28.5B: Classes of Echinoderms

Learning Objectives

• Differentiate among the classes of echinoderms

The phylum echinoderms is divided into five extant classes: Asteroidea (sea stars), Ophiuroidea (brittle stars), Echinoidea (sea urchins and sand dollars), Crinoidea (sea lilies or feather stars), and Holothuroidea (sea cucumbers).

The most well-known echinoderms are members of class Asteroidea, or sea stars. They come in a large variety of shapes, colors, and sizes, with more than 1,800 species known so far. The key characteristic of sea stars that distinguishes them from other echinoderm classes includes thick arms (ambulacra; singular: ambulacrum) that extend from a central disk where organs penetrate into the arms. Sea stars use their tube feet not only for gripping surfaces, but also for grasping prey. Sea stars have two stomachs, one of which can protrude through their mouths and secrete digestive juices into or onto prey, even before ingestion. This process can essentially liquefy the prey, making digestion easier.

Brittle stars belong to the class Ophiuroidea. Unlike sea stars, which have plump arms, brittle stars have long, thin arms that are sharply demarcated from the central disk. Brittle stars move by lashing out their arms or wrapping them around objects and pulling themselves forward. Of all echinoderms, the Ophiuroidea may have the strongest tendency toward 5-segment radial (pentaradial) symmetry. Ophiuroids are generally scavengers or detritivores. Small organic particles are moved into the mouth by the tube feet. Ophiuroids may also prey on small crustaceans or worms. Some brittle stars, such as the six-armed members of the family Ophiactidae, are fissiparous (divide though fission), with the disk splitting in half. Regrowth of both the lost part of the disk and the arms occur, yielding an animal with three large arms and three small arms during the period of growth.

Sea urchins and sand dollars are examples of Echinoidea. These echinoderms do not have arms, but are hemispherical
or flattened with five rows of tube feet that help them in slow movement; tube feet are extruded through pores of a continuous internal shell called a test. Like other echinoderms, sea urchins are bilaterans. Their early larvae have bilateral symmetry, but they develop fivefold symmetry as they mature. This is most apparent in the “regular” sea urchins, which have roughly spherical bodies, with five equally-sized parts radiating out from their central axes. Several sea urchins, however, including the sand dollars, are oval in shape, with distinct front and rear ends, giving them a degree of bilateral symmetry. In these urchins, the upper surface of the body is slightly domed, but the underside is flat, while the sides are devoid of tube feet. This “irregular” body form has evolved to allow the animals to burrow through sand or other soft materials.

Figure 1: Sea urchins: Sea urchins do not have arms, but have rows of tube feet that can be extended out of pores of the internal shell.

Sea lilies and feather stars are examples of Crinoidea. Both of these species are suspension feeders. They live both in shallow water and in depths as great as 6,000 meters. Sea lilies refer to the crinoids which, in their adult form, are attached to the sea bottom by a stalk. Feather stars or comatulids refer to the unstalked forms. Crinoids are characterized by a mouth on the top surface that is surrounded by feeding arms. They have a U-shaped gut; their anus is located next to the mouth. Although the basic echinoderm pattern of fivefold symmetry can be recognized, most crinoids have many more than five arms. Crinoids usually have a stem used to attach themselves to a substrate, but many live attached only as juveniles and become free-swimming as adults.
Sea cucumbers of class Holothuroidea are extended in the oral-aboral axis and have five rows of tube feet. These are the only echinoderms that demonstrate “functional” bilateral symmetry as adults because the uniquely-extended oral-aboral axis compels the animal to lie horizontally rather than stand vertically. Like all echinoderms, sea cucumbers have an endoskeleton just below the skin: calcified structures that are usually reduced to isolated microscopic ossicles joined by connective tissue. In some species these can sometimes be enlarged to flattened plates, forming armor. In pelagic species, such as Pelagothuria natatrix, the skeleton and a calcareous ring are absent.
Figure (PageIndex{1})): **Sea cucumbers**: Sea cucumbers are the only echinoderms that demonstrate “functional” bilateral symmetry as adults, as they lie horizontally as opposed to the vertical axis of other echinoderms.

### Key Points

- Sea stars have thick arms called ambulacra that are used for gripping surfaces and grabbing hold of prey.
- Brittle stars have thin arms that wrap around prey or objects to pull themselves forward.
- Sea urchins and sand dollars embody flattened discs that do not have arms, but do have rows of tube feet they use for movement.
- Sea cucumbers demonstrate “functional” bilateral symmetry as adults because they actually lie horizontally rather than stand vertically.
- Sea lilies and feather stars are suspension feeders.

### Key Terms

- **ossicle**: a small bone (or bony structure), especially one of the three of the middle ear
- **fissiparous**: of cells that reproduce through fission, splitting into two
- **ambulacrum**: a row of pores for the protrusion of appendages such as tube feet.