Animal Diversity II: Ecdysozoa and Echinodermata

Objectives:

- Be able to identify specimens from the Echinodermata as well as the major groups of Ecdysozoa, including the Nematoda, Onychophora, Tardigrada, and Arthropoda.
- Be able to classify arthropods as Chelicerata, Myriapoda, Hexapoda, or Crustacea.
- Be able to describe the major body divisions of various Arthropoda.

Ecdysozoa: animals that molt

The Ecdysozoa are a major monophyletic group of protostomes that share an important and complex synapomorphy: they shed their outer protective skin at least once in their lifetime, a process known as **molting** or **ecdysis.** Steroid hormones called **ecdysones** control this molting process. The Ecdysozoa are the most diverse group of organisms on the planet, especially because they contain the insects, and particularly the beetles, the largest and most diverse group of all organisms.

The Ecdysozoa includes many phyla, including the following:

Kinorhyncha (mud dragons)
Priapulida (penis worms)
Nematoda (roundworms)
Nematomorpha (horsehair worms)
Tardigrada (water bears)
Onychophora (velvet worms)
Arthropoda (joint-legged animals, the most species-rich phylum of all)

This laboratory will emphasize the Nematoda and Arthropoda, the two largest animal phyla.

PHYLUM Nematoda (roundworms, including pinworms, heartworms, and many others)

Nematodes are small worms with tapered ends and a **pseudocoel** instead of a true coelom. Most nematodes are parasites inside the bodies of animals and plants, but *Caenorhabditis elegans* (often studied by developmental biologists and neurobiologists), lives freely in dung piles and other bacteria-rich habitats. Study the life cycle of at least one nematode, such as the vinegar worm *Ascaris.*

PHYLUM Nematomorpha (horsehair worms)

These are long, thin worms that sometimes occur in drinking troughs provided to farm animals.

PHYLUM Tardigrada (water bears)

These tiny animals, closely related to arthropods, are famous for their ability to survive in very harsh conditions, including extremes of cold, heat, acidity, and dehydration.

PHYLUM Onychophora (velvet worms)

These tropical animals have a long fossil record going back to Cambrian times. They are closely related to arthropods, but their stubby legs do not have joints.

PHYLUM Arthropoda (joint-legged animals)

All arthropods have a tough outer covering, the **exoskeleton,** which is further strengthened in many cases by the addition of calcium salts. Joints in this exoskeleton are made of soft, flexible bands that are spanned by muscles. Joints in the legs and mouthparts are the characteristic feature of arthropods.

Observe the great diversity among arthropods, paying special attention to their anatomy and the structural differences among the different arthropod groups.

SUBPHYLUM Trilobita

The are an extinct, ancestral group that flourished in Paleozoic times.
Their many paired appendages were nearly all alike.

SUBPHYLUM Crustacea

These are nearly all aquatic and mostly marine.

CLASS Branchiopoda ("fairy shrimp" or "brine shrimp," important in marine food chains)
The freshwater genus *Daphnia* ("water flea") is also included here.

CLASS Ostracoda (tiny "seed shrimp" that resemble seeds in their small size and hard shells)

CLASS Copepoda (copepods, very abundant in plankton, important in marine food chains)

CLASS Cirripedia (barnacles)

CLASS Malacostraca (larger, more familiar crustaceans)
ORDER Stomatopoda (mantis shrimp)
ORDER Isopoda (terrestrial "pill-bugs," living in rotting logs and also in basements)
ORDER Amphipoda (amphipods or "scuds")
ORDER Decapoda (familiar lobsters, crayfish, crabs, and shrimp)
Examine and draw at least two decapods. How do you think they got this name?

SUBPHYLUM Chelicerata

These arthropods have paired piercing structures (**chelicerae**) in their head regions, allowing them to inject poison into their prey. A second pair of modified appendages, called **pedipalps,** can hold the prey in place while the chelicerae inject the poison. Pay attention to how many pairs of legs each group has.

CLASS Merostomata (horseshoe crabs and their extinct relatives)
Examine *Limulus,* the horseshoe crab (Order Xiphosura).

CLASS Pycnogonida ("sea spiders")

CLASS Arachnida (spiders, scorpions, etc.), a group that became successful on land
SUBCLASS Scorpiones (true scorpions)
SUBCLASS Pseudoscorpionida (pseudoscorpions)
SUBCLASS Opiliones (harvestmen, also called "daddy long-legs")
SUBCLASS Acari (mites and ticks)
SUBCLASS Araneae (spiders)

SUBPHYLUM Myriapoda

These are elongated arthropods with many legs. They all have **mandibles** (chewing mouthparts) and other structural similarities to insects.

CLASS Chilopoda (centipedes)
These carnivorous arthropods often live in moist forest habitats (under logs, etc.) and are often found in basements. Each segment has one pair of legs.

CLASS Diplopoda (millipedes)
These herbivores often roll themselves into a spiral for protection. Odd-numbered segments have a dorsal covering (tegmentum) that extends over the next even-numbered segment that lacks such a tegmentum. The result is a series of double segments, each with two pairs of legs.

SUBPHYLUM Hexapoda

CLASS Insecta (insects)
This is the largest and most diverse group of all, including about 3/4 of all the species in the entire animal kingdom! The body is divided into a **head, thorax,** and **abdomen.** The head always contains a pair of **antennae** and mouthparts that include a pair of **mandibles.**

SUBCLASS Apterygota (wingless insects: bristle-tails, silverfish, etc.)

SUBCLASS Pterygota (insects with two pairs of wings on the thorax)
INFRACLASS Paleoptera (insects whose wings cannot be folded back)
ORDER Odonata (dragonflies and damselflies)
INFRACLASS Neoptera (all other insects, whose wings can be folded back)
EXOPTERYGOTA (insects that undergo "incomplete metamorphosis," with nymph stages that develop adult characteristics gradually)
ORDER Orthoptera (grasshoppers, crickets, and others with chewing mouthparts)

ORDER Dictyoptera:
SUBORDER Mantodea (mantids, including the praying mantis)
SUBORDER Blattaria (cockroaches)
SUBORDER Isoptera (termites)
SUBORDER Phasmida ("walking sticks," with fantastic camouflage)

ORDER Hemiptera (true bugs, with piercing and sucking mouthparts; also includes cicadas and aphids)
ORDER Siphonaptera (fleas)

ENDOPTERYGOTA (insects that undergo "complete metamorphosis" in four well-defined stages: egg, larva, pupa, winged adult)
ORDER Neuroptera (lacewings, with netlike wing structure)
ORDER Lepidoptera (butterflies and moths, with scale-covered wings)

ORDER Diptera (flies and mosquitoes, with the second pair of wings reduced to vestigial "**halteres**" that are used for balance and steering)
ORDER Coleoptera (beetles, the largest group of all, with leathery front wings)

ORDER Hymenoptera (social insects: wasps, ants, and bees)

PHYLUM Echinodermata

The Echinodermata are deuterostomes, meaning that the embryonic blastopore develops into the animal's hind end, near the anus, and the mouth forms at the other end as a secondary structure (deuterostome means "second mouth"). All vertebrates are also deuterostomes.

Except for a few very early fossil forms, all Echinodermata have evolved a complex pattern of development in which the bilaterally symmetrical larva develops into an adult with a five-fold pattern of radial symmetry.

SUBPHYLUM Crinozoa (attached, sessile echinoderms with an upward-facing mouth):

CLASS Crinoidea (and several related extinct classes)

Crinoids are sessile echinoderms attached to the bottom by a stalk. In Paleozoic times, with was once a flourishing and diverse group, but only a few species, called "sea lilies," remain today. The body of a crinoid resembles an upside-down starfish.

SUBPHYLUM Asterozoa (free-moving echinoderms with flattened, star-shaped bodies):

CLASS Asteroidea (sea stars, also called starfish)

These familiar sea creatures are predators that move about with five radial arms. The arms touch one another at their base of attachment to the central disk. Examine the suction-like tube feet that are used in both locomotion and feeding.

CLASS Ophiuroidea (brittle stars)

These deep-sea echinoderms have thinner arms that are separated from one another at their base of attachment to the central disk.

SUBPHYLUM Echinozoa (free-moving echinoderms with globular bodies):

CLASS Holothuroidea (sea cucumbers):

These soft-bodied animals usually live on the sea bottom, taking in loose sediment and filtering nutrients out of it. Find the part of the animal that shows the five-fold radial symmetry.

CLASS Echinoidea (sea urchins and sand dollars):

These are also bottom-dwelling filter-feeders, but they are protected by a shell. Examine a sea urchin. Look for the five-fold radial symmetry pattern. The sand dollar is basically a very flat relative.