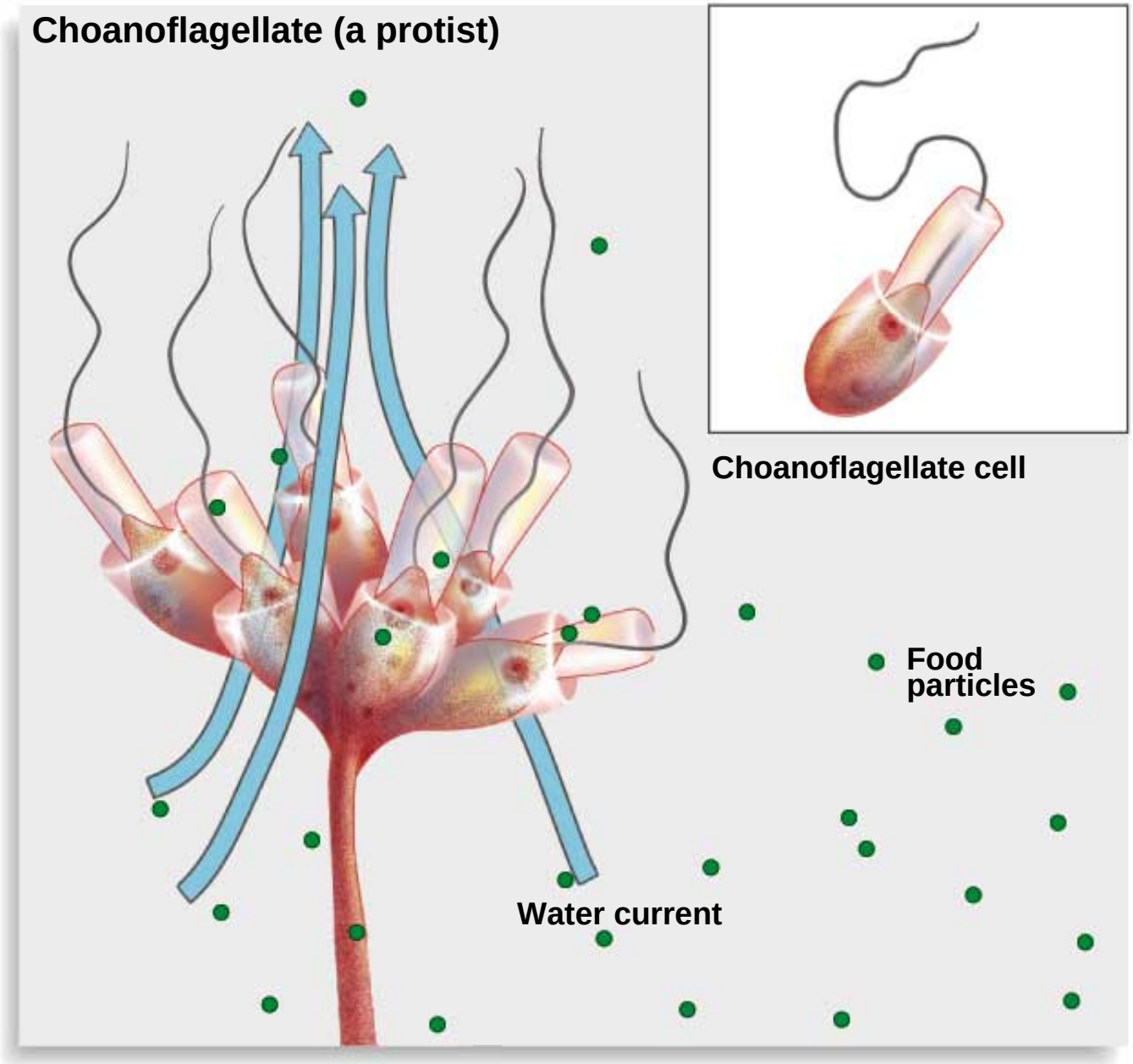
Animals

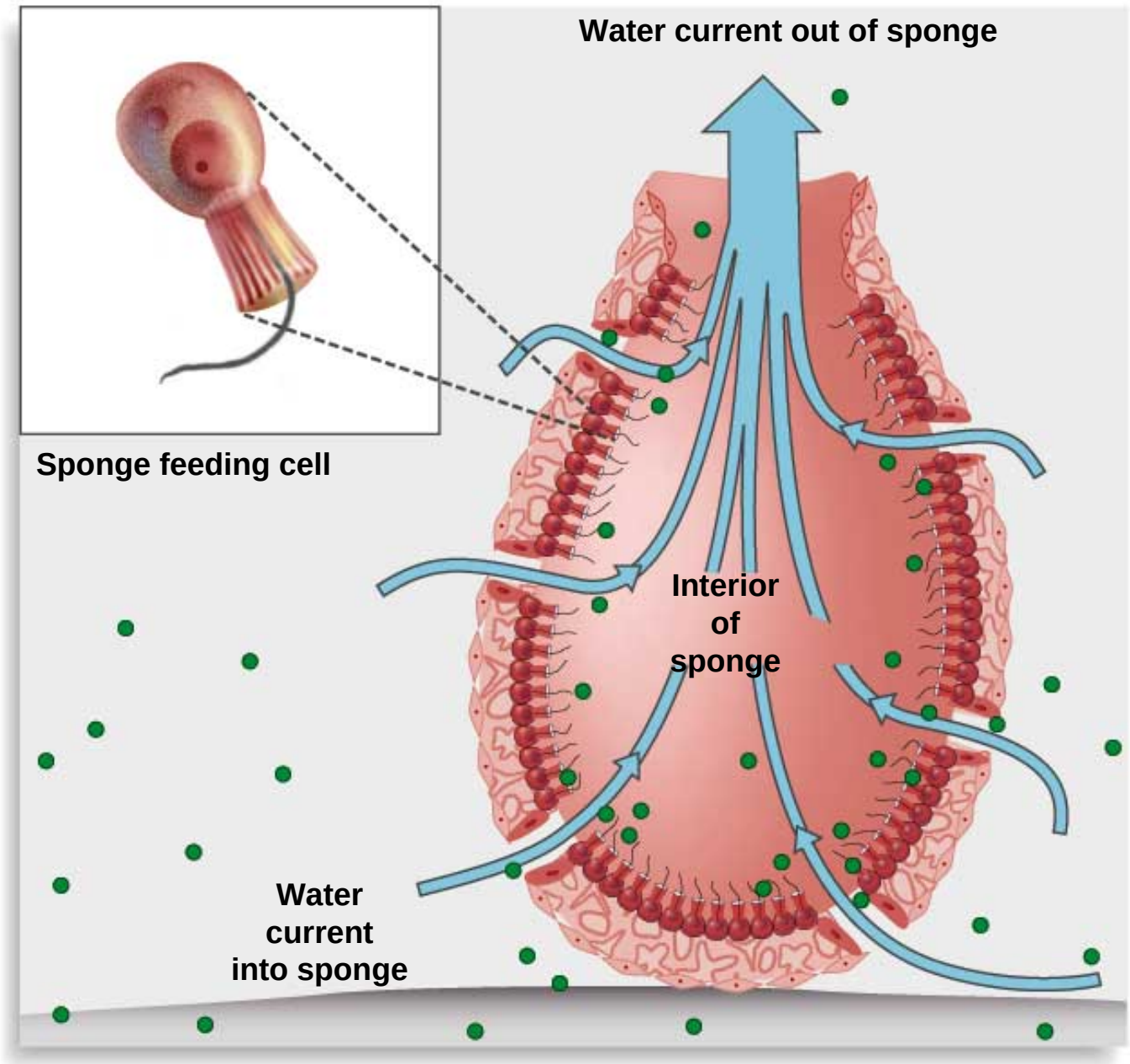
What are animals?

Evolutionary origins

- Animals appear in fossil record 580 mya
- Sponges first animals to appear
  - Feeding cells of some sponges very similar to protists called chanoflagellates (ancestor related to these protists)
    - Both groups sessile
    - Both have flagellum to create water currents
    - Both suspension feeders


Choanoflagellate (a protist)
Choanoflagellate cell
Food particles
Water current

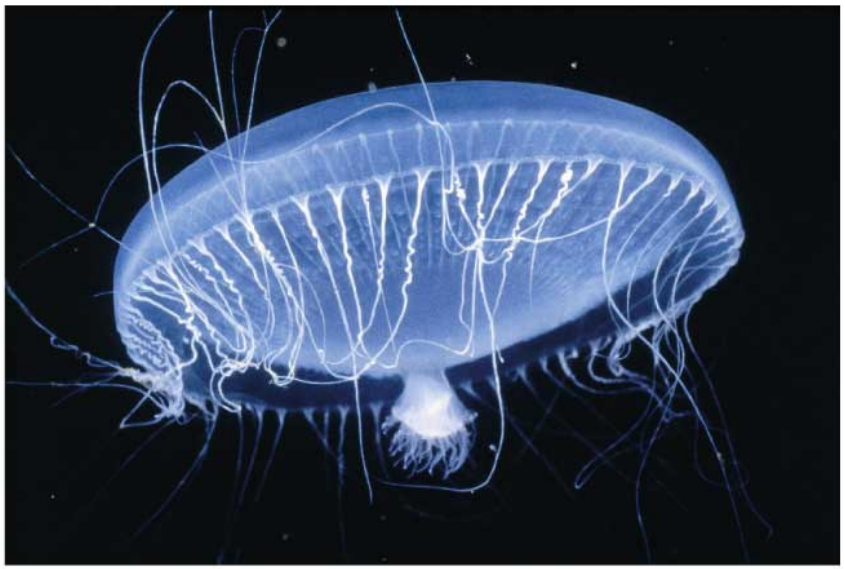
Sponge (an animal)



Organization

- Diploid
- Multicellular
- Complex architecture: body symmetry, organs, tissues, communication systems
- Evolution of a body plan featuring either radial (Cnidaria and Ctenophora) or bilateral symmetry (all other phyla)
  - Bilateral symmetry led to many diverse ways of moving to find food: tunneling, walking, swimming, crawling, creeping, running
- Range in size from microscopic (flatworms, rotifers) to 30.6 m (blue whales)

Cnidaria



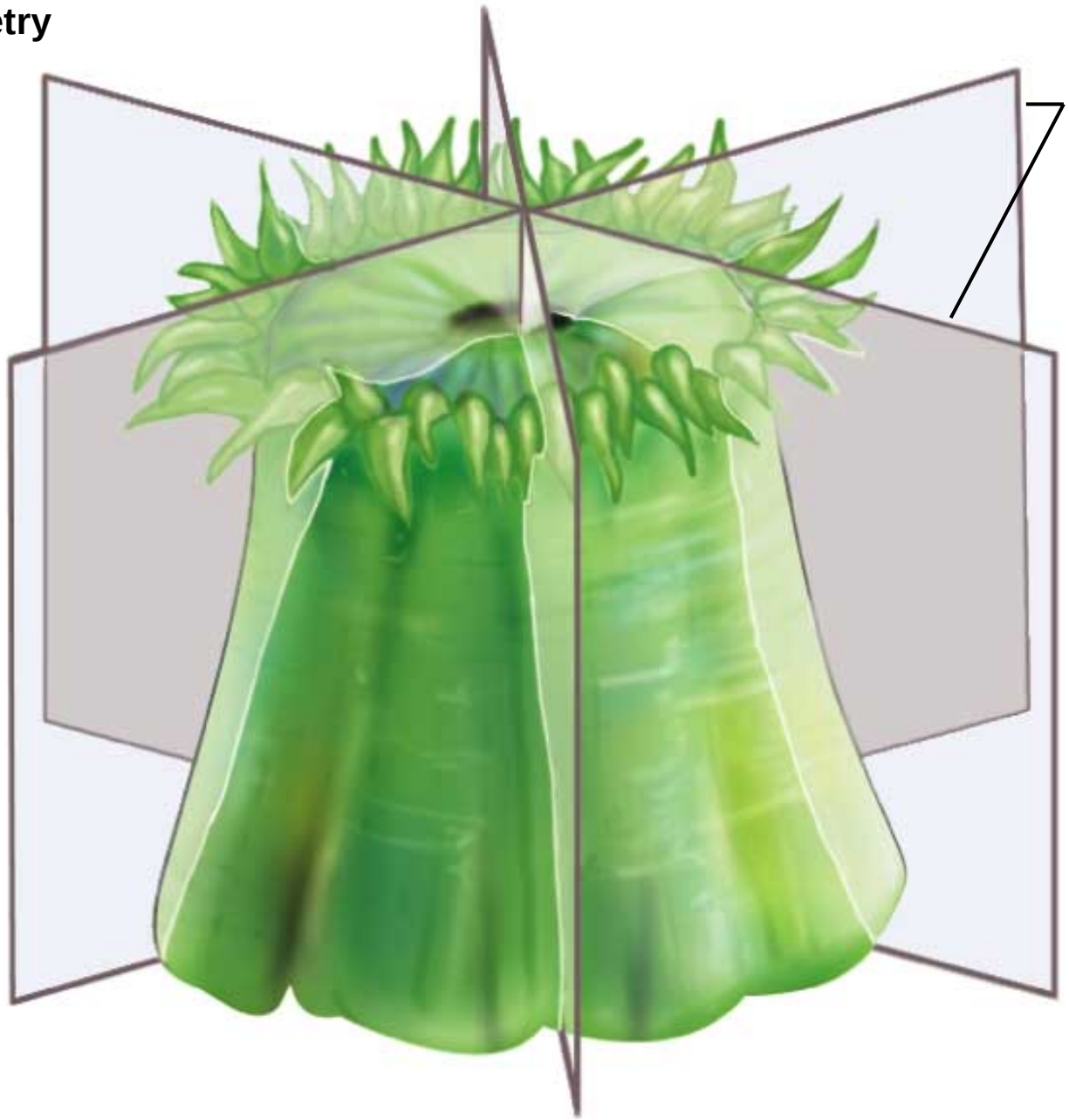
Ctenophora

Asymmetry

No plane of symmetry

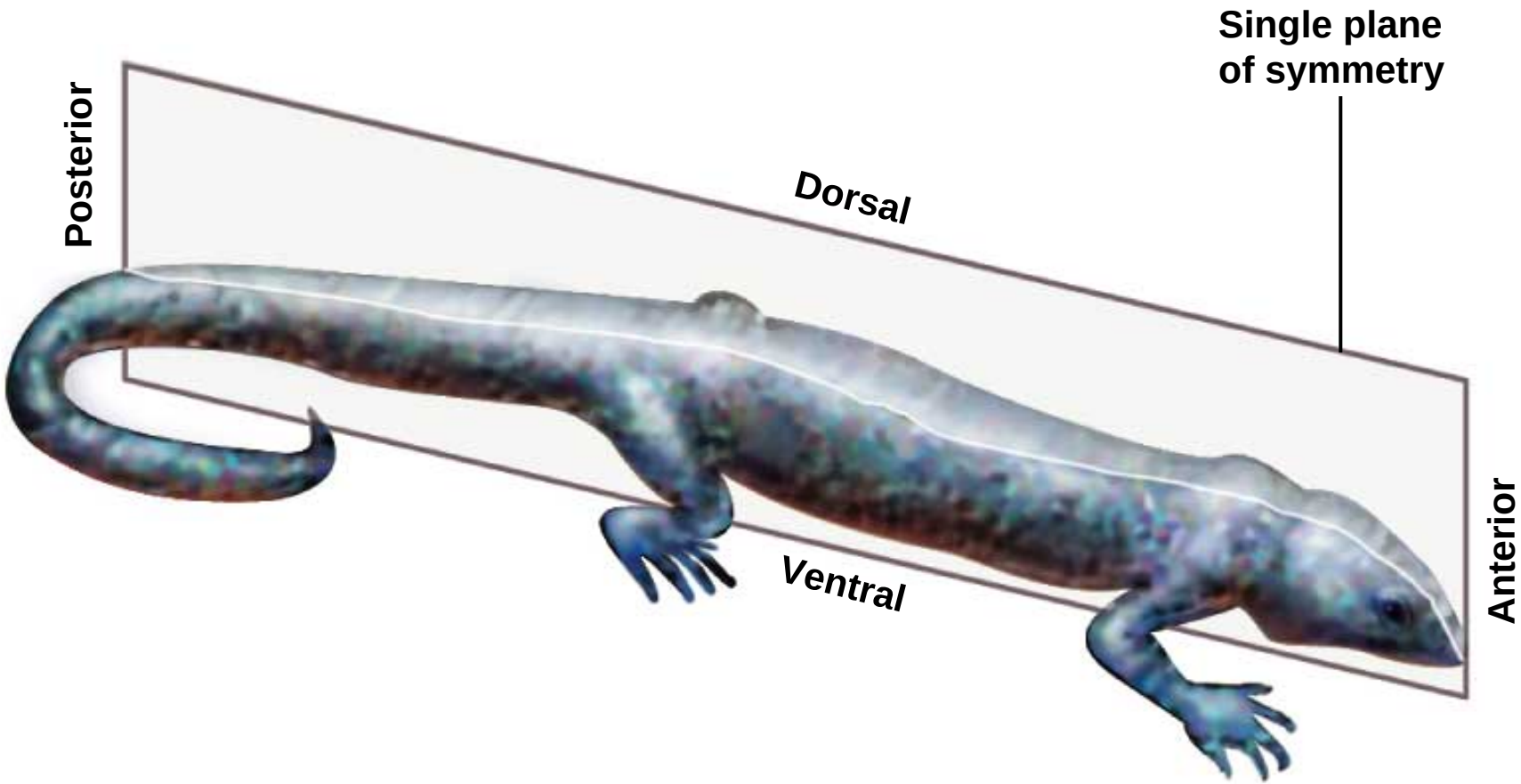
Sponge

Radial symmetry



Sea anemone

Bilateral symmetry



Lizard

Homeostasis

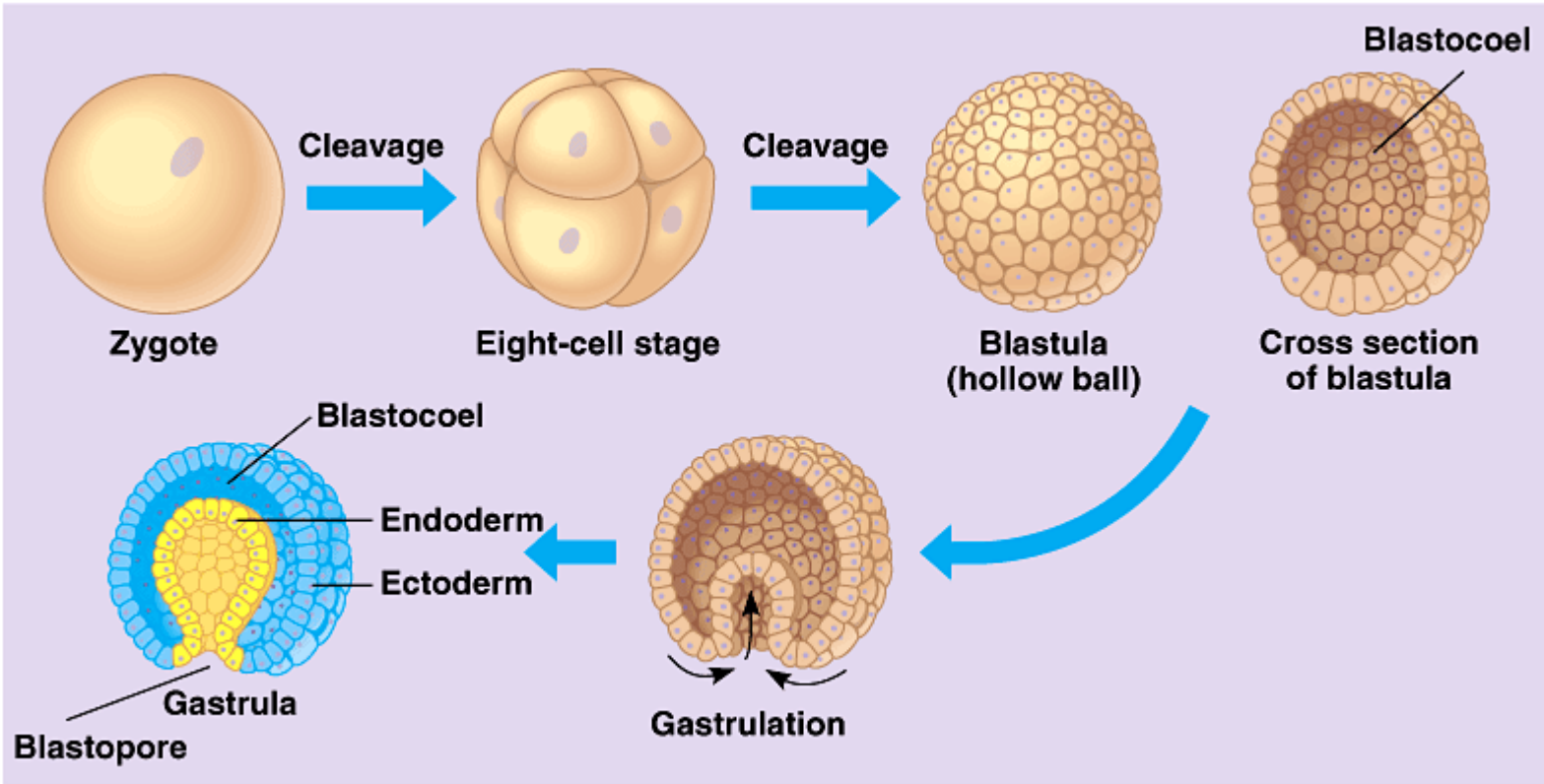
- **Animals have evolved different strategies for active movement**
- Lack cell wall; multicellular bodies are held together by structural proteins (mainly collagen); they also have intercellular junctions composed of other structural proteins
- Presence of nervous and muscle tissue (except Parazoans: sponges) responsible for impulse conduction and movement
- Consequence of bilateral symmetry: cephalization. This provides concentration of sensory equipment on anterior end
- Body cavity to protect from internal injuries; allows organs to grow and be independent of outer body surface

Reproduction and Heredity

- Most reproduce sexually
- In most species, small flagellated sperm (male gamete) fertilizes larger nonmotile egg (female gamete) to form diploid cycle.
- Gametes haploid

Growth and development

- Zygote undergoes cleavage (succession of mitotic cell divisions)
- Cleavage leads to formation of blastula
- Gastrulation occurs afterwards (rearrangement of embryo where one end of embryo folds inward, expands and fills blastocoel) and results in formation of gastrula
  - Produces layers of embryonic tissue: ectoderm gives rise to skin and nervous system, endoderm gives rise to digestive tract or gut; in some animals, mesoderm gives rise to internal structures: bone, circulatory system, muscle tissue
- Some animals develop directly into adults through transient stages of maturation
- Many animals include a larval stage (sexually inmature form) in their life cycle; it engages in metamorphosis to transform animal into adult
- Animals have *Hox* genes to regulate development



Metabolism

- Animals are heterotrophic eukaryotes. They obtain energy and carbon sources by ingesting other organisms or organic material in decomposition

- Diverse ways to engage in ingestion

  - Suspension feeders: Filter food particles suspended in water. Examples: molluscs, arthropods, chordates

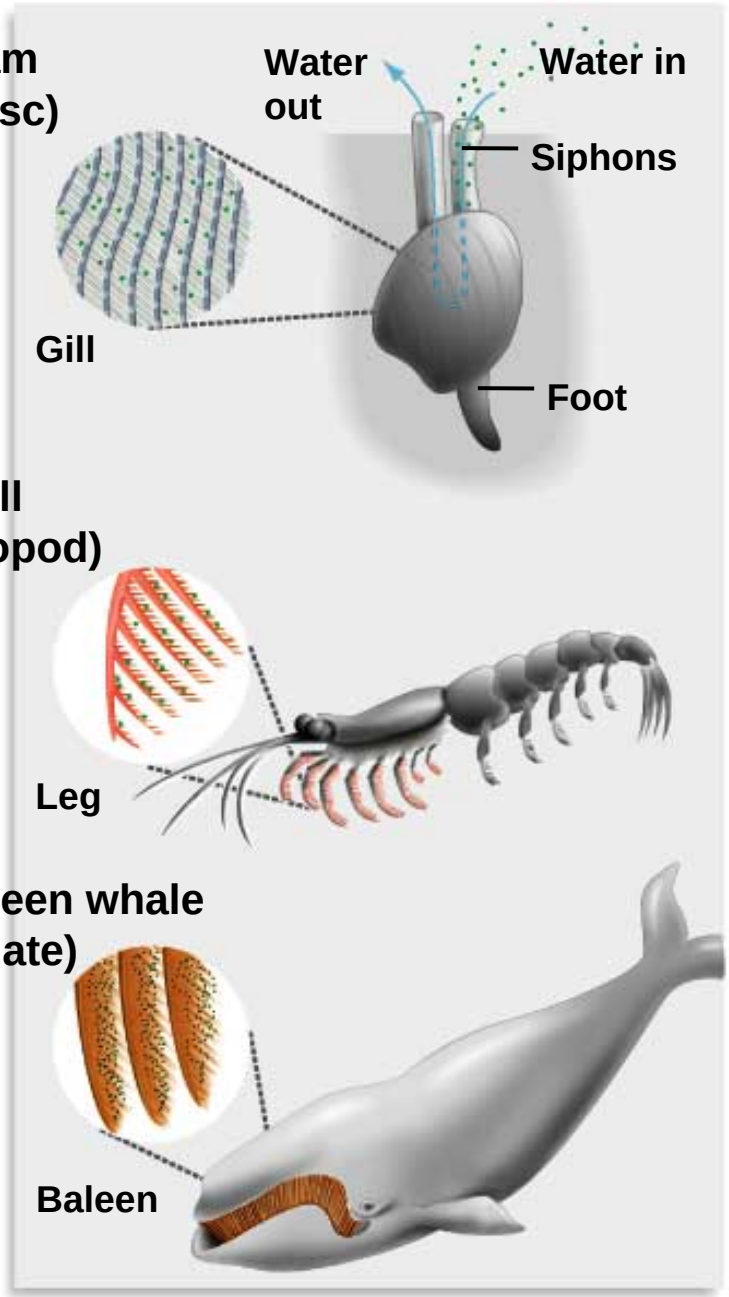
  - Deposit feeders: Eat their way through substrate. E.g. worms, molluscs, insects, hagfish

  - Herbivores: Plant tissue eaters. Correlation between mouthparts and type of tissue harvested. Examples: molluscs, insects, birds, horses, cows

  - Predators: Eat moving prey (other than plants). Two strategies: sit and wait (spiders, corals, sea anemones) and stalkers (wolves, sharks)

  - Parasites: Smaller than hosts, do not always kill them. Endoparasites (tapeworm); Ectoparasites (lice)

Suspension Feeders

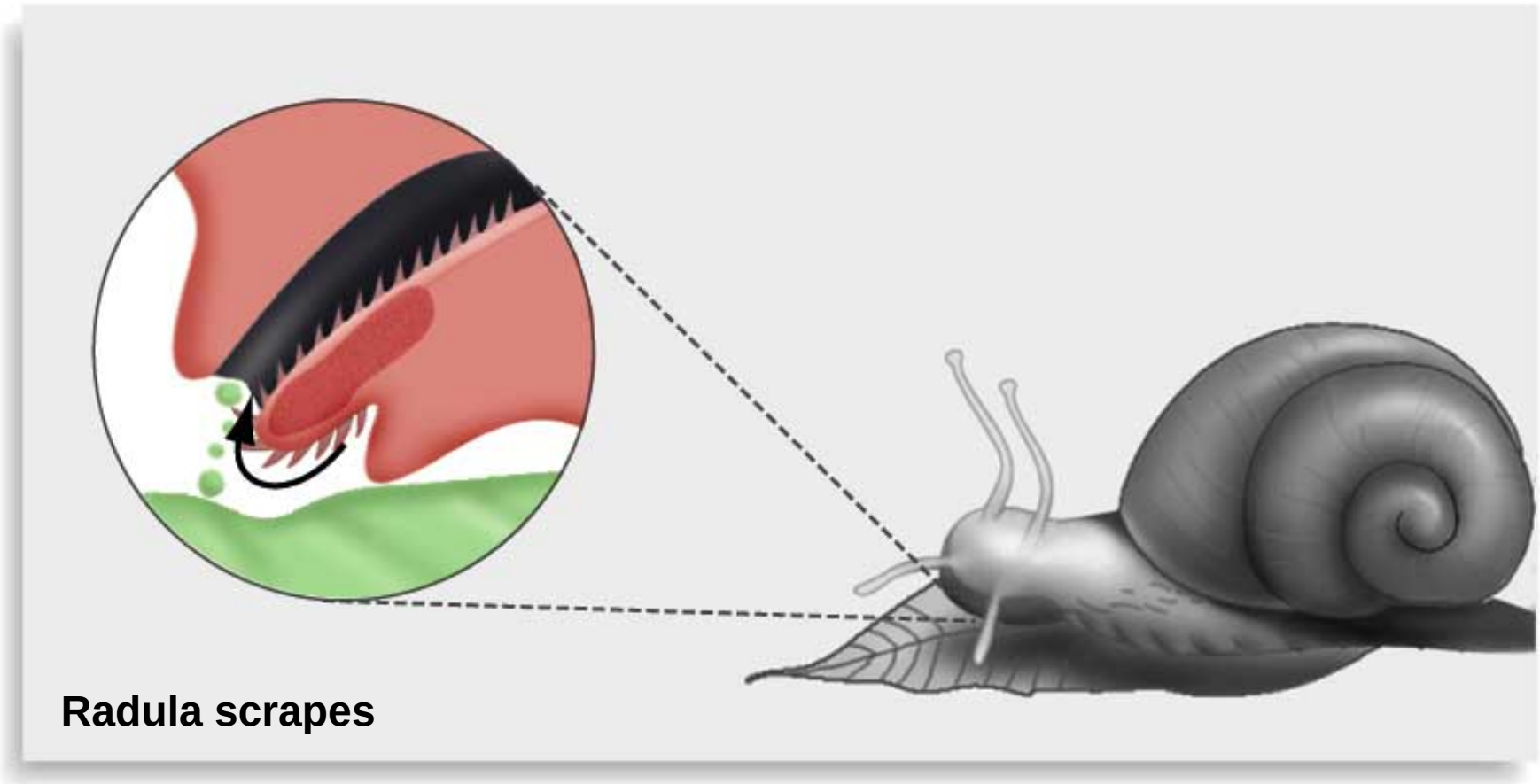


DEPOSIT FEEDERS

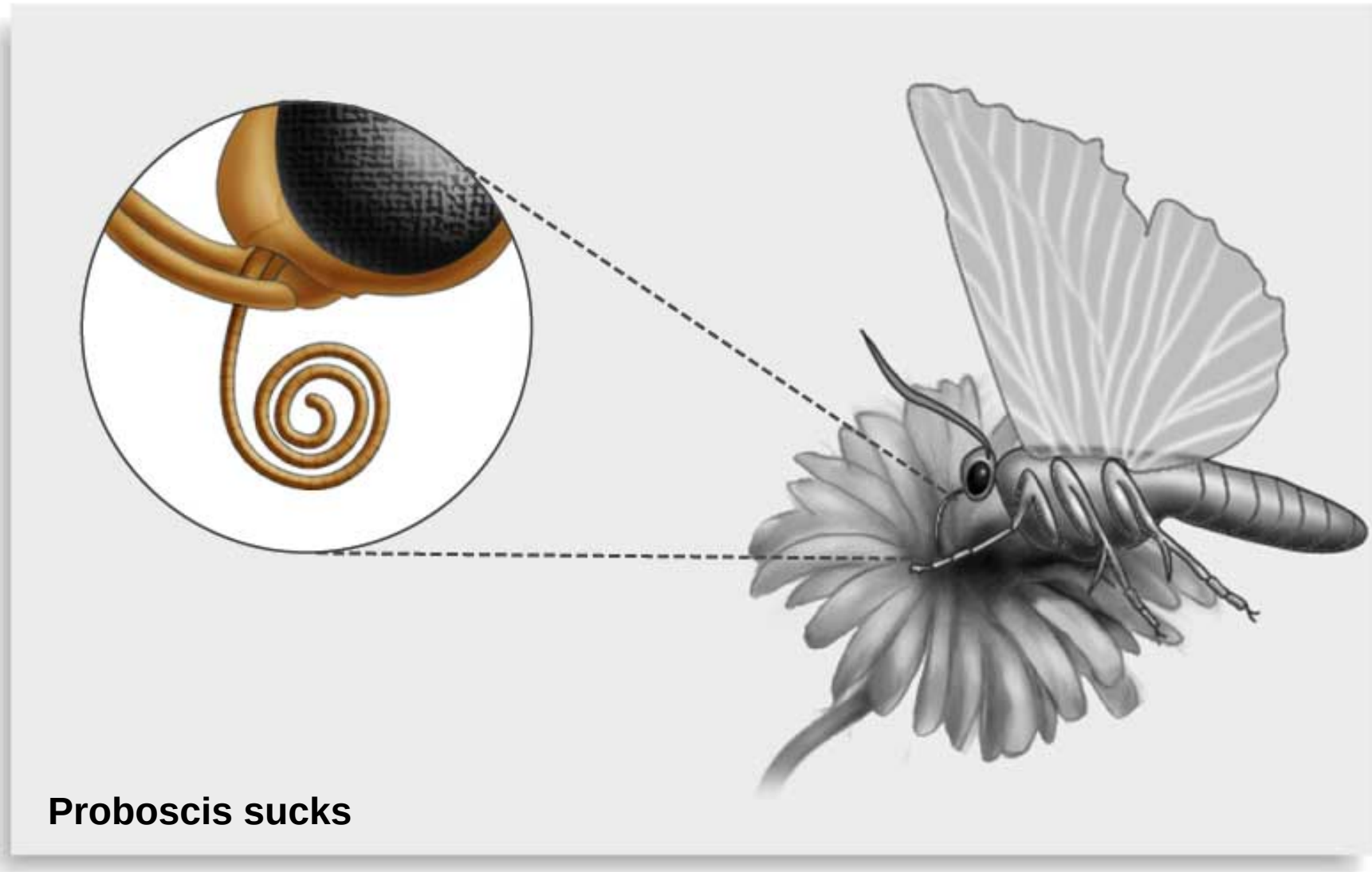
Earthworm (annelid)

Insect larvae (arthropods)

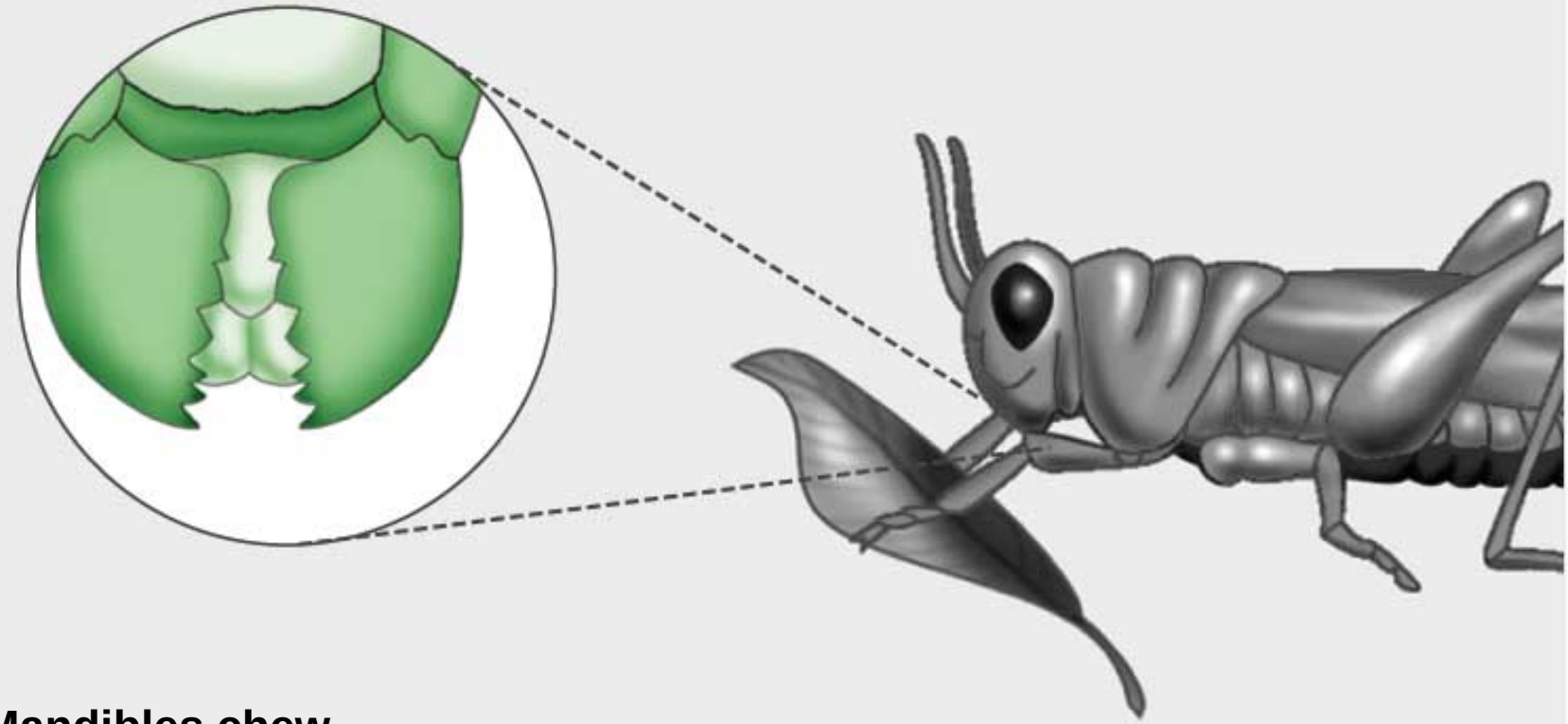
Snail (mollusc)



Moth (arthropod)

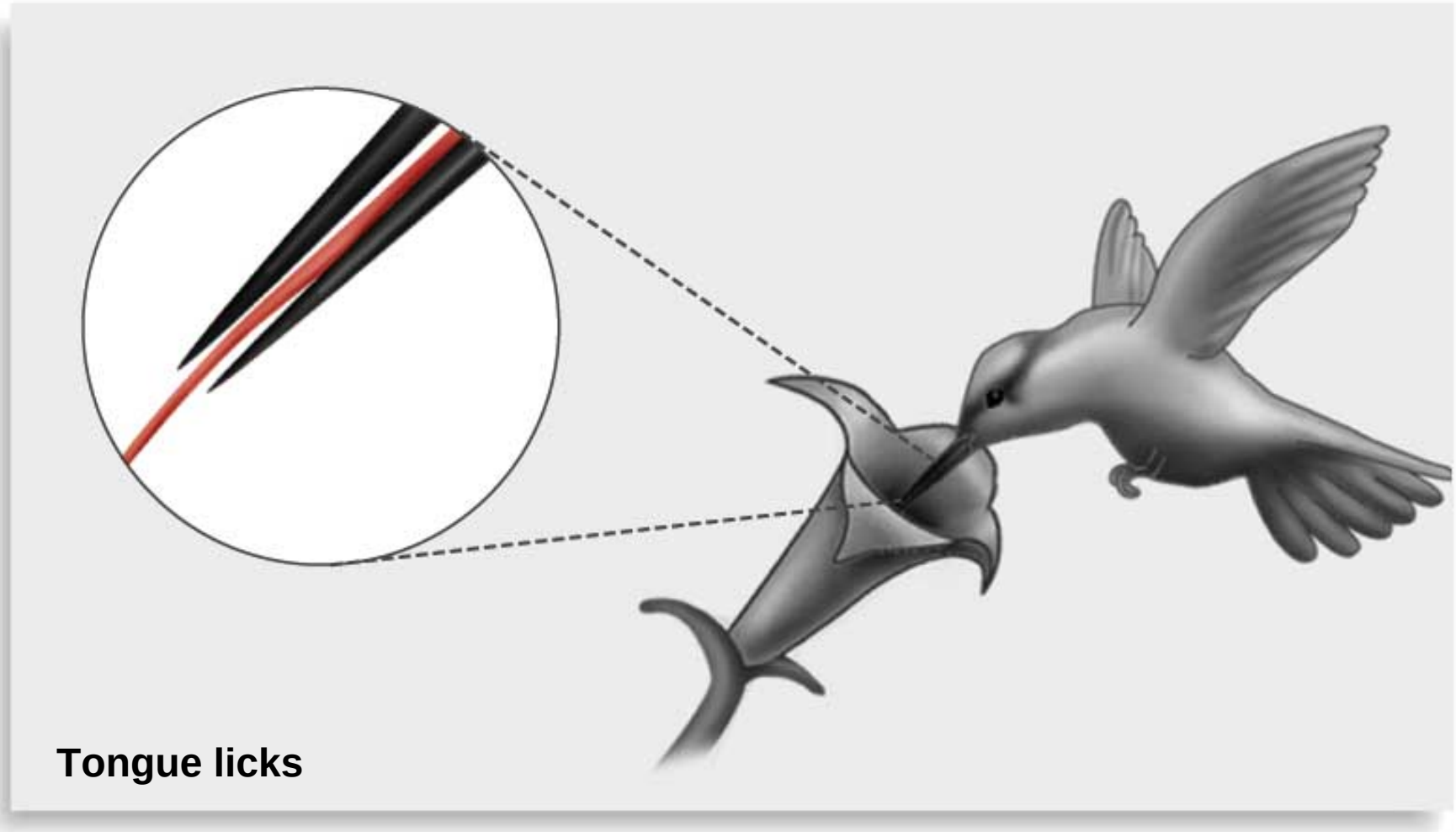


Grasshopper (arthropod)

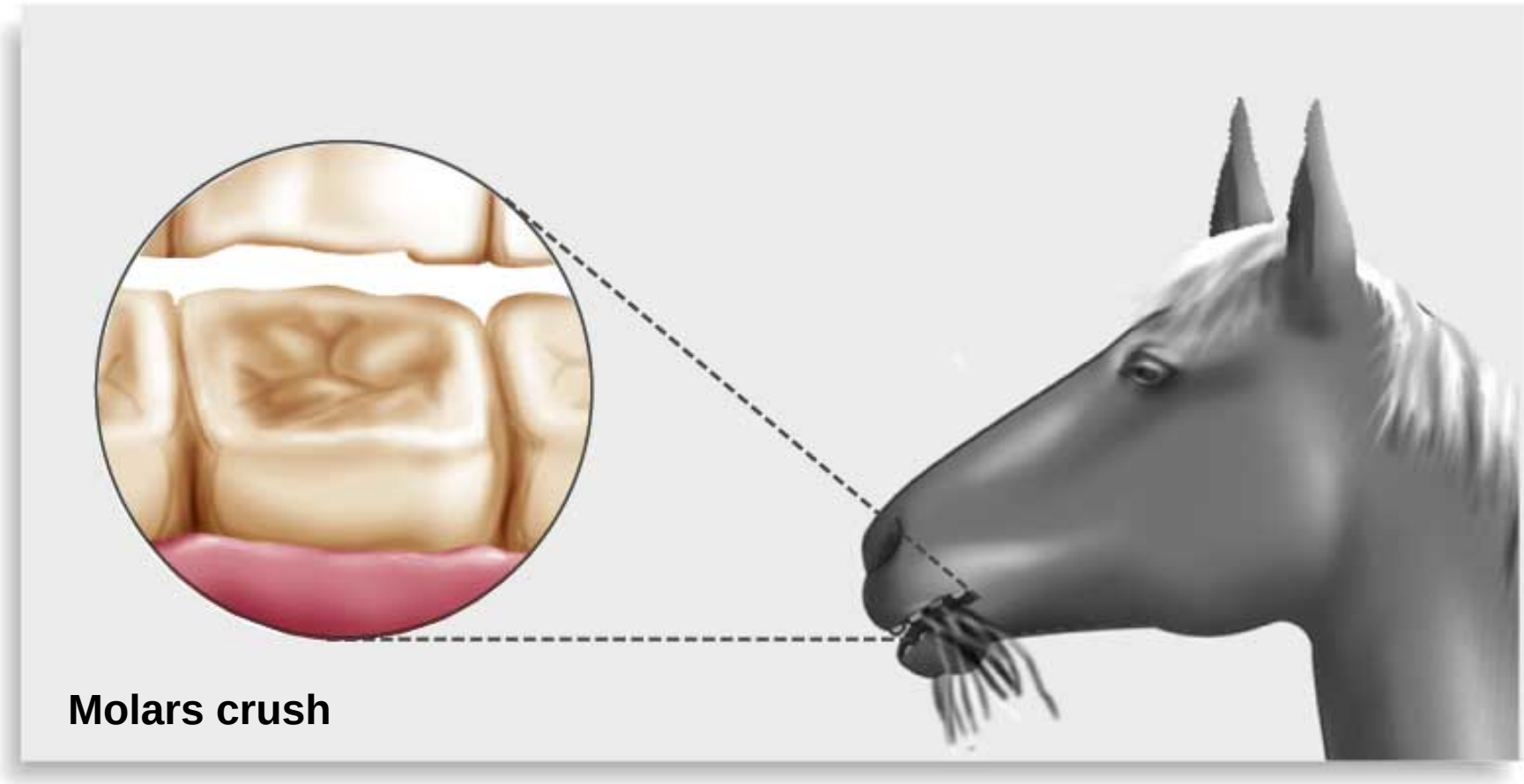


Mandibles chew

Hummingbird (chordate)

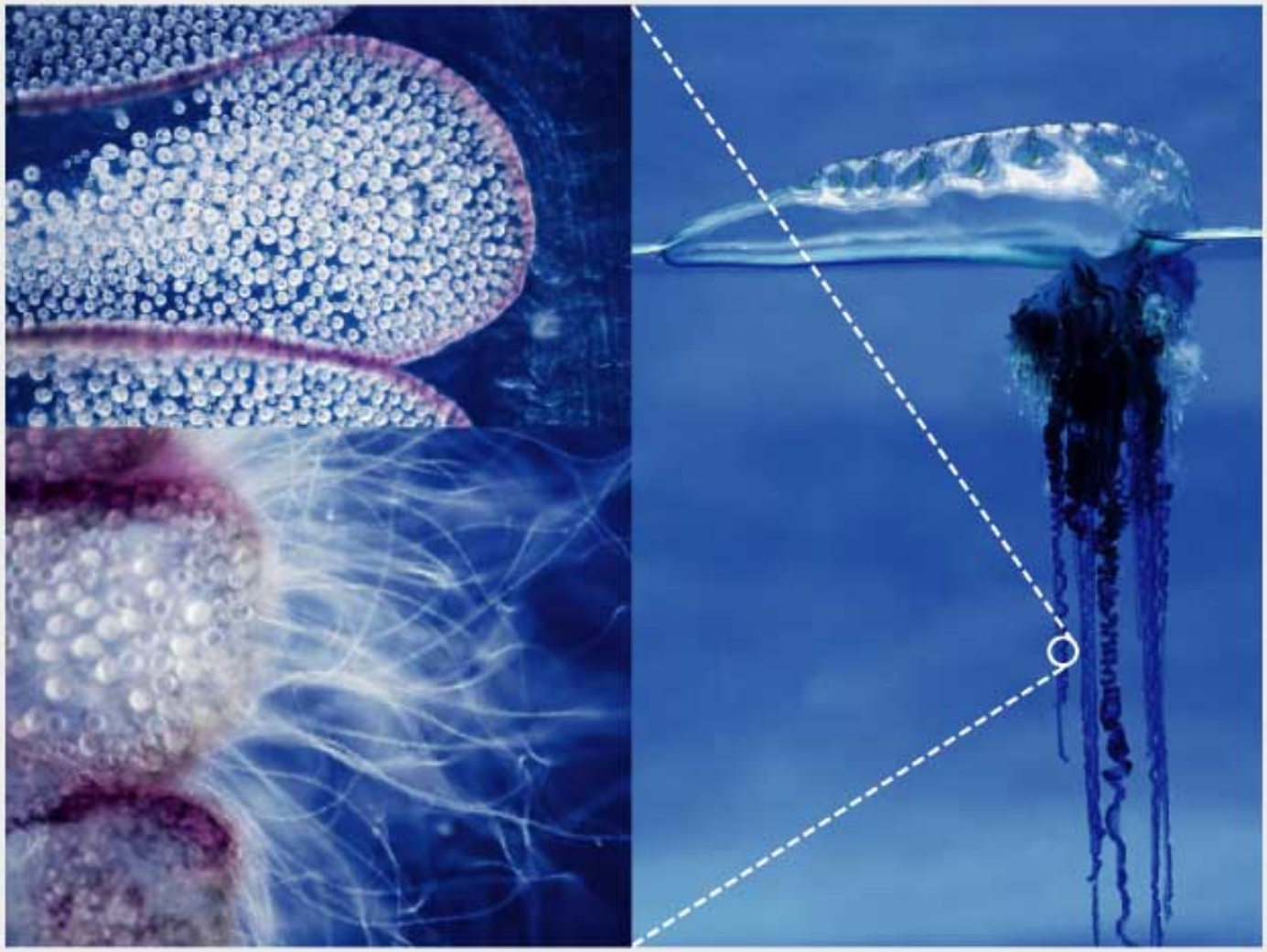


Horse (chordate)



Spider (arthropod)

Portuguese man-of-war (Cnidaria)



Wolf (chordate)

PARASITES

Tapeworm (Platyhelminthes)

Scolex (head)

Louse (arthropod)

Ecology

- Over 1.2 million species have been described
- Diversification in animals was triggered by diversification in methods of feeding and moving (hence diversification in habitat use)
- Animals inhabit nearly all environments on Earth; but most phyla consist of aquatic species. Oceans home to greatest number of animal phyla. Only vertebrates and arthropods are highly diverse in and adapted to terrestrial habitats
- Predation, competition, mutualism

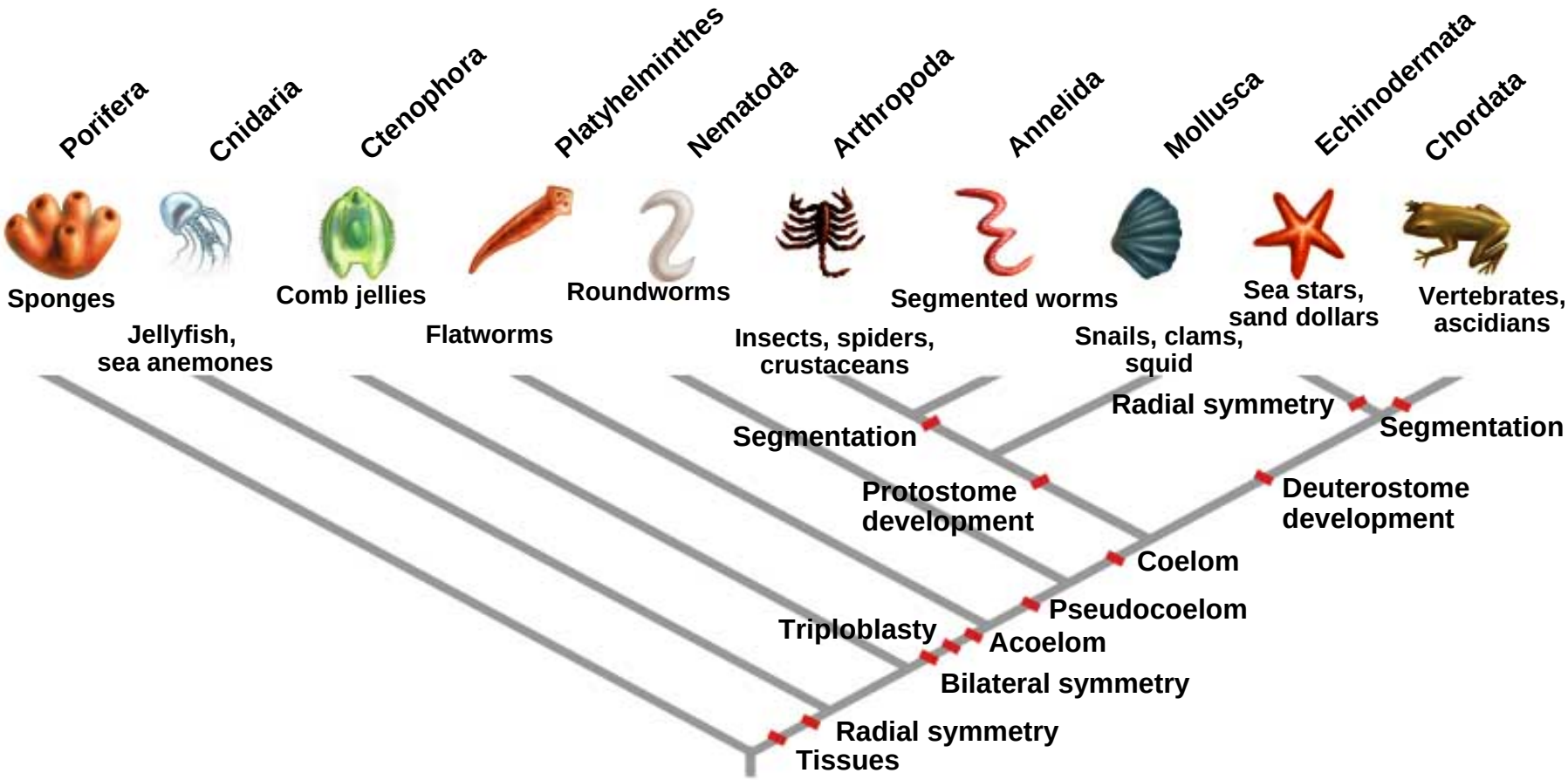
Adaptation

- Diploid genome allows them to wind stand deleterious mutations
- Hox genes allow evolution of complex structures

Importance

- Food
- Diseases
- Top of the food web; basically consumers of organic material
- Environmental pollution and degradation (humans)

Phylogeny of animals based on morphology



Phylogeny of animals based on rRNA sequences