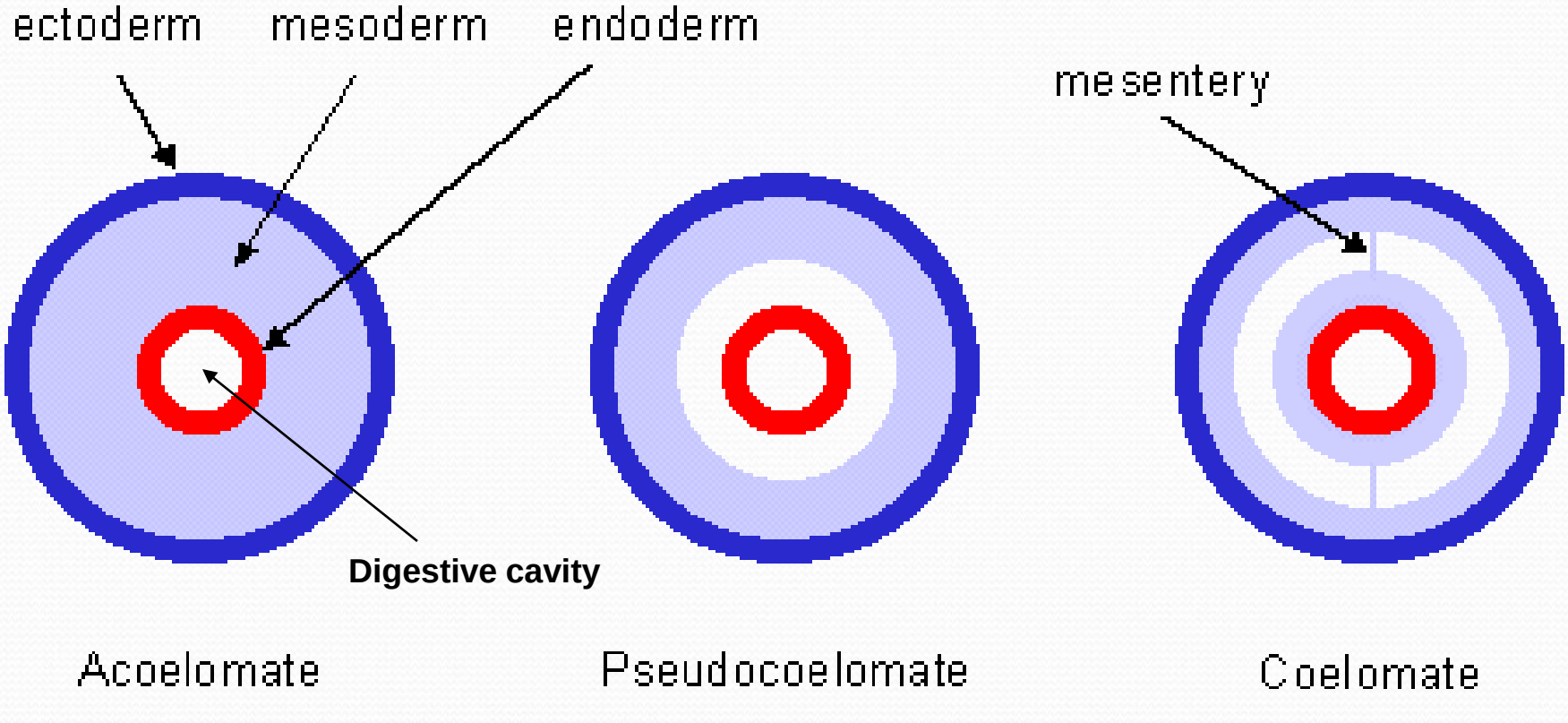
Gastrovascular Cavity (GVC)

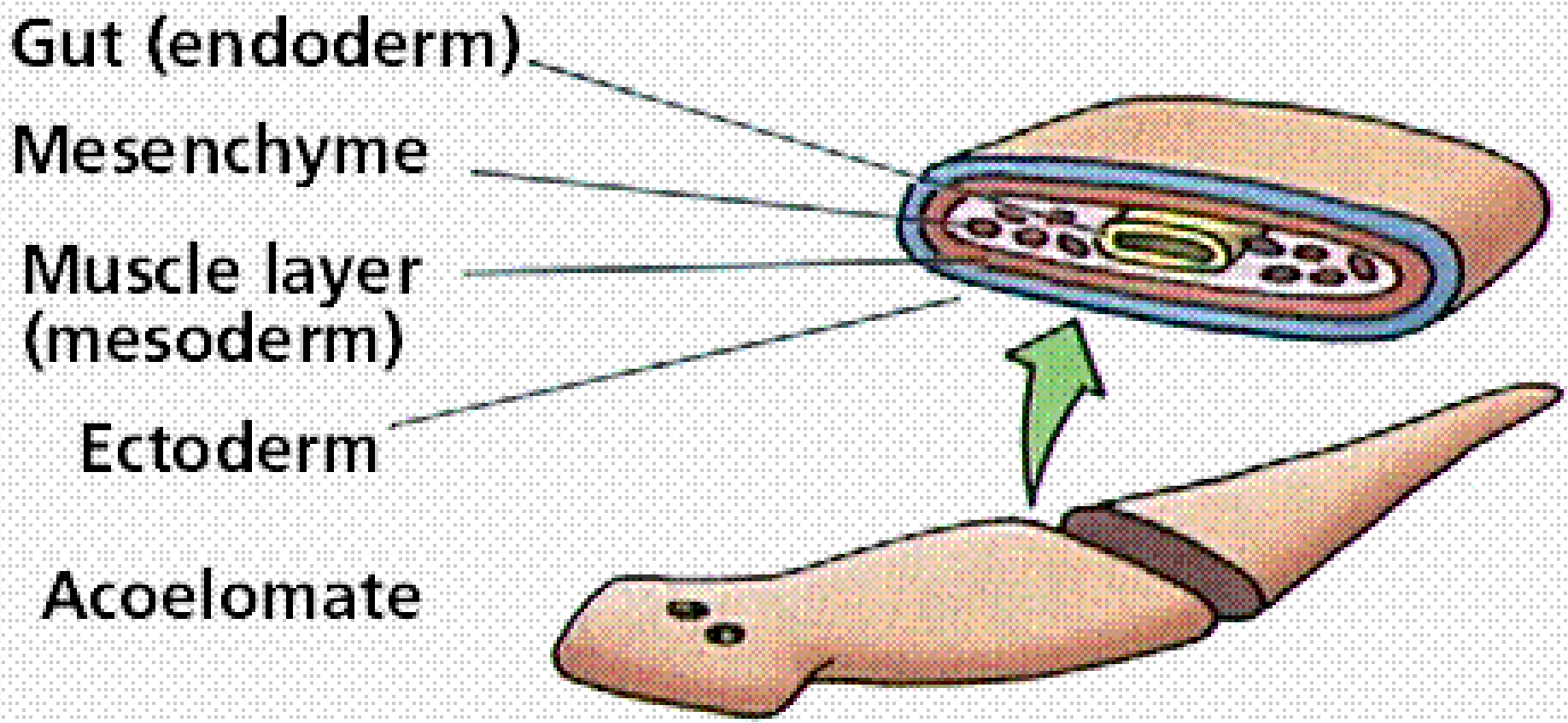
- **G**astro**V**ascular **C**avities (GVC) are areas where food is digested.
- If they have only one opening, the processing is limited.
- Two openings designate a **digestive tract** allowing food to be digested more thoroughly.



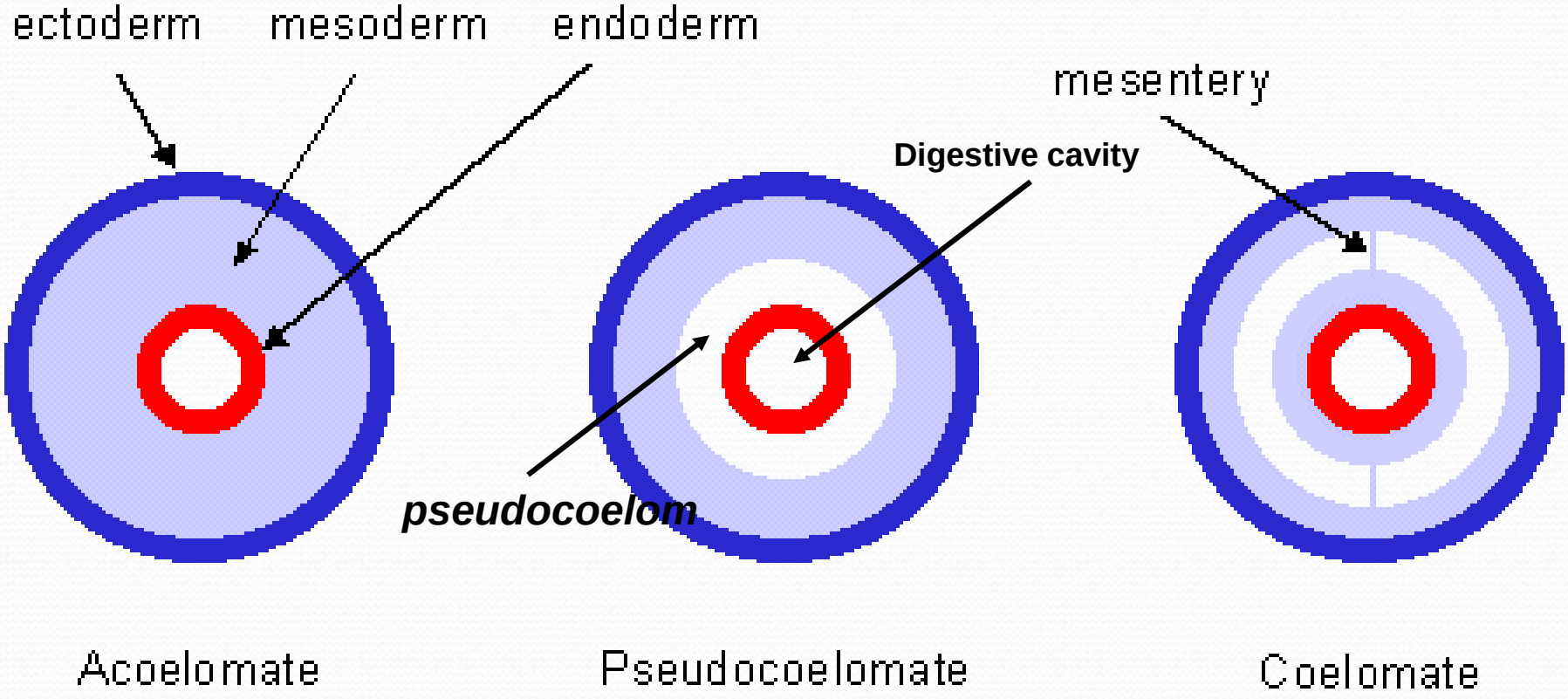
Arrangement of Ectoderm, Mesoderm, and Endoderm

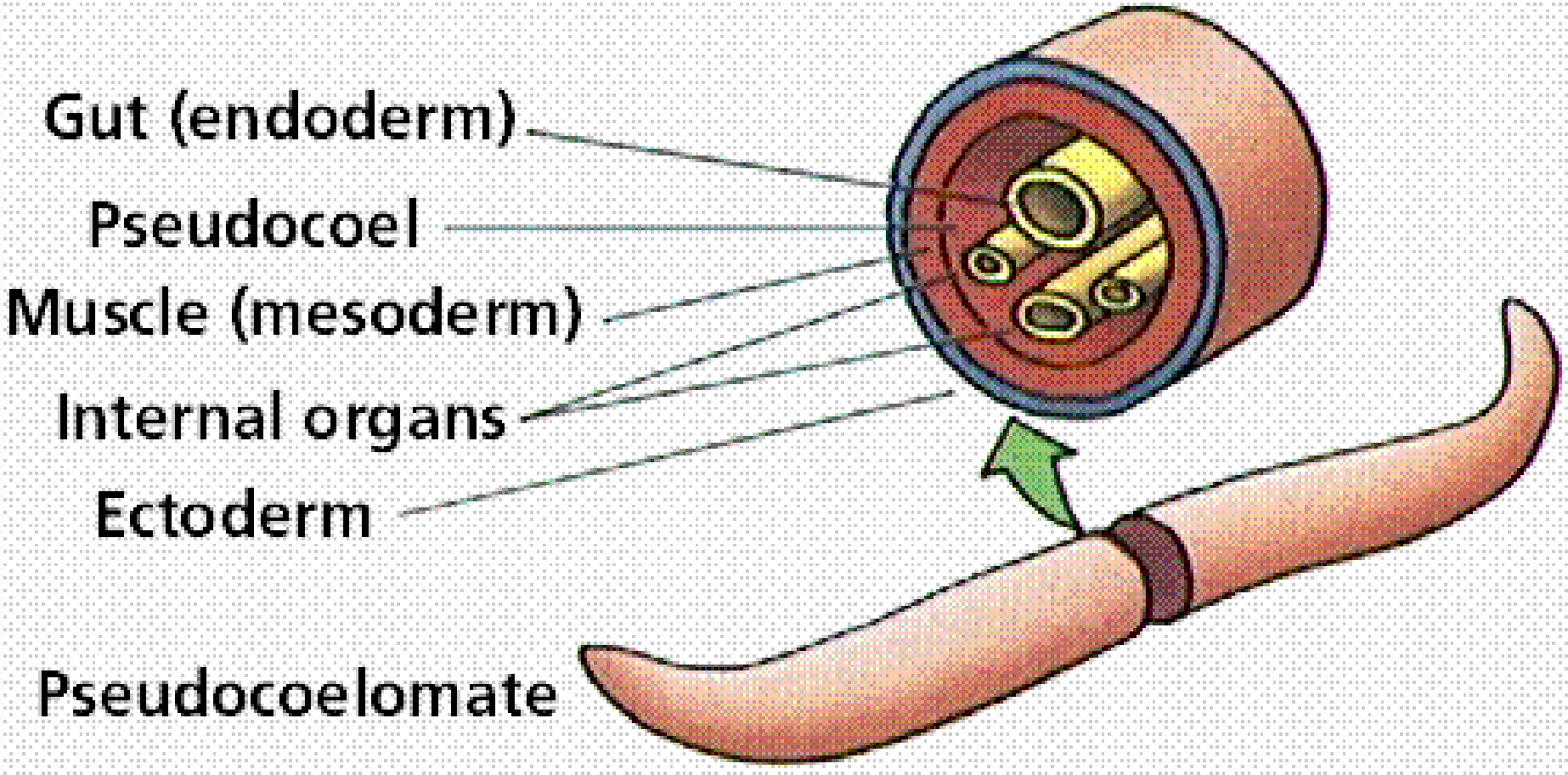
An ***acoelomate*** animal does not have a body cavity.



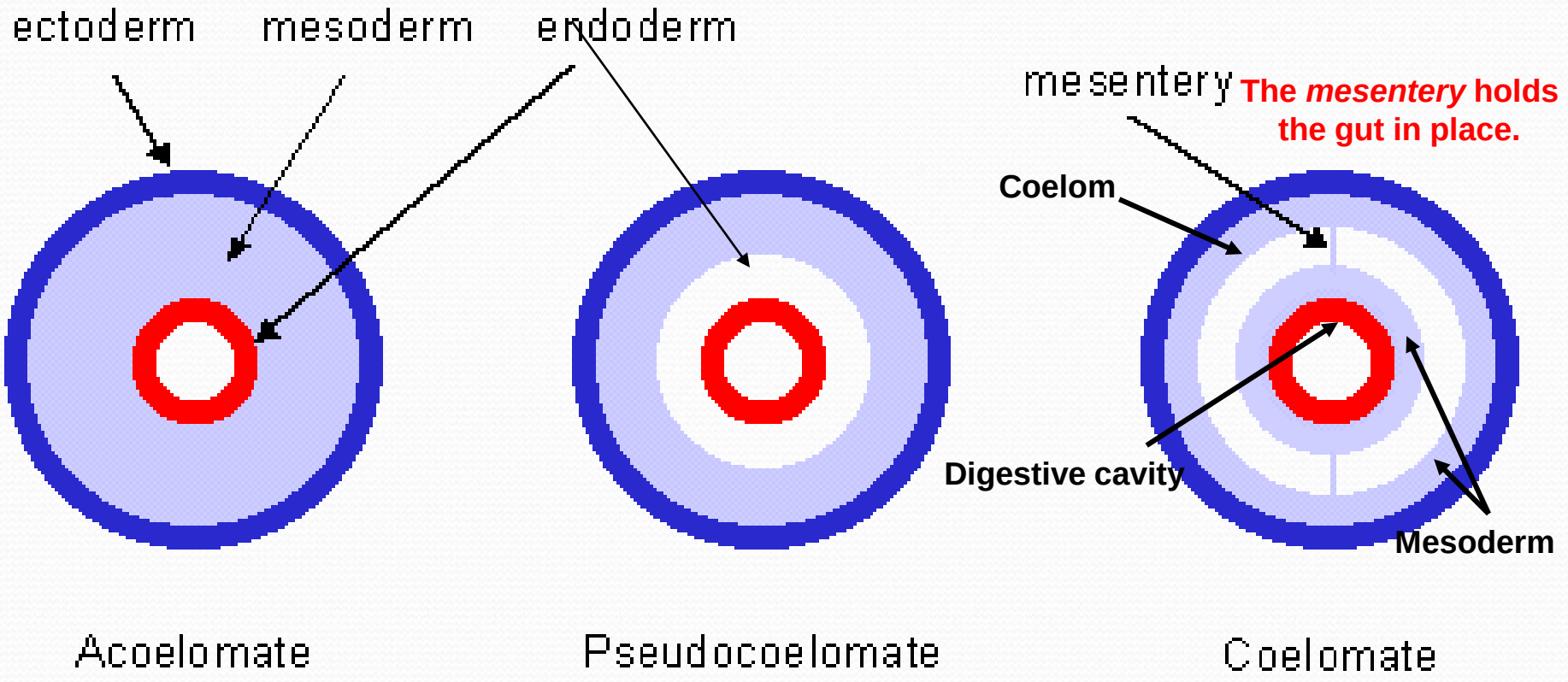

Gut (endoderm)
Mesenchyme
Muscle layer (mesoderm)
Ectoderm
Acoelomate

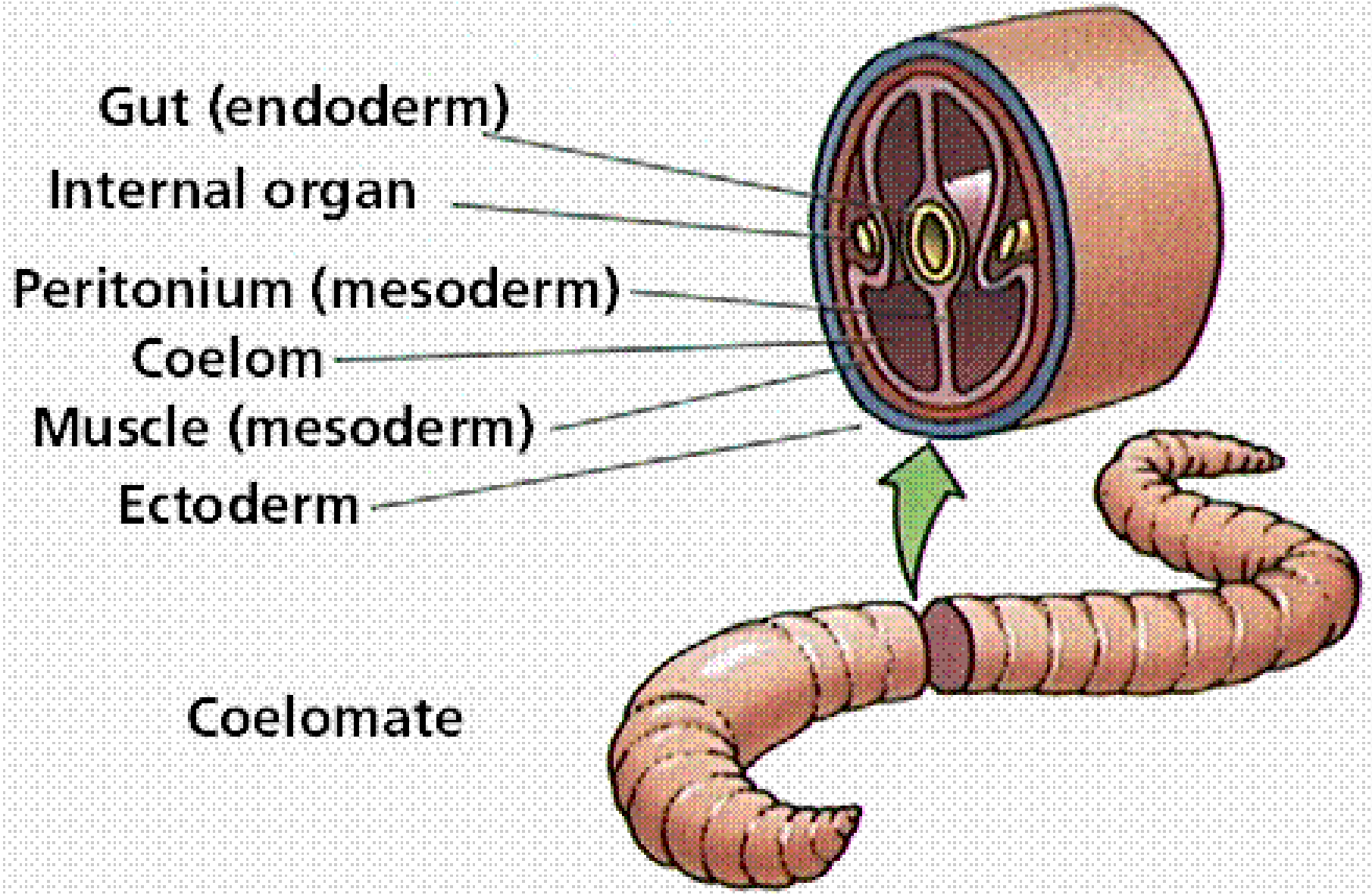
A ***pseudocoelomate*** animal has a body cavity (called a ***pseudocoelom***) located between endoderm and mesoderm.




Gut (endoderm)
Pseudocoel
Muscle (mesoderm)
Internal organs
Ectoderm
Pseudocoelomate

The body cavity of a ***coelomate*** animal (called a ***coelom***) is located within the mesoderm.

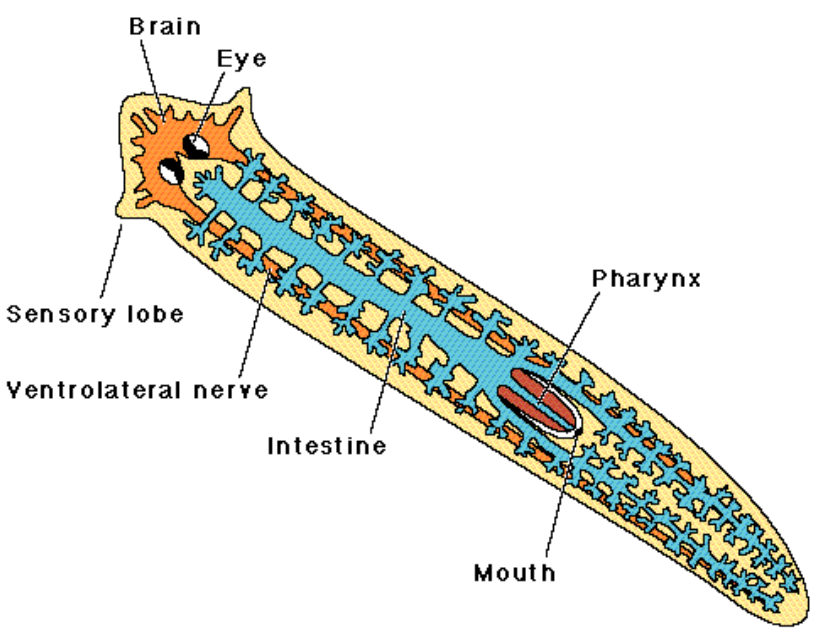



Gut (endoderm)
Internal organ
Peritonium (mesoderm)
Coelom
Muscle (mesoderm)
Ectoderm
Coelomate

2. Cephalization

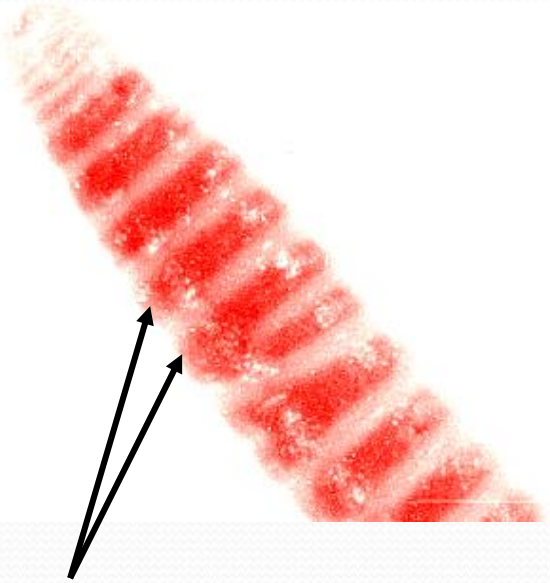
The term “Cephalo” means “head”.

- In animals with bilateral symmetry, there is a greater increase in the nerve tissue concentrated in the anterior end (the head) as animals increase in complexity.
- For example, brains have formed with accessory organs for seeing, hearing, tasting, etc.

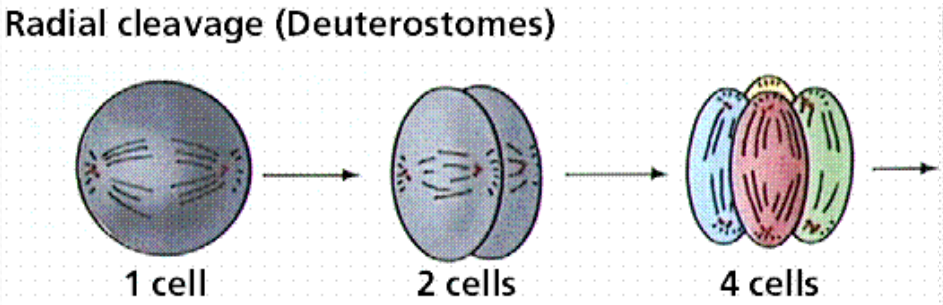


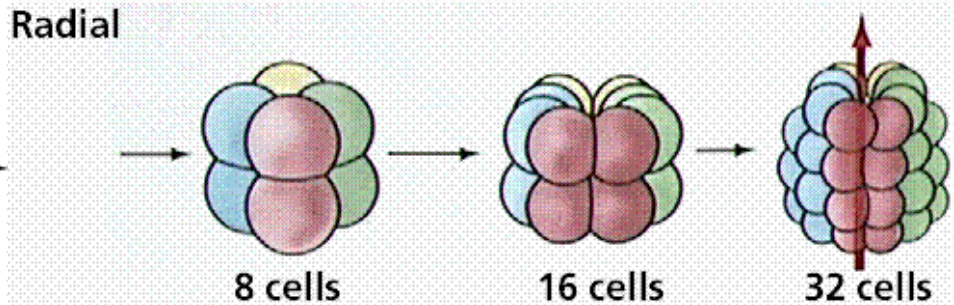
3. Segmentation

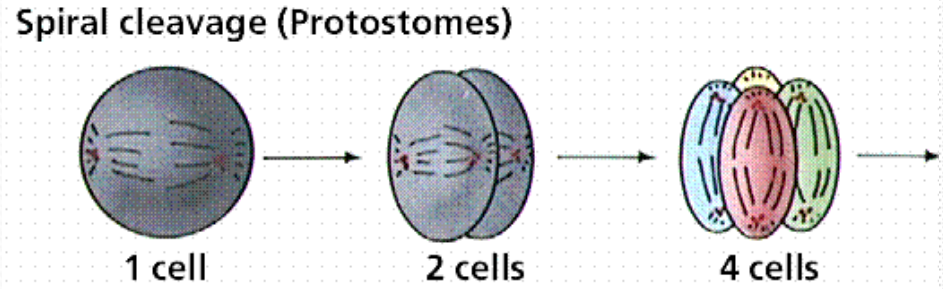
- Many animals have segmented body parts.
- In some cases the parts repeat over and over again, as with earthworms.
- In other animals, the segments are modified, such as with insects… they essentially have 3 segments…. the head, thorax and abdomen.

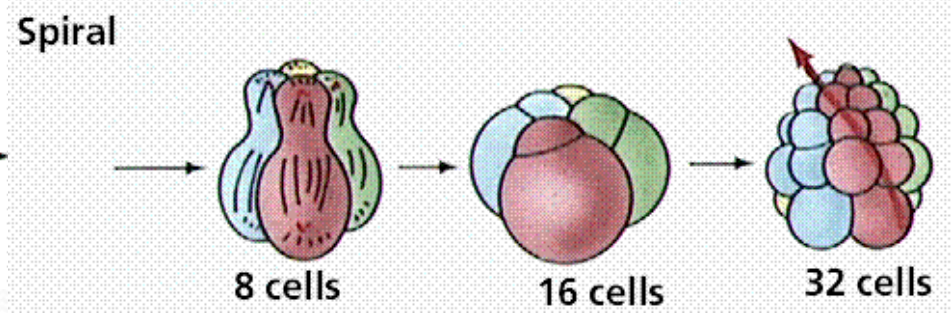


Cleavage Patterns



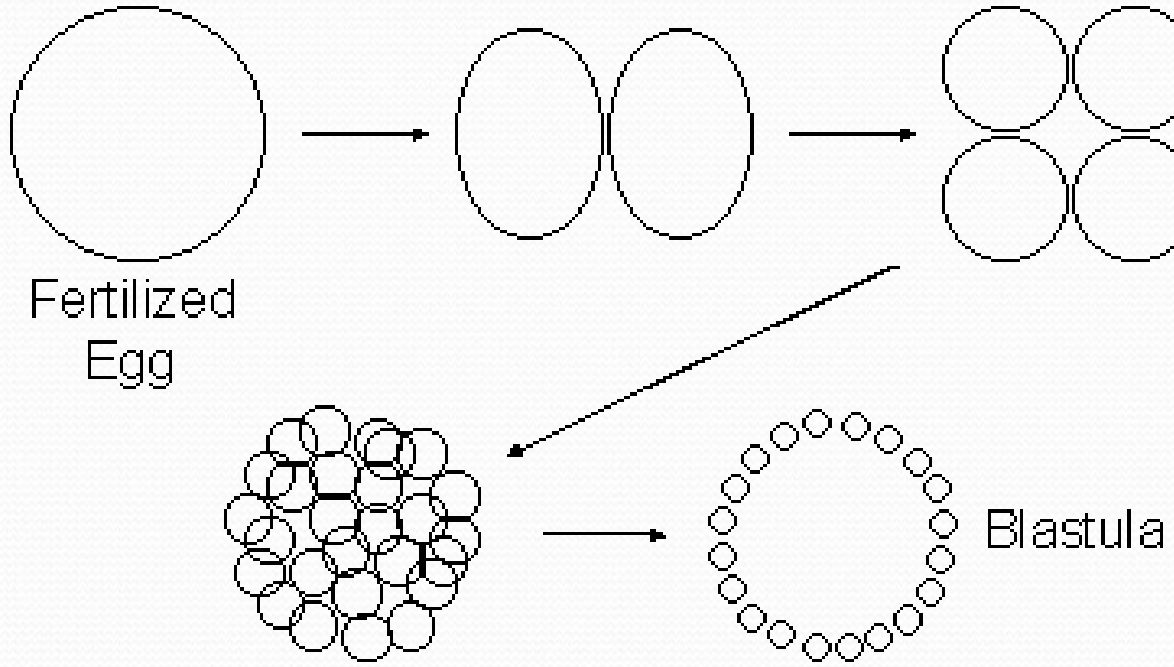






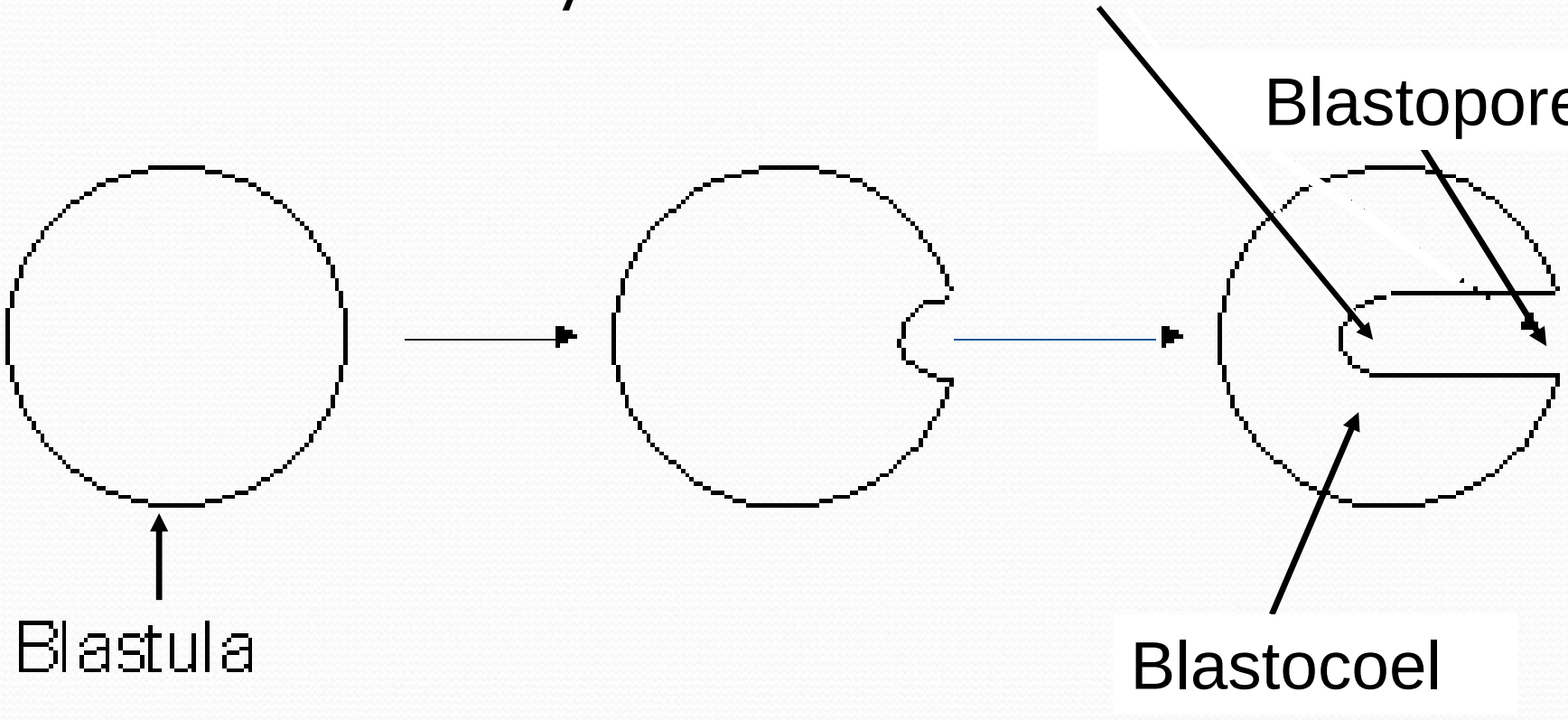
Embryonic Development

- During early development, the fertilized egg divides, or cleavages, to produce a solid ball of cells. Then, cell migration results in a hollow ball called a *blastula*.



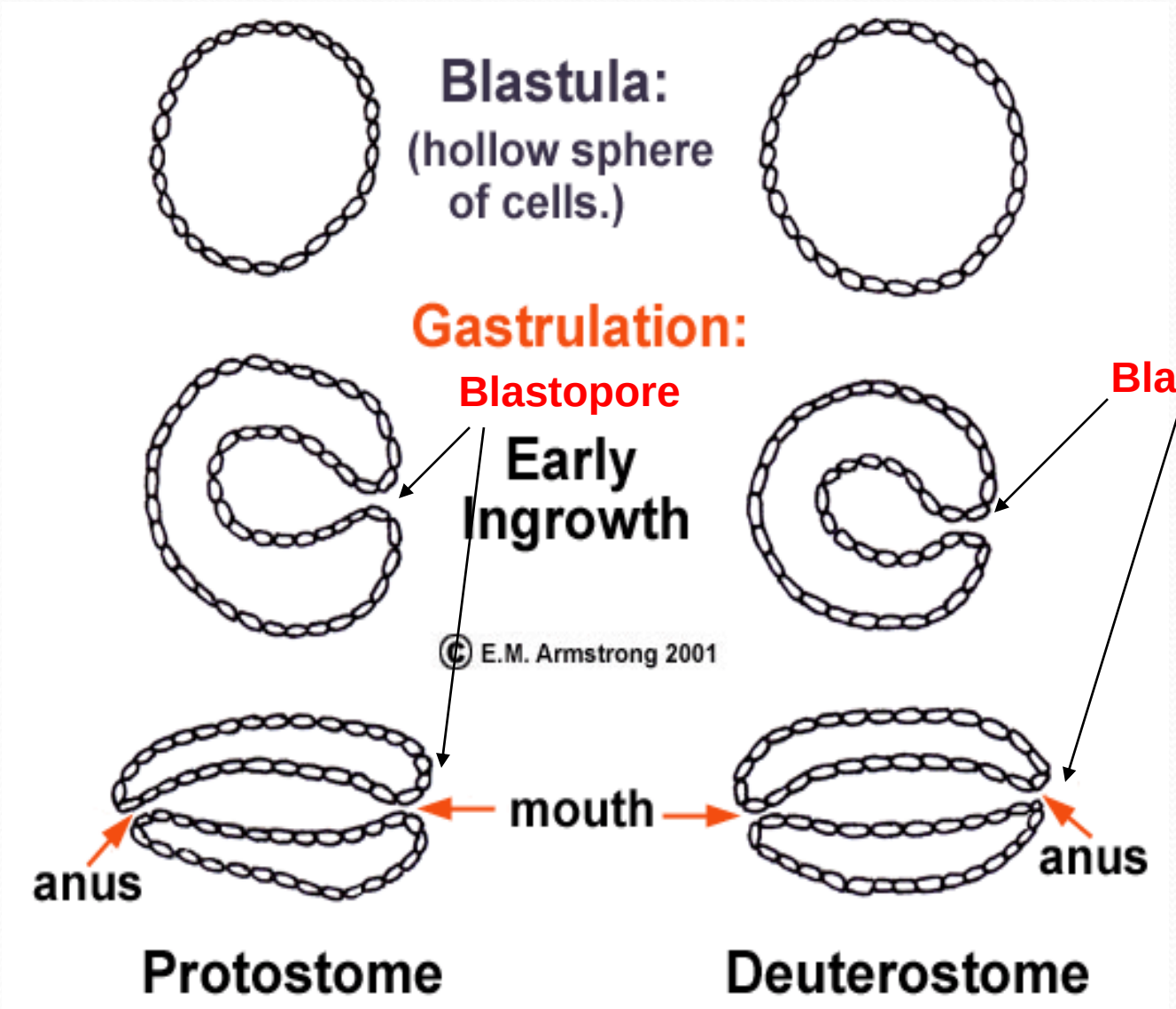
Embryonic Development

- Some cells of the blastula migrate inward and form a three cell layered embryo called a ***gastrula***.
- The opening is the ***blastopore***.
- The internal cavity is called the ***archenteron***.



Embryonic Development

- The Gastrula will become the ***gut*** (digestive tract) of the mature animal.
- In species that have a separate mouth and anus, the tube will eventually extend through the length of the embryo and fuse with the opposite side.
- One opening will become the mouth, the other will become the anus.



(Blastopore becomes the mouth)

(Blastopore becomes the anus)

3 Major Differences between Protostomes and Deuterostomes

Characteristic	Protostome	Deuterostome
Early Cleavages	Slight Angle (spiral cleavage)	Straight Down (radial cleavage)
First Infolding of Archenteron	Mouth	Anus
Coelom develops from	Split in tissue at sides of archenteron	Outpouching of archenteron wall

6 Major trend in Evolution

1. multicellularity
2. development of tissues, first none (sponges), then 2 (cnidarians), then 3
3. development of symmetry, first none (sponges), then radial (cnidarians), then bilateral
4. development of a gut, first none (sponges), then sac-like (cnidarians, flatworms), then complete
5. development of a body cavity, first none (flatworms), then a pseudocoelom (roundworms), then a coelom
6. development of segmentation; segmentation evolved in protostomes (annelids and arthropods) independently of that which evolved in deuterostomes.

Summary of Evolutionary Trends

Symmetry

Asymmetry → Radial → Bilateral

Gut

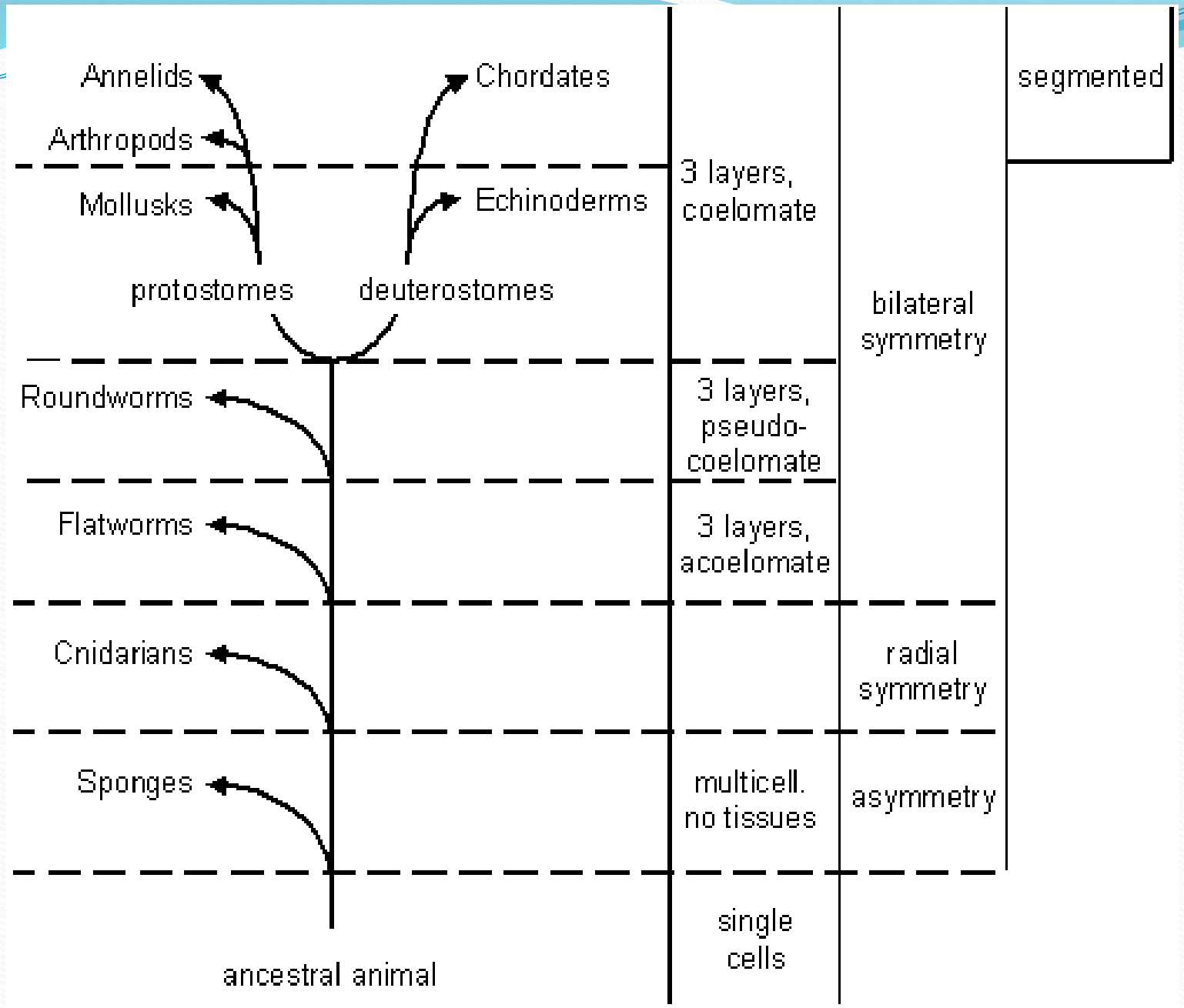
No Gut → Saclike → Complete

Coelom

Acoelomate → Pseudocoelomate → Coelomate

Embryonic Germ Layers

None → 2, (tissues, no organs) → 3, (tissues and organs)


Annelids
Arthropods
Mollusks
Chordates
Echinoderms
protostomes
deuterostomes
3 layers, coelomate
segmented
bilateral symmetry
Roundworms
3 layers, pseudo-coelomate
Flatworms
3 layers, acoelomate
Cnidarians
radial symmetry
Sponges
multicell. no tissues
asymmetry
single cells
ancestral animal

Phylum (common name)	Tissue Complexity	Germ Layers	Body Symmetry	# of Gut Opening	Coelom	Embryonic Development
Porifera (sponges)	parazoa	-	asymmetry	0	-	-
Cnidaria (jellyfish, hydra)	eumetazoa	2	Radial symmetry	1	-	-
Platyhelminthes (flatworms)	eumetazoa	3	Bilateral Symmetry	1	acoelomate	-
Nematoda (roundworms)	eumetazoa	3	Bilateral Symmetry	2	pseudo-coelomate	-
Rotifera (rotifers)	eumetazoa	3	Bilateral Symmetry	2	pseudo-coelomate	-
Mollusca (clams, snails)	eumetazoa	3	Bilateral Symmetry	2	coelomate	protostome
Annelida (earthworms)	eumetazoa	3	Bilateral Symmetry	2	coelomate	protostome
Arthropoda (insects, spiders)	eumetazoa	3	Bilateral Symmetry	2	coelomate	protostome
Echinodermata (starfish, sea urchins)	eumetazoa	3	Radial Symmetry	2	coelomate	deuterostome
Chordata (fish, reptiles, birds, etc)	eumetazoa	3	Bilateral Symmetry	2	coelomate	deuterostome

Evolutionary Trend

Simple → Complex

An increase in "Cell Specialization" and "Division of Labor"

Classification of the Kingdom Animalia

Protozoans

Asymmetry
* No Body Plan

1. Phylum Porifera

(Sponges)

Radial Symmetry
•Body Radiates from a Central Point

2. Phylum Cnidaria

(Jellyfish, Sea Anemone)

Phyla 1-9 are Invertebrates "Animals without backbones"

Protostomes
•Mouth forms at the Blastopore

Bilateral Symmetry

Body Plan Includes

Anterior and Posterior Ends

Dorsal and Ventral Surfaces

"Right" and "Left" sides are mirror images

Acoelomates

3. Phylum Platyhelminthes

(Flatworms)

Pseudocoelomates

4. Phylum Nematoda

(Roundworms)

5. Phylum Rotifera

(Rotifers)

Coelomates

6. Phylum Annelida

(Segmented Worms)

7. Phylum Mollusca

(Snails, Clams)

8. Phylum Arthropoda

(Insects, Spiders)

Coelom: body cavity found between two layers of mesoderm.

Deuterostomes
•Anus forms at the Blastopore

Radial Symmetry

Coelomates

9. Phylum Echinodermata

(Starfish, Sea Urchins)

Bilateral Symmetry

Coelomates

10. Phylum Chordata

*Class Ichthyes

*Class Amphibia

*Class Reptilia

*Class Aves

*Class Mammalia