

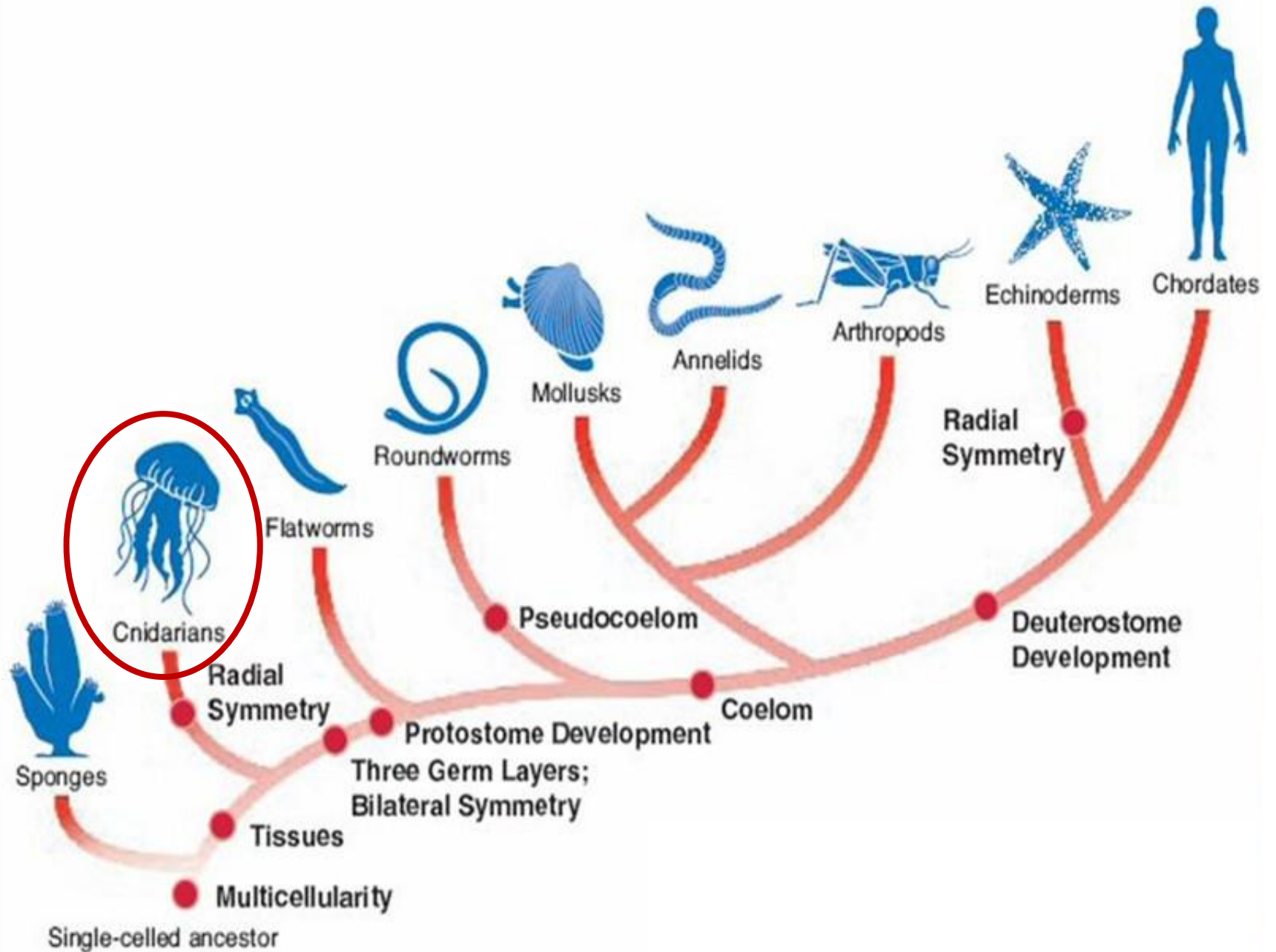
Today's lesson was brought to you by...



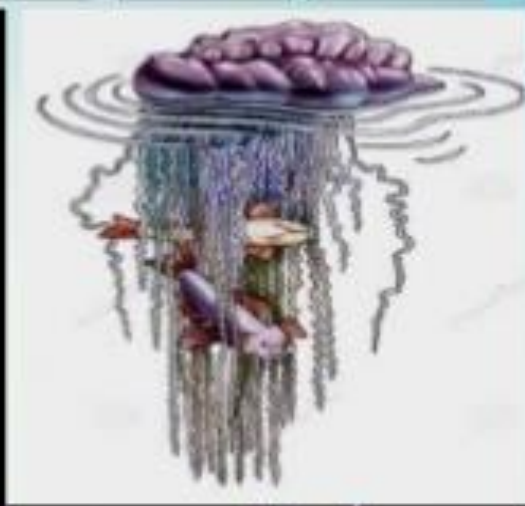
<https://youtu.be/YibPUJTnrGk?t=42>

Brainstorm

- 1) What do you think of when you think of “jellyfish”? What are some of its key characteristics?
- 2) What might a jellyfish be related to? Any other groups of animals you can think of?



PHYLUM CNIDARIA



Cnidarians: overview

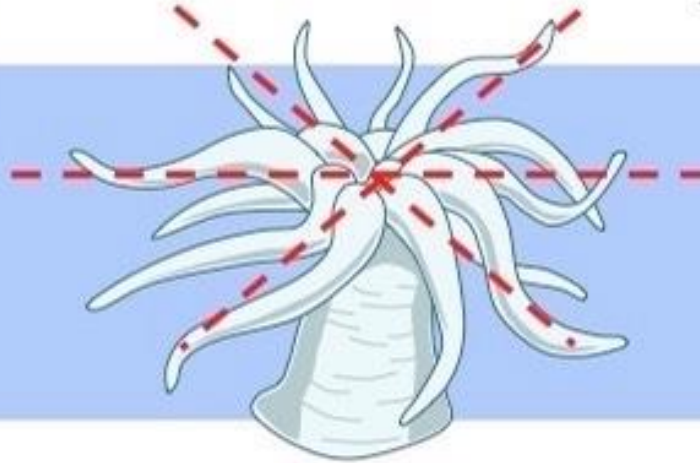
- ❖ Includes sea anemones, coral, jellyfish, hydras
- ❖ Over 10,000 species, mostly marine
- ❖ Carnivores with specialized stinging cells called cnidocytes
- ❖ First appearance of true tissues and germ layers; have a central gastrovascular cavity (GVC or 'gut')
- ❖ Two body forms: polyp and medusa

Cnidarians: key characteristics

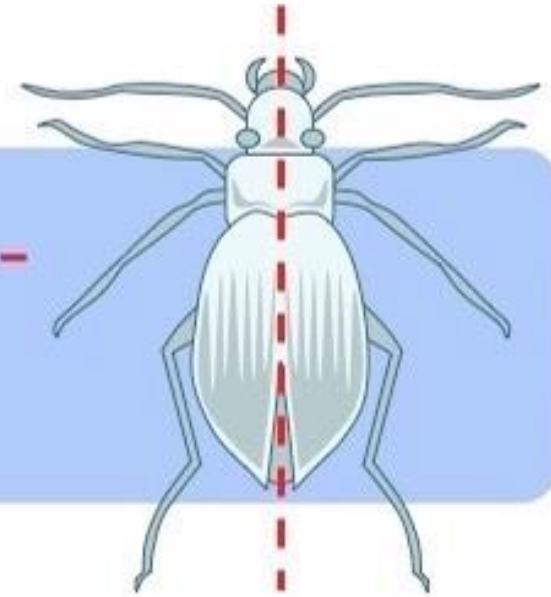
- ❖ (Eukaryotic, Multicellular)
- ❖ Radial symmetry
- ❖ Two germ layers: endoderm and ectoderm
- ❖ Two alternating forms: polyp & medusa
- ❖ Feeding: incomplete gut, cnidocytes
- ❖ Nervous system: nerve net and rhopalia
- ❖ Skeleton:
 - Hydrostatic skeleton
 - Exo- and endoskeletons
- ❖ Epitheliomuscular cells



No symmetry
(e.g. *Porifera*)

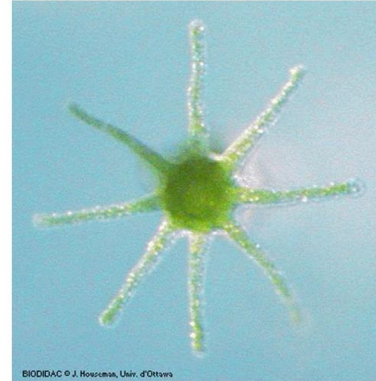
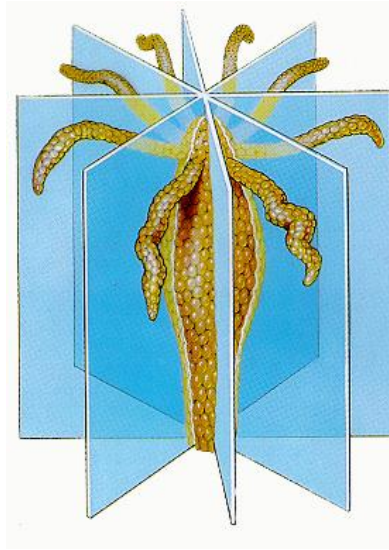
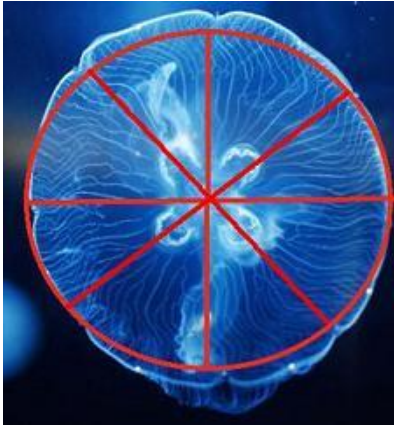


Radial symmetry
(e.g. *Cnidaria*)

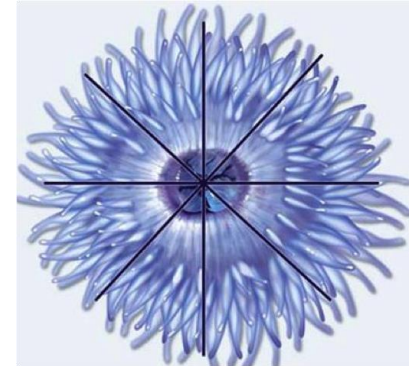


Bilateral symmetry
(e.g. *Arthropod*)

Cnidarians have **radial symmetry**



BIODIDAC © J. Housman, Univ. d'Ottawa

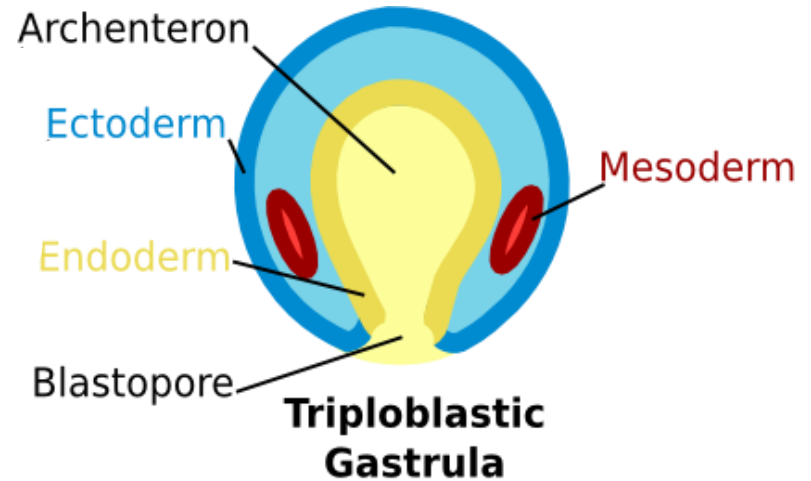
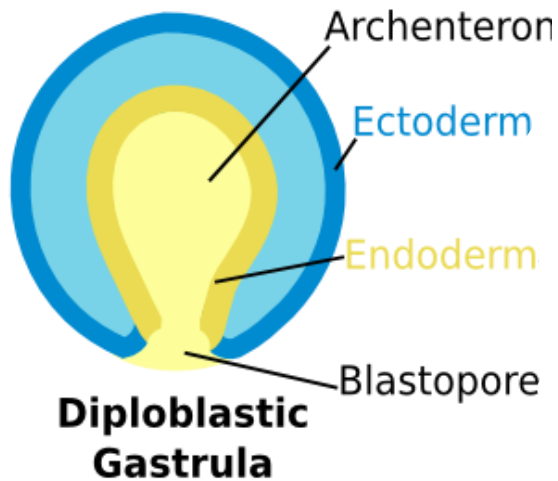


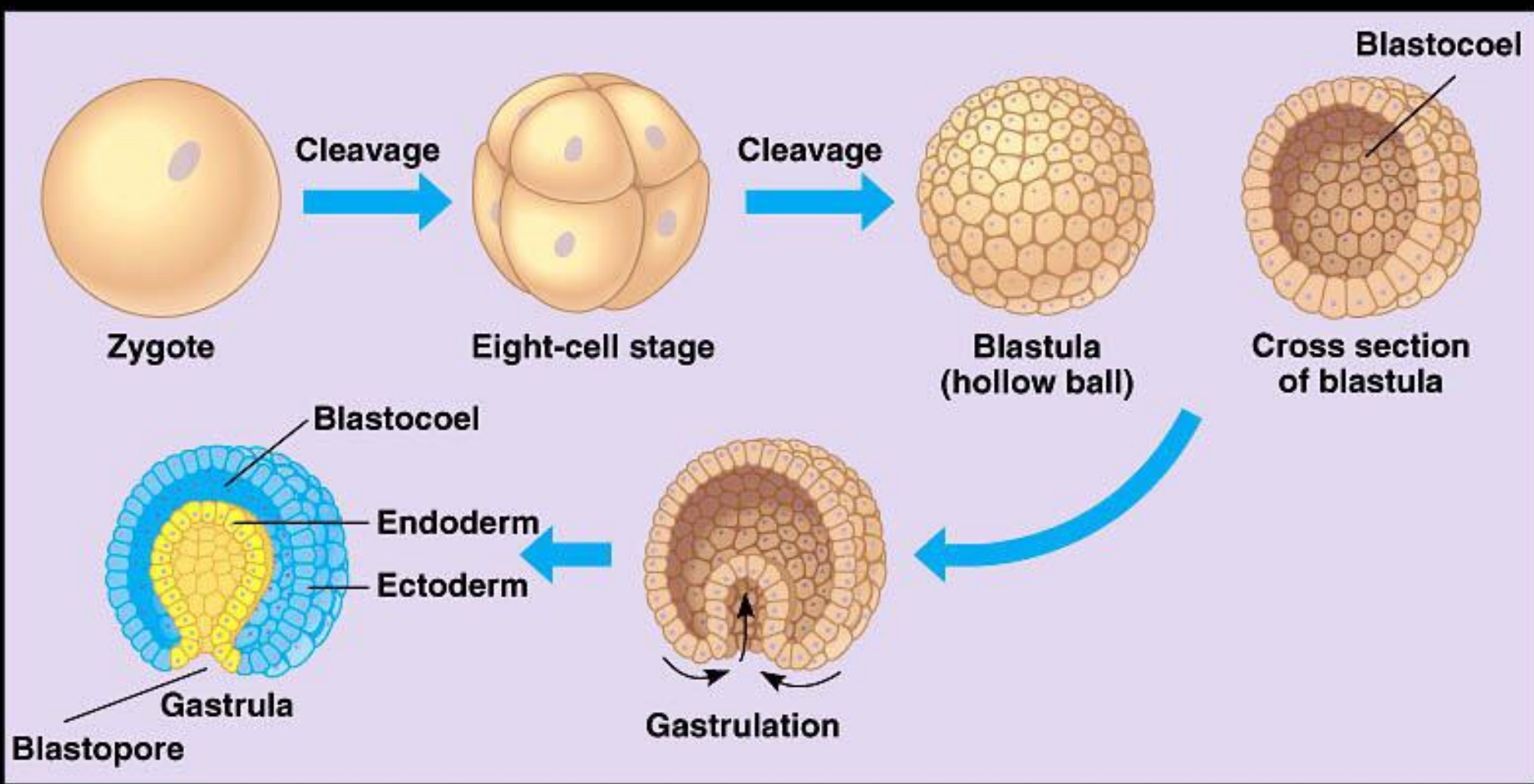
Cnidarians have **radial symmetry**

Germ Layers

Germ layer:

- Group of cells that develop together in the embryo
- Each layer will develop into certain structures





Germ Layers [Video](#)

Ectoderm:

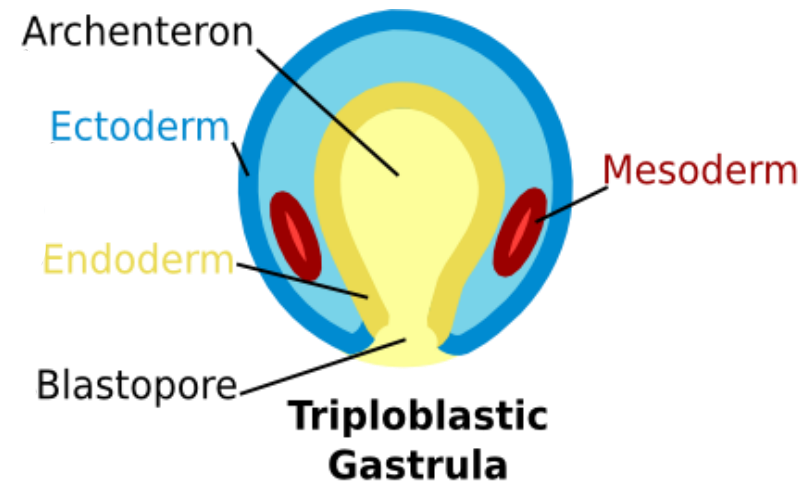
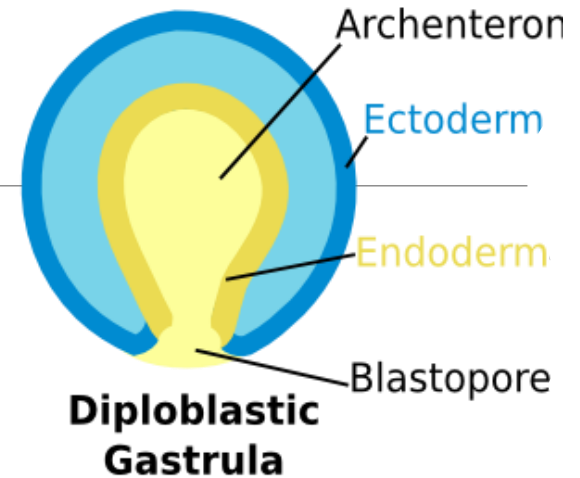
- Outermost germ layer
- External organs: e.g. skin, nervous system

Mesoderm: (absent in Cnidaria)

- Middle germ layer
- Muscles, heart, blood, bones

Endoderm:

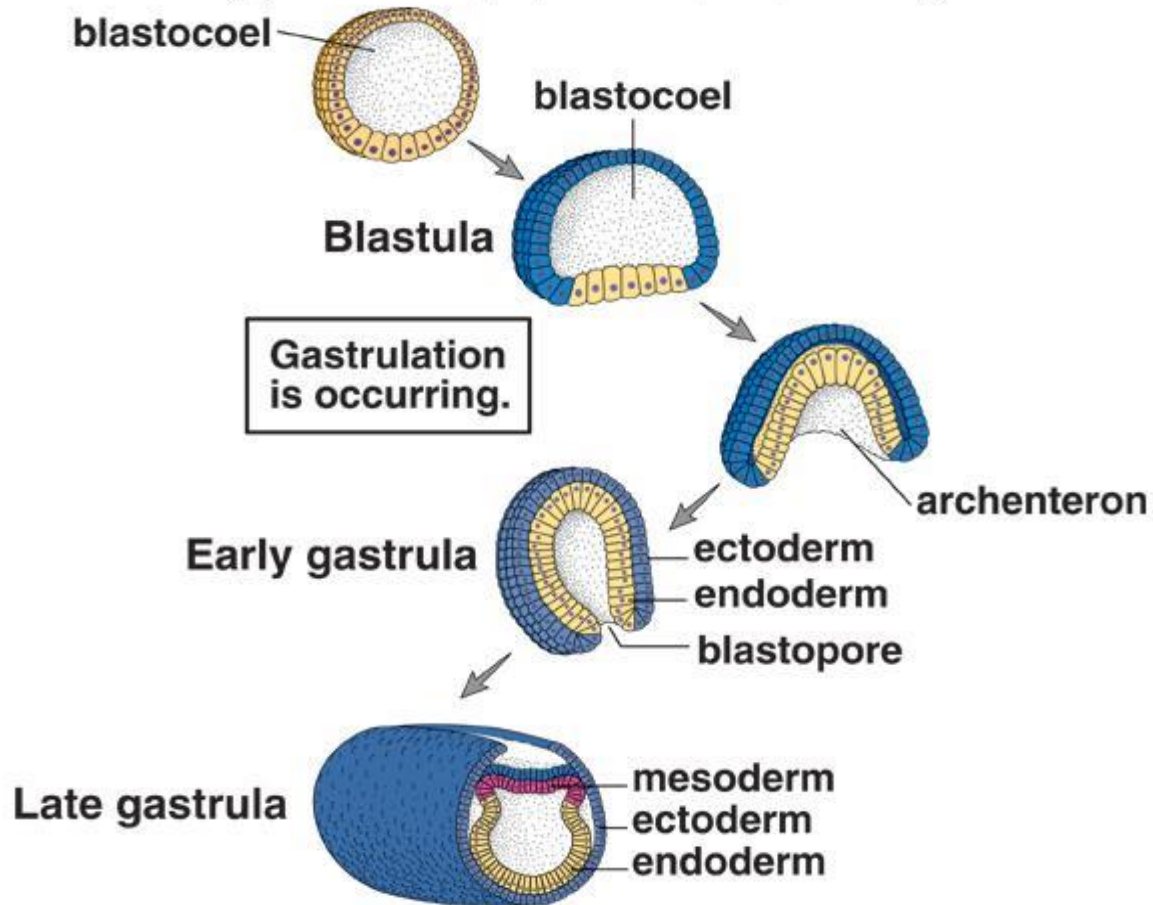
- Innermost germ layer
- Internal organs: e.g. gut (GVC), lungs



Cnidarians have a diploblastic gastrula; humans (and many other animal groups) have a triploblastic gastrula.

Germ Layers

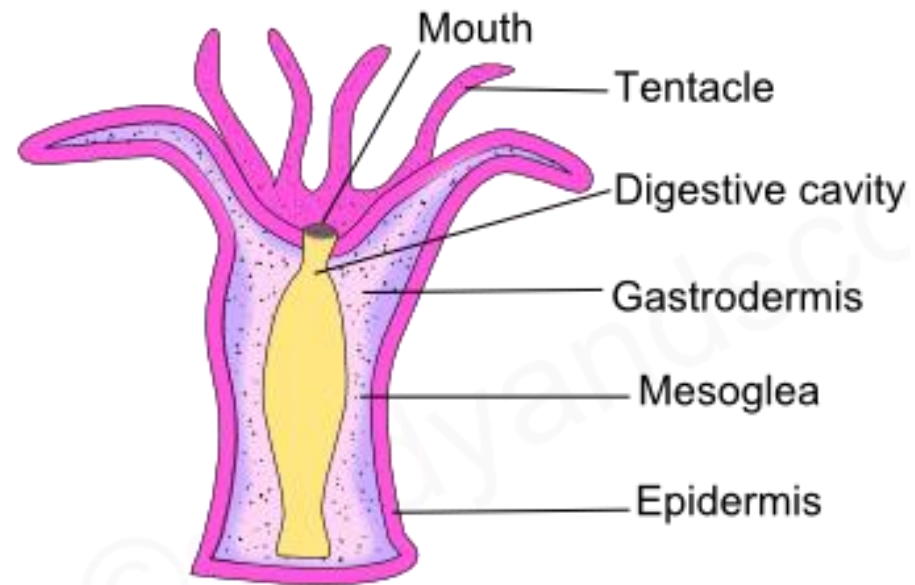
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Life Cycle: Polyp

Polyp:

- **Sessile**, attached to ocean floor
- Mouth facing upward
- Reproduces asexually by **budding**



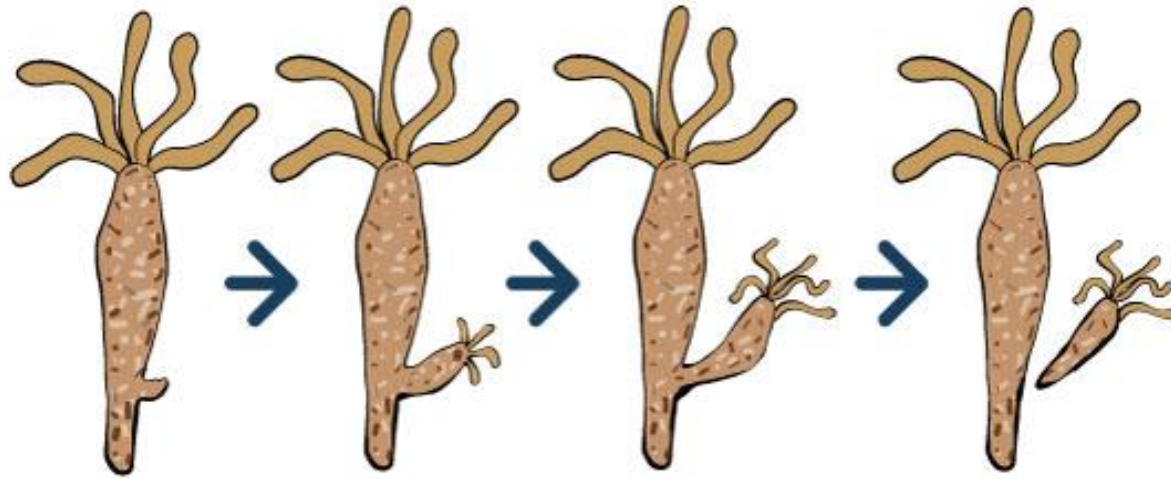
CNIDARIAN POLYP

Asexual reproduction requires *1 parent* and produces offspring that are *identical* to the parent.

Sexual reproduction requires *2 parents (sperm, egg)* and produces offspring that are *different* from the parents.

Life Cycle: Polyp Reproduction

eSchooltoday.com



tiny
bump
appears
on parent
hydra

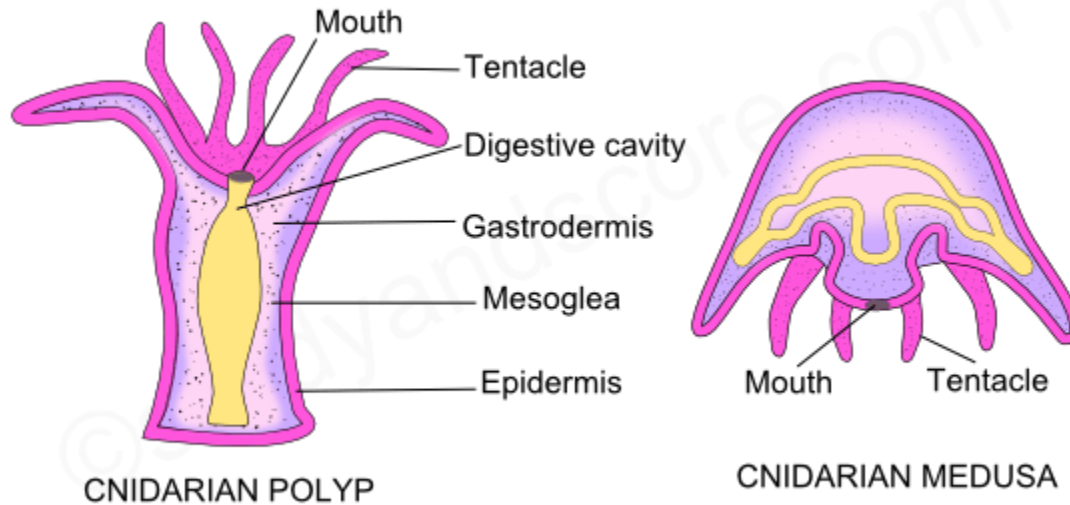
parent
hydra
develops
bud

bud
grows

bud breaks
off to
become
independent
hydra

Life Cycle

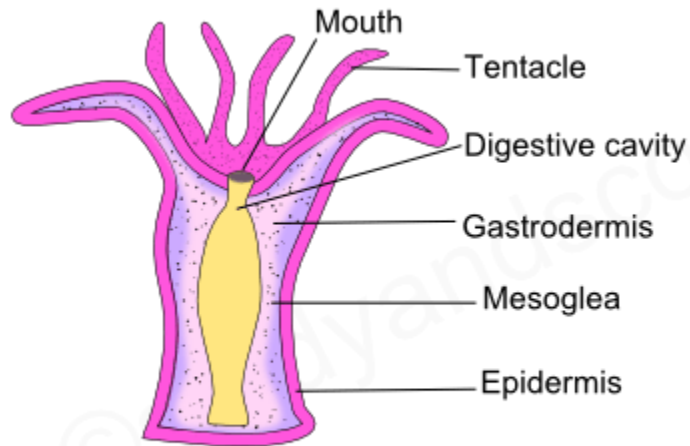
- ❖ Corals, hydra and anemones have polyp stage only
- ❖ Jellyfish alternate between two life forms: **polyp** and **medusa**



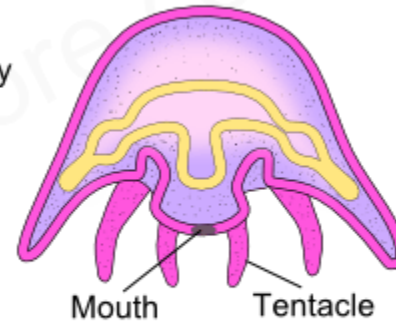
Life Cycle of Jellyfish

Medusa:

- Free-floating
- Mouth facing downward
- Reproduces **sexually**

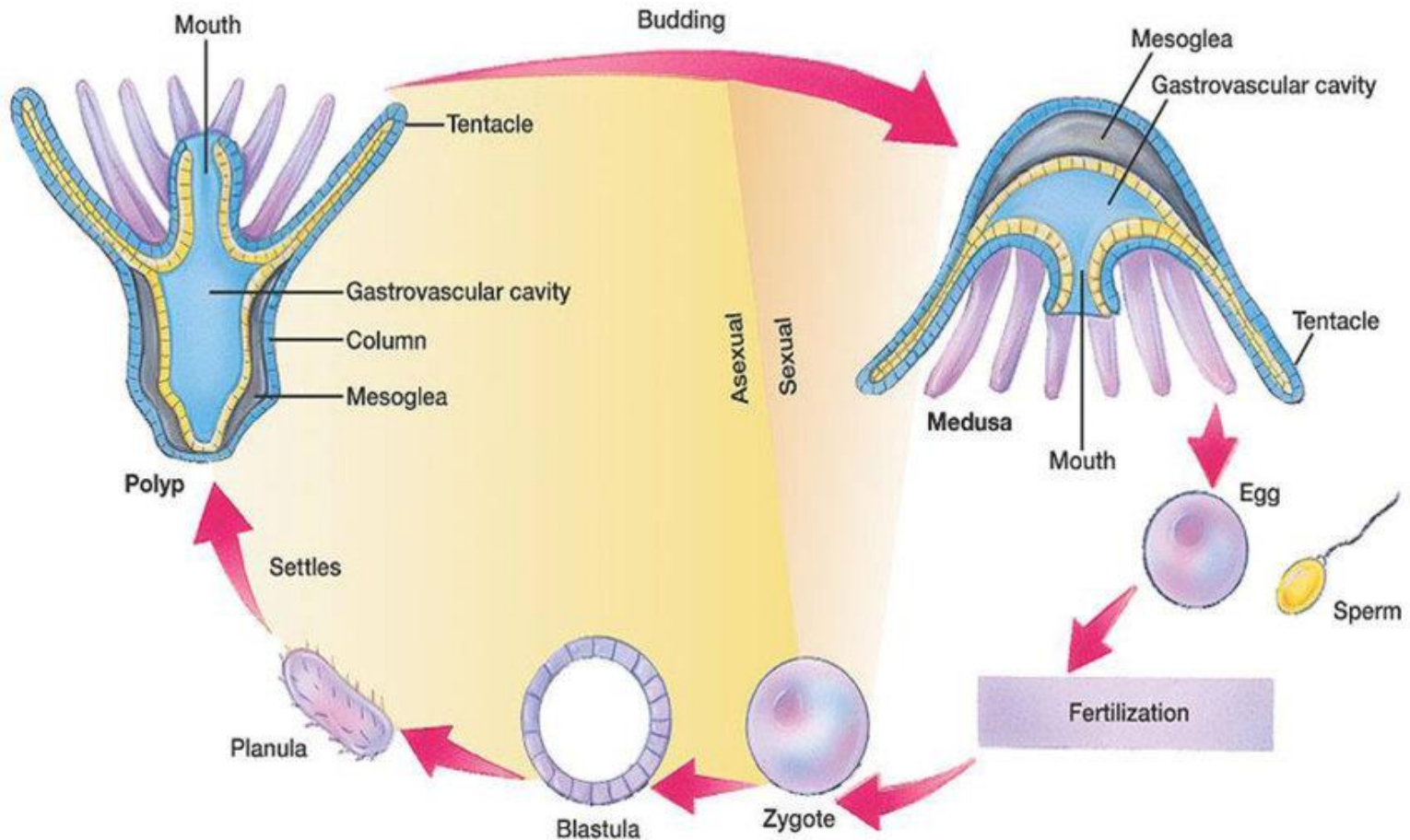


CNIDARIAN POLYP



CNIDARIAN MEDUSA

Life Cycle of Jellyfish



Cnidarian Anatomy

Epidermis: (ectoderm)

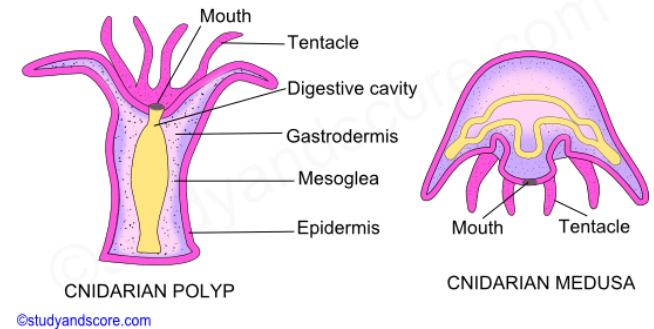
- Outermost layer ('skin')
- Contains **cnidocytes** and **nerve net** in both polyp and medusa

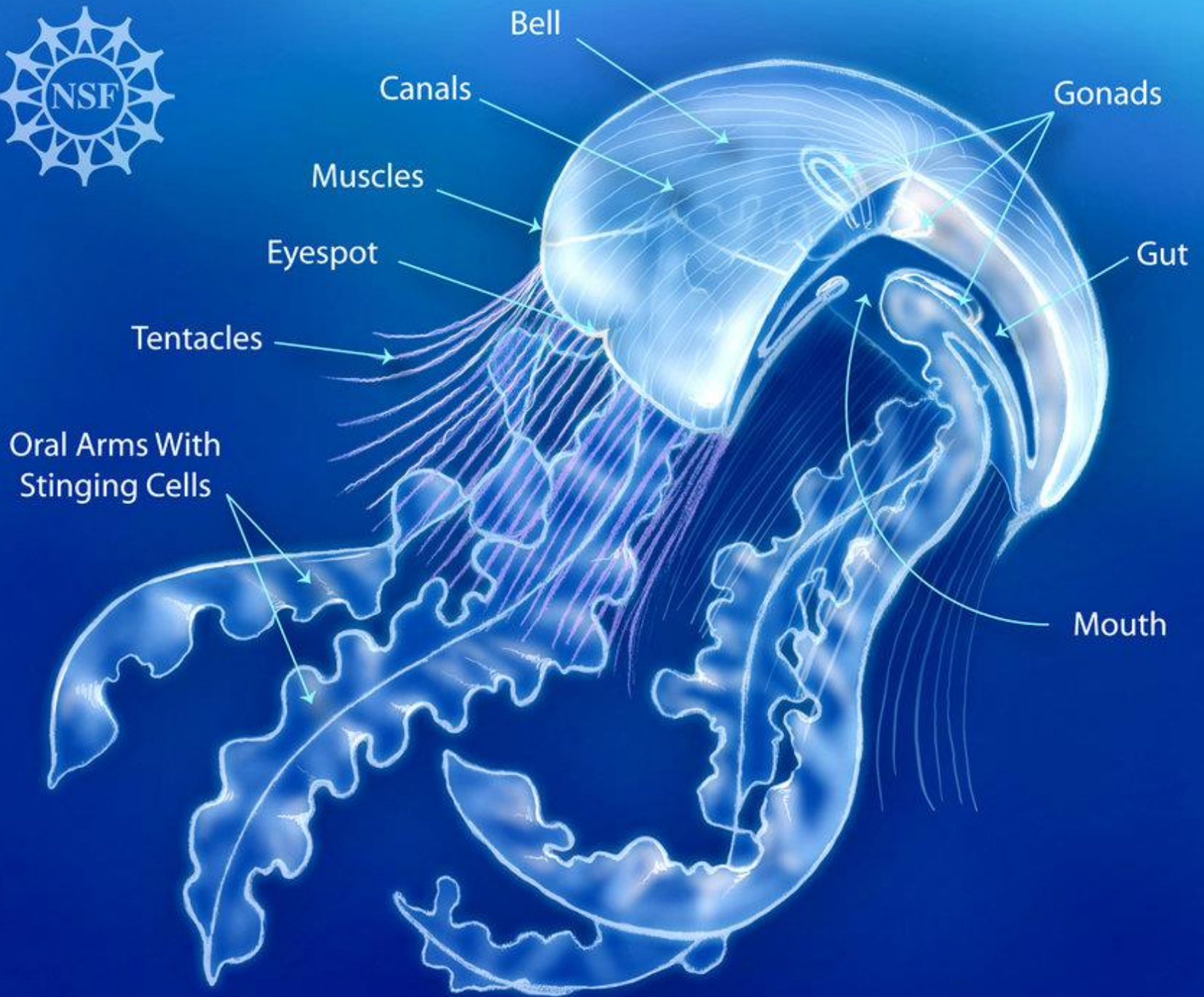
Mesoglea:

- Between epidermis and GVC
- Mostly non-living jelly
- Involved in **hydrostatic skeleton**

Gastrovascular cavity (GVC): (endoderm)

- Digests and processes food
- **Incomplete gut:** single hole is mouth and anus





Bell

Canals

Muscles

Eyespot

Tentacles

Oral Arms With
Stinging Cells

Gonads

Gut

Mouth

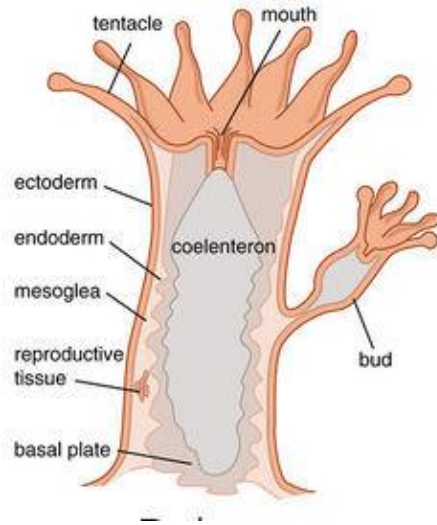


Cnidarian Anatomy

Tentacle:

- Used to capture food, deter predators
- Has **cnidocytes** on surface
- In sea anemone, can be retracted into body





Cnidarian Anatomy

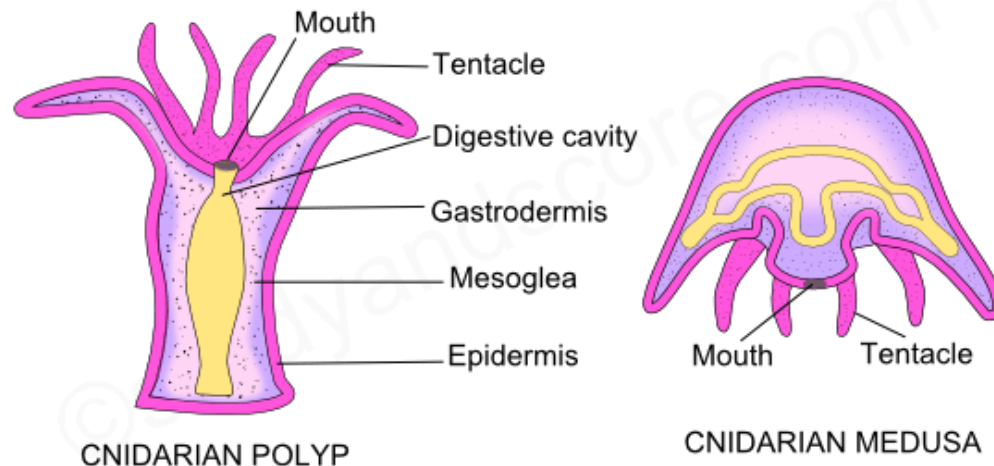
Basal plate

- In polyp form only
- Attaches organism to ocean floor



Feeding and Digestion

- ❖ Cnidarians are carnivores
- ❖ Cnidarians only have one opening into their **gastrovascular cavity (GVC)**: it is their mouth AND anus!



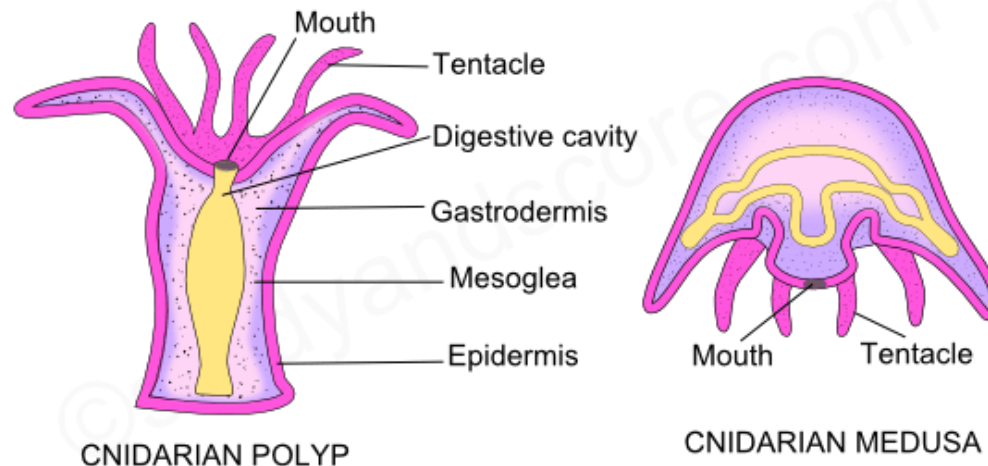






Feeding and Digestion

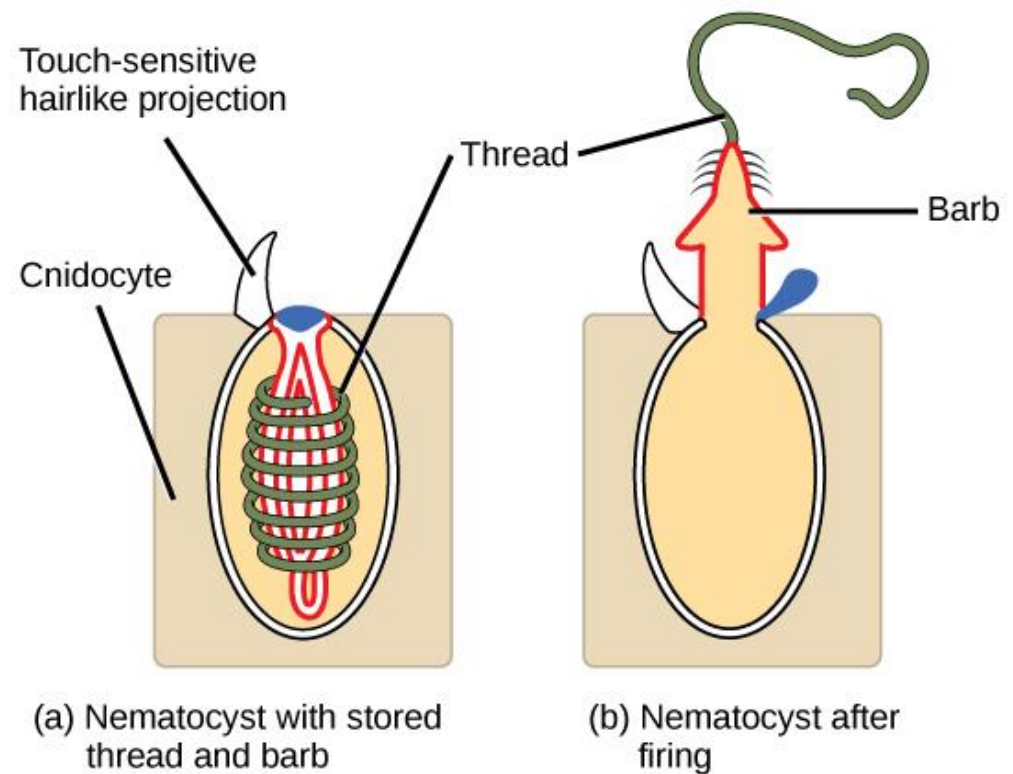
- ❖ Cnidarians are carnivores
- ❖ Cnidarians only have one opening into their **gastrovascular cavity (GVC)**: it is their mouth AND anus!
- ❖ They capture and consume prey by stinging it with cells on their tentacles called **cnidocytes**.



Specialized Cells: Cnidocytes

Cnidocyte (stinging cells)

- Found on tentacle epidermis
- For capturing prey or self-defense
- Contains barbed thread that releases on contact



Video: <https://www.shapeoflife.org/video/cnidarians-anemones-fight>

What do you expect to happen when you touch a sea anemone with your finger?

If you leave your finger in the clutches of the anemone, after a while, it starts to tingle and feel itchy. Why is this?



Nervous System

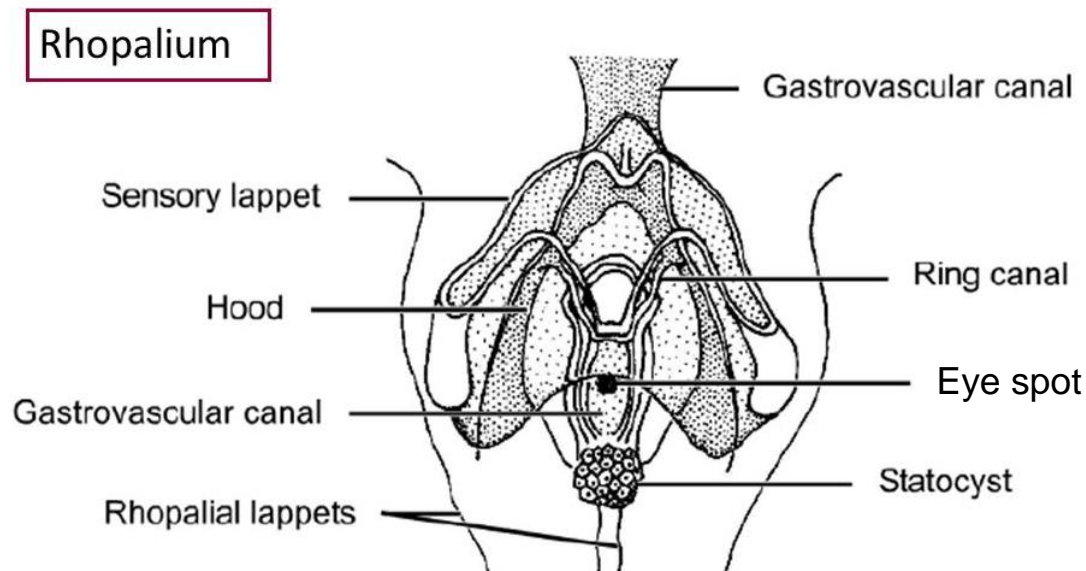
Rhopalium: cluster of sensory structures in jellyfish medusae



Nervous System

Rhopalium: cluster of sensory structures in jellyfish

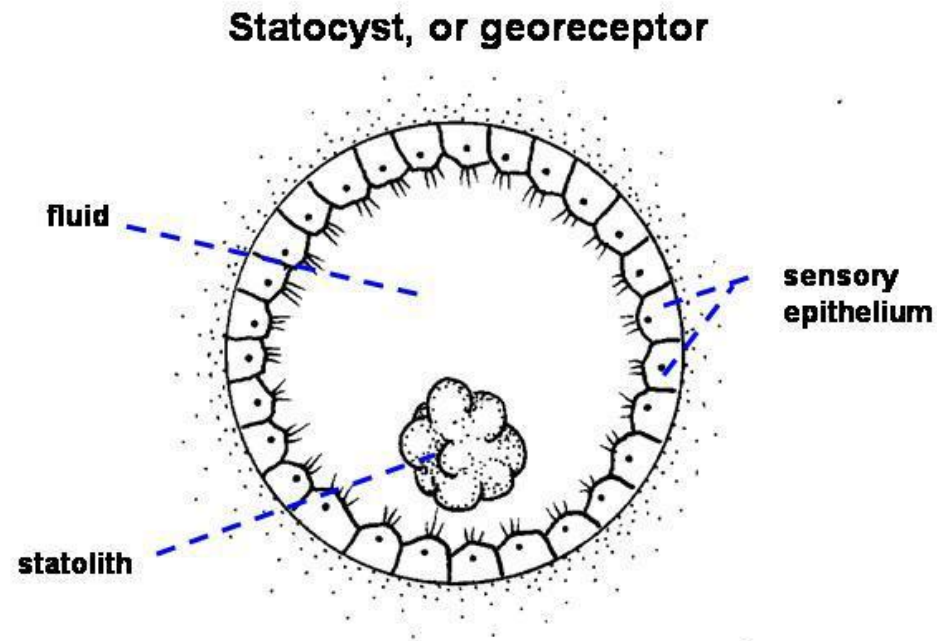
- **Eye spot:** senses light
- Chemoreceptor (not shown): detects chemicals (taste, smell)
- **Statocyst:** senses gravity (which way is up?)



Nervous System

How does the **statocyst** work?

- Rock in fluid surrounded by cells with cilia (hairs)
- When the rock touches a cilium, this is detected
- The cnidarian can always tell which way it is facing!



Ivy Livingstone © BIODIDAC

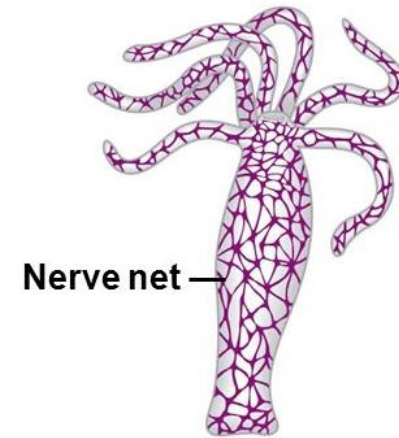
9/3/97

Nervous System

Neurons relay sensory information to **nerve net** from **rhopalia**

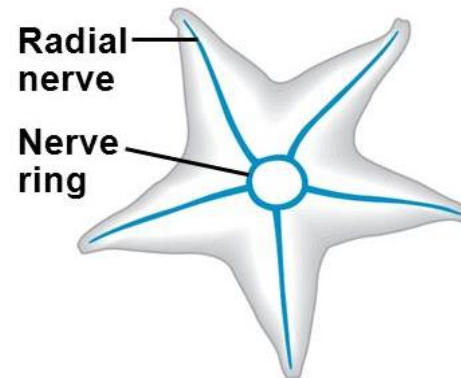
Nerve Net:

- Found in animals with radial symmetry
- Interconnected neurons without a brain or central nervous system



(a) Hydra (cnidarian)

Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.



(b) Sea star (echinoderm)

Neurons are cells of the nervous system. They transmit signals and make decisions.

Specialized cells by germ layer

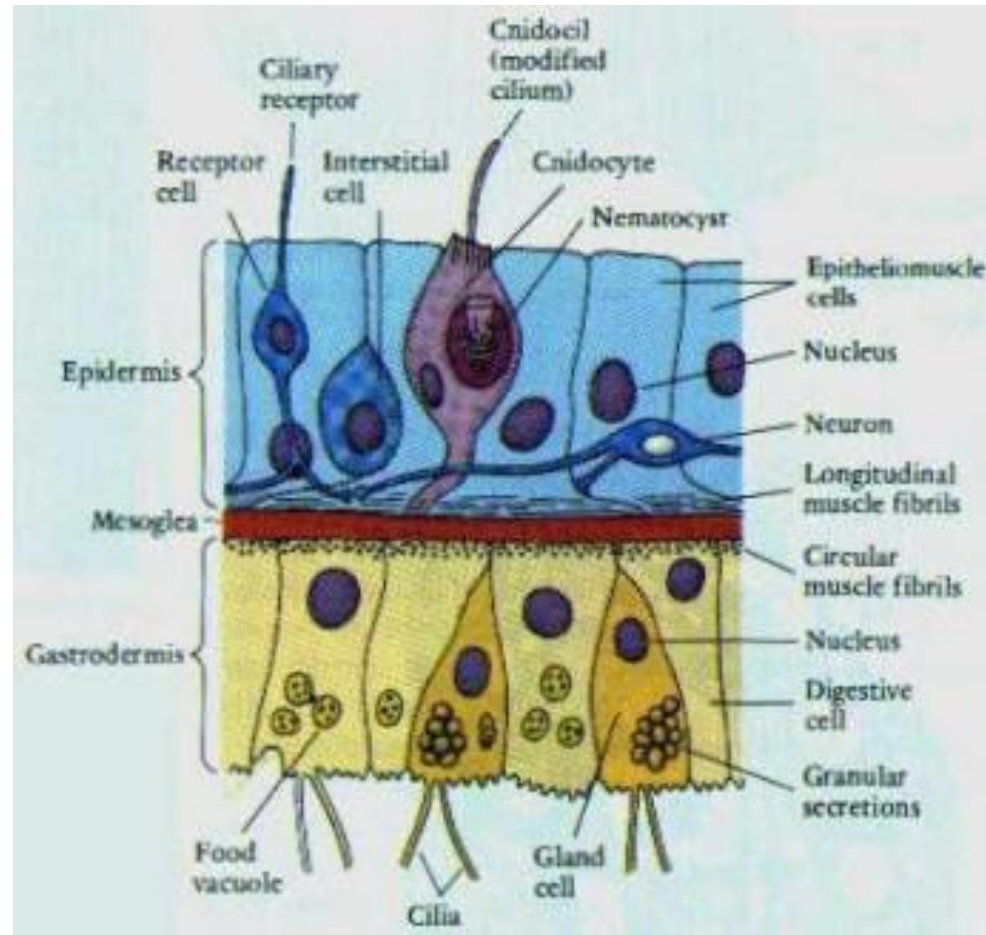
Ectoderm:

- Cnidocyte
- Neuron
- Epitheliomuscular cell

Endoderm:

- Digestive cells*

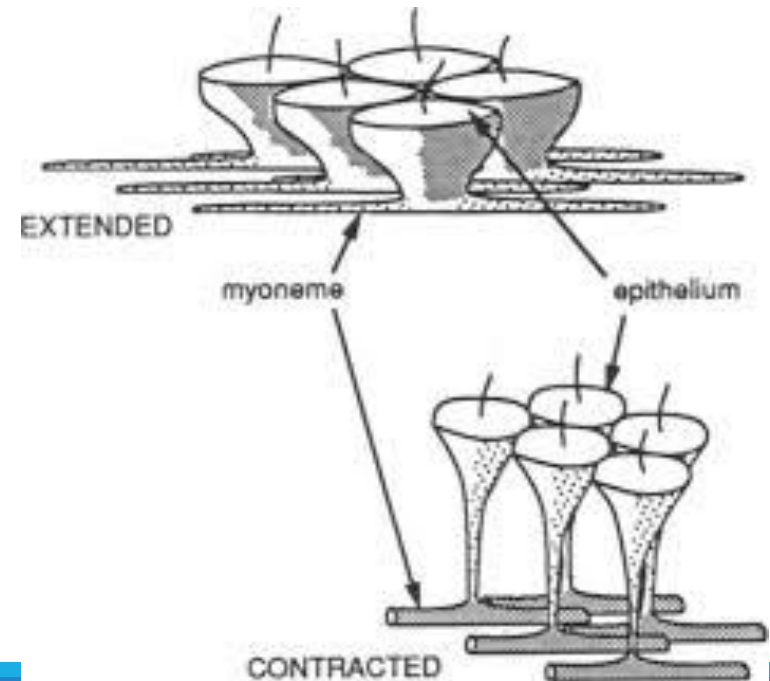
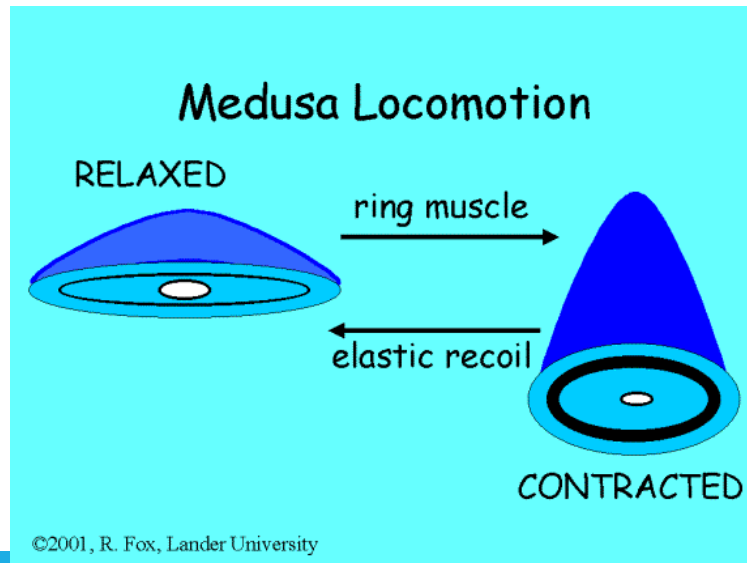
* won't go into detail



Specialized Cells: Epitheliomuscular cells

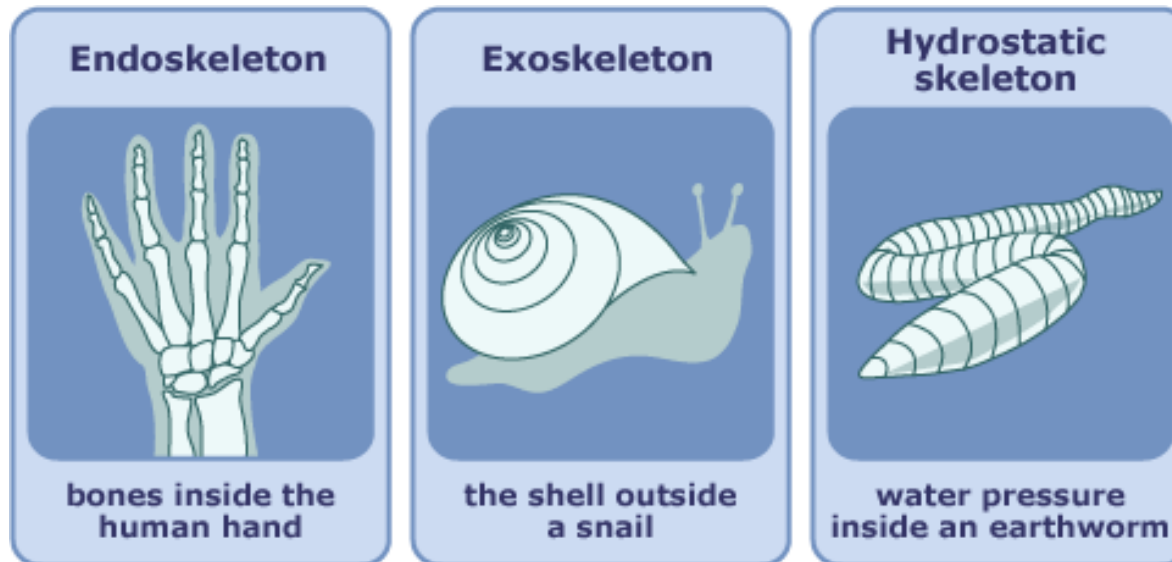
Cnidarians lack mesoderm and true muscles.

Epitheliomuscular cells are modified epidermis cells that work together to allow movement.

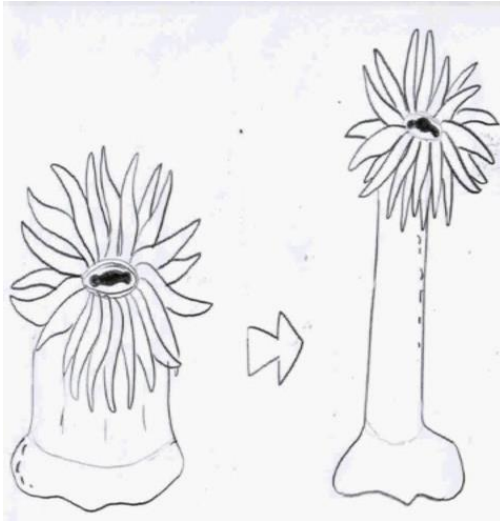


Skeleton Types

- ❖ Animal cells are squishy and lack cell walls
- ❖ Purpose of skeleton:
 - Support animal
 - Works with muscular system to allow for movement




Review: What type of skeleton do sponges have?



Hydrostatic Skeleton (all cnidarians)

- ❖ “Hydro” = water; “static” = not in motion
- ❖ **Mesoglea** exerts outward pressure and provides support for cnidarian body
 - This is just like the insides of a grape, or water in a water balloon: both are surprisingly difficult to ‘pop’!





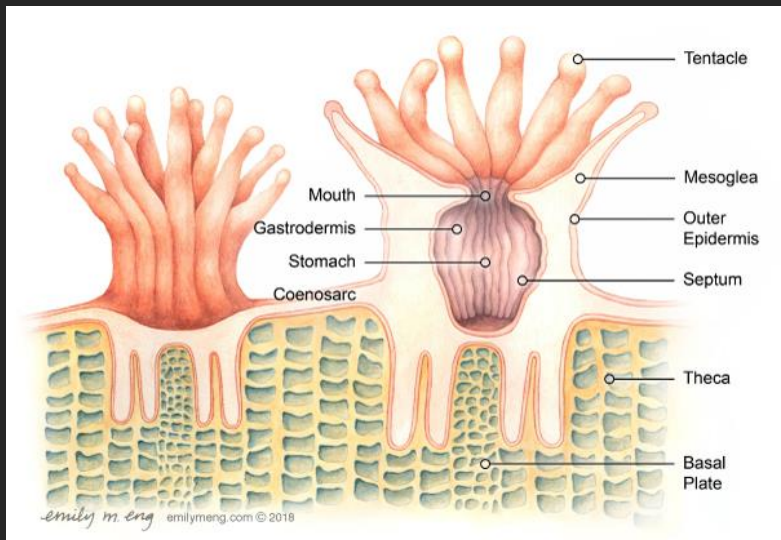
Endoskeleton (corals only)

- ❖ Some corals have hardened components embedded inside their tissue (much like Poriferan spicules)



Exoskeleton (corals only)

- ❖ Hard outer layer made of CaCO_3 (calcium carbonate)
- ❖ Is left behind when coral dies
- ❖ Affected by **ocean acidification**



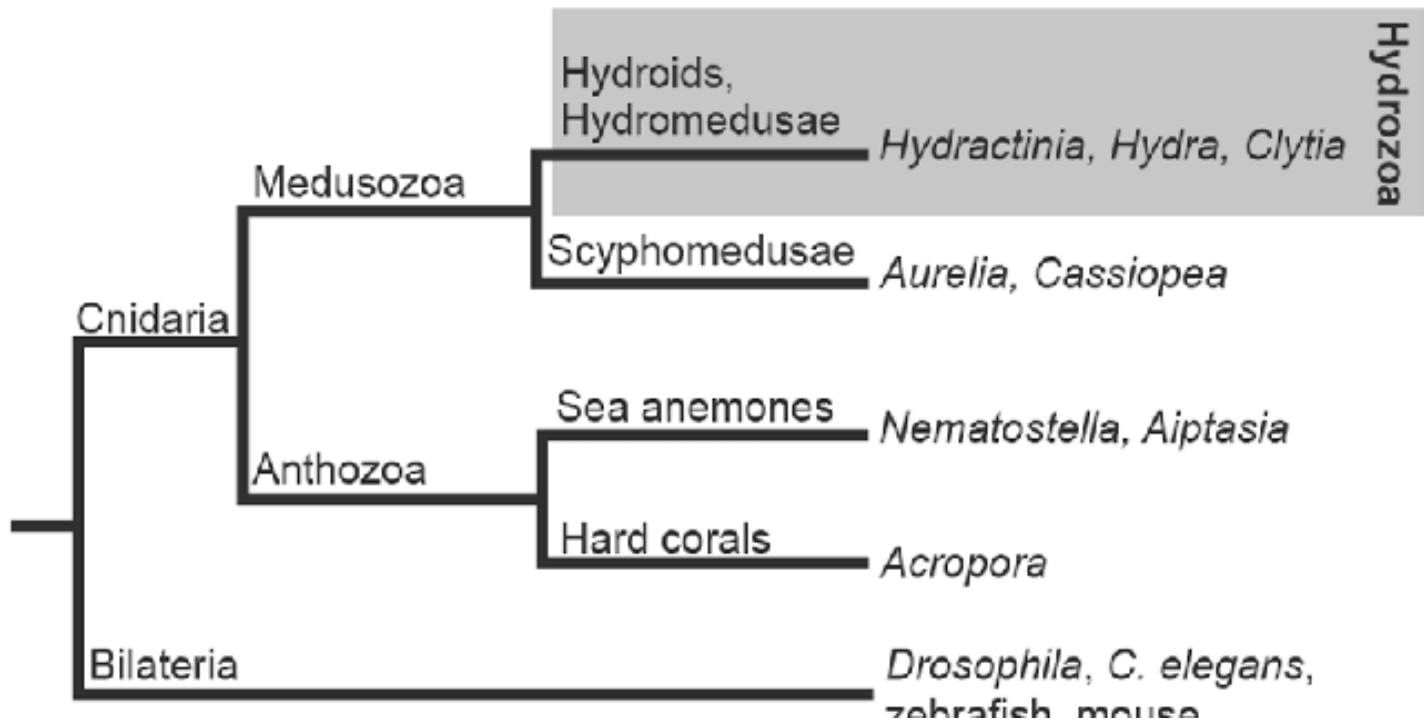
Research Activity

1. What is ocean acidification?
2. What human activities cause ocean acidification?
3. How are corals (and other species) affected?
4. How can humans address the issue of ocean acidification?

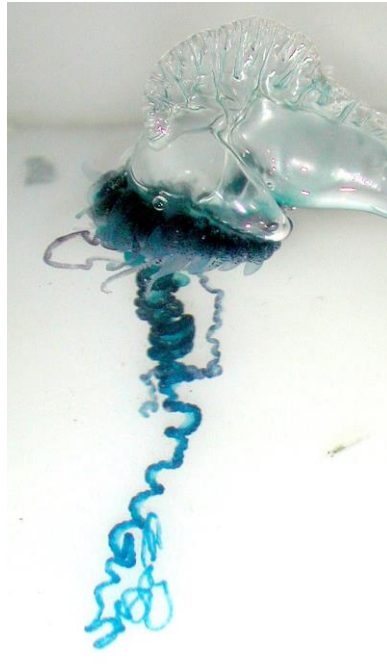
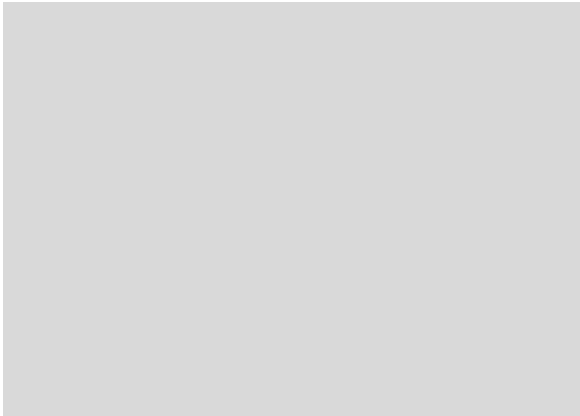
❖ [Video](#) on ocean acidification ([alternate video](#))

❖ [Video](#) on making cement

❖ NasDaily [Video](#)



Major Cnidarian Taxa



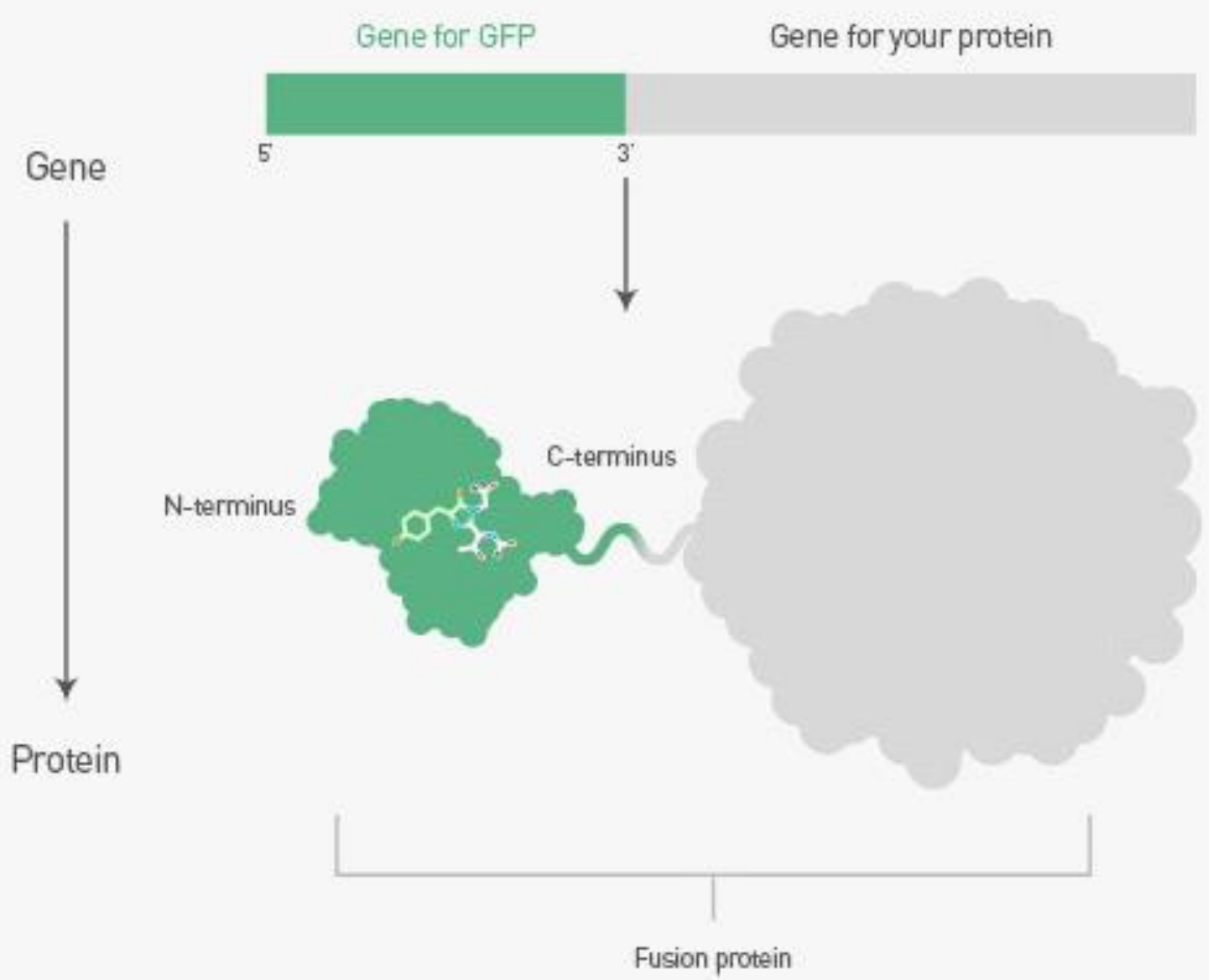
Hydra (Hydrozoa)

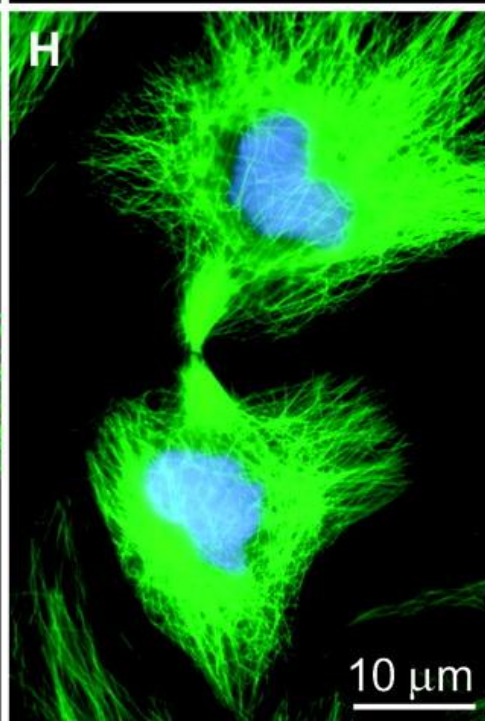
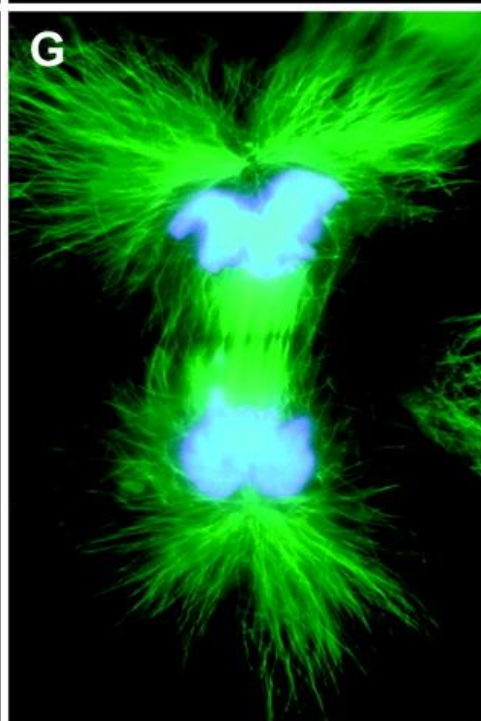
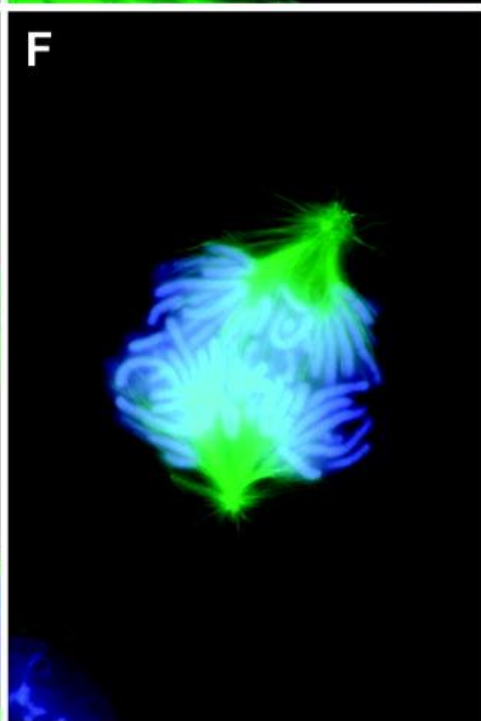
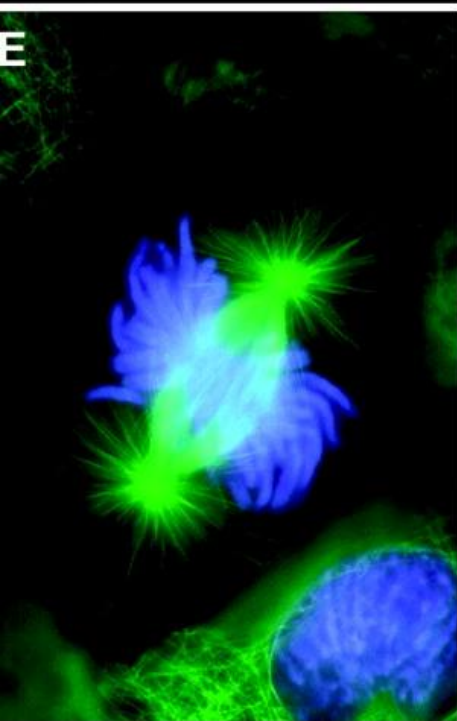
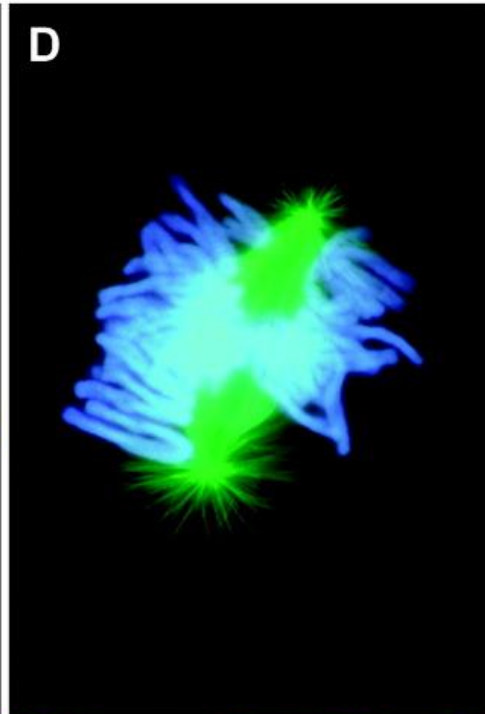
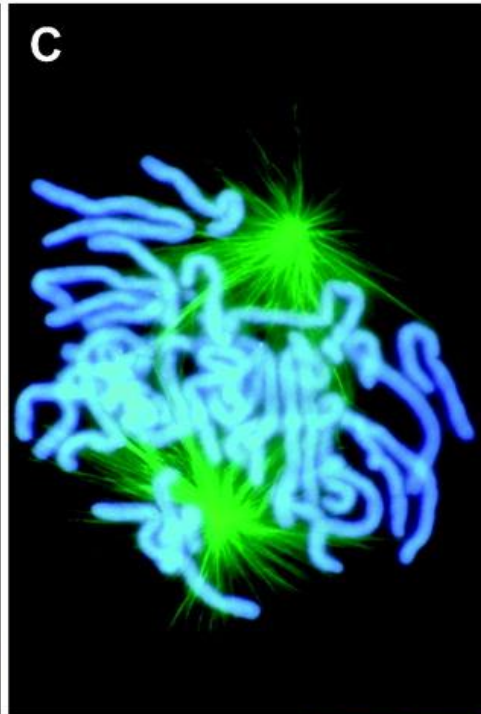
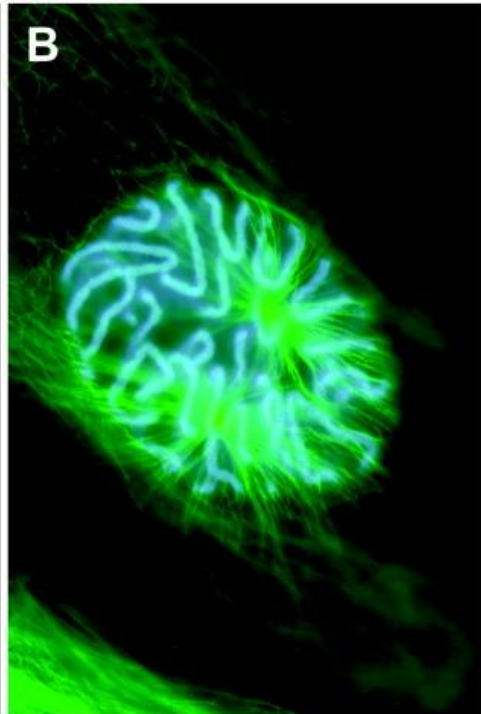
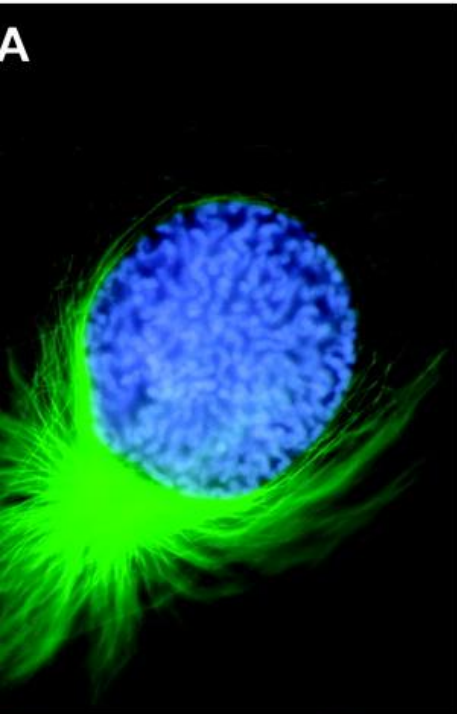
- ❖ Polyp stage only
- ❖ Freshwater (live in lakes, ponds)

Jellyfish (Scyphozoa)

- ❖ Polyp and medusa stages
- ❖ **GFP fluorescent protein** derived from jellyfish → used to make living things glow in the dark!









Sea Anemones (Anthozoa)

- ❖ Polyp stage only
- ❖ Can retract tentacles into body

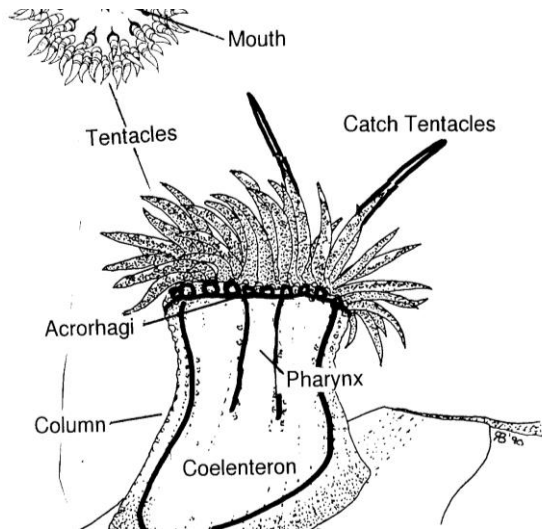




Sea Anemones (Anthozoa)

Adaptations:

- Sessile, but basal plate can ‘walk’ slowly on ocean floor. Or, can detach, float with current, attach elsewhere.
- Can fight off nearby anemones using **acrorhagi**: bulbs that are densely packed with cnidocytes



What are the benefits of sea anemones fighting each other? Drawbacks?

Coral (Anthozoa)

- ❖ Polyp stage only
- ❖ Coral colonies made of many polyps
- ❖ Endo and exoskeletons made of CaCO_3 (calcium carbonate)
- ❖ Build coral reefs (depended upon by many species)
- ❖ Affected by ocean acidification

Coral (Anthozoa)

Symbiosis with photosynthetic algae

- Algae gets protection, nutrients
- Coral gets oxygen, nutrients
- Coral colour comes from symbiotic relationship: if algae die, 'bleaching' occurs

Further reading (stop at "First author..."):

<https://www.princeton.edu/news/2016/11/02/when-corals-met-algae-symbiotic-relationship-crucial-reef-survival-dates-triassic>



Key vocabulary

- ❖ Cnidaria
- ❖ Coral, Sea anemone, Jellyfish, Hydra
- ❖ Radial symmetry
- ❖ Germ layer
- ❖ Endoderm, (Mesoderm), Ectoderm
- ❖ Polyp
- ❖ Medusa
- ❖ (Sessile)
- ❖ Epidermis
- ❖ Mesoglea
- ❖ Gastrovascular cavity (GVC)
- ❖ Tentacle
- ❖ Basal plate
- ❖ Cnidocyte
- ❖ Rhopalium, Eye-spot, Statocyst
- ❖ Nerve net
- ❖ Endoskeleton, Exoskeleton, Hydrostatic skeleton
- ❖ Ocean acidification
- ❖ Epitheliomuscular cells
- ❖ Acrorhagi
- ❖ Symbiotic relationship

Review Activity

1. Make a chart that shows the major features of each of the 4 groups of Cnidaria.