Section E: Deuterostomia

1. Phylum Echinodermata: Echinoderms have a water vascular system and secondary radial symmetry

2. Phylum Chordata: The chordates include two invertebrate subphyla and all vertebrates.
Introduction

- At first glance, sea stars and other echinoderms would seem to have little in common with the phylum Chordata, which includes the vertebrates.

- However, these animals share the deuterostome characteristics of radial cleavage, development of the coelom from the archenteron, and the formation of the anus from the blastopore.

- These developmental features that define the Deuterostomia are supported by molecular systematics.
1. Phylum Echinodermata: Echinoderms have a water vascular system and secondary radial symmetry

- Sea stars and most other **echinoderms** are sessile, or slow-moving animals.
- The internal and external parts of the animal radiate from the center, often as five spokes.
- A thin skin covers an endoskeleton of hard calcareous plates.
  - Most echinoderms are prickly from skeletal bumps and spines that have various functions.
• Unique to echinoderms is the **water vascular system**, a network of hydraulic canals branching into extensions called **tube feet**.
  
• These function in locomotion, feeding, and gas exchange.
• Sexual reproduction in echinoderms usually involves the release of gametes by separate males and females into the seawater.
  • The radial adults develop by metamorphosis from bilateral larvae.
• The radial appearance of most adult echinoderms is the result of a secondary adaptation to a sessile lifestyle.
  • Their larvae are clearly bilateral and even echinoderm adults are not truly radial in their anatomy.
• All 7,000 or so species of echinoderms are marine.
• They are divided into six classes:
  • Asteroidea (sea stars)
  • Ophiuroidea (brittle stars)
  • Echinoidea (sea urchins and sand dollars)
  • Crinoidea (sea lilies and feather stars)
  • Holothuroidea (sea cucumbers)
  • Concentricycloidea (sea daisies)
• Sea stars (class Asteroidea) have five arms (sometimes more) radiating from a central disk.
• The undersides of the arms have rows of tube feet.
  • Each can act like a suction disk that is controlled by hydraulic and muscular action.
• Sea stars use the tube feet to grasp the substrate, to creep slowly over the surface, or to capture prey.

• When feeding on closed bivalves, the sea star grasps the bivalve tightly and everts its stomach through its mouth and into the narrow opening between the shells of the bivalve.

• Enzymes from the sea star’s digestive organs then begin to digest the soft body of the bivalve inside its own shell.
• Sea stars and some other echinoderms can regenerate lost arms and, in a few cases, even regrow an entire body from a single arm.

Fig. 33.37a
• Brittle stars (class Ophiuroidea) have a distinct central disk and long, flexible arms.
  • Their tube feet lack suckers.
  • They move by serpentine lashing of their arms.
  • Some species are suspension-feeders and others are scavengers or predators.

Fig. 33.37c
• Sea urchins and sand dollars (class Echinoidea) have no arms, but they do have five rows of tube feet that are used for locomotion.

• Sea urchins can also move by pivoting their long spines.

• The mouth of an urchin is ringed by complex jawlike structures adapted for eating seaweed and other foods.

• Sea urchins are roughly spherical, while sand dollars are flattened and disk-shaped.

Fig. 33.37d
• The class Crinoidea includes sea lilies that are attached to the substratum by stalks and feather stars that crawl using their long, flexible arms.

• Both use their arms for suspension-feeding.

• Crinoids show very conservative evolution.
  • Fossilized sea lilies from 500 million years ago could pass for modern members of the class.

Fig. 33.37e
• Sea cucumbers (class Holothuroidea) do not look much like other echinoderms.
  • They lack spines, the hard endoskeleton is much reduced in most, and the oral-aboral axis is elongated.
• However, they do have five rows of tube feet, like other echinoderms and other shared features.
  • Some tube feet around the mouth function as feeding tentacles for suspension-feeding or deposit feeding.

Fig. 33.37f
2. Phylum Chordata: The chordates include two invertebrate subphyla and all vertebrates

- The phylum to which we belong consists of two subphyla of invertebrate animals plus the subphylum Vertebrata, the animals with backbones.

- Both groups of deuterostomes, the echinoderms and chordates, have existed as distinct phyla for at least half a billion years, but they still share similarities in early embryonic development.
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<thead>
<tr>
<th>Category</th>
<th>Phyla</th>
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<tbody>
<tr>
<td>Kingdom Animalia</td>
<td></td>
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<tr>
<td>Parazoa</td>
<td>Porifera (sponges)</td>
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<td>Eumetazoa</td>
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<td>Radiata</td>
<td>Cnidaria (hydrias, jellies, sea anemones,</td>
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<td>corals)</td>
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<td>Ctenophora (comb jellies)</td>
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<td>Bilateria</td>
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<td>Protostomia:</td>
<td>Platyhelminthes (flatworms)</td>
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<td>Lophotrochozoa</td>
<td>Rotifera (rotifers)</td>
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<td>Lophophorates:</td>
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<tr>
<td></td>
<td>Bryozoa, Brachiopoda, Phoronida</td>
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<td>Nemertea (proboscis worms)</td>
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<td>Mollusca (clams, snails, squids)</td>
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<td>Protostomia:</td>
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<td>Ecdysoza</td>
<td>Annelida (segmented worms)</td>
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<td></td>
<td>Nematoda (roundworms)</td>
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<td></td>
<td>Arthropoda (crustaceans, insects, spiders)</td>
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<tr>
<td>Deuterostomia</td>
<td>Echinodermata (sea stars, sea urchins)</td>
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<td></td>
<td>Chordata (lancelets, tunicates, vertebrates)</td>
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