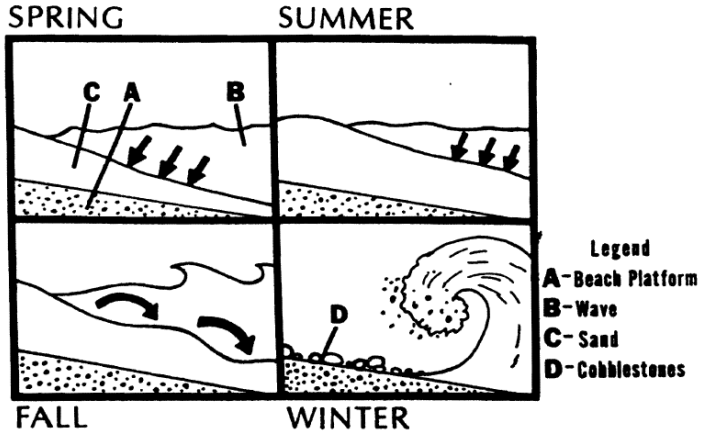
THE SANDY BEACH ENVIRONMENT

The sandy beach is a region of shifting sands and crashing waves. Each time a **wave** pummels the shore, sediment is suspended and scattered in every direction. Together the **wind** and **waves** constantly rework and reshape the face of the beach. Throughout the year, the **beach slope** is continually changing. During the spring and summer, gentle **constructive waves** deposit **sediment** on the **beach platform**, building up the slope. The large **destructive waves** of fall and winter strip the sand from the beach, often leaving only cobblestones and the rocky beach platform.



This unstable environment makes it difficult for plants and animals to settle. In addition to waves, the organisms must contend with the problems imposed by **tidal fluctuations**. The daily ebb and flow of the sea exposes the shore to all the elements. The animals living within the range of the high and low tides (**intertidal**) are subjected to extreme temperature changes, drying out, and other problems resulting from exposure to the air.

Very few animals can survive these rigorous conditions, and no large plants can anchor in the shifting sands. To the casual observer, the sandy beach appears desolate and barren. However, within the sand grains live large numbers of diverse animals. To survive in this environment, these animals have evolved some interesting **adaptations**. Successful species either ride the waves, live just above the tideline, or burrow beneath the sand to protect themselves from the hammering waves.

The upper beach -is full of small scavengers and **beachhoppers**. These animals live just above the breaking waves. They find both food and shelter in the drift kelp that is cast upon the shore by the waves. **Beachhoppers** are **nocturnal** animals, hiding by day in the beach cast and coming out at night to forage.

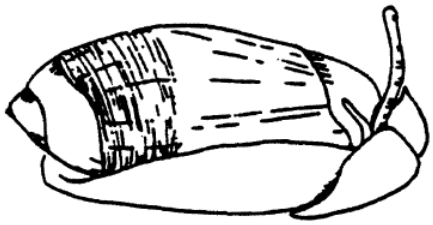
The common **sand crab** lives within the breaking waves. The sand crab rides the waves up and down the beach. To feed, it quickly **burrows** backwards into the sand with its powerful legs, specially adapted for burrowing. It leaves only its featherlike antennae exposed to filter small food particles from the retreating waves.

SAND CRAB

The **razor clam** digs itself into the sand with its strong, ,muscular foot. The foot is specially **adapted** with an expandable, anchor-like tip. The clam alternates between digging into the sand

with the tip and expanding the tip to serve as an anchor while it pulls its shell down through the sand.

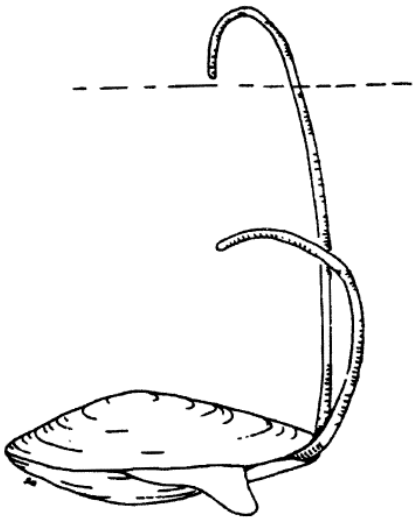
To facilitate burrowing and to resist dislodgement by the waves, many animals have a streamlined body shape. The smooth shell of the **olive snail** reduces water resistance and allows it to burrow quickly into the sand. The egg-shaped carapace of the **sand crab** also allows water to pass over without dislodging the animal.



OLIVE SNAIL

Other organisms have a thick, tough **shell** to protect them from abrasion and from predators. The **Pismo clam** and **bean clam** both have very thick shells for their size.

Although burrowing into the sand provides a means to escape the hammering waves, it imposes an important problem of its own. Marine animals obtain dissolved oxygen from the water. While buried in the sand, the animals must have some mechanism for obtaining oxygen. Many species have a specialized breathing tube or **siphon** which they extend to the surface of the sand. The **siphon** is used to pump water into the body, where it passes over the gills so that the animal can obtain oxygen from the water. Often these tubes are covered with a sieve-like apparatus to prevent sand from getting in the gills of the animal. The **bean** and **Pismo clams** live near the surface of the sand and extend their two short siphons which intake and expel water. Although it does no t have a siphon, the sand crab uses the fine bristles of its shorter antennae to form a breathing tube.



BENT-NOSED CLAM

Deeper along the shore, past the breaking waves, many animals live only partially buried, or on the surface of the sand. Beyond the breakers, the pounding waves are no longer the main adversary of the subtidal animals. The nearshore waters remain turbulent, however, suspending organic matter and sediment into the water column. Most animals in the region are filter feeders, they obtain food by passing water through a filtering mechanism which catches minute food particles. The **Pacific sand dollar** is a common subtidal filter feeder. It may be found along with the predatory **sand star** or the scavenging **elbow crab**. The **sea pansy** is another beautiful subtidal animal which creates its own light through a complex chemical reaction known as bioluminescence.

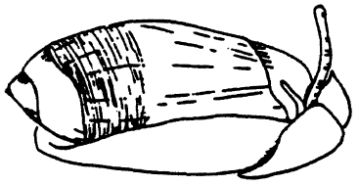
All of these organisms have evolved special features that enable them to survive in the sandy beach environment: there are burrowing adaptations, streamlined body shapes, thick shells, and often specialized breathing tubes. Because they are so specialized, the majority of these animals are found in no other habitat throughout the ocean.

Sandy Beach Organisms

DECORATOR WORM
Diopatra ornata

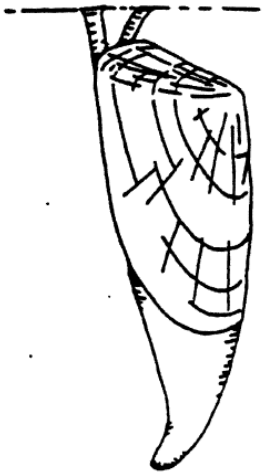
BRISTLE WORM
Nephtys californiensis

SEA PANSY
Renilla kollikeri

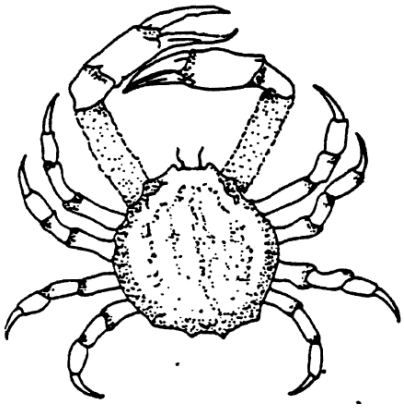


PURPLE OLIVE SNAIL
Olivella biplicata

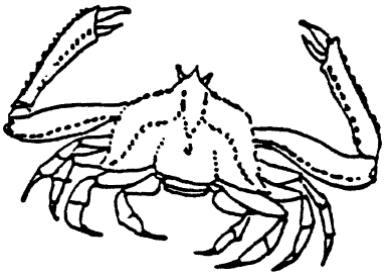
SAND CRAB
Emerita analoga



BEAN CLAM
Donax gouldii

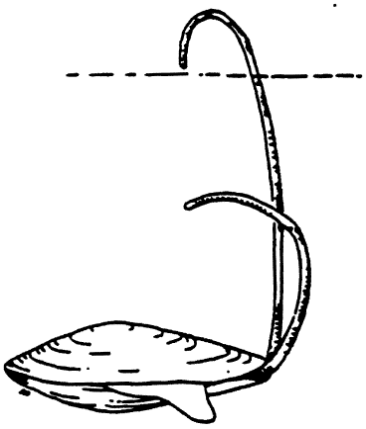


PURPLE CRAB
Randallia ornata



ELBOW CRAB
Heterocrypta occidental

SAND STAR
Astropecten armatus



BENT-NOSED CLAM
Macoma nasuta

SAND DOLLAR
Dendraster excentricus

Cabrillo Marine Aquarium
Sea Search
Version 05-09-2012

Sandy Beach Vocabulary

adaptation	modification of traits, characteristics or behavior of an organism in structure, behavior or function in adjusting to a new condition
beach	a shoreline area composed of sand or pebbles and washed by waves
beach cast (beach wrack)	organic matter and debris washed up on the beach by waves
beach platform	the eroded edge of the coastline on which the sandy beach is formed
bioluminescence	the production of light by a living organism
breakwater	an offshore structure used for reducing wave action
burrow	to make a passageway beneath a surface
camouflage	any device, structure, behavior, action, disguise or coloration that serves to hide or conceal an object or animal in patterns merging with the background
constructive wave	gentle waves which deposit sediment on the beach platform
current	continuous movement of water in a certain direction
destructive wave	strong waves which strip sediment from the beach platform
ecology	interactions of plants and animals with the environment
entanglement	being entwined in something difficult to escape from
erosion	the weathering away of earthy or rocky material
gills	a respiratory structure in aquatic organisms through which gaseous exchange takes place
habitat	natural home or dwelling of an organism. The environment in which specified organisms live
intertidal	area on shore between high and low tides
longshore drift	the movement of water, sand and other loose particles in a given direction along the coast
migrate	to pass periodically from one region to another for purposes of feeding or breeding

nocturnal	animals which are active at night
pollution	a contamination of water, soil and/or air from the discharge of wastes, gases or chemicals
predatory	living by killing and eating other animals
rip current	movement of water away from the beach
salinity	the total amount of dissolved salt in the water
sand	a mixture of tiny grains of different types of disintegrating rocks and shells
scavenger	an animal which devours dead animals or feeds on dead organic matter
sediment	any matter deposited in water (that settles to the bottom)
shell	the hard, rigid exoskeleton or covering of an animal as in mollusks and crustaceans
siphon	a tube like structure for drawing in or expelling fluids
tides	daily rise and fall of ocean waters produced by gravitational pull of the earth by the moon and sun
waves	a moving flow of energy through air or water which causes the up and down movement called swells, generally caused by wind

Sandy Beach Curricular Extensions

- Brainstorm as a class or in small groups to identify animals and plants that might be found on a sandy beach. Animals that the students have seen when they have visited the beach previously can be included. This activity can be repeated after the visit to show a comparison.

- Have students design a new animal species for the sandy beach habitat. Have them include what some of the physical characteristics of the chosen animal are as well as any adaptations the animal would need for survival.

- Have students create a sandy beach environment mural with animals the students have seen. Include any biological or physical features or add human impacts like storm drains, harbors, jetties, piers, etc.

- Use magnets and sand to pull iron out of the sand. Determine what proportion of the sand is iron. Observe the difference in size of sand grains and particles of iron using a magnifying glass and a magnet.

- Locate San Pedro and Pt. Fermin on a map. Have the students map the route to the museum from school using a freeway or local map. Note rivers and streams in the Los Angeles Basin.

- Review the water cycle. Map a path that water follows from the mountains to the ocean and discuss what blocks the sand that the water would have brought to the ocean (dams, cemented rivers. etc.). Have the students take dry sand and slowly add water. Determine through observation how much water can be absorbed. What happens when a large amount is added all at once? Have students form a castle from dry sand and then one from wet sand. Observe and discuss the characteristics of each substance. Compare different sand grain sizes.

- Fill two containers, one with fresh water and one with salt water. (The percentage density of salt in ocean water is approximately 965 grams fresh water and 35 grams salt per liter.) Add a variety of objects to determine if they float. Discuss how/where objects float in salt water as compared to fresh water. Continue adding salt to the fresh water until the objects float at a higher level in the water.

- Using a familiar tune, have students change the words to reflect a sandy beach theme: e.g., Itsy Bitsy Spider can be Itsy Bitsy Grunion Fish, etc.

- Place a shallow container filled with salt water in the sun. Allow the water in the container to evaporate. Record the air temperature, how much water was used, and how long it took the water to evaporate. Check to see what is left in the pan. Investigate how salt is developed for consumer use.

- Make ice cubes with colored water. Fill a flat clear pan such as a baking dish with saltwater solution. Add two or three ice cubes. Observe and record what happens.

- Create waves using a slinky or rope to show wave motion. Observe and discuss what happens when the wave is interrupted by hitting a slope or what could be a reef.

- Create a wave in a bottle using mineral oil and rubbing alcohol and blue food coloring. Make sure the lid is attached tightly.

- Graph the high and low tides each day for a two week period. Compare the changes with the changes of the phases of the moon. (Find tide information in a newspaper or sporting goods store or on the Internet.)

- If your class is in the Spring and we have grunion eggs, we will be hatching grunion eggs. A broad knowledge of which animals reproduce by laying eggs and eggs in general will allow students to make comparisons.

- Discuss prefixes used in oceanography (hydro, zoo, bi, aqua, sub, phyto, chloro, uni).

- Have students cooperatively write a crossword puzzle. trivial pursuit or other game focusing on the animals in the sandy beach habitat.

- Have students write an interview with a sandy beach animal or research an animal so they can be interviewed by other students. Include descriptions of special features and behaviors. This could be "a day in the life of _____" (animal selected).

- Present the students with an opportunity to imagine the sandy beach environment (tapes of waves rolling on the beach or sea birds could be used, could be through guided imagery). Encourage the students to recall the details of what they imagine including colors, actions, sounds, etc. Then write a poem (Haiku, Cinquain or Diamante work well).

- Have students further explore the ways people use beaches and the effects on the sea life including recreation, fishing, harvesting kelp, aquaculture, etc.