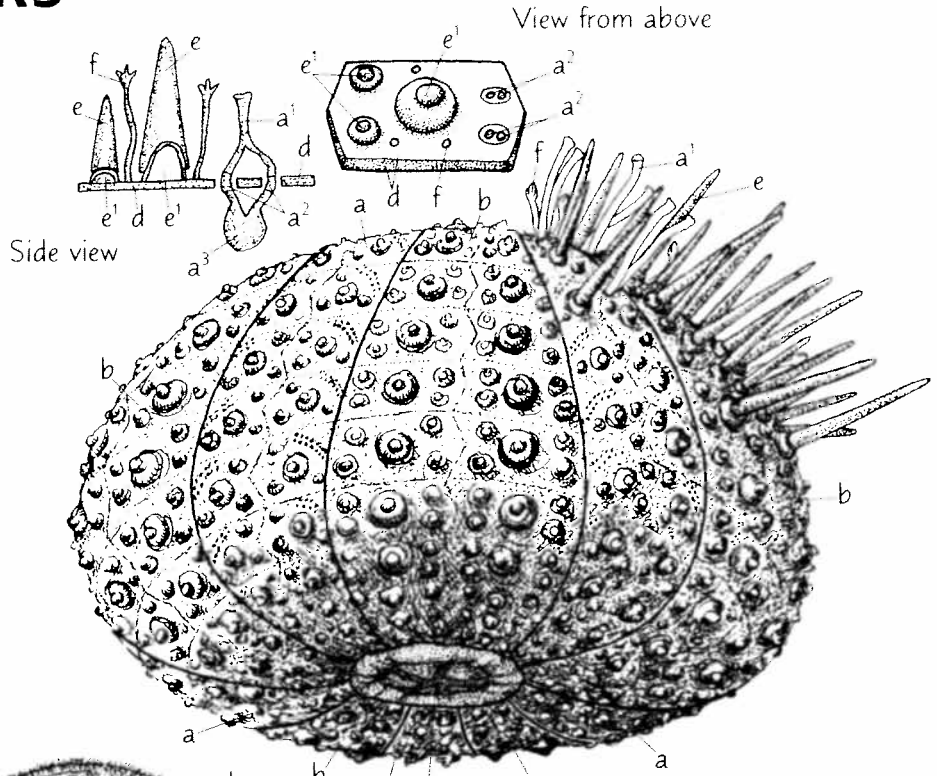
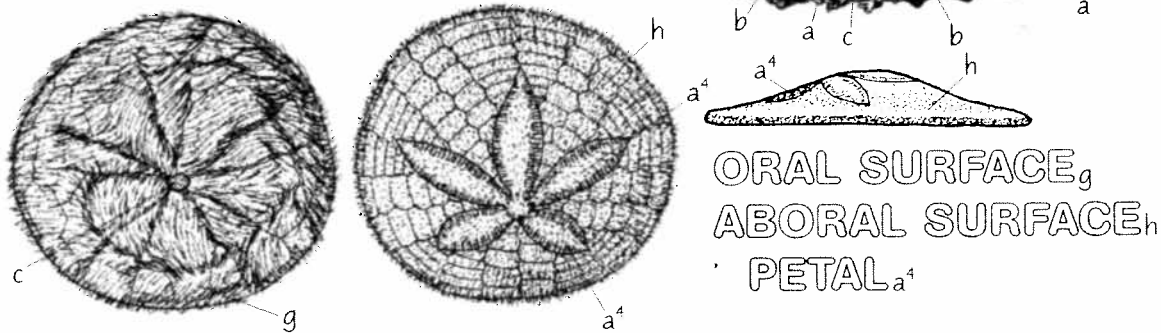


ECHINOIDS AND SEA CUCUMBERS

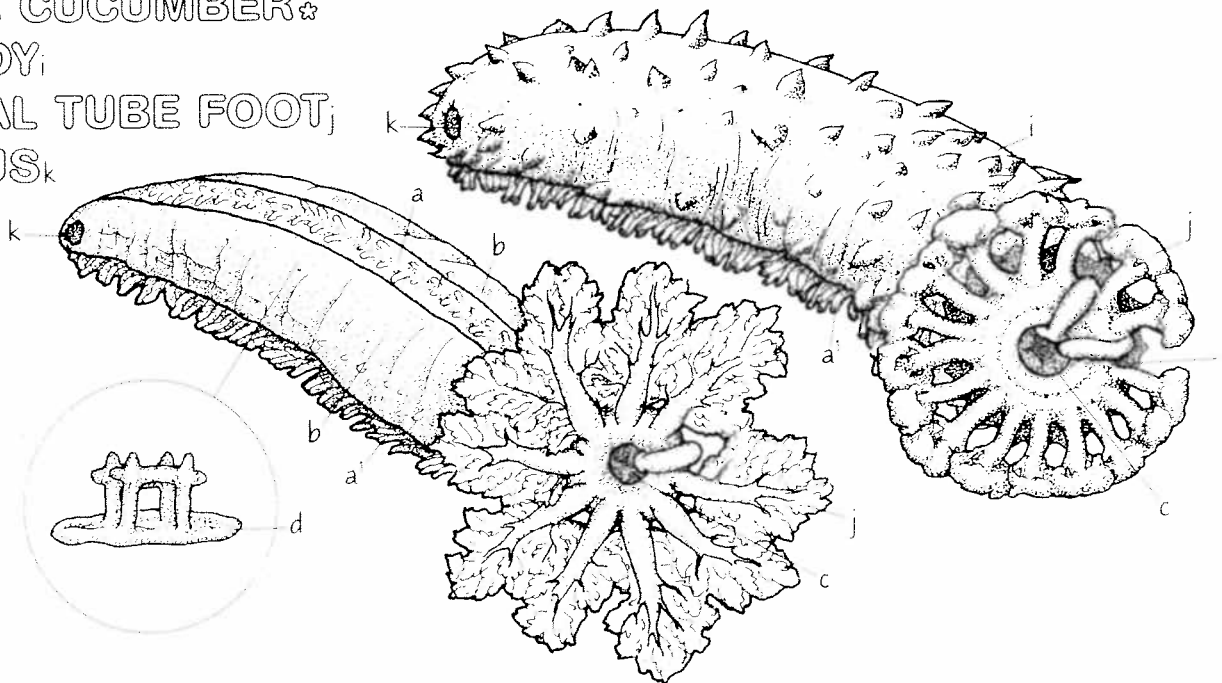
SEA URCHIN*
AMBULACRA_a
INTERAMBULACRA_b
JAWS/MOUTH_c
OSSICLE_d
TUBE FOOT_{a¹}
PORE PAIR_{a²}
AMPULLA_{a³}
SPINE_e
TUBERCLE_{e¹}
PEDICELLARIA_f



SAND DOLLAR*



SEA CUCUMBER*
BODY;
ORAL TUBE FOOT;
ANUS_k



41

ECHINODERM DIVERSITY: ECHINOIDS AND SEA CUCUMBERS

Unlike other echinoderm classes, echinoids and sea cucumbers (holothuroids) lack arms and have bodies that are stretched along the oral/aboral axis.

Begin by coloring the sea urchin skeleton. Note that the alternating ambulacral and interambulacral sections of the skeleton are arranged like sections of an orange. Use light colors for these sections. They are purple in life. Then, color the enlargements of the individual ossicle and the tubercles, including the spines and other appendages.

Color the three drawings of the sand dollar. Note how flat the sand dollar is in the side view, and how the petals are positioned on the aboral surface.

The echinoids include the sea urchins and sand dollars. The individual *ossicles* (skeletal plates) of the echinoid are tightly sutured or joined, producing a rigid skeleton or "test."

The sea urchin is round or oval in shape, and the individual ossicles are organized in ten longitudinal rows, running from the oral to the aboral pole. Five alternating rows are called *ambulacral* plates, and the other five alternating rows are the *interambulacral* plates. The urchin's stalked *tube feet* are located on the ambulacral areas; its long, moveable *spines* and defensive *pedicellariae* are attached to both ambulacral and interambulacral areas.

Sea urchins live primarily on firm substrata. Their *mouthing* and oral surfaces are kept toward the substratum; the *jaws* protruding from the mouth scrape and chew off algae and attached organisms. The jaws are mounted and articulated in an elaborate feeding structure known as Aristotle's lantern. Sea urchins can consume a considerable biomass, and where they occur in large numbers they have a devastating impact on the algae (Plates 107, 113).

Sea urchins move in two ways: by means of their long, stalked tube feet, with powerful suckers at the tips, and by means of their spines. Each tube foot emerges through a pair of holes (*pore pairs*) in the ossicle, as shown in the upper illustration, and moves multidirectionally. The spines come in two or more sizes and pivot freely on *tubercles*, or "bosses," on the ossicle. The urchin coordinates the tube feet and spines and walks and pulls itself along. Some urchins with very long spines walk quite briskly, using only the spines for locomotion.

The jaw-bearing *pedicellariae* protrude from the ossicles and are used for defense and cleaning. The *ampullae* and the other structures of the water vascular system are beneath the ossicles.

Sand dollars, purple gray in life, move solely on their small, short spines, which are visible as hairlike structures on the *oral surface* surrounding the mouth. The small tube feet (not shown) are found among the spines and assist in gathering food. These animals live on or in soft sediments and are primarily deposit feeders, although a few are filter feeders (Plate 105). The *petals* on their *aboral surface* relate to the five ambulacral areas of the sea urchin. These petals contain special respiratory tube feet.

Color the illustrations of the two types of sea cucumbers as well as the enlargement of the ossicle. Note the sea cucumber on the right lacks ambulacral/interambulacral areas.

Most sea cucumbers have thick, leathery bodies with unattached tiny ossicles scattered within. This gives the sea cucumber a wormlike flexibility with a potential for burrowing (in fact, many species are burrowers). The elongated body of the sea cucumber creates a "head" area, and "tail," and dorsal and ventral surfaces. Sea cucumbers have a prominent anus, and breathe through special respiratory "trees" that branch internally from the anus. Respiratory water is both brought in and expelled through the anus by muscular contraction.

The sea cucumber illustrated on the right is a surface-dwelling deposit feeder. It uses its *oral tube feet* to pick up food from the substratum. The tube feet, located on the well-developed "sole," are used for movement along the substratum. This light orange cucumber can grow up to 40 cm (16 in) in length.

The sea cucumber on the left is a filter feeder and lives among rocks. This red orange cucumber has five rows of tube feet for movement. The oral tube feet are highly branched and coated with mucus, which acts to trap suspended plankton and detritus when the tube feet are spread open. To feed, the cucumber moves each foot into its mouth in a rhythmic, systematic fashion, and removes the trapped food particles. Sea cucumbers are found on all types of substrata, from the intertidal zone to the deepest ocean depths (Plate 16).