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Kingdom Animalia I

Invertebrates



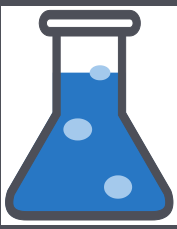
Learning CTR Online



Chapter 26:
Kingdom Animalia I



Lesson Objectives



By the end of this lesson, you should be able to:

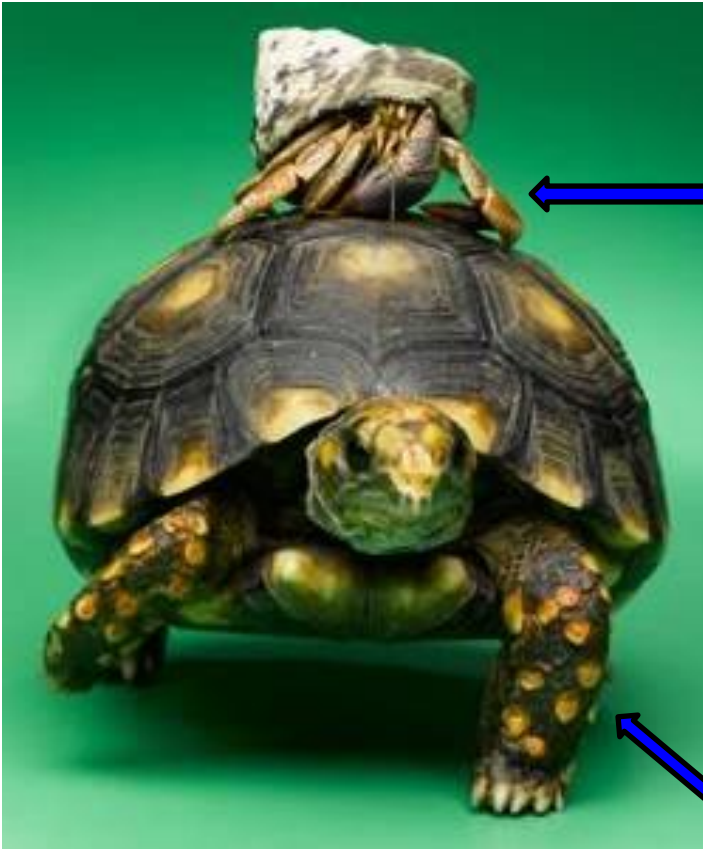
- ❑ Identify the two branches of the animal kingdom (invertebrates and vertebrates).
- ❑ Explain five common characteristics of organisms in the animal kingdom.
- ❑ Describe the process of embryonic maturation (blastula, gastrula, true tissues).
- ❑ Distinguish the five Animal Body Plans and how this relates to animal phyla.
- ❑ Understand and explain the general features of invertebrate animals (non-chordates), including porifera and cnidarians. ... Phylum, Examples of organisms, Location, Symmetry, Body plan (tissue layers), Coelom relationship (acoelomate, pseudocoelomate, coelomate), Protostome or deuterostome, Reproduction, Special features
- **Science Practice: Animal Phyla Project**

Animals are Divided into **Invertebrates**

- do **NOT** have a spinal column ("backbone").

Ex. Insects

- Most animals are invertebrates.



Vertebrates

- have a spinal column ("backbone").

Ex. Mammals, Birds, Reptiles

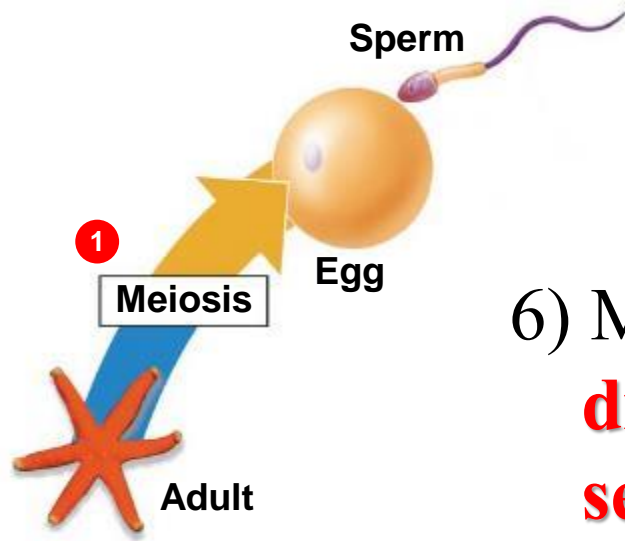
Characteristics of Animals

- 1) Multicellular
- 2) Eukaryotes
- 3) No Cell Walls
- 4) Ingestive Heterotrophs (take in food and internally digest it).
- 5) Go through a **Blastula** stage of development.

ZOOLOGY

= Study of Animals



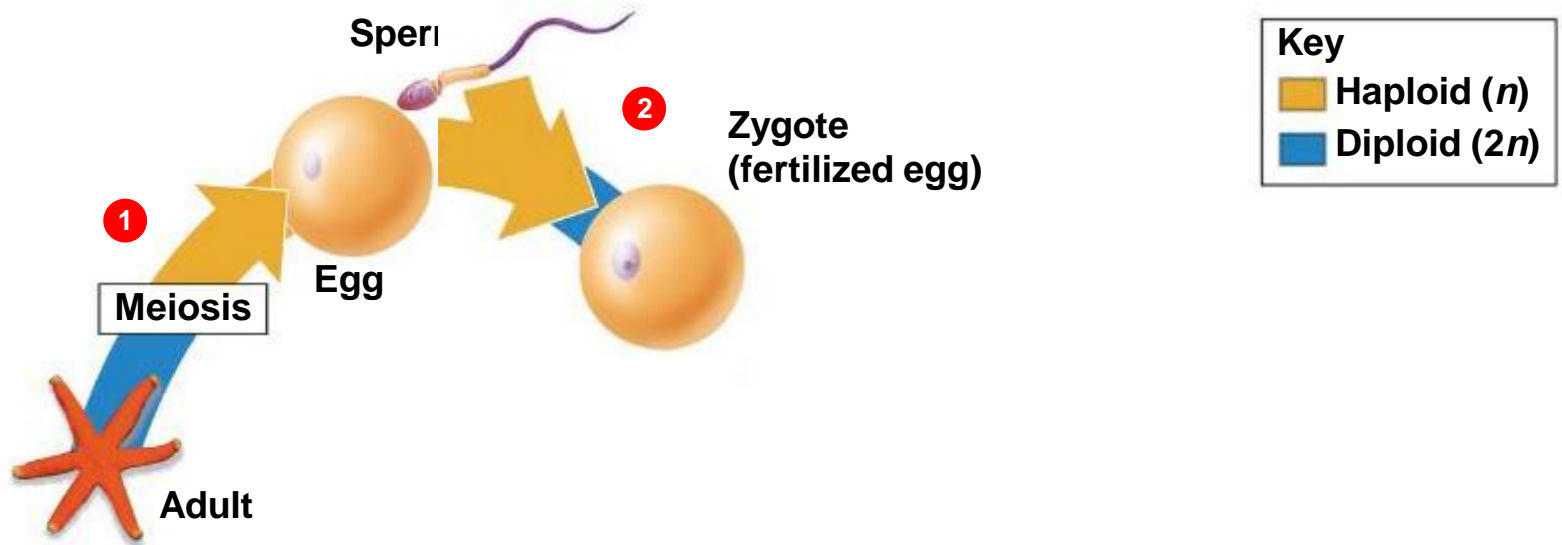


6) Most adult animals are **diploid** and reproduce **sexually ...**

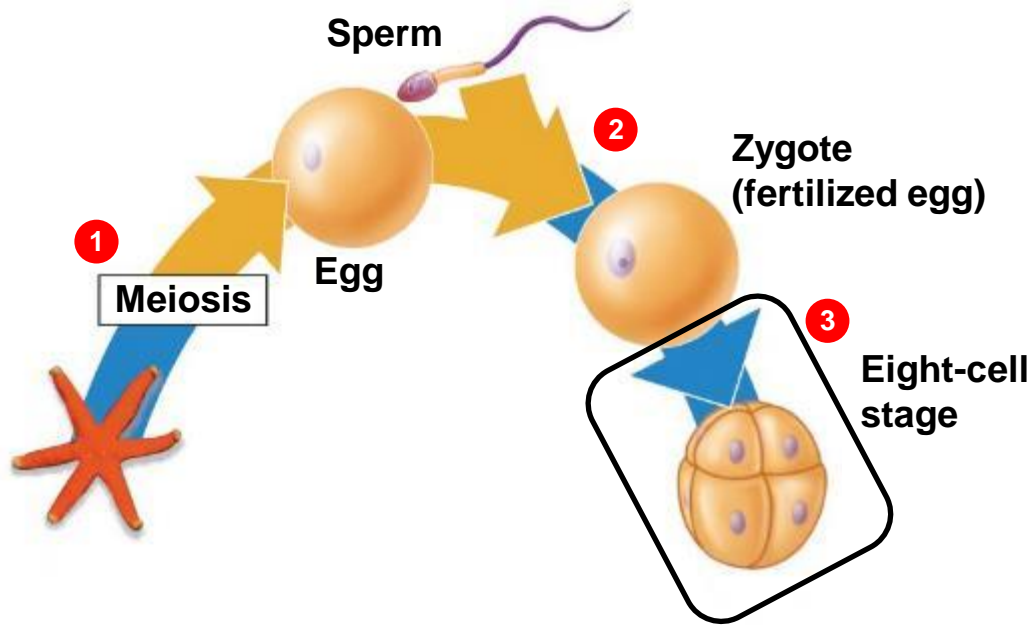
by **eggs** and **sperm**

1) are produced by **meiosis**

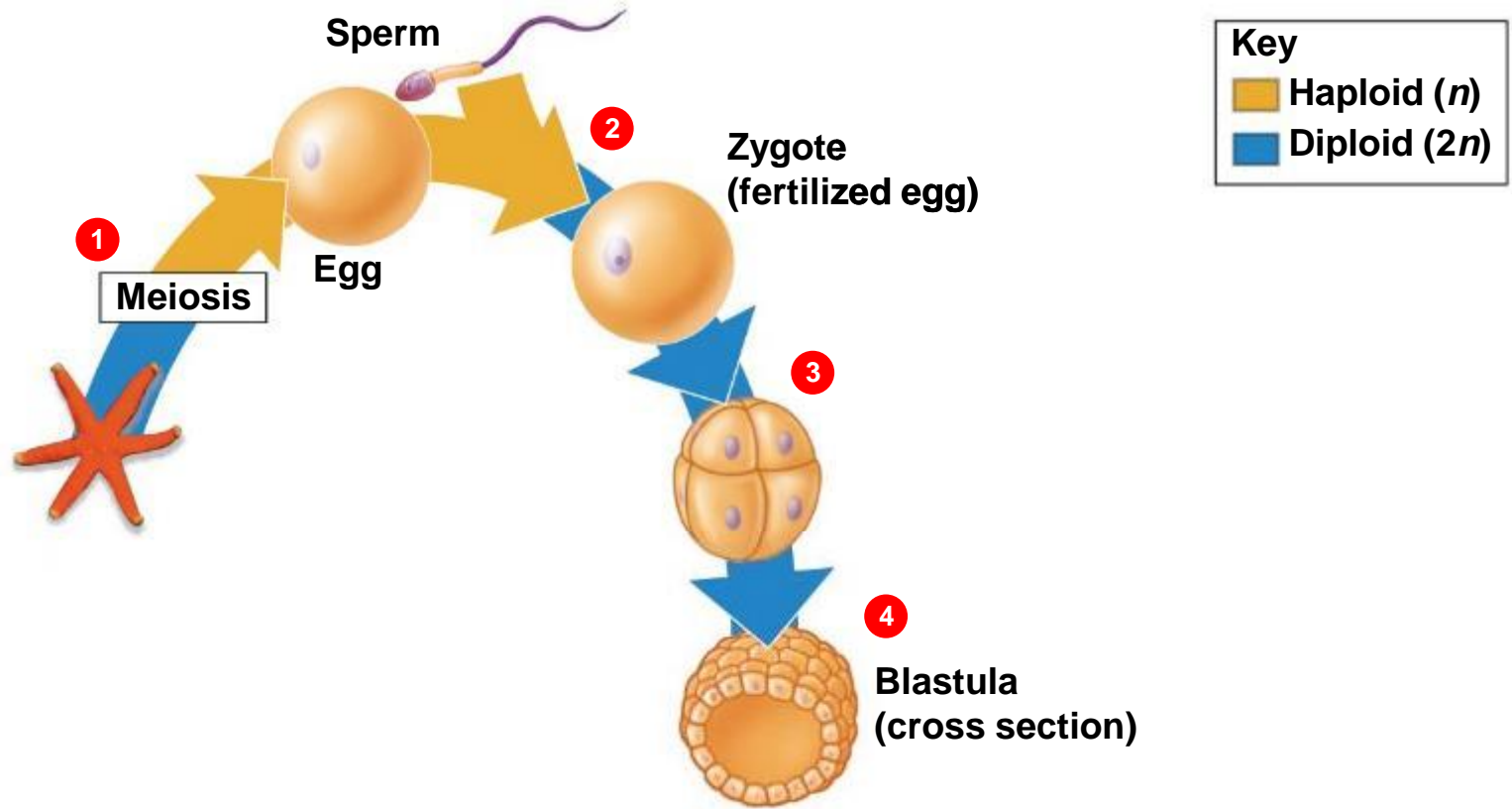
2) are the only **haploid** cells



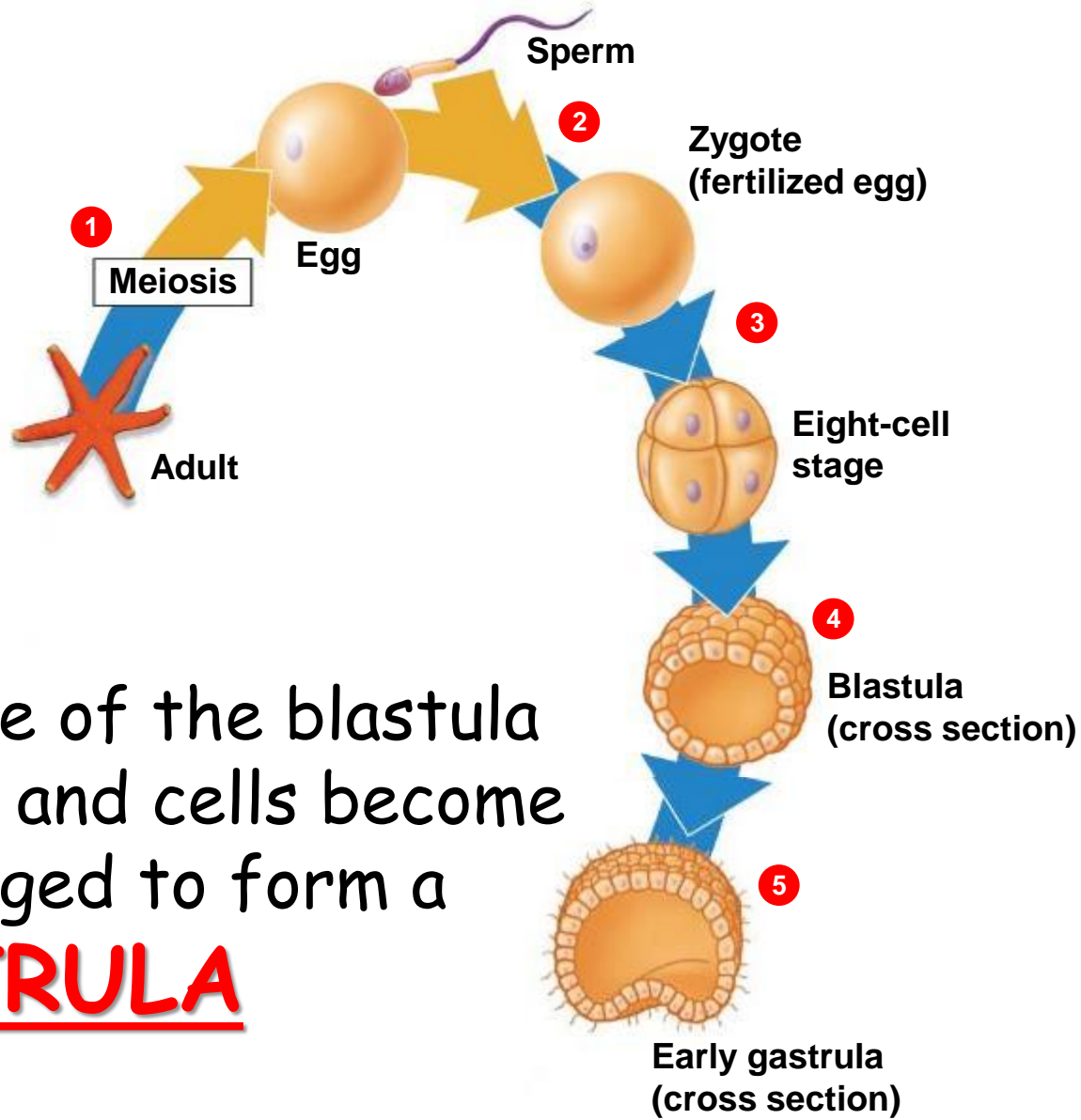
Gametes fuse during **fertilization** to form a **zygote**.



The **zygote** divides into cells.

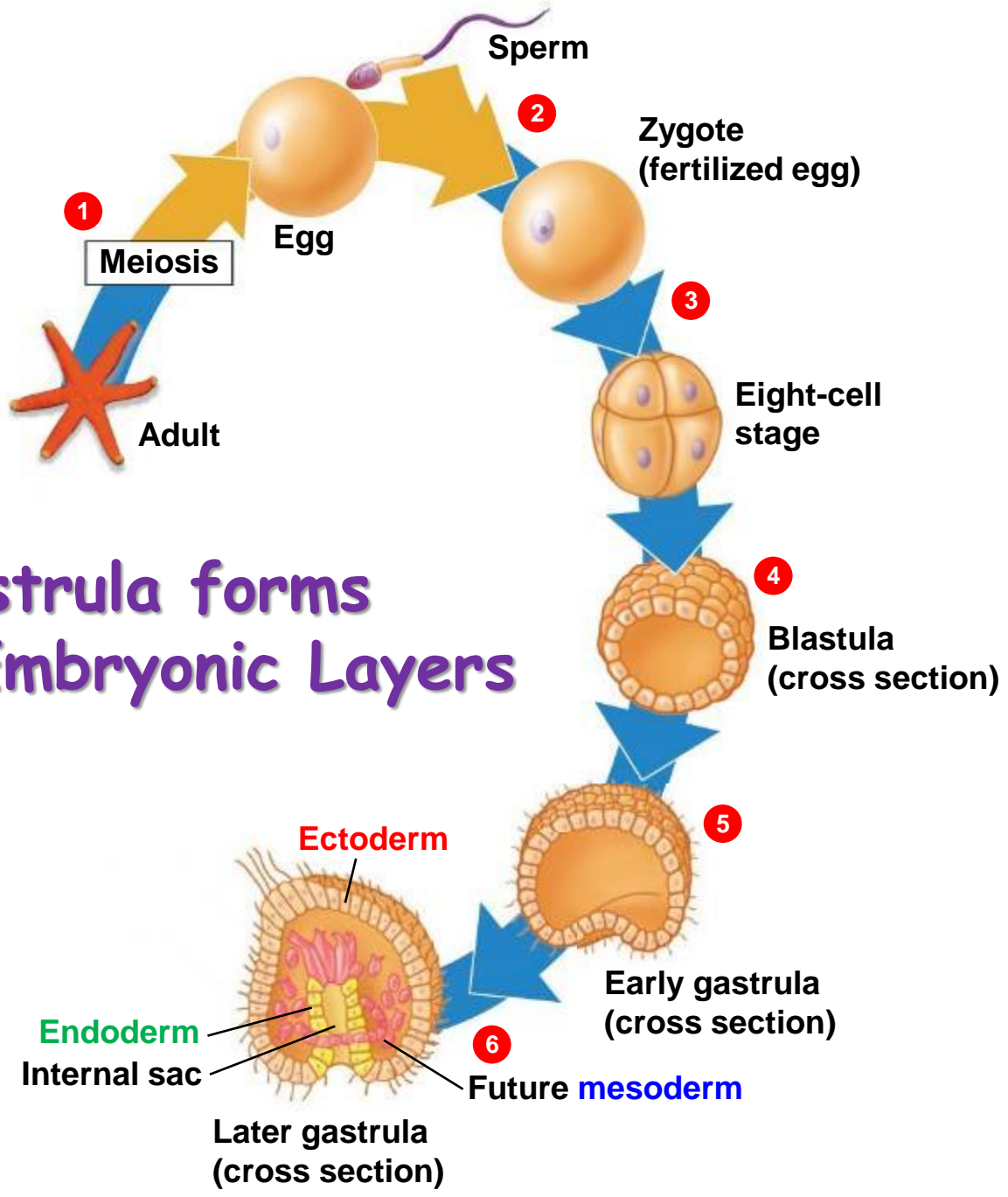


The zygote divides by mitosis to form a hollow ball of cells called a **BLASTULA**.



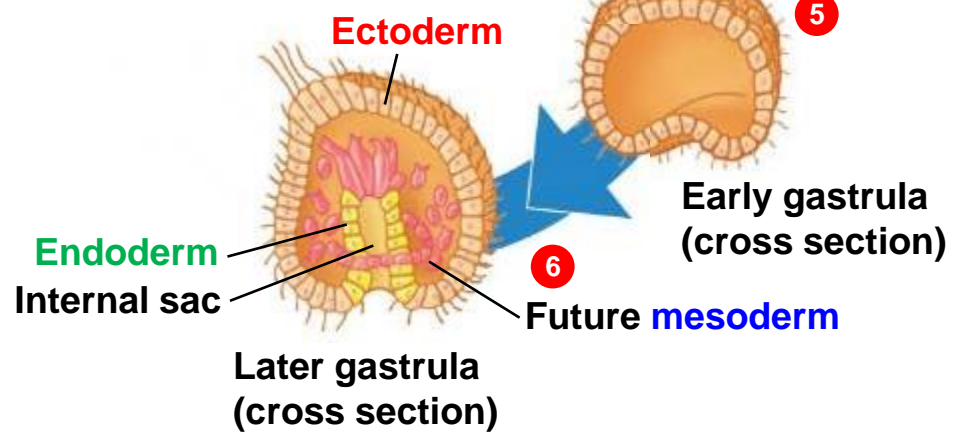
One side of the blastula folds in and cells become rearranged to form a

GASTRULA



Key	
	Haploid (n)
	Diploid ($2n$)

The gastrula forms three Embryonic Layers



Gastrula Development

Endoderm

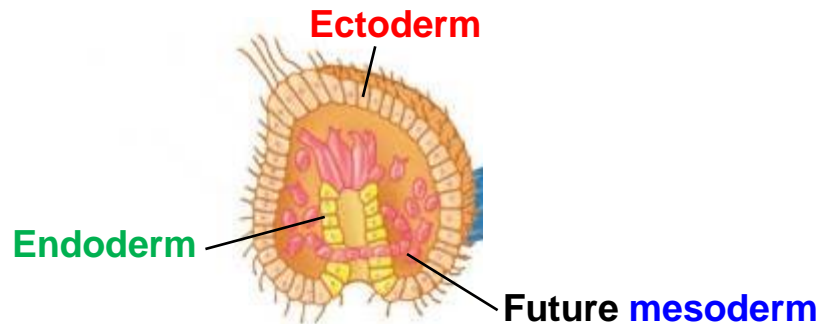
forms a lining of the future digestive tract.

Ectoderm

forms an outer layer that will give rise to the skin and nervous system.

Mesoderm

forms a middle layer that will give rise to muscles and most internal organs.



Maturation

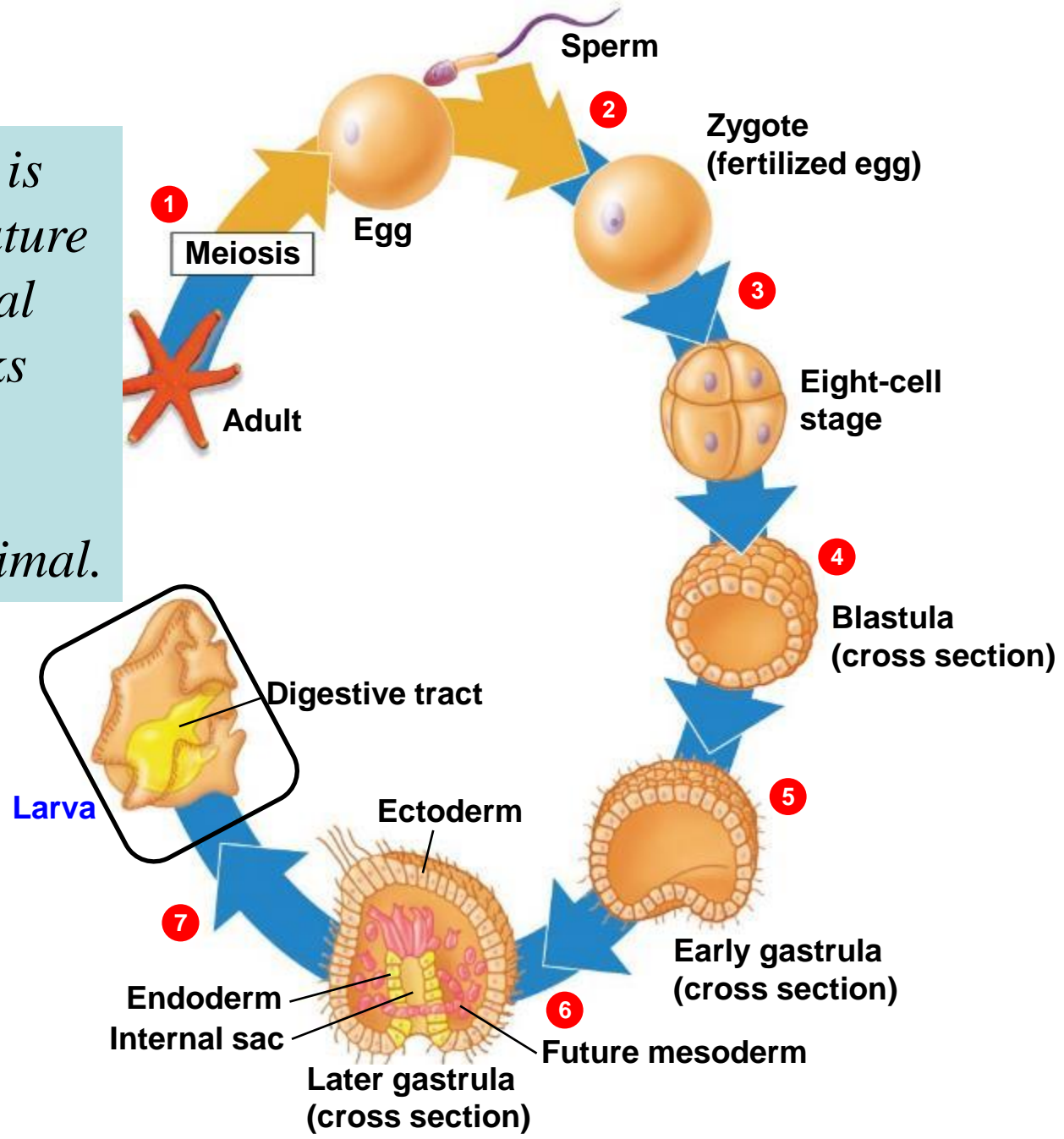
After the gastrula stage, many vertebrate animals **develop directly into adults.**

Invertebrate and some vertebrate animals **do NOT develop directly into adults.**

Phyla of Invertebrates:

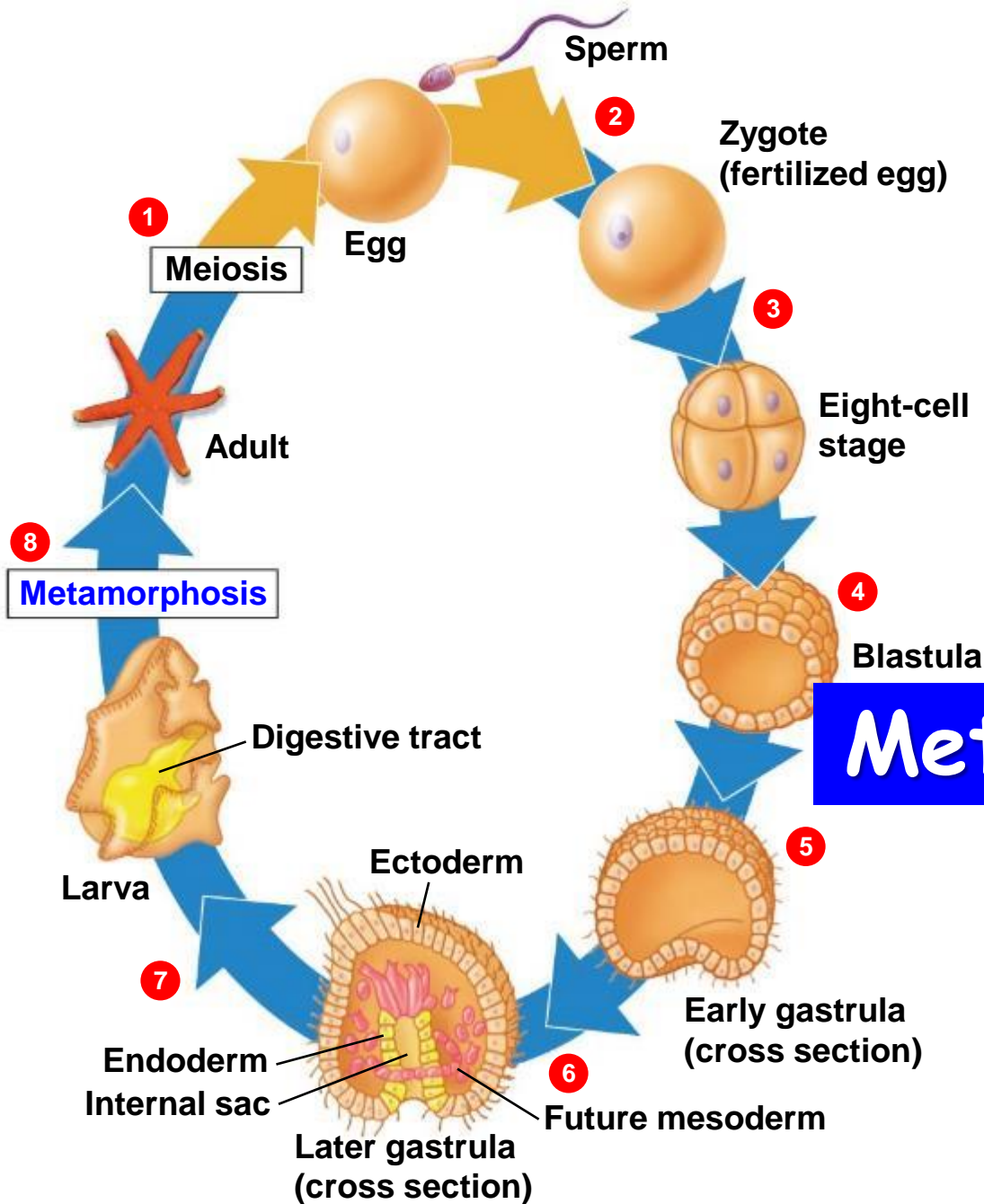
Porifera, Coelenterata (Cnidaria),
Platyhelminthes (flat worms), Nematoda (round
worms), Annelida (segmented worms),
Echinodermata, Mollusca, and Arthropoda.

A *Larva* is an immature individual that looks different from the adult animal.



Key	
	Haploid (n)
	Diploid ($2n$)

Some animals, such as the sea star, **develop into one or more larval stages.**



A larva undergoes a major change in body form.

Metamorphosis

It becomes a mature adult that can reproduce.



What are the two branches of the animal kingdom?

List five characteristics of animals.

List the embryonic tissues and what they produce.



What are the two branches of the animal kingdom? **Invertebrates & vertebrates**

List five characteristics of animals.

- 1) **Multicellular**
- 2) **Eukaryotes**
- 3) **No Cell Walls**
- 4) **Ingestive Heterotrophs (take in food and internally digest it).**
- 5) **Go through a **Blastula** stage of development.**

List the embryonic tissues and what they produce.

Endoderm forms a lining of the future **digestive tract**.

Ectoderm forms an **outer layer** that will give rise to the **skin and nervous system**.

Mesoderm forms a **middle layer** that will give rise to **muscles and most internal organs**.

Creation of the Animal Kingdom

"And God said, Let the waters bring forth abundantly the moving creature that hath life, and fowl that may fly above the earth in the open firmament of heaven.

²¹ And God created great whales, and every living creature that moveth, which the waters brought forth abundantly, after their kind, and every winged fowl after his kind: and God saw that it was good.

²² And God blessed them, saying, Be fruitful, and multiply, and fill the waters in the seas, and let fowl multiply in the earth.

²³ And the evening and the morning were a **fifth day**.

²⁴ And God said, Let the earth bring forth the living creature after his kind, cattle, and creeping thing, and beast of the earth after his kind: and it was so.

²⁵ And God made the beast of the earth after his kind, and cattle after their kind, and every thing that creepeth upon the earth after his kind: and God saw that it was good.

³¹ And God saw every thing that he had made, and, behold, it was very good. And the evening and the morning were the **sixth day**."

Genesis 1: 20-31

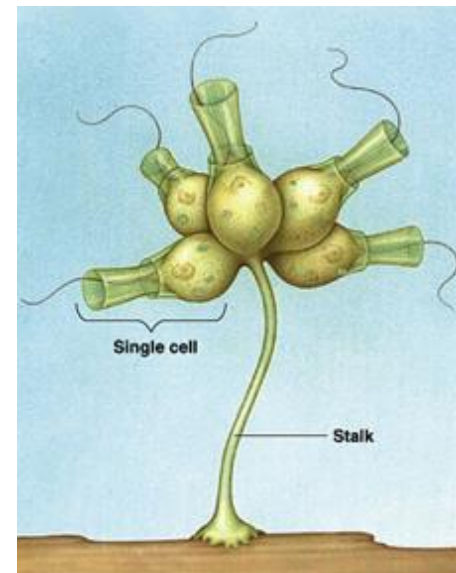


Animal Diversity

(according to Evolution)

Animals are believed to have descended from a common ancestor (an **ancestral flagellated protist**).

Most of today's phyla of animals are believed to have appeared for the first time in the geological column during a period called "**Cambrian Explosion**".



Animal's Body Plan

1) Presence of True Tissues

2) Symmetry

3) Embryonic Tissue Layers

4) First Opening formed by Gastrulation

5) Presence of a Body Cavity

1) True Tissues

What is a Tissue?

Presence or **Absence** of true tissues separates animals into two groups:

- **Sponges** (simplest animals): **NO** true tissues.



- **Animals with true tissues.**

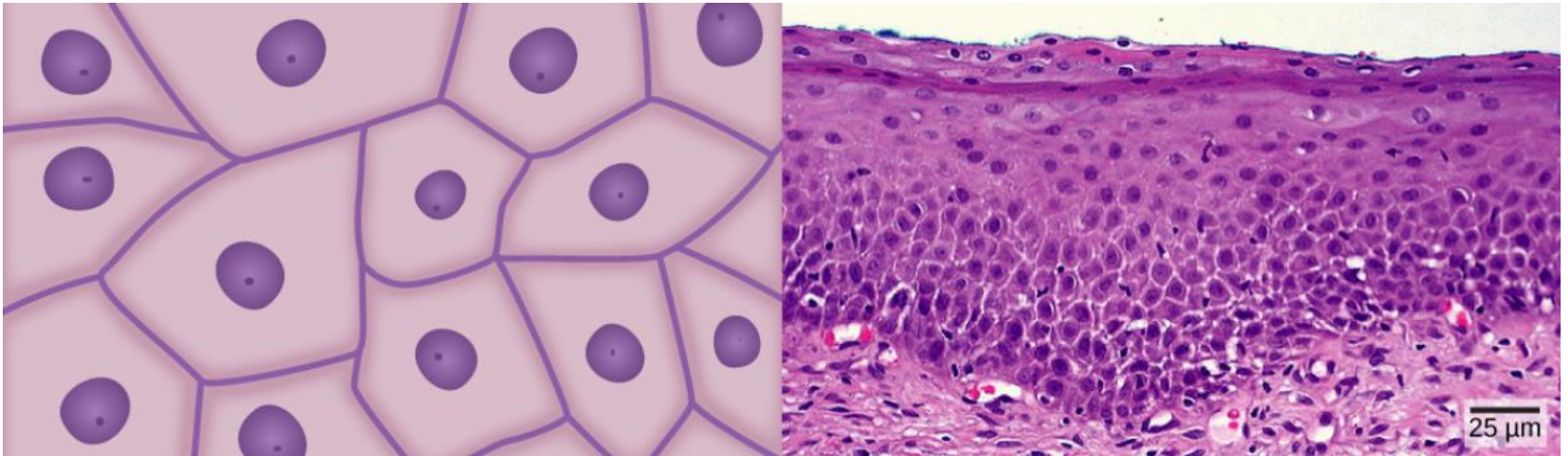


1) True Tissues

What is a Tissue?

Tissues are an integrated group of cells that share a common structure and a common function.

For example, **epithelial**, connective, nervous or muscle tissue).



2) Body Symmetry

- **Symmetry** is the arrangement of body parts around a central point or axis.
- **Asymmetry** occurs when the body can't be divided into into equal parts (sponges).



This ant has **bilateral symmetry**. The two halves of its body mirror each other. On each side you see one eye, one antenna, and three legs.



This sea anemone has **radial symmetry**. Animals with radial symmetry have a body organized around the center, like spokes on a wheel.

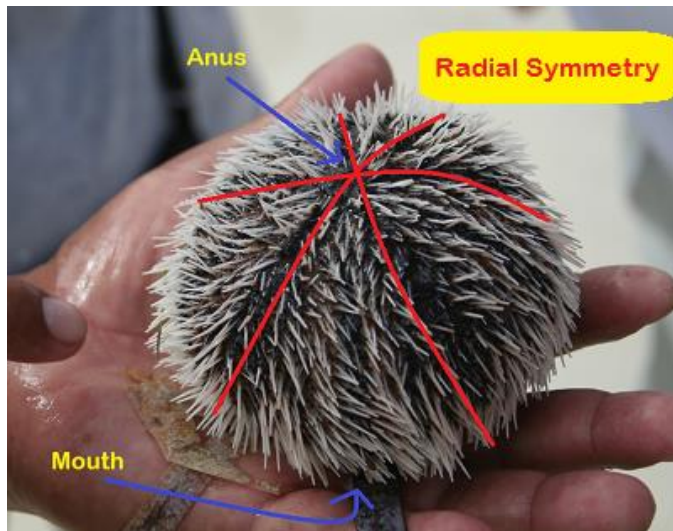


This sponge is **asymmetrical**. You cannot draw a straight line so that its body is divided into two equal halves.

2) Body Symmetry

Radial Symmetry occurs when body parts are arranged around a central point **like spokes on a wheel** (jellyfish, sea stars, sea urchins).

Most animals with radial symmetry are **sessile** (attached) or **sedentary** (move very little).



2) Body Symmetry

Bilateral Symmetry occurs when animals can be divided into **equal halves** along a single plane.

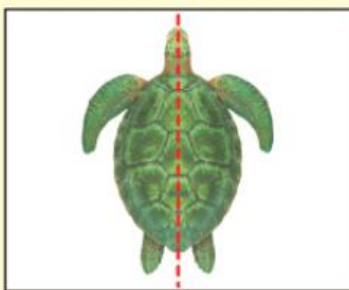
Organisms will have **right and left sides** that are mirror images of each other.



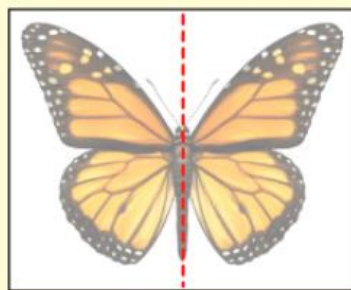
2) Body Symmetry

Animals with **Bilateral Symmetry** are **usually motile**.

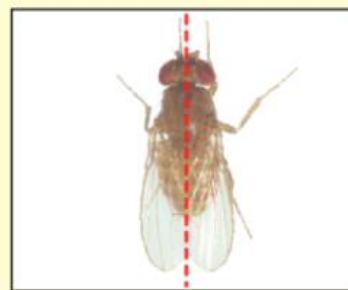
- Have an **anterior** and **posterior** ends.



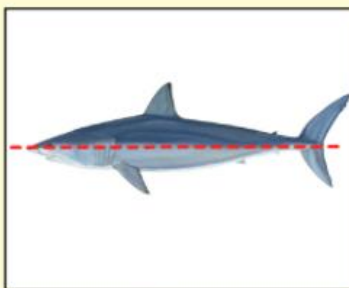
Sea Turtle



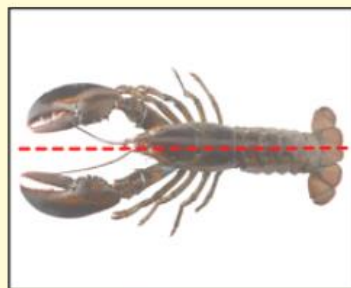
Butterfly



Drosophila (fruit fly)



Shark



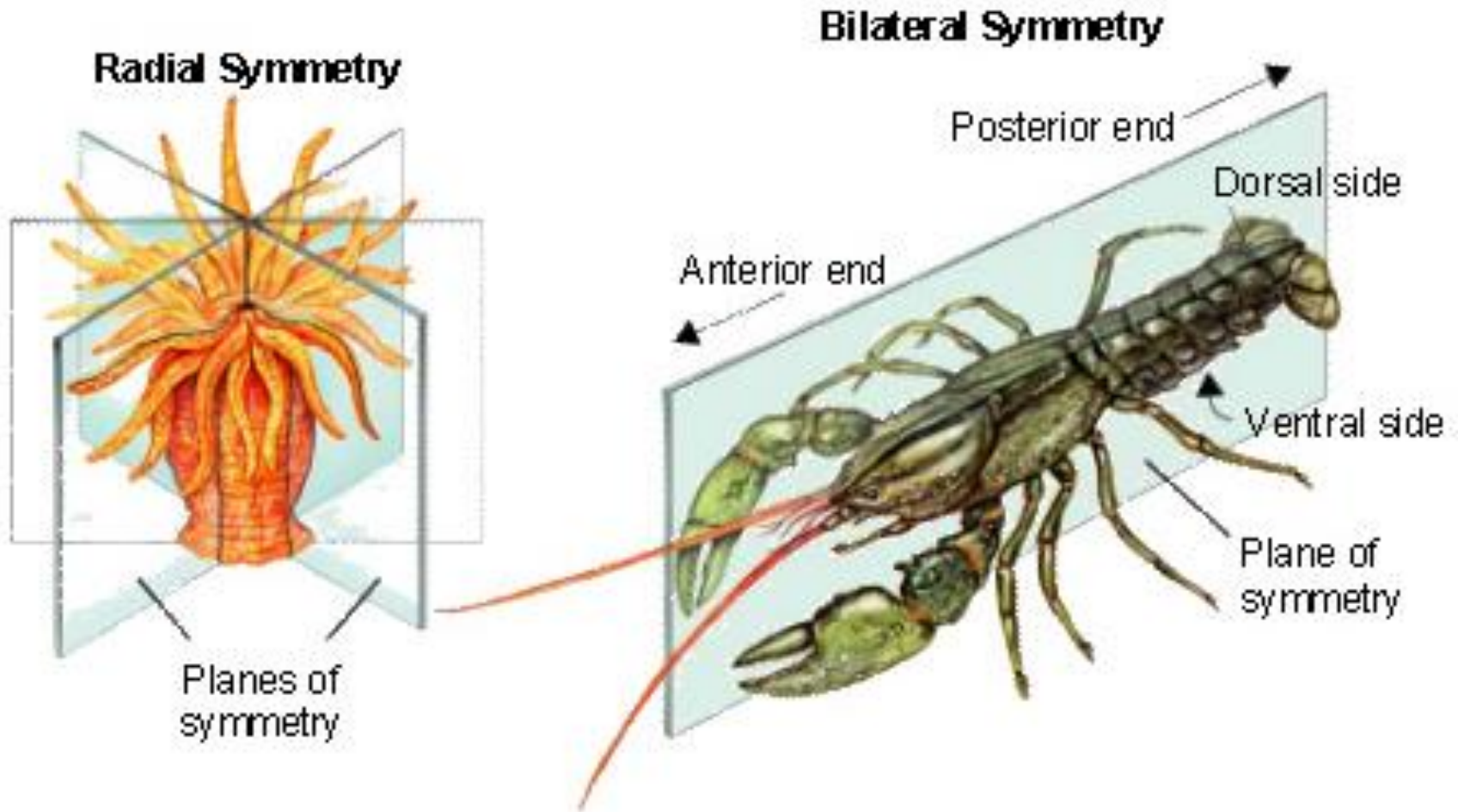
Lobsters



Human

Show **Cephalization**
(tendency to concentrate sensory organs and a brain at the head or anterior end).

2) Body Symmetry



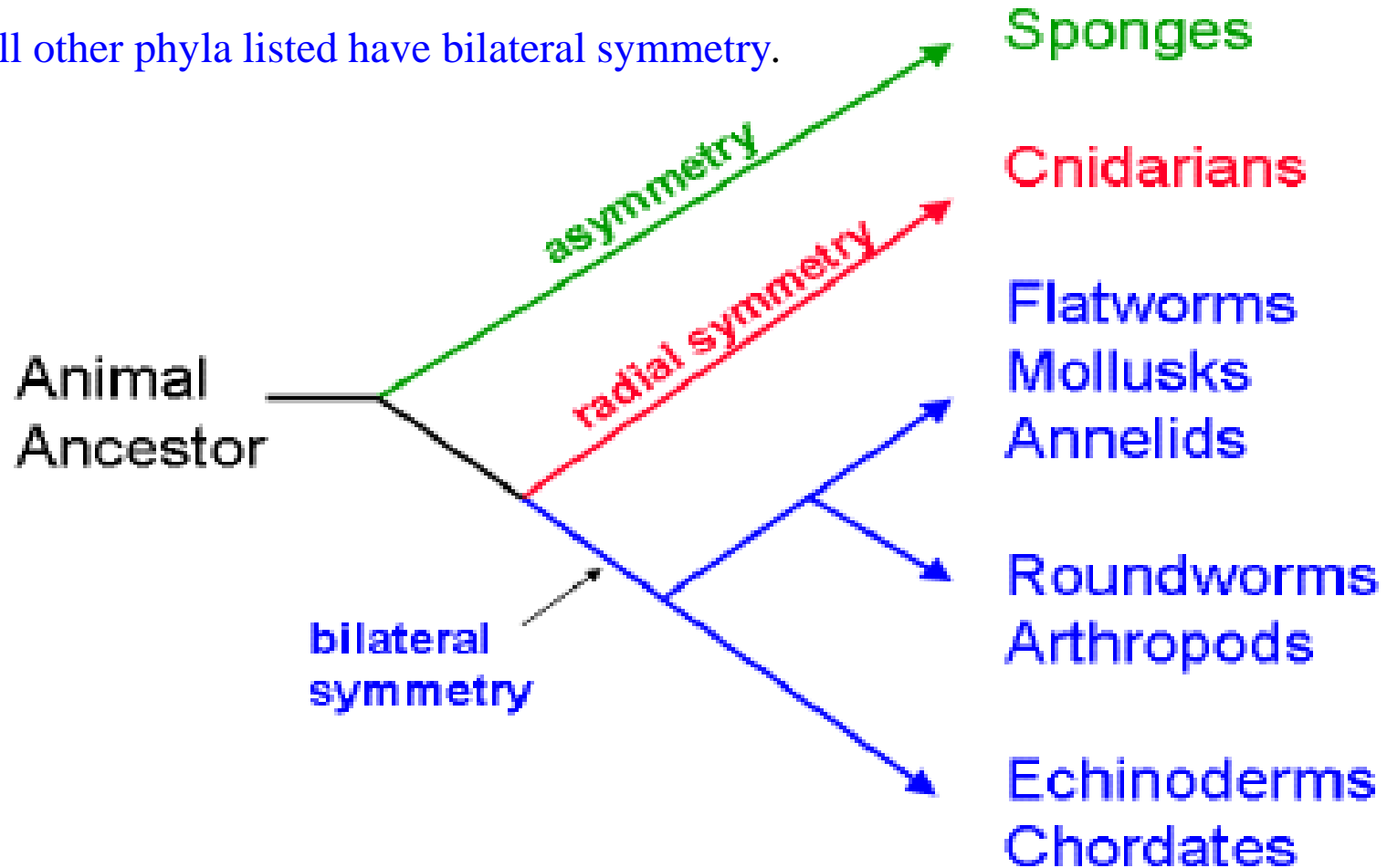
2) Body Symmetry

Evolution of Symmetry (*simple to complex*)

Sponges lack symmetry.

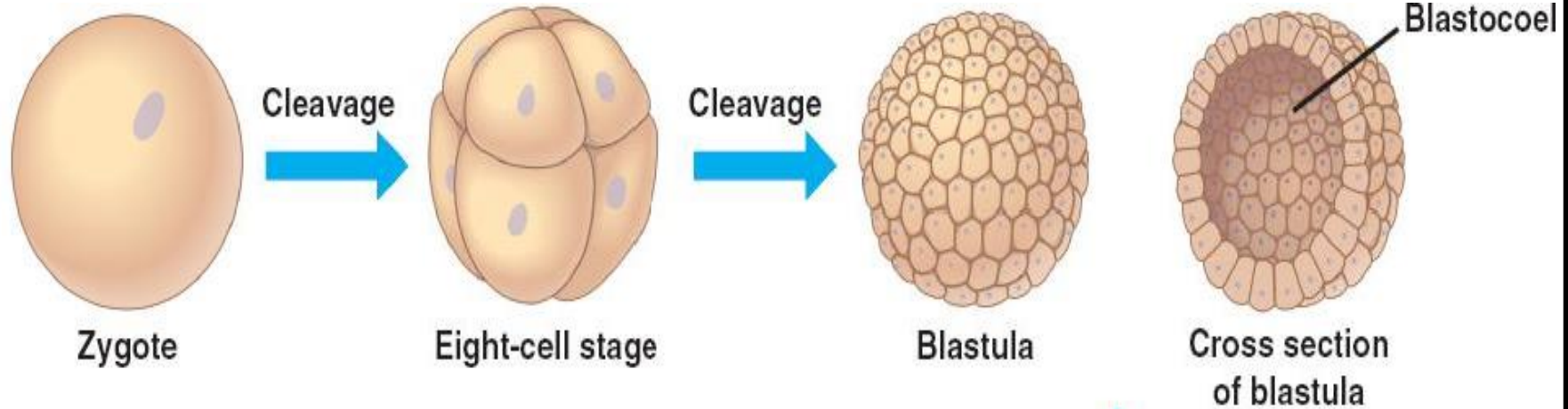
Cnidarians exhibit radial symmetry.

All other phyla listed have bilateral symmetry.



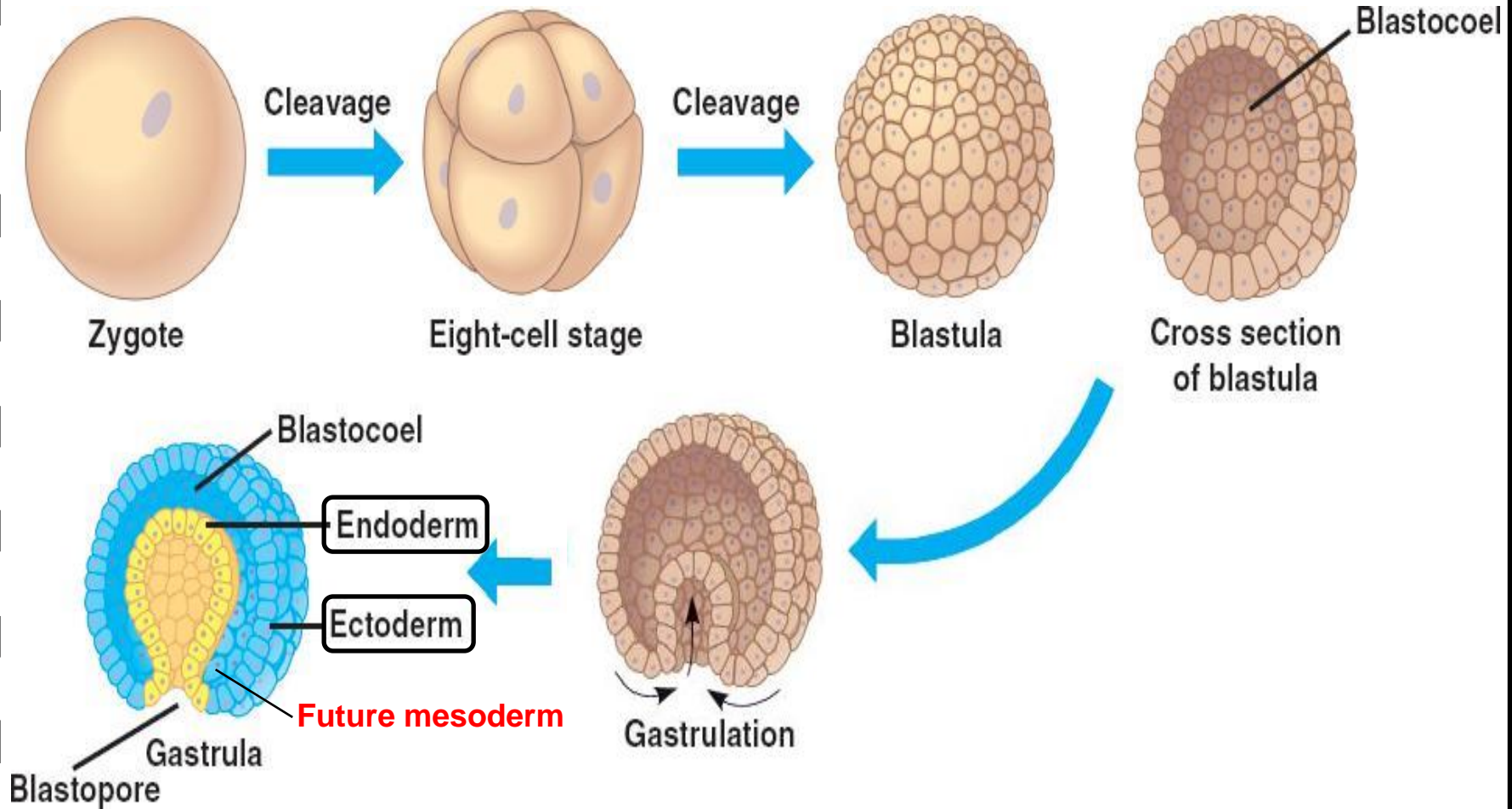
3) Embryonic Development

2 or 3 Tissue Layers



3) Embryonic Development

2 or 3 Tissue Layers



3) Embryonic Development

2 or 3 Tissue Layers

In animals with TRUE tissues, the Blastula folds in on itself to generate the Gastrula.

Gastrulas of Cnidarians (jellyfishes and their relatives) have two tissue layers:

- Ectoderm: Outside

- Endoderm: Inside

All other animals with true tissues have a third tissue layer:

- Mesoderm: between ectoderm & endoderm

Gastrula Development

Endoderm

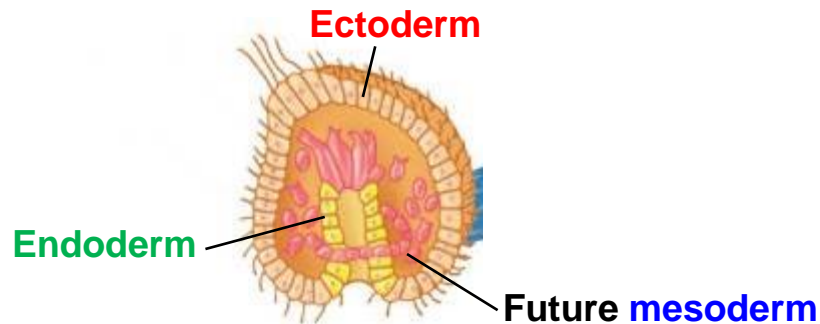
forms a lining of the future digestive tract.

Ectoderm

forms an outer layer that will give rise to the skin and nervous system.

Mesoderm

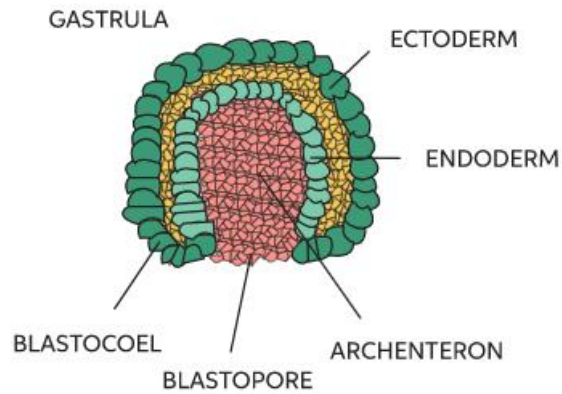
forms a middle layer that will give rise to muscles and most internal organs.



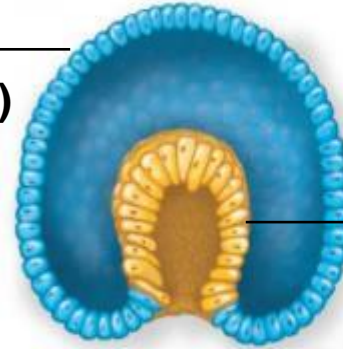
3) Embryonic development: tissue layers

Two layers (some animals)

Gastrulation

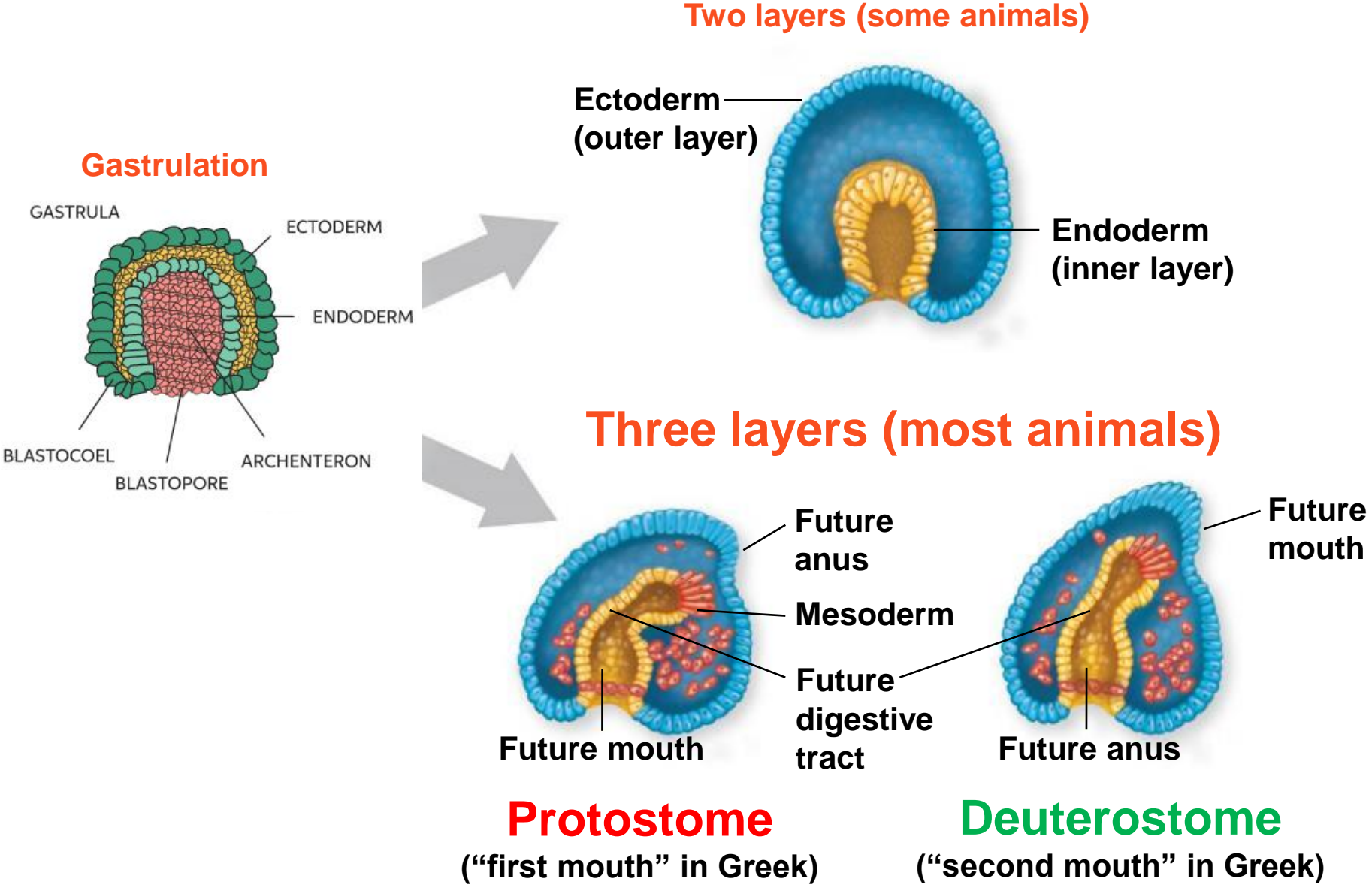


Ectoderm
(outer layer)



Endoderm
(inner layer)

3) Embryonic development: tissue layers



4) Embryonic Development: First Opening formed by Gastrulation

Animals with **3 tissue layers** are divided into 2 groups:

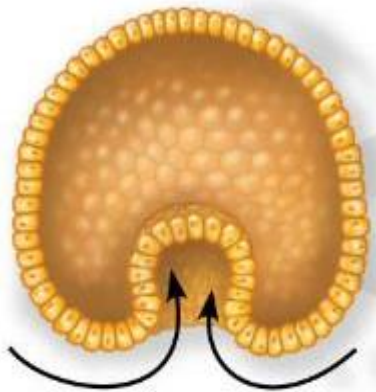
Protostomes if the first indentation (opening) during **Gastrulation** becomes the **Mouth**.

Ex. Arthropods, Worms

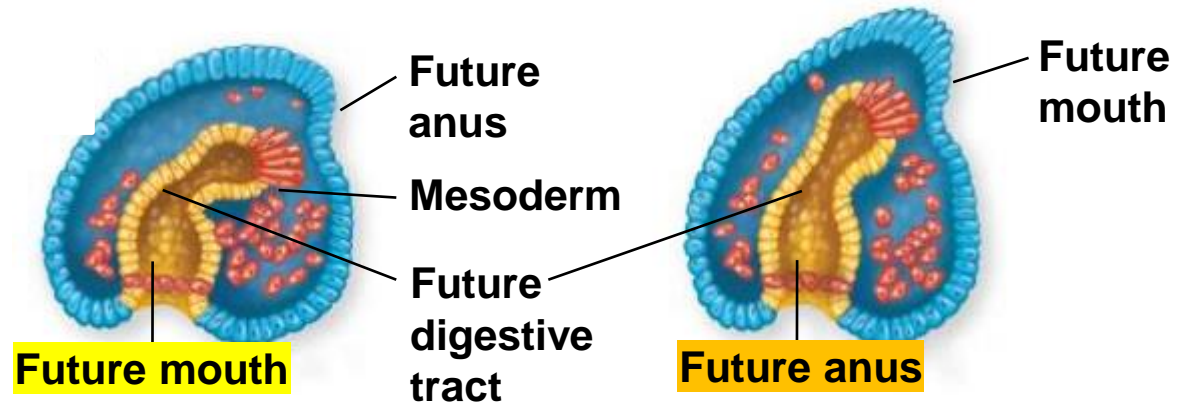
Deuterostomes if the 1st indentation (opening) during **Gastrulation** becomes the **Anus** & the mouth forms from a 2nd opening.

Ex. Echinoderms, Chordates

Gastrulation



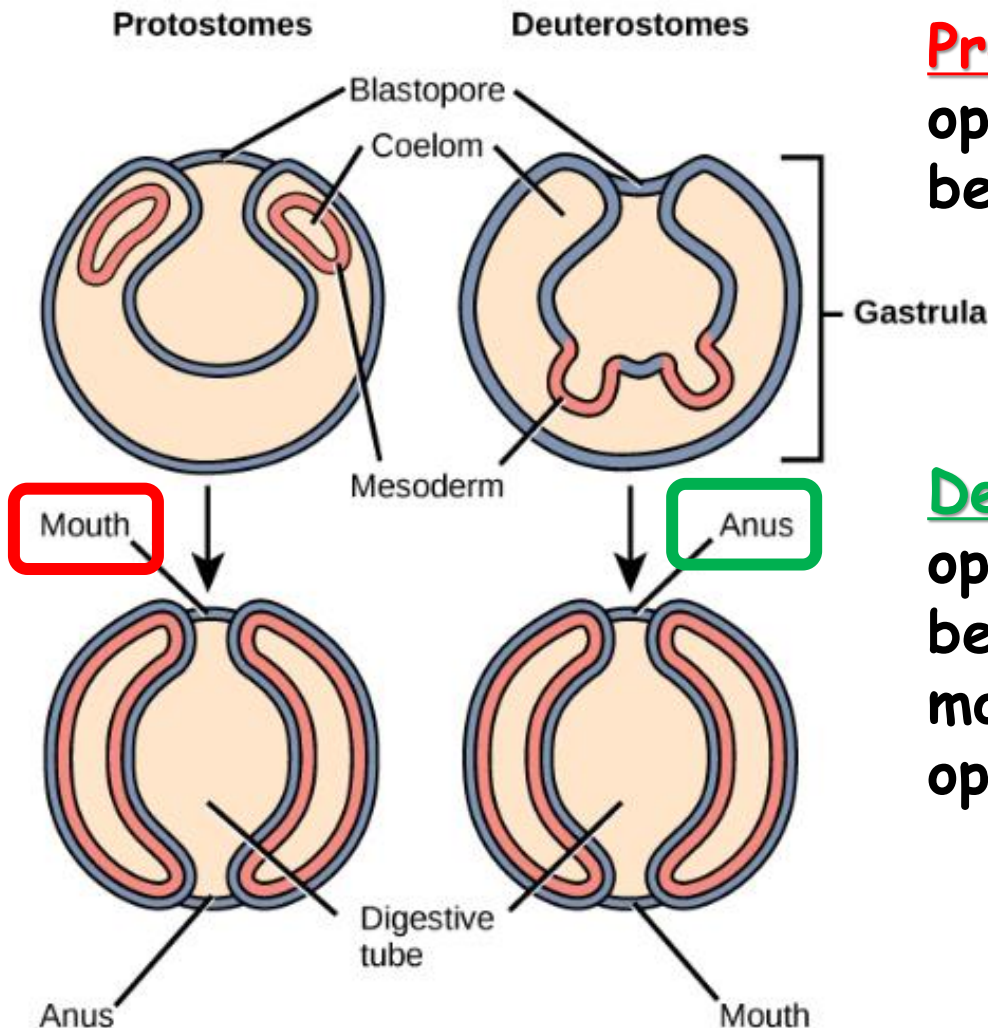
First opening in embryo



Protostome
("first mouth" in Greek)

Deuterostome
("second mouth" in Greek)

4) Embryonic Development: First Opening formed by Gastrulation



Protostomes if the first opening during Gastrulation becomes the **Mouth**.

Ex. Arthropods, Worms

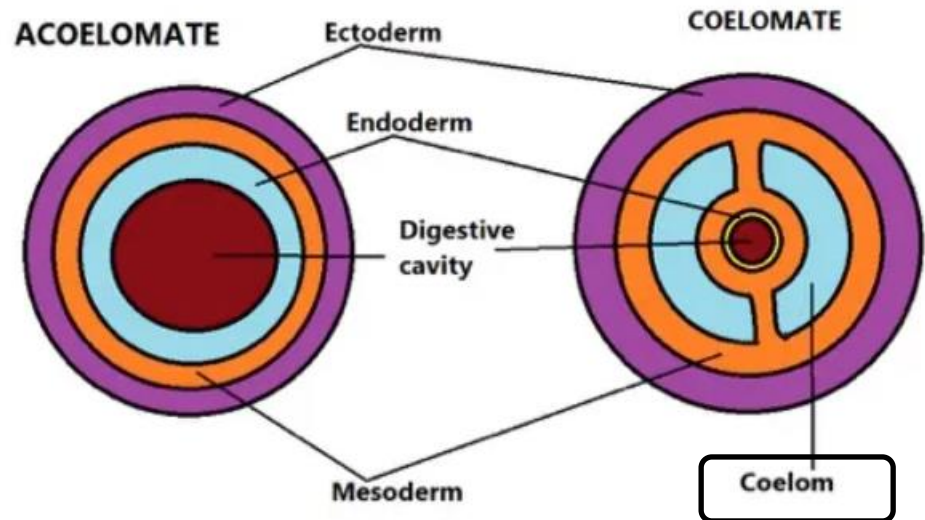
Deuterostomes if the 1st opening during Gastrulation becomes the **Anus** & the mouth forms from a 2nd opening.

Ex. Echinoderms, Chordates

5) Coelom: Body Cavity

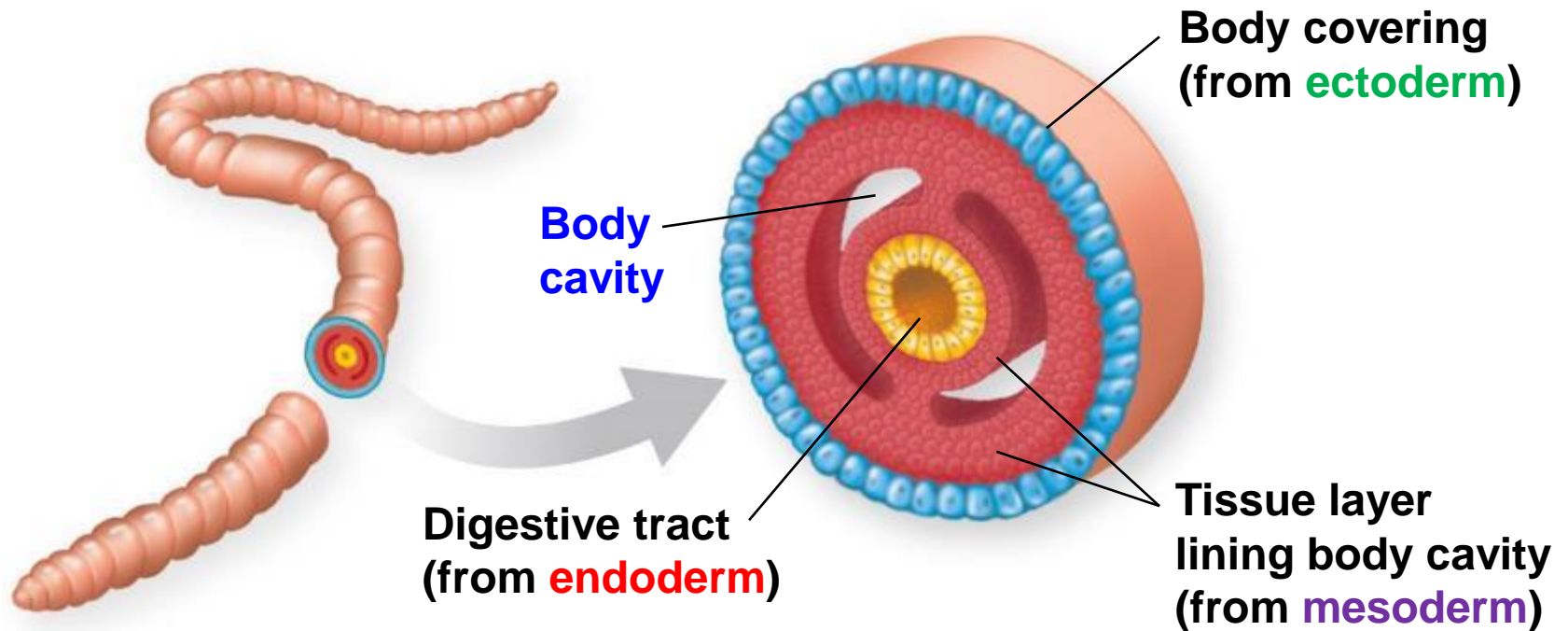
Most animals with 3 tissue layers have a **Body Cavity** or **Coelom**:

- Fluid-filled space between the outer body wall (**ectoderm**) and the digestive tube (**endoderm**) in which the internal organs are suspended.
- This body cavity helps protect the suspended organs from injury.



5) Coelom: Body Cavity

Embryonic development: body cavity
(helps protect organs from injury)



5) Coelom: Body Cavity

Acoelomates (No Coelom)

Animals that have no internal, fluid-filled body cavity separating its body wall from its digestive tract. E.g. Porifera (sponges), Platyhelminthes (flatworms).

Pseudocoelomate

Organisms with body cavity lined with patches of mesoderm, but not derived from the mesoderm, as in a true coelom, or body cavity. E.g. Nematodes (round worms).

Coelomates

Organisms with a body cavity, ("True Coelom") that is derived from and lined with mesoderm. The coelom is the space (body cavity) between the digestive organs and the outer body wall.

What are two major ways to explain diversity?



List the five animal body plans.

Distinguish asymmetry, radial and bilateral symmetry.



What are two major ways to explain diversity?

**Creation (Genesis 1-2) & macroevolution
(gradual, random)**

List the five animal body plans.

- 1) Presence of True Tissues**
- 2) Symmetry**
- 3) Embryonic Tissue Layers**
- 4) First Opening formed by Gastrulation**
- 5) Presence of a Body Cavity**

Distinguish asymmetry, radial and bilateral symmetry.

Asymmetry no definite shape.

radial body parts are arranged around a central point

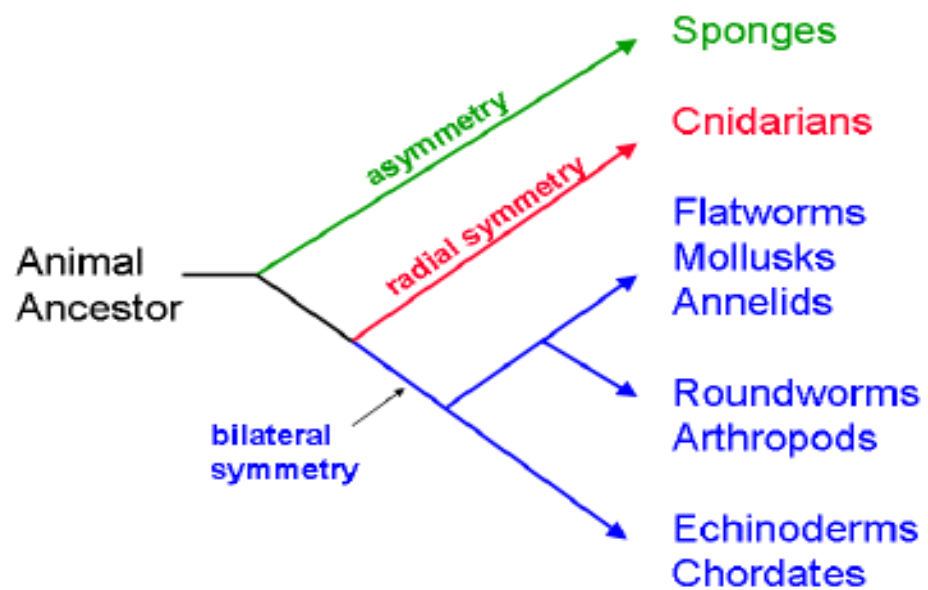
bilateral divided into **equal halves** along a single plane.

Give examples of phyla with each type of body symmetry.

Name and define the branches of animals with 3 embryonic tissue layers.

Name and define the 3 body cavity types in animals.

Give examples of phyla with each type of body symmetry.



Name and define the branches of animals with 3 embryonic tissue layers.

Protostomes the first opening during Gastrulation → Mouth.

Deuterostomes the first opening during Gastrulation → Anus.

Name and define the 3 body cavity types in animals.

Acoelomate → no body cavity (flatworms)

Pseudocoelomate → patches of mesoderm (round worms)

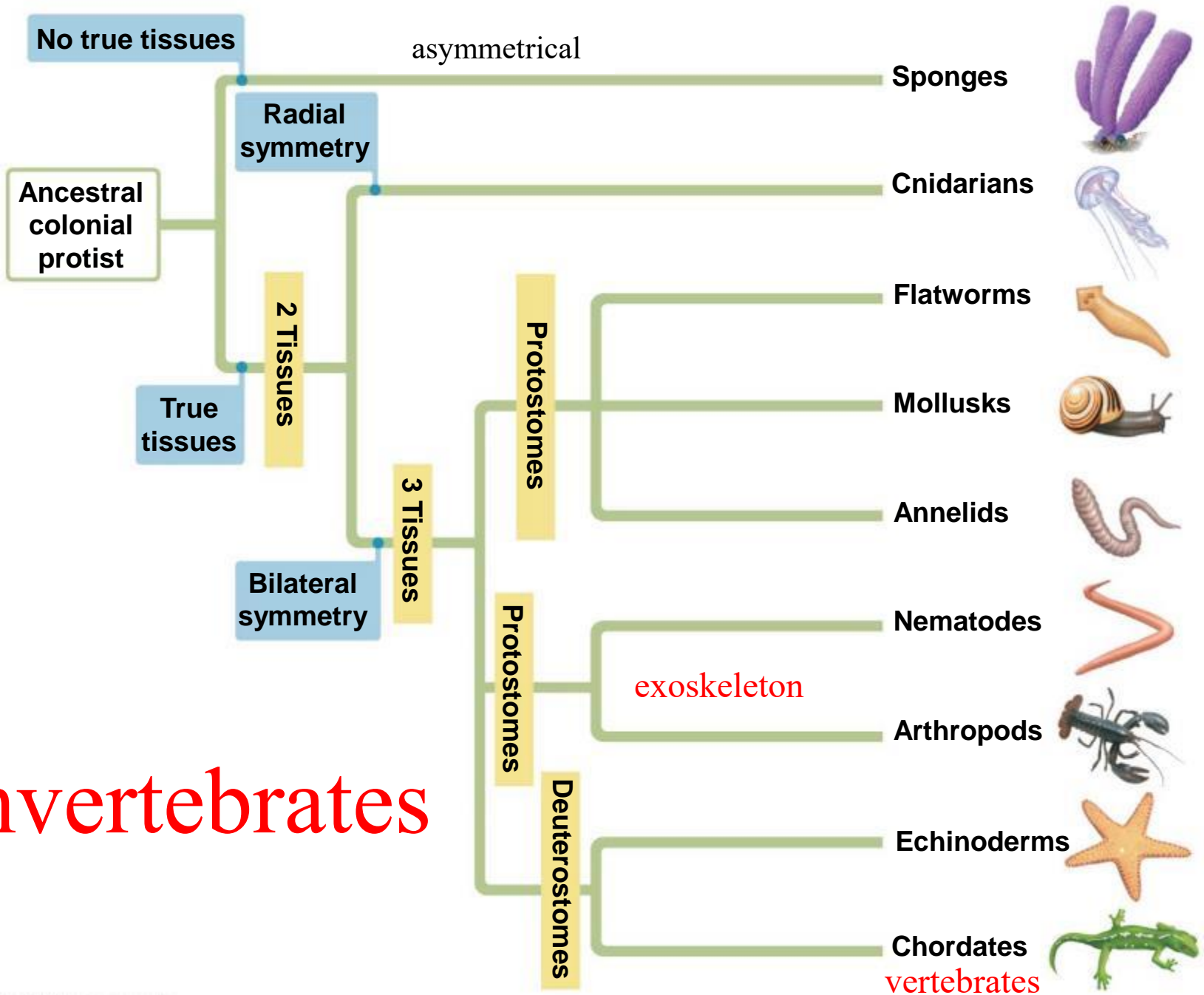
Coelomates → derived from and lined with mesoderm.

Invertebrates

- "Simplest" animals.
- Contain the **greatest number** of different **species**.
- Do **NOT** have a backbone.
- Includes sponges, cnidarians, flatworms, roundworms, mollusks, annelids, arthropods, and echinoderms.



Invertebrates



Phylum Porifera: Sponges

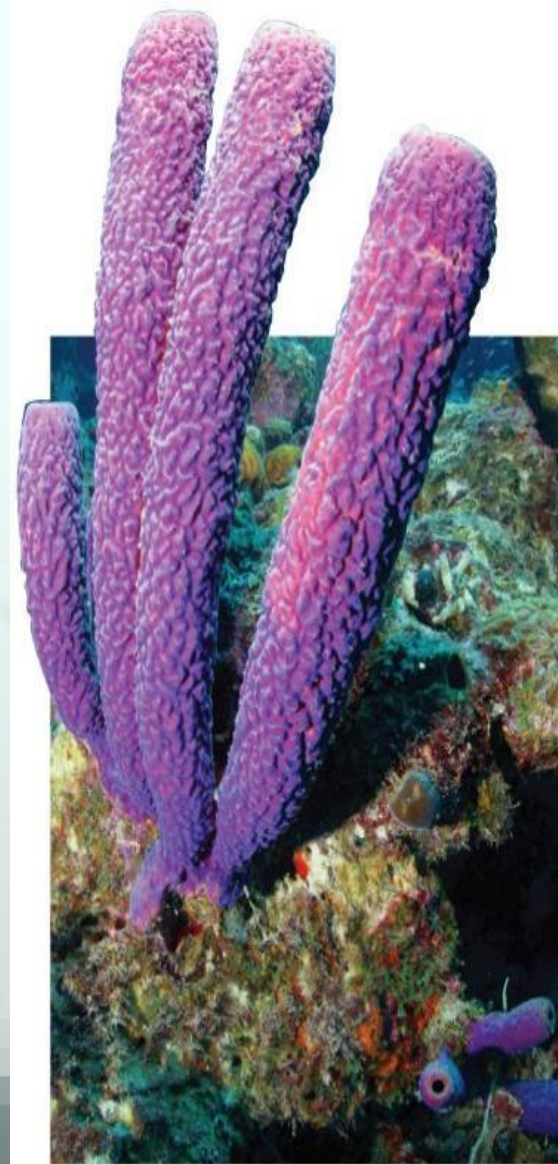
The phylum includes about 5,000 species of sponges, grouped into 3 classes depending mainly upon the types of skeleton found in them.

The Porifera may be defined as an **asymmetrical** or somewhat radially symmetrical, multicellular organism with a cellular grade of an organization **without true tissues** and organs.



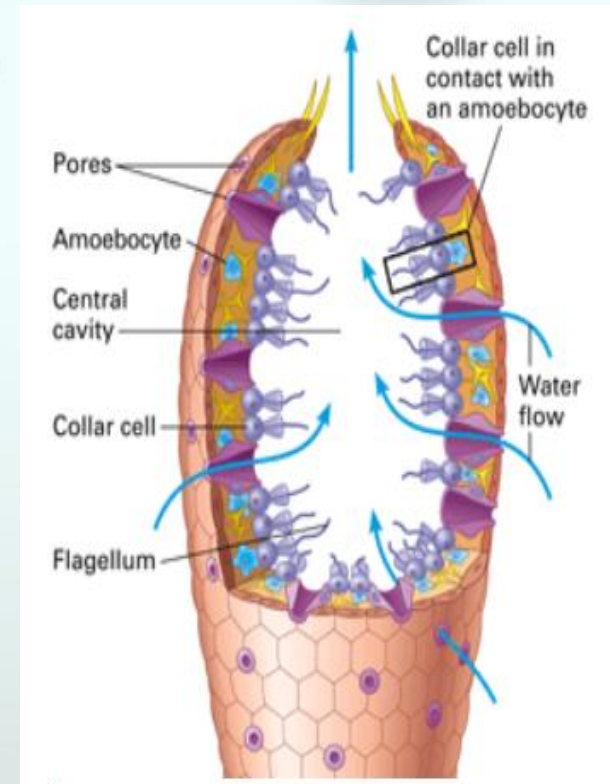
Phylum Porifera: Sponges

- **Simplest** of all animals
 - **Lack true tissues** and organs
- **Aquatic**, mostly marine
- **Lack** body **symmetry (asymmetrical)**
- Hollow, **Porous** bodies
- **Sessile**: generally remain anchored to their substrate.



Phylum Porifera: Sponges

- Body wall has **outer layer of flattened cells** and **inner layer of flagellated "collar cells"**.
- Between these two layers is a **jelly-like matrix** that has **many types of cells** embedded in it (**amoebocytes**).
- These cells digest food, store and transport nutrients, etc.

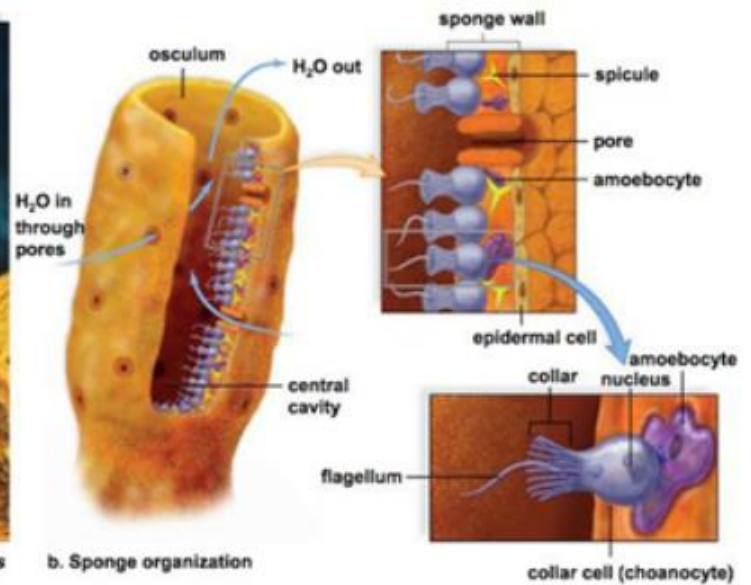


Porifera do not have a circulatory system.

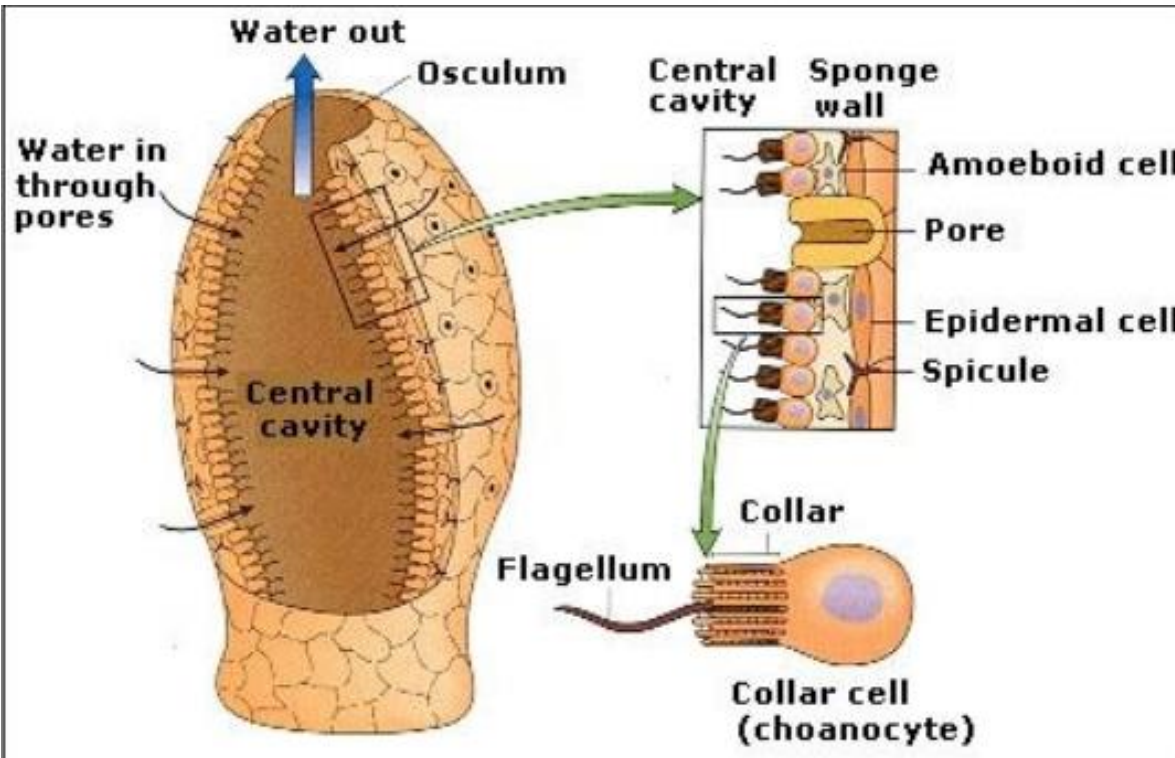
Porifera have no coelom (acoelomate).



i. Yellow tube sponge, *Aplysina fistularis*



b. Sponge organization

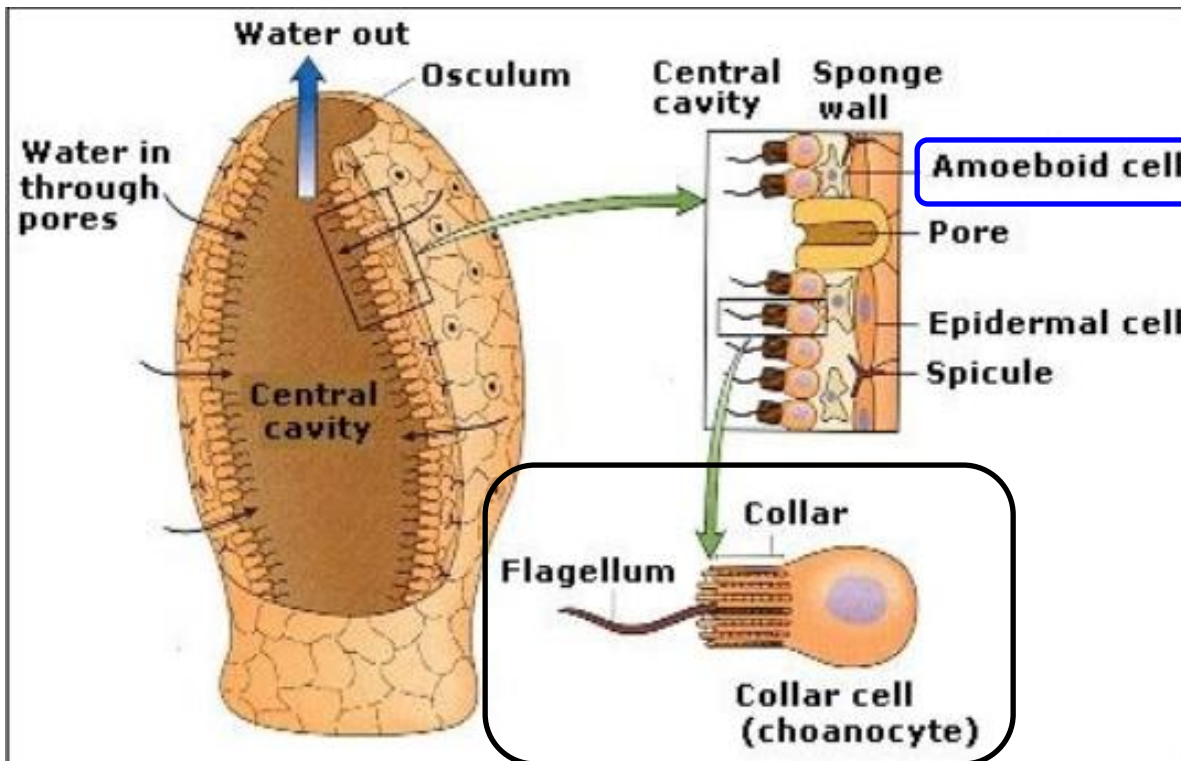


Porifera have no real body layers but they do have 2 cell layers:

- an outer layer that makes up the epidermis
- an inner layer that makes the inner cavities.

Porifera have specialized cells called choanocytes (collar cells). Choanocytes have a flagella, which is surrounded by collar composed of cytoplasm. Flagella produce water current to capture food.

Amoebocytes are cells that perform similar tasks of a circulatory system and store nutrients.



Phylum Porifera: Sponges

Filter Feeders

Movement of flagella on collar cells produces a current of water into the sponge's **central cavity**.



- **Food particles are trapped and distributed to other cells.**
- Water and wastes exit through a large hole at the top.

Phylum Porifera: Sponges

Porifera have both Asexual and Sexual reproduction.

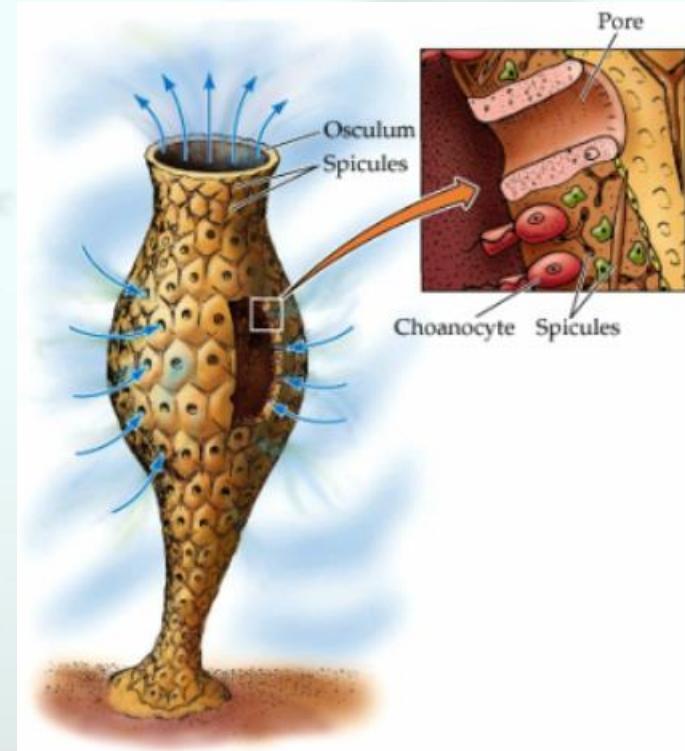
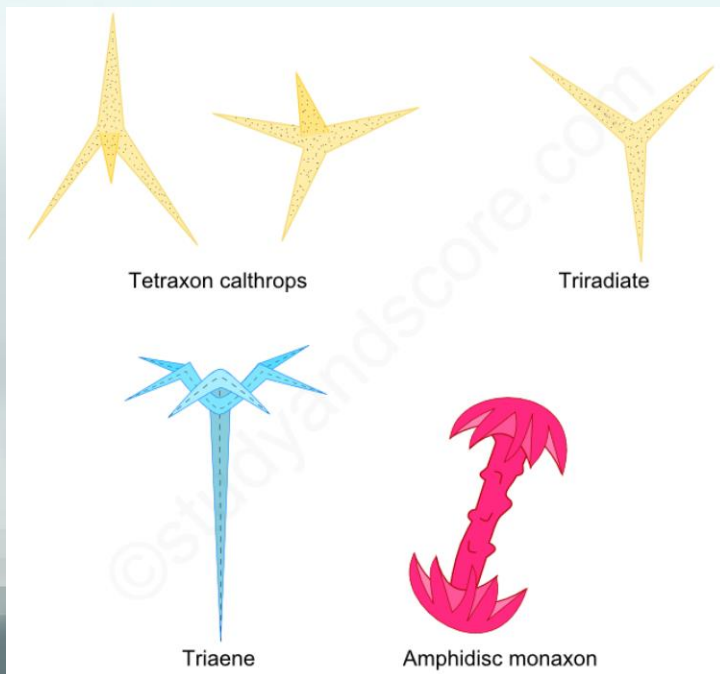


- **Hermaphrodites**
 - Possess & release **BOTH eggs and sperm** into the water (**SEXUAL** reproduction).
- Sponges can reproduce **asexually** by **BUDDING** ... the unique ability of regeneration, a form of **asexual** reproduction. E.g. injury

Phylum Porifera: Sponges

“Skeleton”

- **Spicules** are microscopic crystalline structures that give rigidity and form.



Some spicules have toxic chemicals that help deter predators or catch prey.

Which branch of animals has the most species?



Sponges are phylum ____ and most are ____ (body symmetry). They are ____ (live in water) and ____ (attached to a substrate). They have no ____ tissues.

They are ____ (body cavity type). For circulation, digestion, and storage they have ____ cells and ____ and are called ____ feeders.

Sponges reproduce ____ with sperm and egg and are called ____ because they use both gametes. They reproduce ____ by ____ and can regenerate body parts.

Sponges' skeletal system for form and rigidity come from ____, which can also capture ____ and deter ____.

Which branch of animals has the most species?



invertebrates

Sponges are phylum porifera and most are asymmetrical (body symmetry). They are aquatic (live in water) and sessile (attached to a substrate). They have no true tissues.

They are acoelomate (body cavity type). For circulation, digestion, and storage they have collar cells and amoebocytes and are called filter feeders.

Sponges reproduce sexually with sperm and egg and are called hermaphrodites because they use both gametes.

They reproduce asexually by budding and can regenerate body parts.

Sponges' skeletal system for form & rigidity come from spicules, which can capture prey and deter predators.

Phylum Cnidaria

Hydra, jellyfish, coral, & sea anemones



Phylum Cnidaria

Includes **hydras, jellyfish, coral, sea anemones**

Aquatic (mostly marine)

Radial symmetry

Body Plans: 2 Tissue Layers

- **Ectoderm → protective & sensory**
- **Endoderm → nutritive, glandular, digestion**
- **Mesoglea → nerve network**

Gastrovascular cavity → 2-way digestion

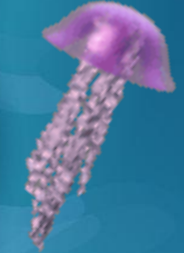
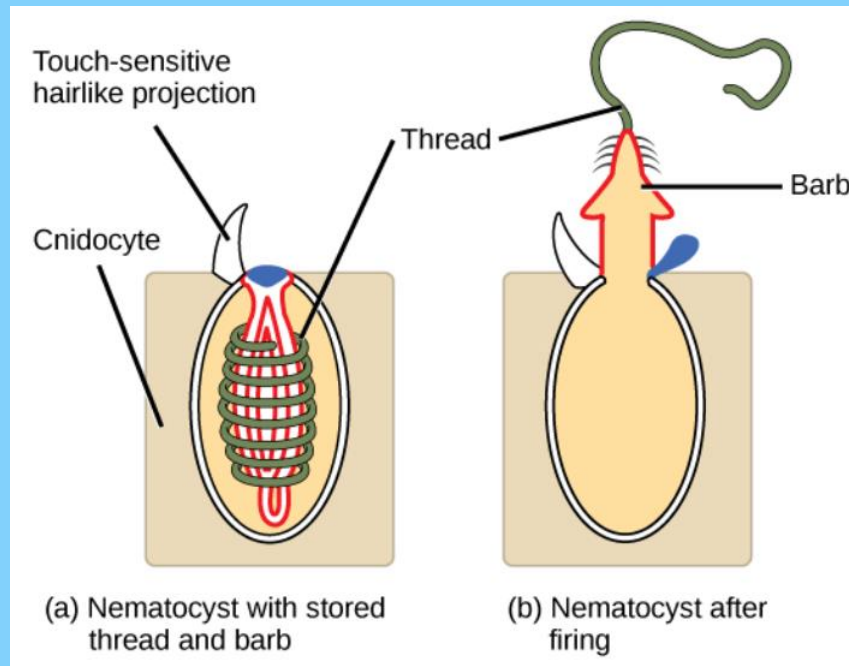
- **Acoelomate**
- **Mouth surrounded by tentacles.**
- **Nematocysts: (stinging cells)**



Phylum Cnidaria

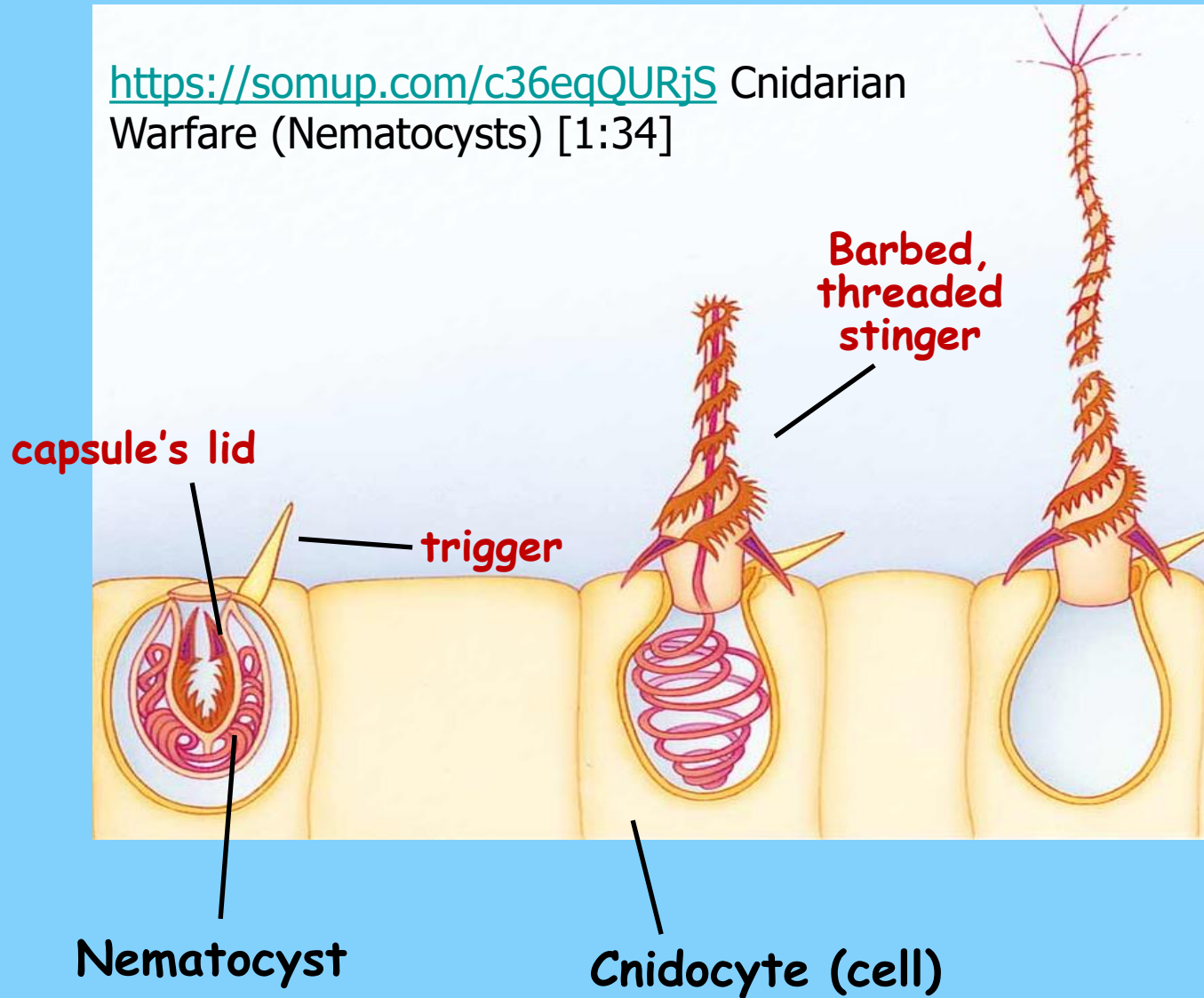
Feeding Habits

- Food is grabbed by tentacles and paralyzed with **nematocysts** to sting predators and prey.
- **CNIDOCYTES** (stinging cells) found in the **Tentacles**. Each has a **Nematocyst** that has a coiled, harpoon-like stinger that shoots out when triggered.



Nematocyst

<https://somup.com/c36eqQURjS> Cnidarian Warfare (Nematocysts) [1:34]

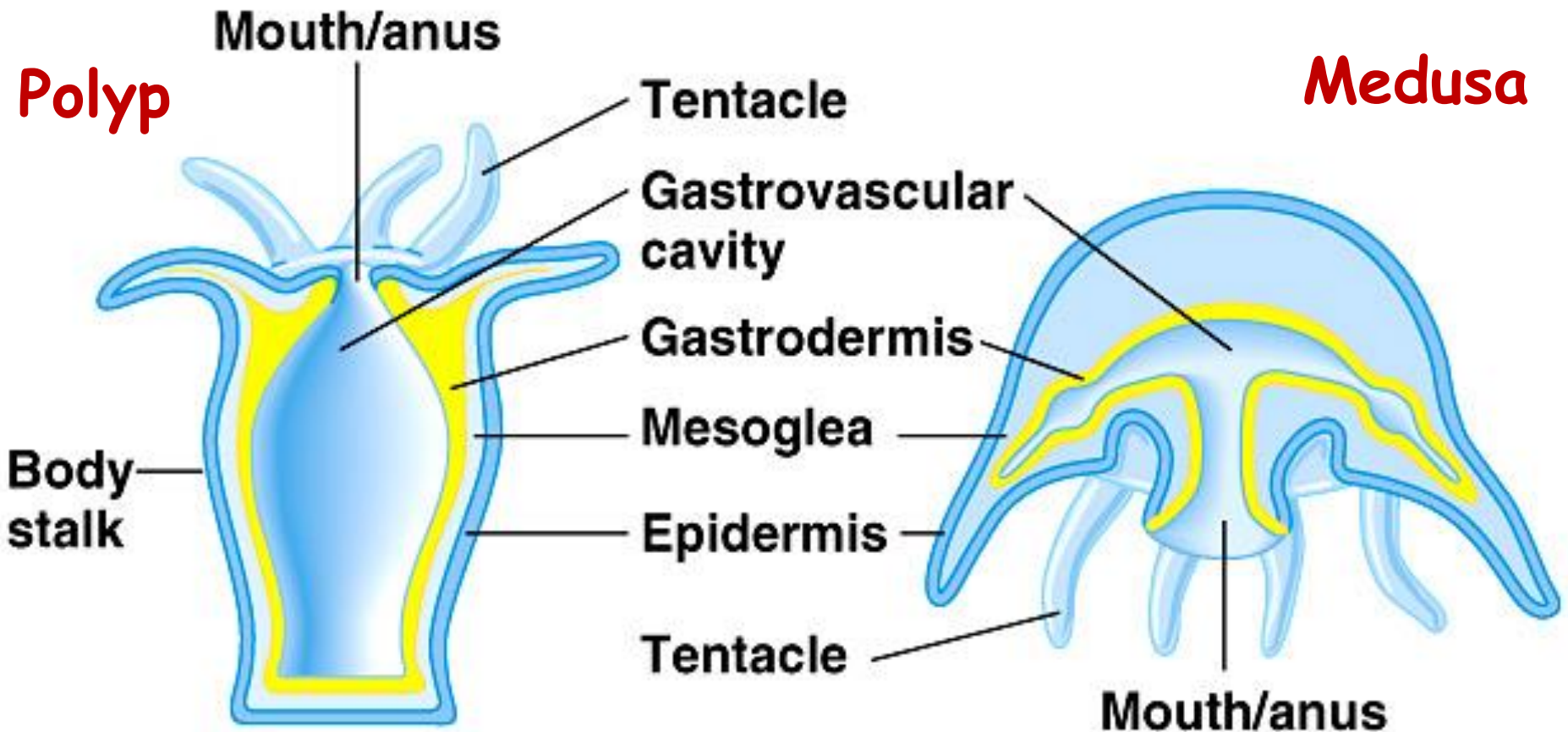


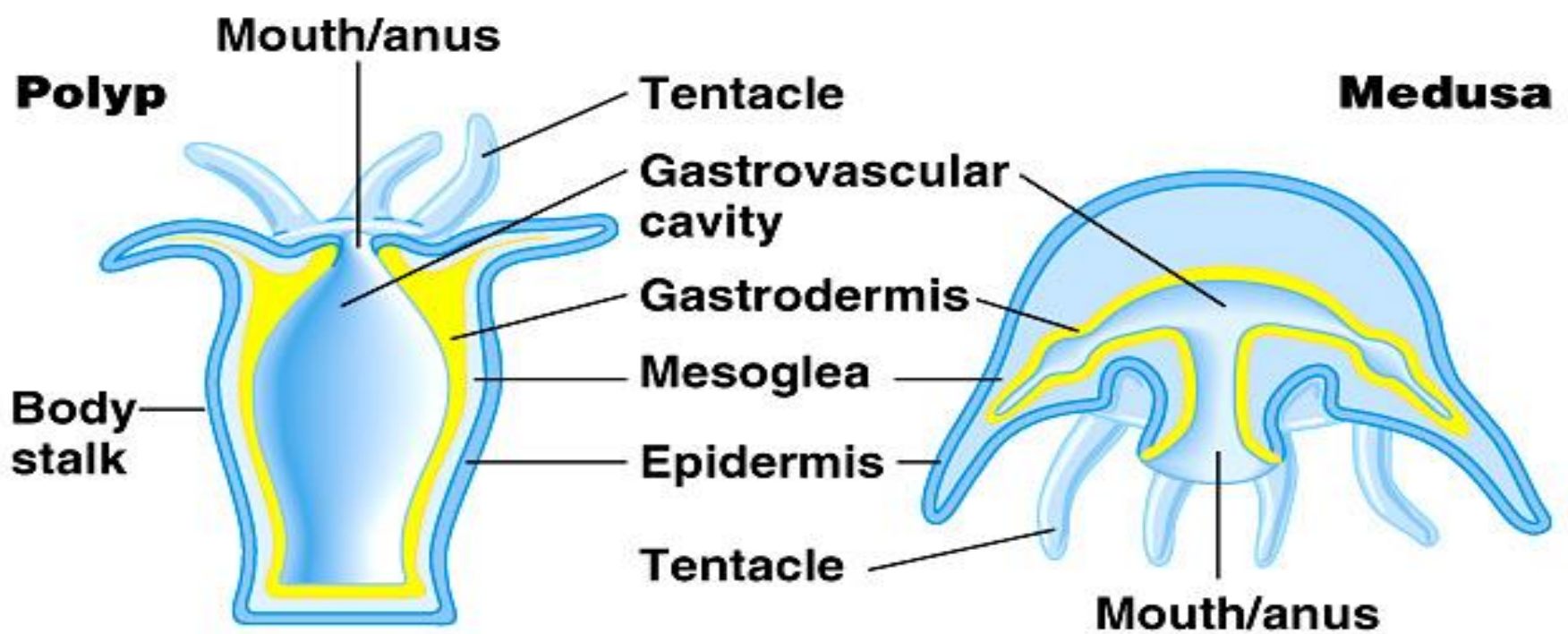
Phylum Cnidaria

Life Forms

POLYP: mouth directed **upward**; hydra, Coral

MEDUSA: mouth directed **downward**; Jellyfish





(a) Sea anemone: a polyp



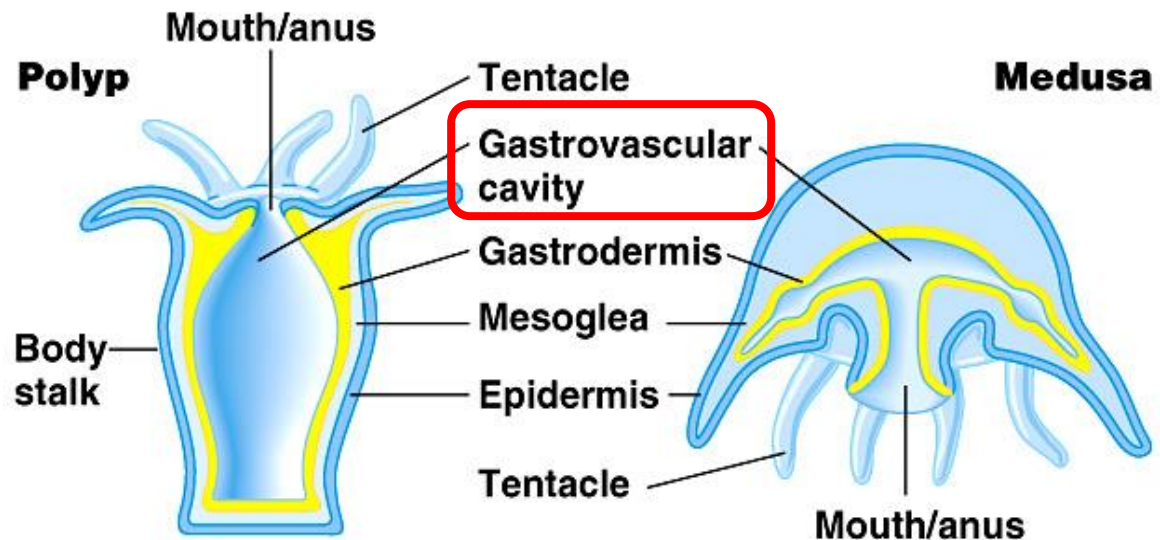
(b) Jelly: a medusa

Cnidarians have an incomplete digestive system with only one opening; the **gastrovascular cavity** serves as both a mouth and an anus.

Cnidarians carry out **EXTRACELLULAR DIGESTION**, where enzymes break down the food particles and cells lining the gastrovascular cavity absorb the nutrients.

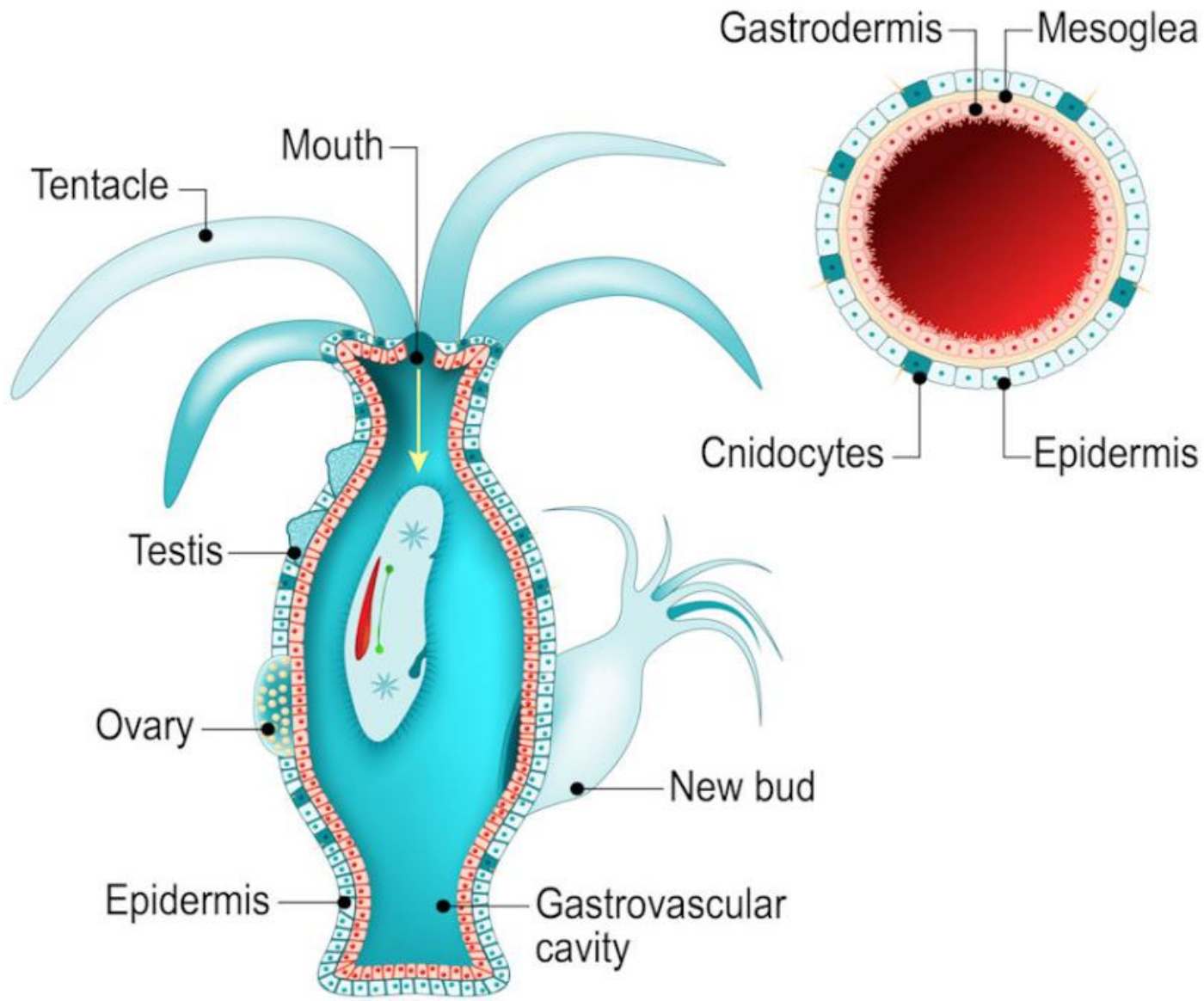
An advantage of extracellular digestion is the capacity to eat larger food particles.

<https://somup.com/c36eqgURXL> (4:49) Cnidarians
General Features



Phylum Cnidaria

Anatomy (polyp)



Phylum Cnidaria

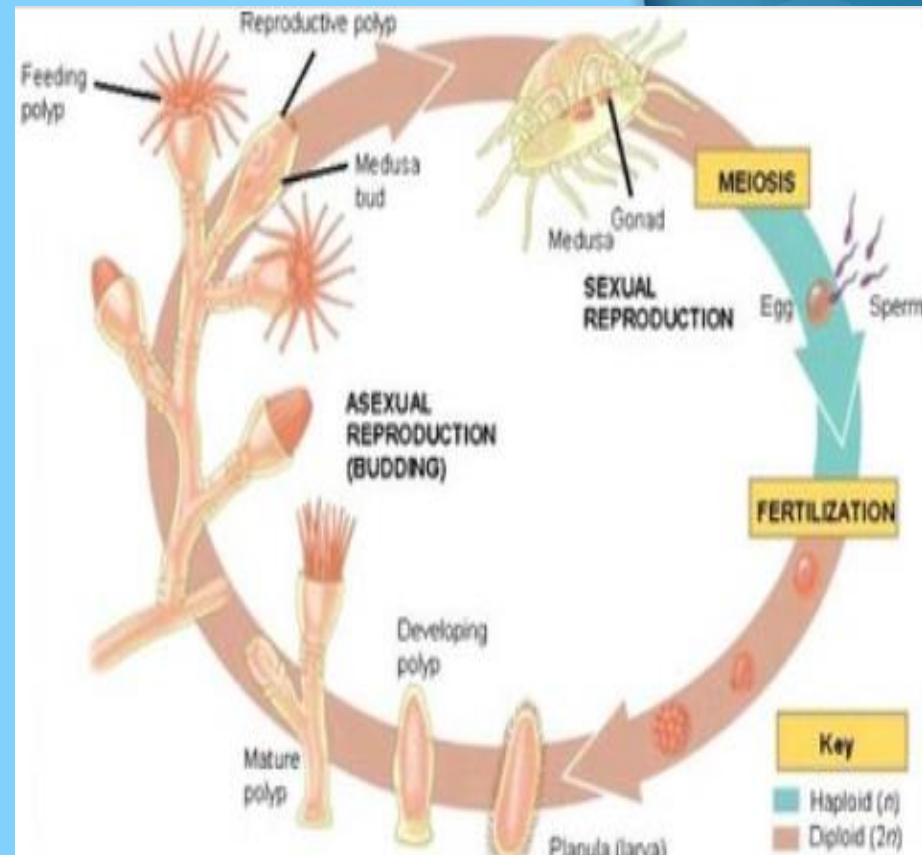
REPRODUCTION

Cnidarians reproduce **both sexually and asexually**.

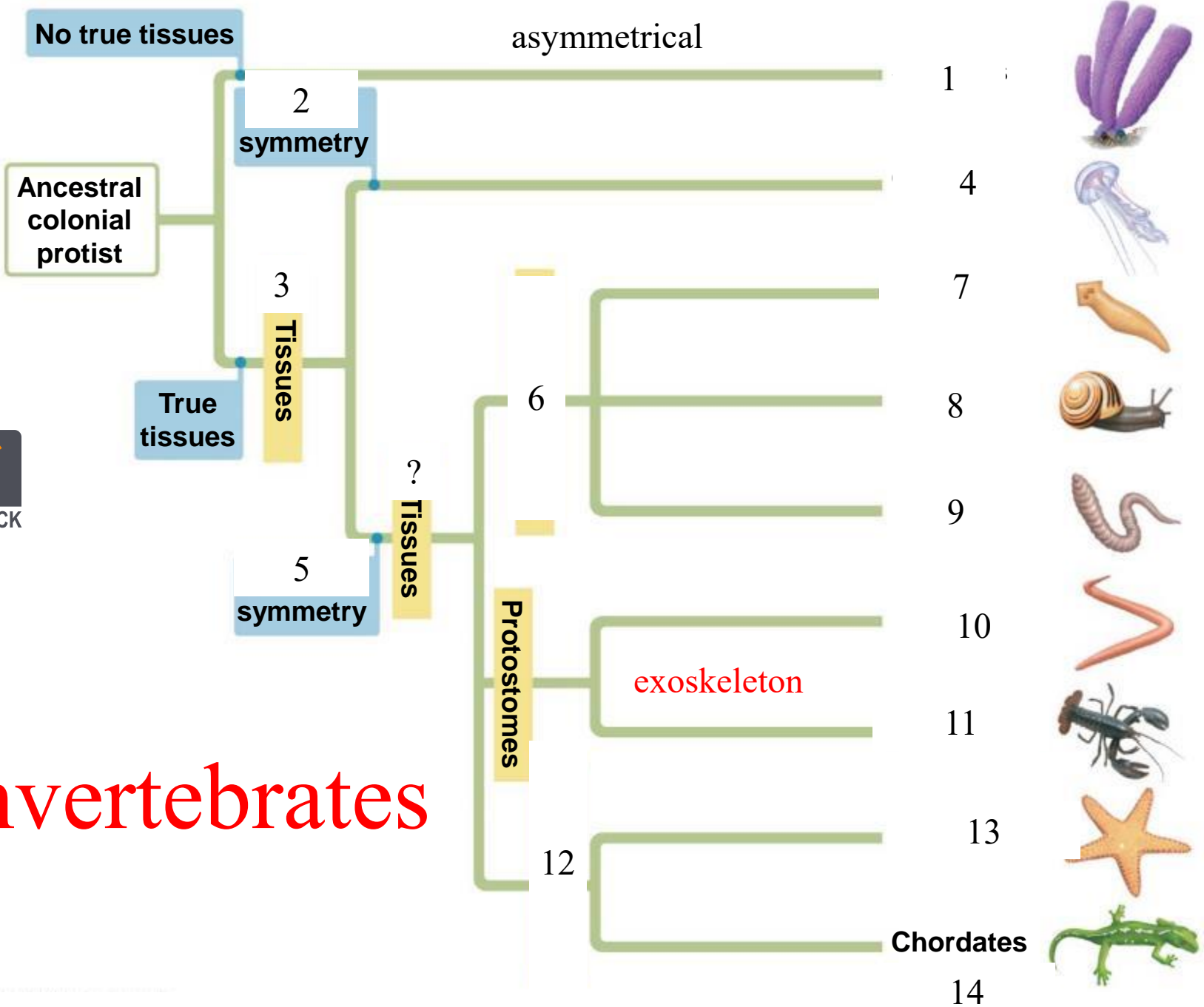
Some species can produce both eggs and sperm in the same organism. These organisms are called simultaneous hermaphrodites and release gametes into the ocean in egg-sperm bundles.



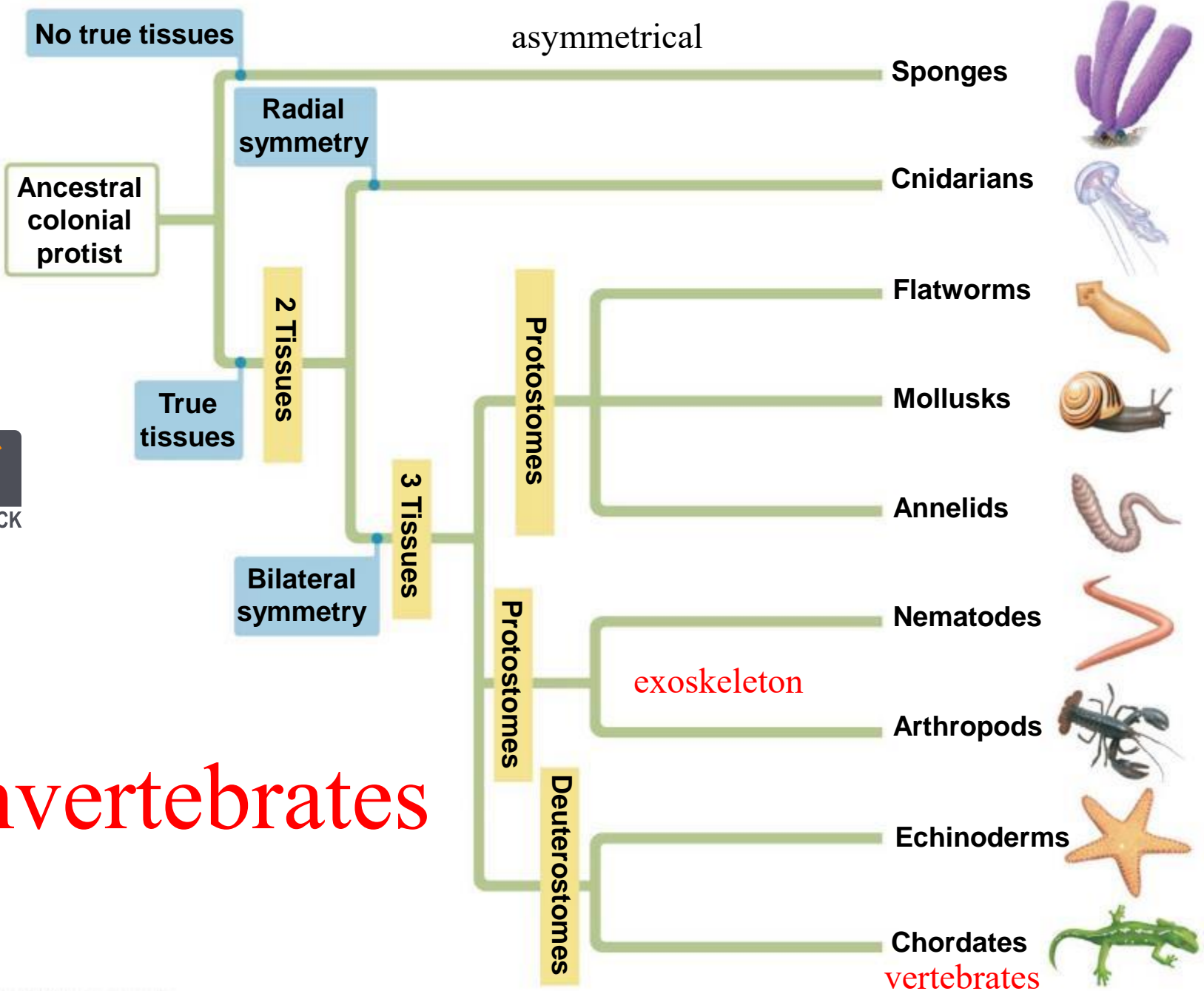
Some species are also either male or female and produce either eggs or sperm.



Invertebrates




Invertebrates



Animal Phyla Project

- Download the worksheet.
- Download the PowerPoint template.
- Secure “google drive” access.

-  a porifera
-  b cnidaria coelenterates
-  c nematodes round worms
-  d platyhelminthes
-  e Annelids
-  f echinoderms
-  g Mollusks
-  h Arthropods
-  i Chordates
-  Animal PPT Sample