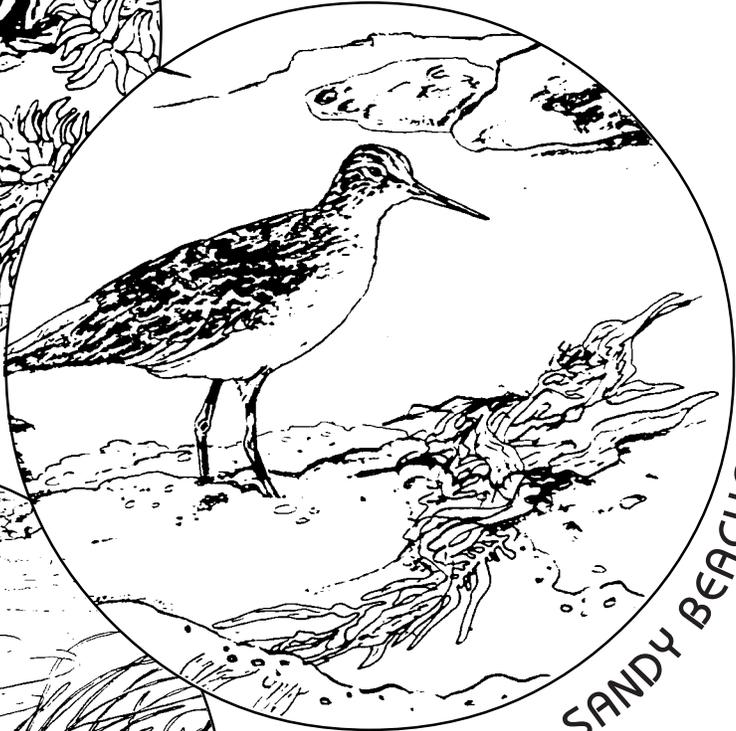


# Educator's Guide to The Coastal Marine Environment

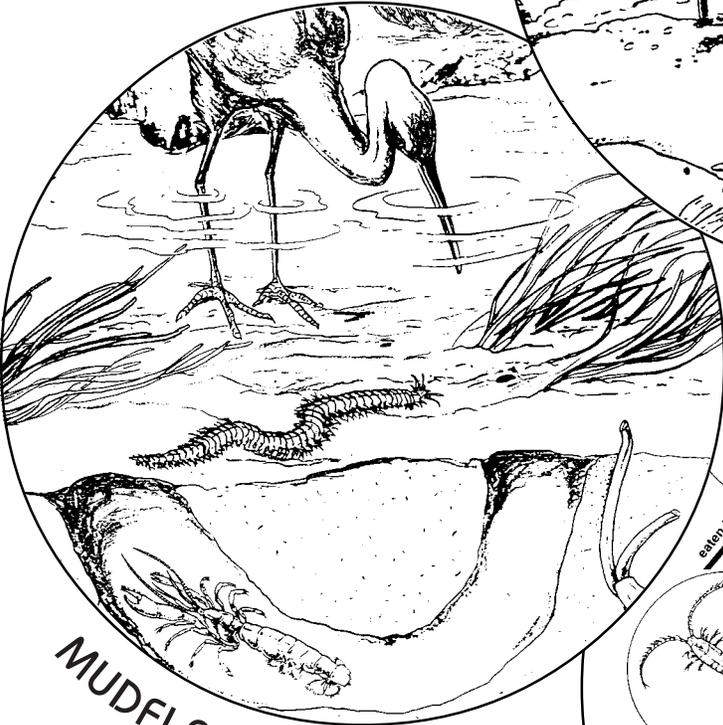
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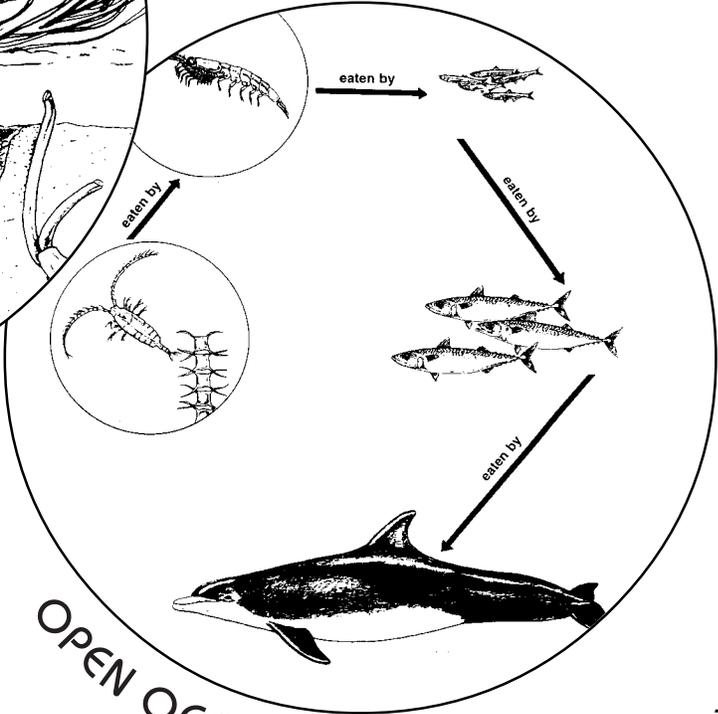
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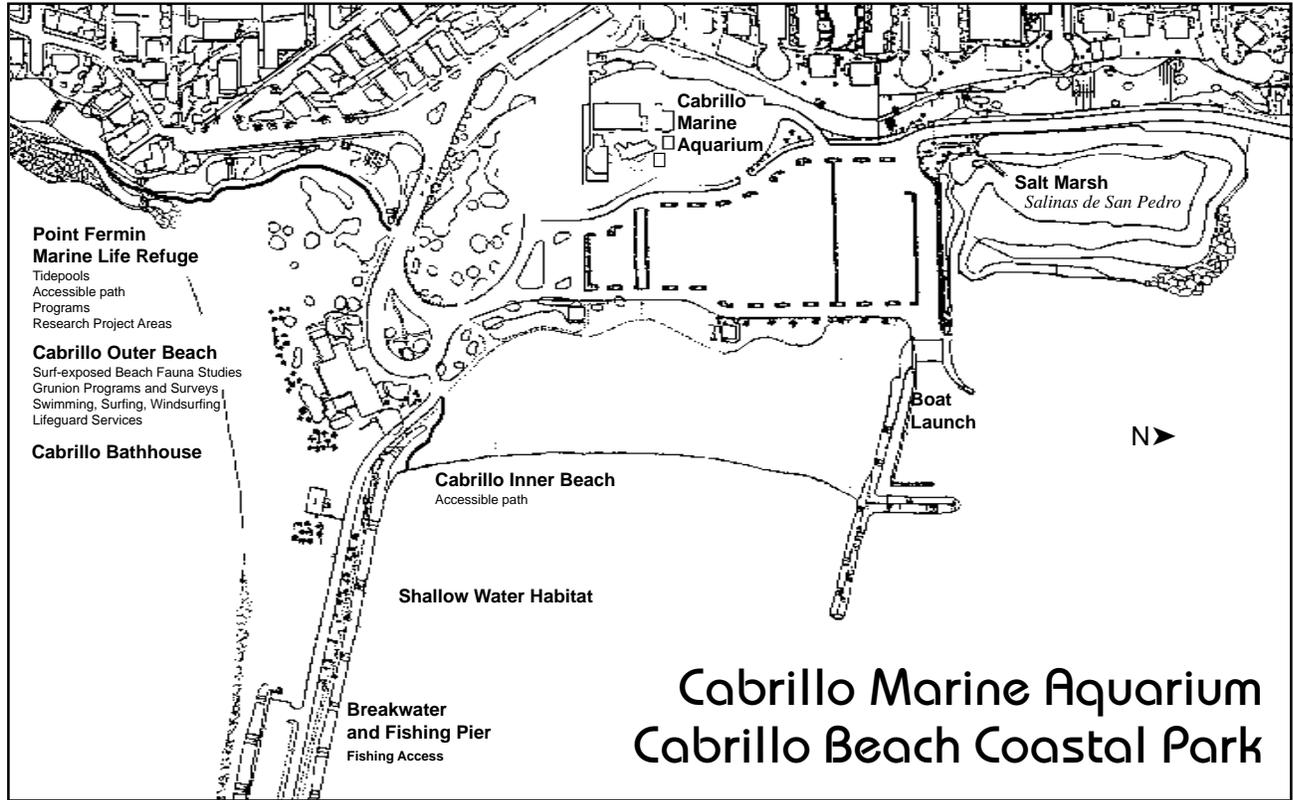
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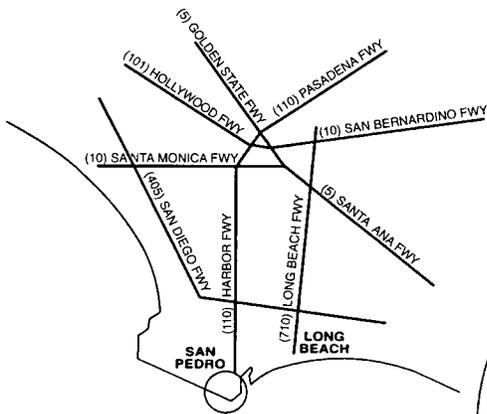
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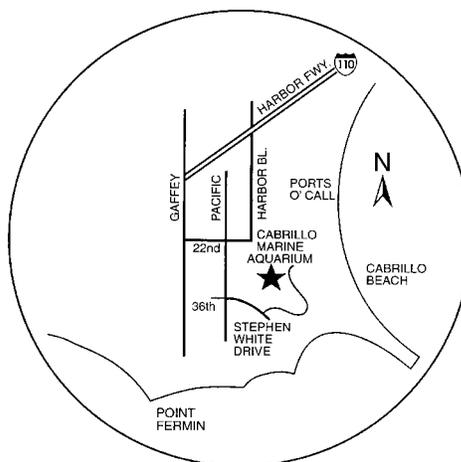
OPEN OCEAN



## Cabrillo Marine Aquarium Cabrillo Beach Coastal Park



Visit the Aquarium and see the marine life of southern California.



Harbor Freeway (110) south; exit at Harbor Boulevard in San Pedro.

Right turn onto Harbor Boulevard to 22nd Street.

Right turn onto 22nd Street to Pacific Avenue.

Left turn onto Pacific Avenue to 36th Street/Stephen White Drive.

Left turn at Stephen White Dr. to the Cabrillo Beach parking lot.





# Educator's Guide to The Coastal Marine Environment

Produced through generous funding  
from the following:

Wells Fargo Foundation  
Santa Monica Bay Restoration Project  
The Entertainment Industry Foundation  
The Times Mirror Foundation  
Josephine Gumbiner Foundation





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For more information, visit Cabrillo Marine Aquarium’s website at [www.cabrilloaq.org](http://www.cabrilloaq.org).

# The Southern California Bight



Illustration shows the California Current and Channel Islands.



**W**elcome to Cabrillo Marine Aquarium. We look forward to your visit. This guide was developed for K-4 educators, to use with your class to enhance your visit to Cabrillo Marine Aquarium or any southern California coastal area. For an enjoyable and educational visit we have included recommended activities for you and your students to do before, during, and after your field trip. In addition, we provide maps, illustrations, background information, a bibliography, glossary (words in bold), and a listing of sites to visit.

**T**he guide begins with biological resource information about the various coastal marine **habitats** and the organisms that inhabit them. The accompanying illustrations give a close-up view of each environment. The back section contains specific suggestions for planning a field trip and activities for educators to use.

If you are planning to visit the Cabrillo Marine Aquarium, you may also wish to spend time in the surrounding coastal habitats found at Cabrillo Beach Coastal Park. There are many opportunities within easy walking distance: you can tidepool in the Point Fermin Marine Life Refuge, wade or swim in an outside wave-swept sandy beach, visit the fishing pier and observe some of the traffic of the harbor, explore the inner harbor beach, or visit the salt marsh to observe birds. See the enclosed map of habitat areas surrounding the aquarium (inside front cover). We hope that you can find time to explore one or more of these areas during your visit.

**C**abrillo Marine Aquarium is located in southern California and displays local marine life found from Point Conception to the Mexican border. The exhibits are divided by habitats, representing the rocky shore (hard substratum), sandy beach and mudflat (soft shifting bottoms), and the open ocean. Within the aquarium there are 35 different aquaria, interactive exhibits, and a tidepool touch tank. Key scientific concepts encountered in the exhibit hall include:

- 1** **Habitats** have specific physical features. A habitat is represented by the diverse geologic features that comprise the ocean bottom and shore, including the land forms (rock, sand, or mud), and the impact of saltwater and its movement (tides and currents). The coastal habitat exhibits found at Cabrillo Marine Aquarium reflect the physical features (hard substratum, sandy shore, muddy bottoms, and the open ocean) of each major type of habitat and its inhabitants.
- 2** Plants and animals in each of the habitats survive using a variety of **adaptations**. The form and behavior of an organism (plant or animal) reflect both its habitat and the community of other organisms found there in order for the organism to grow and reproduce.
- 3** Humans have an impact on the marine environments and the organisms that live there as they explore the ocean, use its resources, and bring about changes to its habitats.



# The Ocean Environment and the Southern California Bight

About 79% of the earth's surface is ocean water, and an average of 3.5% of ocean water is composed of dissolved substances, primarily salts. The measure of total dissolved substances in water is **salinity**. Salinity levels may vary depending upon evaporation, precipitation, and runoff from land.

Tidal changes occur daily, shown by two high tides and two low tides each day. As a result, twice a day the **intertidal** zone is uncovered by the falling tides. **Tides** are a wave form resulting from centrifugal and gravitational interaction among the sun, moon, and earth, and the rotation of the earth. Very high and very low tides, called spring tides, occur with the full and new moon when the earth, moon, and sun are aligned. Neap tides, which are moderate high and low tides, occur with the half moon phases each month when the moon and sun are at right angles to each other. Tide schedules can be found at sportfishing stores and in the newspaper.

The Pacific Coast of North America winds its way along some 56,000 miles of shoreline from Alaska to Baja California. Here in southern California we find ourselves within a temperate region of overlap. **Currents**, the massive rivers of circulating ocean water powered by the rotation of the earth, the sun's heat, and the movement of the wind, provide the necessary resources. The cold Arctic water of the California Current from the north mixes with warmer, tropical water from the south in a sort of backwater eddy south of Point Conception. This area is identified as the Southern California Bight. This meeting of cold and warm water enables many animals from both regions to survive in the diverse habitats found here. These habitats include rocky shores, sandy beaches, mudflats, and the open ocean. Each environment hosts distinct **communities** of plants and animals which have evolved characteristics (adaptations) that enable them to reside there.

Because of our eastern location on the Pacific Rim and the prevailing northwest winds, a phenomenon known as **upwelling** occurs in which deep, cold, nutrient-laden water is brought to the nearshore surface. This causes microscopic plant **plankton (phytoplankton)**, such as diatoms, to bloom and to begin a food cycle which, directly or indirectly, feeds the "higher" marine animals. Phytoplankton provides much of the oxygen we breathe and can color the sea green, red, or golden when there is a phytoplankton bloom.

Habitat loss and degradation have resulted in major impacts to the **wetlands** in this region. Wetlands have been dredged, filled, and built upon, resulting in significant elimination of natural homes for feeding and breeding purposes. Some organisms have been able to adapt; others have been eliminated from the area. Human pollution, through **urban runoff** and impacts on the **watershed**, have resulted in a significant decrease in the health of marine environments. Understanding how we, as individuals, impact the water cycle, and in turn the ocean, allows each of us to make choices that can influence the preservation of these coastal habitats.



Feather Boa Kelp  
*Egregia menziesii*

Purple Sea Urchin  
*Strongylocentrotus purpuratus*

Hermit Crab  
*Pagurus sp.*

Mussel  
*Mytilus californianus*

California Brown Sea Hare  
*Aplysia californica*

Coraline Algae  
*Coralina chilensis*

Aggregating Anemone  
*Anthopleura elegantissima*

# Rocky Shores

## Rocky Shore Habitat



Ochre Sea Star  
*Pisaster ochraceus*

The rocky shore begins with the **tidepools** which are found in the intertidal area and extends into the subtidal area to the **kelp forest**. Rocky shores have a hard substrate. Imagine living attached to a rock on the shore—the pounding of **waves** both battering you and bringing bits of food and other animals within your grasp to eat. The rotation of the earth, interacting with the gravitational pull of the sun and

moon, lowers the tide and some six hours later you are a tidepool animal left high and dry! What sort of adaptations might a tidepool organism possess to survive this baking and beating? Sea stars, urchins, and sea cucumbers use many suction cup tube feet to cling to the rocks as they walk. **Molluscs** such as wavy top snails, sea hares, limpets, and abalone use a muscular, adhesive foot to anchor themselves.

Others are builders and borers on the rocky shore. If you examine rocks on the shore, many will have holes that appear as if someone stuck a finger in clay. Within these holes are often the two shells of a piddock clam, which the clam uses to grind into the rock. Some worms and snails build protective tubes from dissolved calcium or cemented sand grains. Others, like mussels and barnacles, cement themselves in place to the rocks' surfaces. In addition to holding tightly to the rocks, many animals are **camouflaged** for protection, blending easily into their surroundings and making it more difficult for predators to find them. Many glide or scurry to the undersides of rocks and ledges which afford them additional protection.

Most ocean “plants” (**algae**) are actually **protists** and distinct from most land plants in that nutrients for photosynthesis are absorbed directly from the water instead of through roots. Off our rocky shore lies the unique kelp forest. The undersea forest canopy protects a delicate and teeming community of plants and animals. Many invertebrates reside in the root-like holdfasts which attach the plant to the rocky bottom. Algal growth, whether in single-celled diatoms or giant kelp forests, begins a food chain for zooplankton and grazers such as abalone, sea hares, and sea urchins. The snails scrape off algae by rasping with a file-like tongue called a radula. These small grazers are in turn eaten by larger animals.

Many marine invertebrates grow attached to the rocky substrate and have no head or legs. They capture food carried by the water and may look like plants. The sea anemones and sea fans (**cnidarians**) use stinging cells in their tentacles to “harpoon” food. Sea squirts, clams, fanworms, and barnacles **filter feed** by straining small food particles from the water.

**Echinoderms** such as sea stars, which are mostly **carnivores**, sea urchins, which are **herbivores**, and sea cucumbers, which are **detritivores** (eating decomposed organic waste material), are found clinging to rocks. Some are predatory, and their suction cup tube feet allow them to pry open food as well as attach to rocks; others are **scavengers**. **Crustaceans** such as crabs, shrimp, lobsters, and barnacles live in a suit of armor which is their skeleton, and use modified legs and claws for defense and a variety of food gathering techniques, from filter feeding to spearing, crushing, and scraping.



Willet  
Catoptrophorus semipalmatus

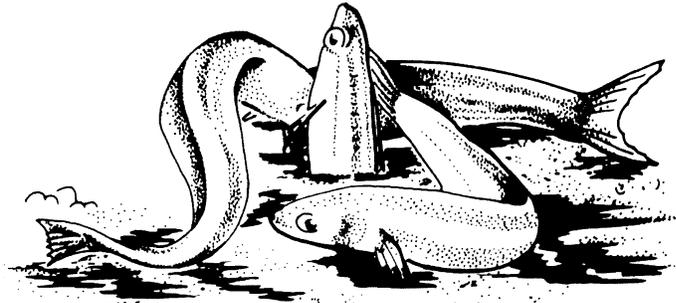
Beach Wrack

Pacific Mole Crab  
Emerita analoga

Purple Dwarf Olive Snail  
Olivella biplicata

# Sandy Beach

## Sandy Beach Habitat



California Grunion  
*Leuresthes tenuis*

Wind-generated waves produce a current along the shore which keeps sandy beaches constantly moving like a river. Most sandy beaches in southern California are artificially replenished. The rivers that used to carry new sand to the sea have been dammed and cemented, reduc-

ing or eliminating the natural source of sand. Beach sand is made up of fragments of shells and rocks with many exposed edges. The color and texture of the sand depends upon the source of sediments. Seasonal changes result in significant changes in the profile of the beach. Winter storms wash sand off the beach and often leave a steep beach profile. Gentle summer waves build up the beach. Much like a desert, sandy bottoms look barren, yet they may host large numbers of animals. Most of these animals blend in with the sand while others burrow for protection.

Plants do not live on the sandy beach since there is no stable surface for attachment. The **beach wrack**, made up of plants and other materials washed on shore by the tide, provides temporary refuge and food for animals along the high tide line. Among this beach wrack, beachhoppers, kelp flies, and other small scavengers gather in large numbers. Birds such as willets, plovers, and gulls in turn gather to search for food left behind by the tides. As the kelp continues to decompose, animals such as mole crabs filter out the tiny particles.

Along the sandy bottom, worms, clams, snails, sand stars, sea pansies, sand dollars, crabs, and sand urchins search for food and work to prevent themselves from becoming food. The major adaptation for these bottom inhabitants is the ability to burrow. Because the sand is swept clean by waves and currents, detritus and deposit feeders are rare. Animals must prey upon one another (sea stars and tube anemones), filter the plankton (mole crabs and clams), or scavenge on dead animals (olive snails).

Sand crabs can thrive in the zone of wave wash by rapidly burrowing backward and migrating up and down with the tides as they filter plankton with featherlike antennae. Sand dollars live on their sides, catching particles to eat with their tube feet and fine spines. Snails secrete a slimy mucus allowing them to glide along the sand. When those snails die, hermit crabs move into their empty shells for protection. Visitors to the sandy shore include rays and sharks that come in to feed at night on small invertebrates.

Flatfishes (halibut, sole, flounder, and turbot) literally lie on their sides. While they are still juveniles, one eye migrates to the upper side in order to stay out of the abrasive sand. Some flatfish find food in the bottom sediment while others feed above the sand surface. With their flattened profile, they rapidly wiggle to cover themselves with a thin sand layer. Some species can change color to blend in with the sand.

Another fish, the grunion, beach themselves on spring and summer nights following the full and new moon high tides. The females bury eggs in the sand where they develop, out of the reach of other fish, until they hatch two weeks later when agitated by the high tide waves. (In the spring check with the Department of Fish and Game at (562) 342-7100 or Cabrillo Marine Aquarium for predicted grunion run nights).



Pickleweed  
Salicornia virginica

Snowy Egret  
Egretta thula

Eelgrass  
Zostera marina

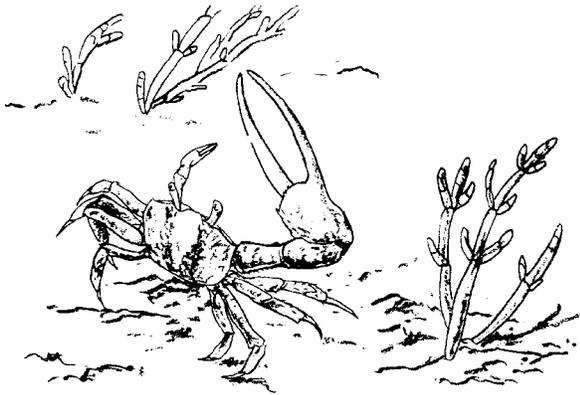
Polychaete Worm

Bay Ghost Shrimp  
Callinassa californiensis

Bent-Nosed Clam  
Macoma nasuta

## Mudflat

## Mudflat Habitat



Fiddler Crab  
*Uca crenulata crenulata*

**W**etlands are areas of transition between land and water. They include swamps, bogs, estuaries, prairie potholes, saltmarshes, mudflats, and mangroves. Natural factors affecting the wetlands include storms that flush the system, temporarily changing the balance between fresh and salt water.

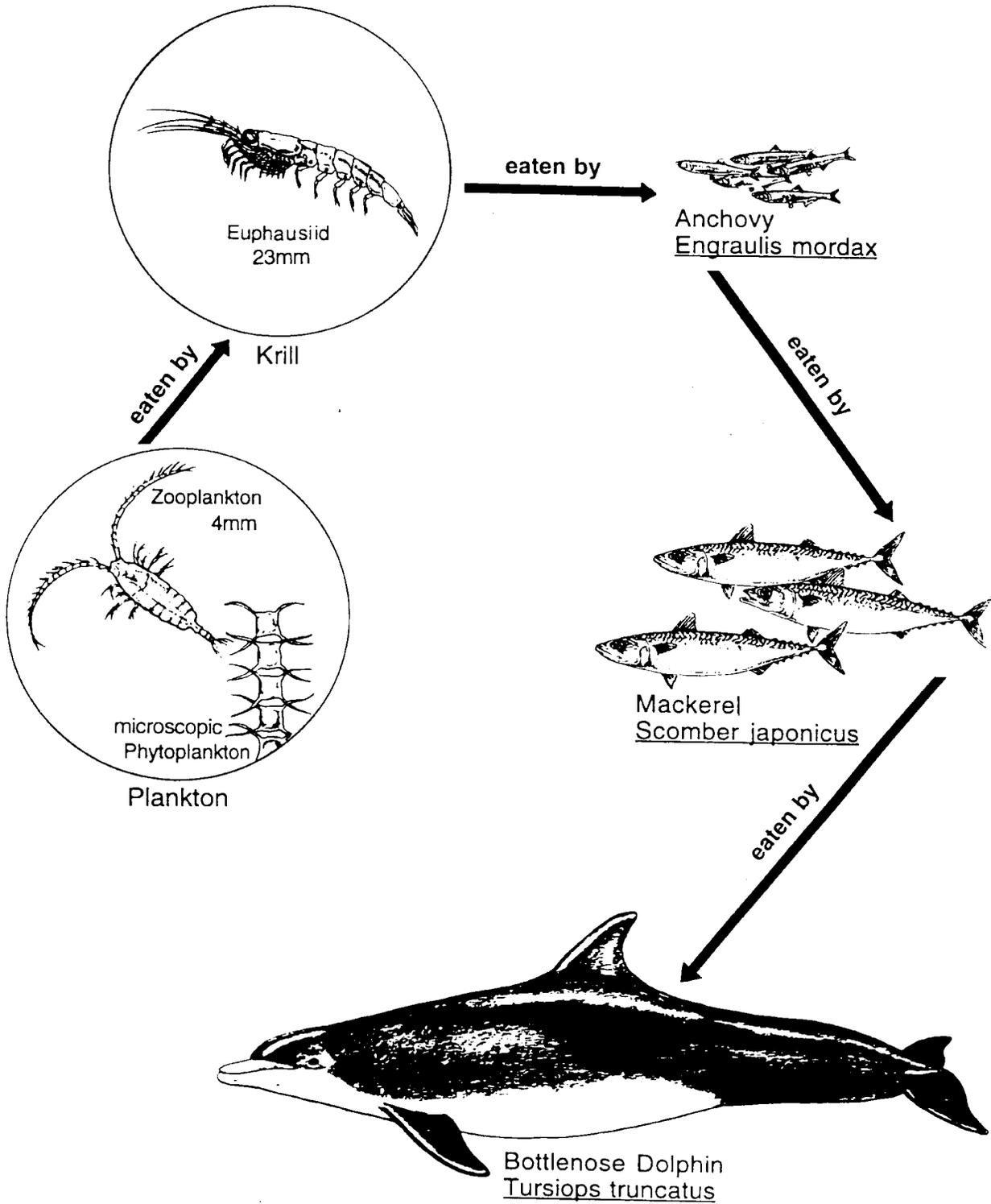
**Mudflats** often appear as lifeless, barren areas, yet they are home to an incredible number

of small animals (worms, clams, ghost shrimp, and fiddler crabs), which most often are found burrowed in the mud. The “mudflat metropolis” is composed of burrowers and tube dwellers that help oxygen-rich seawater percolate to keep the mud alive. Mudflats provide food for massive numbers of shorebirds, whose legs and bills are shaped to allow access to varying depths and types of burrowing clams, worms, and snails.

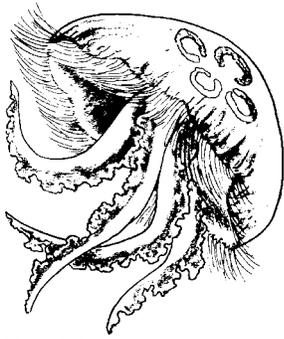
The plants of the wetlands are adapted to tolerate soggy, wet soil with widely varying salt concentrations as well as low oxygen concentrations. To survive saturation by saltwater, many plants concentrate the salt in sections that later break off (pickleweed) or excrete salt through glands (salt grass). The saltwater wetlands are one of the most productive habitats in the world, and through tidal movement some of the nutrients produced flow into adjacent habitats providing food and refuge for a rich variety of animal life. The main food pathway in the mudflat is through the bacterial breakdown and decay of plant material such as eel grass to yield organic debris (detritus), which is used by a large variety of invertebrates, who in turn are eaten by fish and birds. The plants along the shore provide resting sites and food sources for many of the animals living in a mudflat.

In addition to providing homes for resident birds, southern California wetlands are rest stops for birds migrating along the Pacific Flyway. Bird legs and feet are adapted to reach different depths in the mud and water. Many wading birds, such as sandpipers, curlews and willets, follow the changing tide line and probe into the mud with their beaks. Herons and egrets use their keen eyesight to locate prey and grab it with their strong forceps-like bills. Swimming birds like grebes, loons, and ducks dive after fish or dabble along the bottom, straining small plants and animals with their sieve-like beaks.

Salt marshes and mudflat communities are nourished daily by the tides and seasonally by nutrients from freshwater runoff. Wetlands are “nurseries of the sea,” providing a protective nutrient-rich habitat for baby fish. Many outer coast and offshore fish species are dependent upon estuaries as breeding or nursery grounds for their young. More than half of local commercial and sportfish species spend some time in a mudflat or other wetland habitat. In addition, wetlands trap sediment nutrients and pollution as well as absorb excess rainwater that flows toward the ocean from rivers and storm drains. Human impact has resulted in a loss of over 50% of wetland areas nationwide and over 91% loss of California’s wetlands. Wetlands worldwide have been transformed into housing, farm lands, factories, and harbors through landfill and dredging, thus eliminating the essential roles of these areas.



## Open Ocean Food Chain



Moon Jelly  
*Aurelia aurita*

## Open Ocean and Offshore Island Habitats

In the open ocean are found the microscopic and larger drifters, floaters, and wanderers of the sea, called **plankton**. With the exception of drifting kelp paddies, all the plants composing the meadows of the sea are microscopic phytoplankton. These plants are set into motion by the currents. They compose the base of the oceanic food chain and contribute more than 60% of the earth's oxygen. Phytoplankton is fed upon by **zooplankton** (animal plankton), including jellyfish. The larger zooplankton are eaten by filter feeders, including fish and baleen whales. The predator-prey relationship continues until dead organisms and waste material (detritus) are broken down by bacteria to provide nutrients to fuel the next plankton bloom.

Strong swimmers comprise the **nekton**, largely made up of over 20,000 diverse species of fish. **Fish** are vertebrates with fins that use **gills** to respire in the water. They can live many places in the ocean, and their appearance often reflects the way they live. Some lie still on the bottom and suddenly gulp in their food, while others swim rapidly to pursue prey. Open ocean fish tend to be streamlined, have **countershading** (light underneath the body and dark on the back) and are fast, constantly moving swimmers. Many fish gain protection from predators by swimming together in large schools; try to imagine yourself charging a large school of anchovies, smelt, or mackerel for food—which individual do you go after as they all try to escape? In the case of the Pacific sardine and many other species of fish, schooling helped humans to gather too many, resulting in overfishing. Overharvesting of all fish, including sharks, has a tremendous impact upon the balance of ocean life when key animals are eliminated from the food web.

Sharks are fish with a skeleton of cartilage (not bone) and skin of denticles (teeth-like, rather than scales). Of over 370 identified species of sharks, approximately six may be considered dangerous to humans, most notably the great white shark. The 35-foot basking shark, the largest shark in our area, has tiny oral teeth and merely filters plankton from the water. The leopard, horn, and swell sharks in our tanks are commonly found close to shore, are mostly nocturnal, and like most species of shark, are harmless to humans.

The largest **mammals** in the ocean, the baleen or mysticete whales, are giant filter feeders straining small crustaceans, fish, and plankton from the water. Gray whales, unique bottom feeders, **migrate** along the California coast each year, moving from the Bering Sea in the north to the lagoons of Baja California to mate and give birth, and then back north again to feed. At 100 feet and 150 tons, the blue whale is the largest animal to ever live on this planet. The toothed whales (killer, pilot, sperm and dolphins) are great predators, feeding on vast quantities of squid and fish. The populations of many whale species have been greatly reduced. Whale hunting has been outlawed by the International Whaling Commission, but a few countries still hunt whales.

Offshore southern California's continental shelf is marked by islands, shallow banks, deep basins, and submarine canyons. Although most of the sea floor consists of mud and sediment, the Channel Islands provide shelter for mammals and birds to breed. Five species of **pinnipeds** have **rookeries** here, including the California sea lion, harbor seal, and northern elephant seal. The islands also provide nesting sites in the form of ledges on rocky cliffs, steep rocky slopes, crevices, caves, flat ground, and burrows for many species of seabirds. A wide variety of **endemic** (native) plant and animal species are found on these offshore islands (p. 4) which make up the Channel Islands National Park.

# Environmental Etiquette Tips

- **The best time** to be at the tidepools is 30 to 60 minutes before the predicted low tide. When you go to the tidepools, go all the way out with the tide and then work your way back in. Birds are often seen feeding when the tide is going out at a marsh or sandy beach.
- **When is a good low tide?** Newspapers on the coast usually carry the tide tables with the weather. Tides of one foot or lower are usually good for exploring the tidepools. Minus tides are best. Many sporting goods stores have free tide guides.
- **Plan ahead.** Wear sturdy, nonskid shoes and dress in layers when exploring the tidepools. For a wetland, boots or old tennis shoes work well.
- **Don't turn your back to the waves.** Be alert and keep an eye on the water. Watch to avoid becoming stranded as the incoming tide surrounds the area. Be aware of the incoming tide.
- **Take a partner.** You can take turns with your partner watching the waves and exploring.
- **Watch where you put your feet.** Try not to walk on animals and plants that live on the rocks and in the tidepools. Seaweeds growing on rocks can be dangerously slippery. Animals and plants in the marsh are easily disturbed. Try to view from a distance, staying on a path, rather than going directly into the wetland.
- **Touch animals gently with wet hands.** Most tidepool animals have a coating of slime to protect them. Dry hands can damage the animals. Use other senses, including listening for the sounds of the area and smelling the scents.
- **Leave animals, rocks and shells as you found them.** Seashore organisms are alive and adapted to a very specific environment. Changing the habitat of tidepool animals and plants or moving them to new surroundings can injure or kill them. If you look under a rock, return it to how and where you found it. Make drawings or take photos rather than taking samples from the area of study.
- **Organisms in tidepools are protected by law.** Taking them home with you is illegal and will kill the animals. The Point Fermin Marine Life Refuge tidepools, like all tidepool areas in California, are a protected environment. California Department of Fish and Game Wardens enforce these regulations.
- **Leave natural habitats cleaner than you found them.** Pick up any refuse or debris you find and dispose of it properly.
- **Alternatives to tidepooling.** In order to reduce the impact on these complex and vulnerable systems, and to avoid having to schedule field trips around low tides, consider doing the following instead: study sand samples from the outer and inner beaches, do a tideline scavenger hunt along the shore, conduct current and wave observations, do a bird survey, walk through the coastal park and make comparisons of the different habitats, or do a beach clean-up.

## Coastal Locations to Visit with Your Class

where interpretive programs are available by reservation (listed north to south)

**Leo Carrillo State Beach:** 36000 block of Pacific Coast Highway, Malibu, CA. Wildlife preserve, State Park, tidepools, beach, campground, interpretive program through Rangers. (805) 986-8591.

**Malibu Lagoon State Beach:** 23200 block of Pacific Coast Highway, Malibu, CA. Wildlife preserve, tidepools, beach, interpretive center, interpretive programs through Resource Conservation District of Santa Monica Mountains. (310) 455-1449.

**Santa Monica Beach/UCLA Ocean Discovery Center:** Colorado and Ocean Avenue, Santa Monica, CA. Beach, pier, interpretive programs/aquarium. (310) 393-6149.

**Ballona Wetlands:** National Audubon Society Education Division/Friends of Ballona Wetlands: Culver Blvd., Playa del Rey, CA. Outreach programs, walks, and outdoor classroom with hands-on, docent-led experiences along Ballona Creek. (310) 574-2799.

**Manhattan Beach Pier and LA County Roundhouse Program:** foot of Manhattan Beach Blvd., Manhattan Beach, CA. Beach, pier, interpretive programs from pier and beach, aquaria. (310) 379-8117.

**SEA Laboratory (Science Education Adventure):** 1021 N. Harbor Drive, Redondo Beach, CA. Interpretive programs on the beach and in the lab. (562) 529-7357.

**Point Vicente Interpretive Center:** Palos Verdes Drive West, south of Hawthorne Blvd., Rancho Palos Verdes, CA. Visitor center, whale observation point, interpretive programs, including tidepooling at Abalone Cove Beach and Ecological Reserve. (310) 377-5370.

**Cabrillo Marine Aquarium and Cabrillo Beach Coastal Park:** 3720 Stephen White Drive, San Pedro, CA. Marine Life Refuge, beach, tidepools, pier, salt marsh, accessible trails, harbor, aquarium; interpretive programs, including tours, lab classes, outreach and whalewatch available. (310) 548-7562.

**Bolsa Chica Ecological Reserve:** Pacific Coast Highway, Huntington Beach, CA. Interpretive center, wetlands, beach (across street), tours through wetlands. (714) 897-7003.

**Upper Newport Bay Ecological Reserve:** 600 Shellmaker, Newport Beach, CA. Wetlands interpretation. (714) 640-6746.

**Little Corona Del Mar Beach and Newport Marine Life Refuge:** Newport Beach at Poppy Avenue. Tours available. (949) 644-3038.

**Dana Point Marine Life Refuge and Ocean Institute of Orange County:** Tidepool tours available with reservation. (949) 496-2274.

*Collecting animals, shells and/or rocks significantly impacts the rocky shore and in most areas is prohibited. Visitors to the tidepools can protect and preserve tidepools by stepping lightly and leaving all shells, rocks, animals, and plants behind.*



# Activities to Do with Your Students

The activities in this guide will help to maximize student observations, discovery and inquiry within the aquarium or along the coastal shore. As a teacher, you know your students' needs best. You can adapt them to suit your class. Each is aligned with the California State Science Framework, which you will find on the following pages. For additional activities, please see the resource section (pp. 20-45) or check the aquarium web site at [www.cabrilloaq.org](http://www.cabrilloaq.org).

## Evaluation/Assessment

Three phases of evaluation are critical to measuring student growth during science instruction.

- 1** Assessment of students' prior experiences, attitudes and knowledge helps students identify what they know and want to know about the ocean. Prior to instruction, assessment can be conducted through brainstorming, creating a concept map, a multiple choice questionnaire, a short essay, or ocean drawings from a sea animal's perspective.
- 2** Ongoing assessment during instruction helps students in developing their own questions from which to seek answers. It includes looking at process skills, increased knowledge, application of major concepts and implementation of the scientific process. Activities included in the lower grades are observing, comparing, questioning, inferring, classifying, measuring and recording skills through the use of field notebooks, student writing, and observational drawings.
- 3** Final assessment can encompass a student portfolio, project or oral presentation sharing their findings, and questions. It might include a post test, repeat drawing, concept map, or short essay. The NSTA *Science Educator's Guide to Assessment* presents a model of assessment that can be used to better incorporate evaluation into the instructional process.

The activities in this guide can be incorporated or adjusted for use as assessment tools and included in a student portfolio.



# Alignment of Activities with California State Science Framework

PHYSICAL SCIENCE	LIFE SCIENCE	EARTH SCIENCE	INVESTIGATION/EXPERIMENTATION
<p><b>K</b> - Objects can be described in terms of their physical properties. <b>Activity:</b> Experience That!</p> <p><b>1st</b> - Materials come in different states (solid, liquid, water). <b>Activity:</b> How Does The Water Flow?</p> <p><b>2nd</b> - Motion of objects can be observed and measured. <b>Activities:</b> How Does The Water Flow?, Experience That!</p> <p><b>3rd</b> - Energy and matter have multiple forms and can be changed from one form to another. <b>Activity:</b> How Does The Water Flow?</p>	<p><b>K</b> - Different types of plants and animals inhabit the earth; describe similarities and differences in appearance and behavior and identify major structures. <b>Activities:</b> How Do They Make A Living?, Surviving In My Neighborhood, Experience That!, Census Taker Is Here, Are You A...?, Role Call, Poster Perfect.</p> <p><b>1st</b> - Plants and animals meet their needs in different ways. <b>Activities:</b> Experience That!, Census Taker Is Here, Is This My Neighborhood?, Are You A...?, Is The Seasoning Right?, Role Call, Poster Perfect.</p> <p><b>2nd</b> - Plants and animals have predictable life cycles; there is variation among individuals of a population. <b>Activities:</b> How Do They Make a Living?, Census Taker Is Here, Who's Connected?, Role Call, Poster Perfect.</p> <p><b>3rd</b> - Adaptations in physical structure or behavior may improve an organism's chance for survival. Plant structures and animal structures serve specific functions. Living things change their environment. <b>Activities:</b> Who Makes Up The Community?, How Do They Make A Living?, Surviving In My Neighborhood, Census Taker Is Here, Is This My Neighborhood?, Who Is Connected?, Are You A...?, Is The Seasoning Right?, Role Call, Poster Perfect.</p> <p><b>4th</b> - All organisms need energy and matter to live and grow. Plants are producers, the primary source of matter and energy for food chains. Producers and consumers are related in food webs and may compete with each other for resources in ecosystems. <b>Activities:</b> How Do They Make A Living?, Surviving In My Neighborhood, Census Taker Is Here, We Are Making A Difference, Who Is Connected?, Are You A...?, Is The Seasoning Right?, Role Call, Poster Perfect.</p>	<p><b>K</b> - The earth is composed of land, air and water. <b>Activity:</b> How Does The Water Flow?</p> <p><b>1st</b> - Weather can be observed, measured and described. <b>Activities:</b> Experience That!, Can I Make A Difference?</p> <p><b>2nd</b> - Earth is made of materials (rocks, sand, soil, etc.) that have distinct properties, and the earth provides resources for humans. <b>Activities:</b> Experience That!, Can I Make A Difference?, Bits and Pieces, Complete The Picture, Is This My Neighborhood?</p> <p><b>3rd</b> - Objects in the sky move in regular and predictable patterns. <b>Activity:</b> Experience That! (tidal changes)</p> <p><b>4th</b> - Waves, wind, water and ice shape and reshape the Earth's land surface <b>Activity:</b> How Does The Water Flow?</p>	<p><b>K</b> - Ask meaningful questions, conduct careful investigation. Develop your own questions, use five senses to observe, describe properties, position of objects, compare and sort objects and communicate observations.</p> <p><b>1st</b> - Ask meaningful questions, conduct careful investigation. Develop own questions, draw pictures that portray some features, record observations with data and make new observations when discrepancies exist.</p> <p><b>2nd</b> - Ask meaningful questions, conduct careful investigation. Develop own questions, make predictions based on patterns of observation, compare and sort objects; write or draw description of a sequence of events.</p> <p><b>3rd</b> - Ask meaningful questions, conduct careful investigation. Develop own questions, repeat observations to improve accuracy, differentiate evidence from opinion. Use numerical data in describing and comparing objects, events and measurements.</p> <p><b>4th</b> - Ask meaningful questions, conduct careful investigation. Develop own questions. Differentiate observation from inference and know that explanations come from observation and how observations are interpreted.</p>

# Before Your Trip...

## **Who Makes Up The Community?**

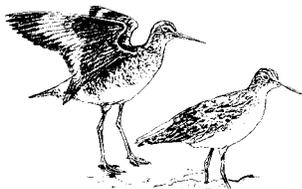
**Outcome:** Students will make a concept map, mural and/or brainstorm to identify previous knowledge about the different coastal habitats.

**Materials:** Pictures of marine life, illustrations of the different coastal habitats, paper on which to put a mural, books, chart paper on which to create lists.

**Resource pages in background section:** Illustrations of the different habitats (pp. 8-15 and 29-44).

**Procedure:** (This activity can be done as an entire class or in cooperative groups.)

1. Identify with students what makes up their own community or home (the structures, residents, plants, and animals).
2. Show students a picture of a selected habitat (rocky shore, sandy beach, mudflat, or open ocean). Have them identify the structures, residents, plants, and animals they find in the picture. Make a list of challenges animals might have in trying to survive in each location (moving through the sand, holding onto rocks, finding a safe place to hide, etc.).
3. Repeat with the other habitats (rocky shore, sandy beach, mudflat, or open ocean) as time allows.
4. Have students create a collage or mural of sea life, from magazines or drawings, organized by habitat.
5. Have students identify the organisms they expect to see during their upcoming trip. Make a list of remaining questions the students have and what they want to learn more about.



## ***How Do They Make A Living?***

**Outcome:** Students will apply different feeding strategies to simulate how animals in the marine environment feed and gain an understanding of competition and how each organism survives in its own niche.

**Materials:** For each group: a turkey baster, a sieve, chop sticks, pasta tongs (to represent different feeding mechanisms); dried spice like oregano, popcorn, cooked spaghetti noodles (to represent types of food); clear bowls of different sizes with water (to represent a habitat).

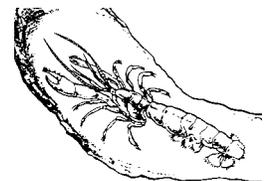
**Resource pages in background section:** Illustrations of animals to see how they collect food (pp. 29-44).

**Procedure:** (Begin as whole class, then break into small groups for hands-on exploration.)

1. Discuss with students that animals have adaptations for survival. Ask students to imagine that they are animals living along the shore. Let the students know they are going to collect food. The feeding mechanisms they can use include a turkey baster to collect by sucking in the food, chop sticks to probe and reach specific items, a sieve to filter items, or pasta tongs to grab items.
2. For each group put the food items in a bowl filled with water. Allow students a minute to try each implement and determine which is most effective for getting each type of food.
3. Have each group explain its findings and record them on the board.
4. Have students attempt to gather food again. This time, have one student with each type of feeding tool in each group and have them try to collect food, from a single bowl, at the same time for a minute.
5. Ask what it was like trying to collect food with other animals trying to do the same. Record the group observations on the board.
6. Have students identify which animals use the feeding strategies represented by the kitchen tools, using identification cards and other references.

### **Extension:**

1. Repeat the activity but change the habitat (bowl) to a smaller, similar container representing loss of habitat through human development.
2. Again evaluate the success of feeding. Discuss how many of the animals would or would not be able to survive. Discuss what you would change so the animals might survive.



### ***How Does The Water Flow?***

**Outcome:** Students will gain an understanding of where they are located in the watershed and the impact they have on the ocean through the urban water cycle.

**Materials:** Picture of storm drain and stencil, or storm drain you can walk to; map showing water routes from mountains to ocean (watershed).

**Resource pages in background section:** Illustration of watershed (p. 6).

#### **Procedure:**

1. Discuss how water flows to the ocean and how sediments and anything else in a river, stream, or storm drain also washes to the sea.
2. Locate the Pacific Ocean, your field trip site, and your school on a map. Try to trace the route the river, stream, or gutter closest to your school takes in getting to the sea.
3. Using a map, explain the water cycle from precipitation to river to ocean to evaporation.
4. Show students a picture of a gutter/storm drain and explain the connection of storm drains to rivers and/or the ocean. Discuss how urban runoff impacts the ocean. Discuss what students might expect to find along the shore that originated in a gutter or storm drain.
5. Plan to bring trash bags to do a beach clean-up as a portion of your visit. You may wish to find out more about Adopt-A-Beach programs and annual coastal clean-ups from the California Coastal Commission.

#### **Extension:**

1. Find out the path for sewage treatment and how it is dumped offshore in many areas by contacting your city sanitation department.
2. Find the storm drain catch basin closest to your school. Is it stenciled? Identify any concerns or problems found there. You can join the Adopt-A-Gutter program by contacting Heal The Bay (p. 46).



### ***Can I Make A Difference?***

**Outcome:** Students will find ways that they can reduce their impact on the environment.

**Materials:** Large container for collecting trash from the students' lunches for the day, scale, data sheet to record types of trash.

#### **Procedure:**

1. Have students put all trash from their lunches on a given day in a designated container. After lunch weigh the trash.
2. Ask students where the trash would probably end up and what then would happen to it.
3. Sort out any recyclable items (aluminum cans, bottles, etc.). Weigh them.
4. Ask students to find out how and where to recycle items in their community. Discuss what happens to items at a recycling plant and what the benefits of recycling are.
5. Challenge the students to make a trash-free lunch. A reduced trash lunch would leave little or no trash behind. To do so, the students bring their lunch in a reusable bag with reusable plastic containers for the sandwich, a thermos or water bottle for a drink, etc. Assign the project as part of homework. Collect all the trash after this lunch. Compare the amount of trash generated in a normal lunch with a trash-less or reduced-trash lunch.
6. Contact the California Coastal Commission at (415) 904-5200 or [www.coastal.ca.gov](http://www.coastal.ca.gov) and find what items are most commonly found during beach clean-ups and what effect they have on marine life. Encourage students to pack a trash-less lunch daily to reduce, reuse, and recycle.

## **Poster Perfect**

**Outcome:** Students will identify the organisms and characteristics of an ecosystem and share how they relate to one another.

**Materials:** Photocopy habitat picture or make an overhead transparency of the picture.

**Resource Pages in background section:** Habitat and organism descriptions (pp. 4-13).

### **Procedure:**

1. Show the picture to the students. Ask students what they see in the picture.
2. Ask students where the waterline is in the drawing and how they can tell. Is it always going to be in the same place? Why or why not?
3. Have students discuss what types of protection they can see in the illustration.
4. Have students identify any food chains that they see. Have students guess how they fit in the larger food web. Develop questions about what they would like to learn.
5. Ask students what might be on the outside boundaries of the picture if it were larger.
6. What might be in a habitat like the one shown that we can't see in this illustration? What other organisms might be found in this habitat?
7. Have students predict what they will see when they visit the seashore habitat depicted and what they may not see, and explain why or why not. (For example – clams are not visible from the surface.)
8. Have students develop a field checklist to take on their trip to see if they observe the organisms they predicted they would see.
9. Have students predict whether the habitat will be “picture perfect.” What could they do at home/school or at the beach to make it “picture perfect?”



## On the Day of the Trip...

- In the Aquarium (during a self-conducted visit or after your tour):

### **Surviving In My Neighborhood**

**Outcome:** Students will observe and record animal behavior and compare findings with one another.

**Materials:** Clipboard, paper and pencil, watch to time movement, 5 cm piece of string.

**Procedure:**

1. Ask students to select a tank or sea creature and record information about the behaviors and adaptations an organism has for survival in that environment. Observations may include how the organism moves and where it stays in the tank.\*

Record the time an animal takes to move 5 cm.\*\*

2. Ask students to share their observations with the rest of the class upon returning to school.

3. On the board, group animals by similar behavioral characteristics.

**Extension:** Discuss and compare how the organisms are scientifically classified by phyla.

\* *Please remind students not to tap on the tanks as it will cause stress on the animals.*

\*\* *Some animals move very slowly. Students may want to observe for a few minutes before selecting an animal.*



- In the surrounding natural habitats

Extending the learning experience into the natural environment will allow students to practice scientific skills of observation and interpretation. This will also give them a framework to use when learning more about plant and animal needs and adaptations, and about human impact on the marine environment.

### **Bits And Pieces, Complete The Picture**

**Outcome:** Students will observe and record the diversity of organisms found in a specific habitat and determine human impact on the habitat.

**Materials:** Scavenger hunt sheet, pencil, trash bag, ruler.

**Procedure:**

1. Before arriving at the beach, create a scavenger hunt (see #3) for students to follow.

2. Ask students to complete the scavenger hunt without collecting or removing animals or plants from their homes. Remind students to return everything but trash to exactly where and how they found the items so as not to disturb them.

3. Activities for the scavenger hunt may include these:

a. Find an animal, count how many there are on one rock, and then draw the animal.

b. Find something from the ocean which makes its own food, draw it, and show one of its measurements (length, width, etc.).

c. Find something very old, write its name, and tell how old you think it might be.

d. Draw something you find that is natural and was carried by water onto the sand.

e. Find something which the ocean has changed and tell how the ocean has changed it.

f. Find something which doesn't belong at the beach and remove it.

4. Have students compare findings. What are common elements found in each habitat? Discuss what adaptations the plants and animals have to survive in the habitat. Note the diversity of answers that can fit a similar description and organisms which share common characteristics.

### ***Experience That!***

**Outcome:** Students will observe the natural environment with their senses and communicate their observations.

**Materials:** Paper and pencil.

**Procedure:**

1. Encourage students to use all of their senses in observing the coastal habitat. Take time to listen, to smell, and to feel something rough, smooth, slippery, soft, hard, dry, wavy, etc.
2. Have students look at things from the eye level of a shore crab or a gull standing on shore.  
How do the beach and those visiting it appear from this view?
3. Make a list and discuss the words students use in describing what they observed.
4. While on the trip or back at school have students translate their impressions into a haiku poem or into a drawing.

### ***Census Taker Is Here***

**Outcome:** Students will use measurement and other tools to survey a specific habitat and the organisms found there, then graph findings to compare populations.

**Materials:** Data sheet, length of string tied in a loop, magnifying lens, pencil, and clipboard.

**Resource pages in background section:** Rocky shores (pp. 8-9).

**Procedure:**

1. In groups, have students conduct a field survey of a habitat. Give each group a string one meter in length tied into a loop.
2. Each student team should select an area (a rock crevice, under a rock, the top of a dry rock, in a shallow pool in the sun, under seaweed) in the given habitat. Place the loop of string in a circle to serve as a boundary. Record animals observed, number and type of animals, types of plants, what the surface of the area is like, and other special features. Students should also record their location in the tidepool and the physical features of that location.
3. Back at school create a comparative chart or graph showing the diversity (types of different organisms) and abundance (number of each type) of animals in different locations of the given habitat.

### ***We Are Making A Difference***

**Outcome:** Students will complete a beach clean-up categorizing the different types of trash found.

**Materials:** Trash bags, data sheet of types of trash, garden gloves, pencils.

**Procedure:**

1. Review what are natural parts of the marine environment (seaweed, wood, shells, sand, animals, etc.) and what is trash.
2. In teams, have students pick up trash within a designated area. Ask them to tally the types of trash on their data sheet.
3. Remind students not to pick up broken glass, needles, sharp metal, or anything that might be dangerous. Let an adult know instead.
4. When finished or back at school, sort the trash first by type and then by whether it is recyclable or non-recyclable. Discuss what effects each piece might have had on marine life if it hadn't been picked up. Dispose of the trash in the trash can and recycle the recyclable items.
5. Using tally sheets, rank the items from most abundant to least abundant.
6. Talk about what each person can do to reduce trash and pollution in everyday life.

**Homework:** Write what he/she will do to make a difference.

## Back at School...

**K**ee the excitement going with follow-up activities to help reinforce what your students have learned and to promote caring for our ocean planet. Each activity below emphasizes one or more of the key scientific concepts represented in the exhibit hall.

### ***Is This My Neighborhood?***

**Outcome:** Students will identify the characteristics and organisms that define specific habitats.

**Resource pages in background section:** Habitat and organism information (pp. 4-15, 29-44).

**Procedure:**

1. Have each student select one organism seen during the visit to the ocean or aquarium, draw its habitat and list its survival needs.
2. As a class, review the students' creations, putting those organisms from similar habitats together. Discuss how their needs overlap.
3. Assign students to cooperative groups and ask each group to select a different habitat. Have each group create a new organism that would be adapted well to that habitat. Have them address how it would make its living getting food, its shelter, how it would escape from predators, the environment it would live in, and what things they would want to learn about it if they were scientists trying to study it further.

**Extension:** Have students create a diorama with the necessary habitat elements for their imaginary organisms to survive.

### ***Who's Connected?***

**Outcome:** Students will identify roles of different organisms in a food chain and in the larger food web. They will discuss natural and human impacts on the survival of a food web.

**Resource pages in background section:** An open ocean food chain (pp. 14, 29-44).

**Procedure:**

1. Select a specific habitat and have students make food chain links by using strips of paper to show organisms and their predator/prey relationships. List each link on a separate strip of paper. For example:



2. Give each student a piece of a chain. Have them work together to put themselves in the order of the chain (food source next to predator).
3. Have students demonstrate the interrelationships among food chains by playing a food web game.
  - a. Make additional links of plants and animals for the specific habitat selected, including all levels of the food web (sunlight, nutrients, phytoplankton, zooplankton, predators, scavengers, and decomposers/nutrients).
  - b. Pass one link out to each person in the class. Get into a large circle.
  - c. Using a ball of yarn, have students pass the ball from prey to predator connecting each predator/prey relationship. Continue until all students have been connected.
  - d. Discuss what would happen if one organism were eliminated. Have one student lower his/her yarn and then have the others report who felt the effect.
  - e. Discuss what would happen if a specific article of trash were introduced into this marine habitat (plastic pellets, fishing net, plastic bags). Again have the targeted student lower his/her yarn in response to the item and discuss the effect.

### ***Are You A...?***

**Outcome:** Students will demonstrate their understanding of animal adaptations in their habitat through charades.

**Resource pages in background section:** Habitat and organism descriptions (pp. 4-15, 29-44).

**Procedure:**

1. Discuss what animal adaptations the students were able to observe when they visited the aquarium and/or coastal areas. (ex: streamlined body, hard shell, claws, etc.)
2. Which adaptations seemed to be the most successful within a specific habitat? Have students discuss this question as a class.
3. Divide the class into groups.
4. Through charades, have each group act out some of the animals and their adaptations for the rest of the class to guess. Remind the students to show the habitat as well, if possible.
5. Have each student research and draw his or her favorite animal, including habitat, adaptations, and predator-prey relationships.

### ***Is The Seasoning Right?***

**Outcome:** Students will identify the essential elements for a healthy ecosystem.

**Resource pages in background section:** Habitat and organism descriptions (pp. 4-15).

**Procedure:**

1. In groups, have the students create a recipe for a healthy habitat. Have each group select a habitat and then write the necessary ingredients for survival, including the physical features (type of substrate and water), environmental effects (weather and tides), living inhabitants (microscopic to large), plants, predators, and prey. Encourage students to use terms similar to a recipe, such as “toss” or “a pinch of.”
2. Have groups share their recipes with the rest of the class.

### ***What Can I Do?***

**Outcome:** Students will become active in making a difference for the environment.

**Resource pages in background section:** Habitat and organism descriptions (pp. 4-15).

**Procedure:**

1. Have students identify their greatest concerns for the ocean environment.
2. Plan and follow through on a class project where the students can make a difference. This may be a beach clean-up (Adopt-A-Beach); stenciling storm drains by your school; creating posters about protecting the environment that could be displayed at the local library, public offices, or stores; creating books to be read to cross-age peers; or developing an ecology club to plan ongoing activities. Contact resource organizations for more information (pp. 46-47).
3. Have students summarize and evaluate their project experience through a writing assignment or presentation.



## **Role Call**

**Outcome:** Students will share observations of organisms and their adaptations.

**Materials:** Picture cards with facts about animals; habitat picture.

**Resource Pages in background section:** Habitat and organism descriptions (pp 4-15, and organism cards pp. 29-44).

### **Procedure:**

1. Duplicate and cut out reproducible page.
2. Pass out a card to each student to study the card to determine at least one adaptation for survival.
3. Have students introduce the organism shown to the other students. This may be done by role playing the animal or explaining it as if a tour guide.
4. Have students pair up with one another based upon some type of connection between the organisms they selected (food they eat, where they live, how they are protected, etc.).

### **Extension:**

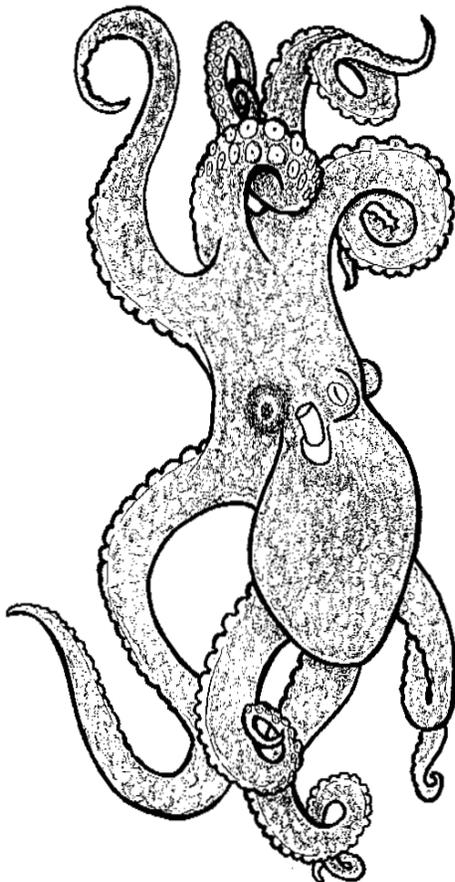
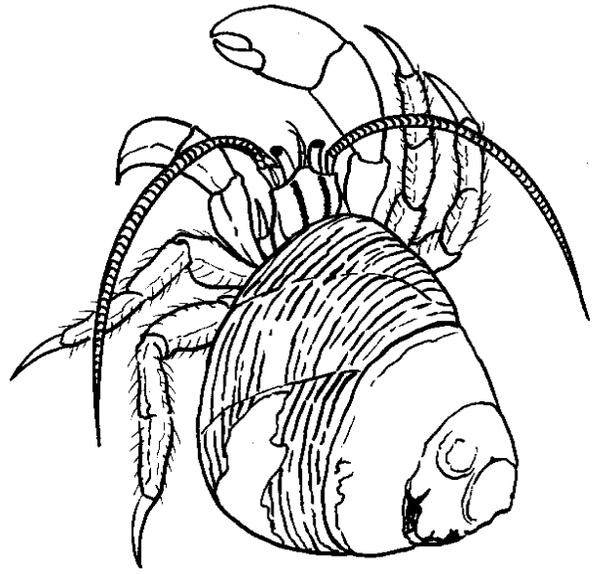
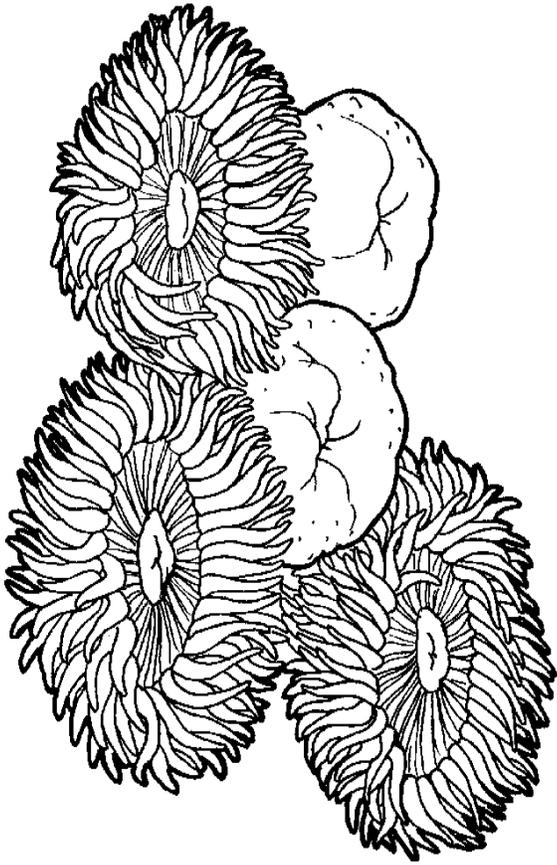
1. Use cards to create a mural showing where each organism lives.
2. Use the cards to create a food web, draw in additional links.
3. Collect a bag of trash, match the organism card with the trash, and discuss how the trash might affect the organism.
4. Have a student give clues about the card that he/she is holding and ask if others can guess what it is.
5. Place a picture card on the back of each student. Have students ask each other "yes"/"no" questions to narrow down what animal they are.
6. Bring the card on your visit. Observe and record information about the organism.



## **Keep in Touch. How Was The Trip?**

Did you sign up to be on our mailing list? If not, please let us know if you would like to be added to our educator mailing list. Also, please feel free to send notes, pictures, or projects to docents to let them know the students' impressions of their visit. There is always a great delight in the docent lounge sharing student work. Samples of student notes and projects are posted as part of the Children's Art Wall in the exhibit hall. Please complete and return the enclosed evaluation form. We invite your comments and evaluation.





**Common name:** Feather boa kelp.

**Range:** Low intertidal to depths of 20 m (66 ft.).

**Habitat:** In rocks or kelp beds; found in beach wrack on sandy shores.

**Identifying features:** Strap-shaped flattened branches.

Covered along both edges with short blades and floats; golden brown to dark olive brownish green in color. Though well-adapted, can be damaged by high surf.

**Producer:** Makes own food through photosynthesis; requires adequate light, space, nutrients, and temperature.

**Predators:** Kelp limpet and purple sea urchins.



in 2 – 4 months and then the female dies.

**Common name:** Hermit crab.

**Phylum:** Arthropoda.

**Range:** Mid-intertidal to subtidal areas, from Vancouver Island, British Columbia, to Baja California.

**Habitat:** Tidepools and sandy bottoms as well as kelp holdfasts.

**Identifying features:** Live in empty snail shells by coiling abdomen and back legs around whorl. Grows carapace up to 19 mm (.75 in.). Active in late afternoon through night.

**Prey:** Eats algae and dead animal matter.

**Predators:** Perch, kelpfish, and sheephead.

**Life cycle:** Females carry fertilized eggs until they hatch as planktonic larva.

**Common name:** Two-spotted octopus.

**Phylum:** Mollusca.

**Range:** San Simeon, California, to Ensenada, Mexico, to depths of 20 m (66 ft.).

**Habitat:** Tidepools, rocky reefs and kelp beds.

**Identifying features:** Changes color and texture to camouflage. Is nocturnal and gives off ink for protection. Eight tentacles covered with suction cups used for movement and capturing prey. Mantle size to 20 cm, arms 2.5 to 3.5 times as long as mantle.

**Prey:** Crustaceans, snails, clams and fish.

**Predators:** Moray eels, scorpion fish, and seals.

**Life cycle:** Females lay eggs in clusters and guard them until they hatch



**Common name:** Aggregating anemone.

**Phylum:** Cnidaria.

**Range:** Alaska to Baja California.

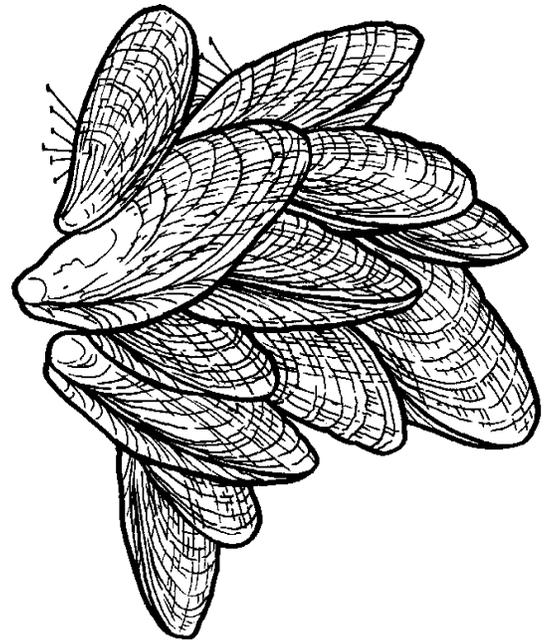
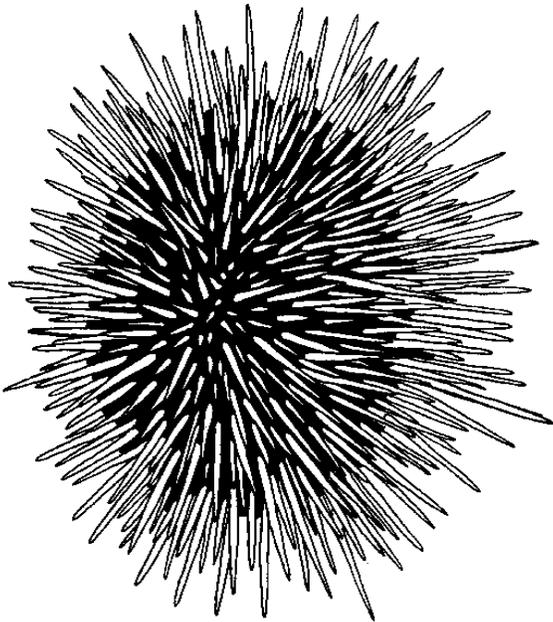
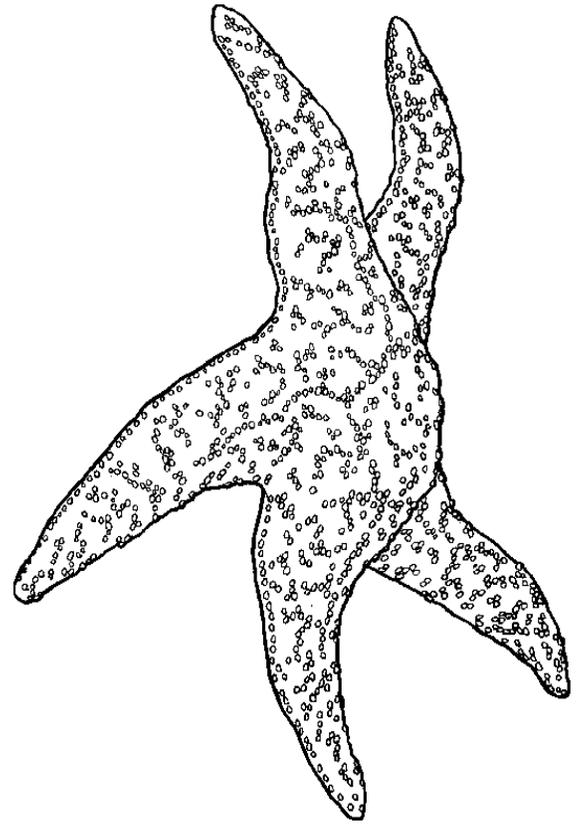
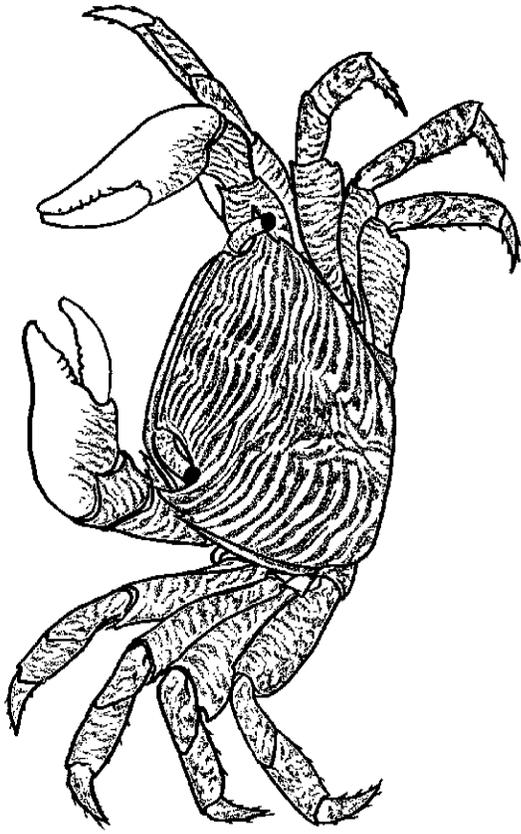
**Habitat:** Attached to shells, rocks, pilings between mid- and low-tidelines of exposed rocky shores.

**Identifying features:** When extended, the body is light green to white with pink or greenish-tipped tentacles reaching 25 cm (10 in.) across. When contracted, it becomes a low hemispherical mound covered with shells, rocks and pieces of seaweed to protect it from the sun during low tide.

**Prey:** Copepods, isopods, amphipods, and small fish that come in contact with their tentacles.

**Predators:** Few; certain nudibranchs, snails, and sea stars.

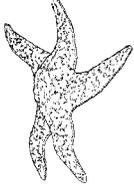
**Life cycle:** Reproduce by spawning or asexually by cloning; can be



decades old.



**Common name:** California mussel.  
**Phylum:** Mollusca.  
**Range:** Alaska to Baja California.  
**Habitat:** Mid-intertidal, surf-swept rocky shores.  
**Identifying features:** Blue, black, brown heavily ribbed bivalve that grows to 130 mm (5 in.) long on California shore. Attach with strong byssal threads. Can survive a wide variation of temperature.  
**Prey:** Filters microscopic plankton and detritus using ciliary currents.  
**Predators:** Shore birds, intertidal crabs, predatory snails, sea stars, southern sea otter, and spiny lobster.  
**Life cycle:** Reproduces by spawning.



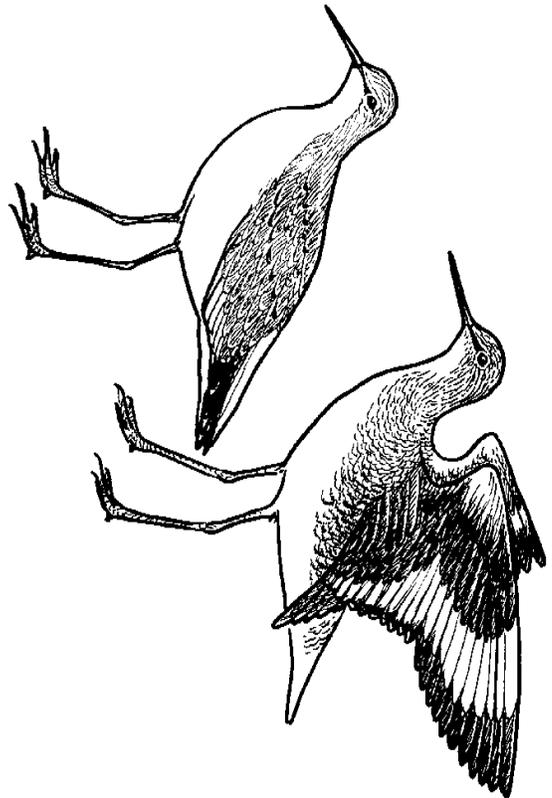
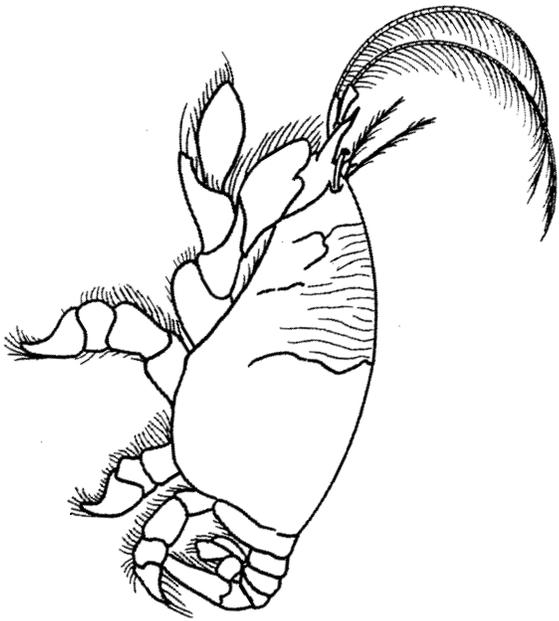
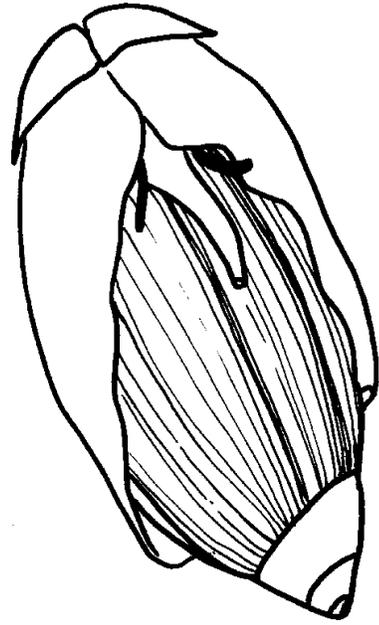
**Common name:** Ochre star.  
**Phylum:** Echinodermata.  
**Range:** Alaska to Baja California.  
**Habitat:** Mid- to subtidal zones of the rocky shore; juveniles found in crevices and under rocks.  
**Identifying features:** Usually 5 arms with small white spines on back surface. Yellow or pale orange to deep purple in color. Radius 14 – 28 cm (5.5 - 11 in.) in size.  
**Prey:** Eats mussels, barnacles, snails, limpets, and chitons by everting its stomach and digesting the organism outside, then swallowing the digested prey.  
**Predators:** Rare; occasionally gulls and sea otters.  
**Life cycle:** Spawns in late spring-early summer. Life span is to 20 years.



**Common name:** Purple sea urchin.  
**Phylum:** Echinodermata.  
**Range:** Vancouver Island, British Columbia, to Baja California.  
**Habitat:** Lower intertidal on rocky shores, inhabiting burrows or depressions in rocks.  
**Identifying features:** Up to 100 mm (4 in.) test (shell) though usually smaller. Uses tube feet to adhere to rocks as well as bits of algae and shell pieces for shade and camouflage; sensitive to extreme changes in temperature and oxygen level in the water.  
**Prey:** Red and brown algae; primarily drift kelp.  
**Predators:** Sea stars, sheephead, sea otters, and gulls.  
**Life cycle:** Spawn after two years of age. Grow to be 10-30 years of age.



**Common name:** Striped shore crab.  
**Phylum:** Arthropoda.  
**Range:** Oregon to Baja California.  
**Habitat:** Crevices of rocks, tidepools, pilings and occasionally muddy bays.  
**Identifying features:** Hard exoskeleton purple to blackish green, with two claws white to red in color. Carapace to 4.8 cm (2 in.) in size.  
**Prey:** Algal film and diatoms found on rocks, dead and decaying animals, algae, limpets, snails, hermit crabs, and isopods.  
**Predators:** Gulls, raccoons, rats, anemones, fish, and sometimes other crabs.  
**Life cycle:** Mating occurs when females molt. Females brood or carry up to 50,000 eggs until they hatch as planktonic larvae which drift and settle after metamorphosis. They do reach a terminal molt.





**Common name:** Willet.  
**Phylum:** Chordata.  
**Range:** Found on both North American coasts from Canada to the north coast of South America.  
**Habitat:** Winters on coastal beaches and in California Salton Sea; nests in wet fields, marshes, offshore islands in dunes and tall grasses and along lake shores.  
**Identifying features:** Largest member of the sandpiper family. Grayish-brown plumage with brown legs and thick bill, contains white stripes under the wings visible when flying.  
**Prey:** Wades into the water as it feeds in salt and brackish marshes and on mud or sand flats, in bays, estuaries, muddy banks, and rocky shores. Picks and probes for insects, worms, crabs, mollusks, small fishes and some grasses and tender shoots.  
**Predators:** Unknown.  
**Life cycle:** Eggs are incubated 22 days, mostly by the female.



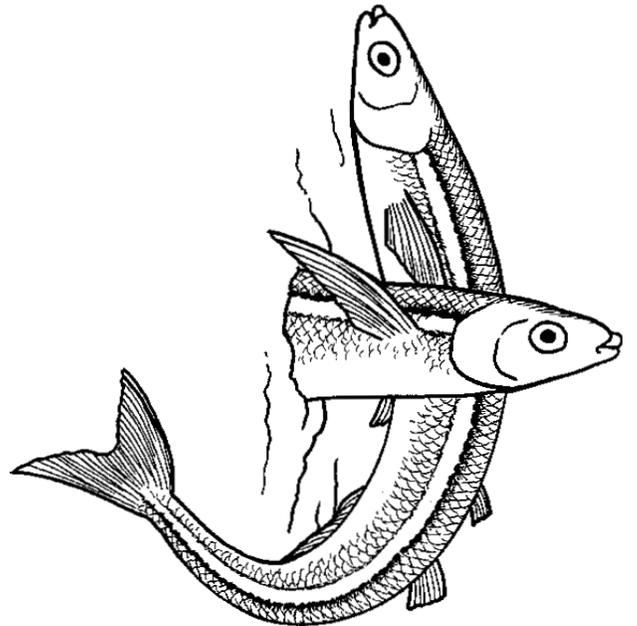
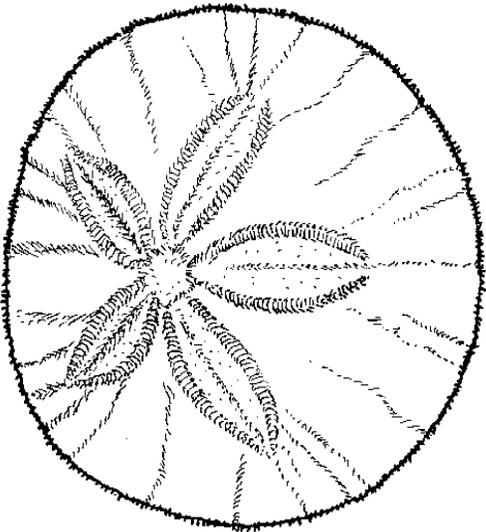
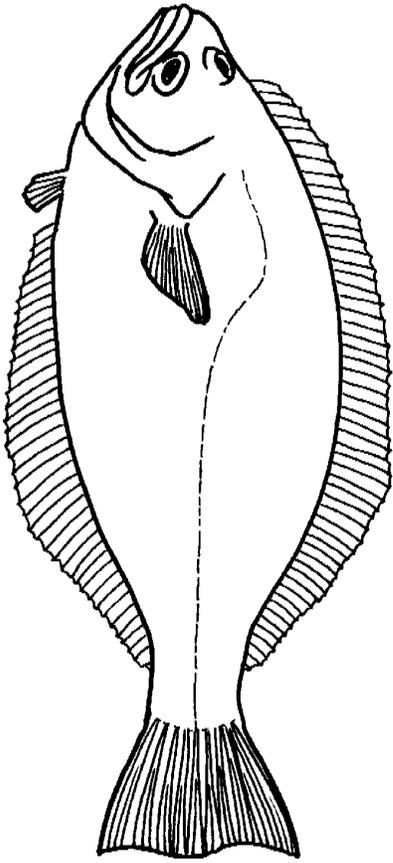
**Common name:** Mole crab.  
**Phylum:** Arthropoda.  
**Range:** Alaska to Baja California; Peru and Chile.  
**Habitat:** On open, sandy, surf-swept beaches, usually burrowed in sand between low- and high-tide lines.  
**Identifying features:** Oval and up to 35 mm (1.4 in.) long; no spines nor claws; sand colored; bury rapidly to maintain position along the tide line. Migrate to deeper waters in the winter.  
**Prey:** Use long feathery antennae to strain small food particles from waves receding along the beach.  
**Predators:** Shore birds, fish, and swimming crabs.  
**Life cycle:** Breed from spring into fall. Life span is 2-3 years. Females brood or carry bright orange eggs under their tails until they hatch out as plankton.

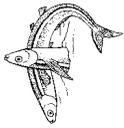


**Common name:** Purple olive snail.  
**Phylum:** Mollusca.  
**Range:** Vancouver Island, British Columbia, to Baja California.  
**Habitat:** Sandy bottoms in lagoons, bays, and protected areas along the open coast; from low-tide line to 50 meter (164 ft.) depths.  
**Identifying features:** 1.3-3.8 cm (0.5-1.5 in.) high shell that is oval, smooth and shiny. Color variation from white to lavender or gray with dark purple lines outlining the edges. It has a large foot that folds back over the shell, serving as a plow for effective burrowing. Active from dusk through the night. Shells have been used as currency by local natives and prized by collectors.  
**Prey:** Omnivorous; kelp, decaying and fresh animal material, detritus.  
**Predators:** Octopuses, moon snails, sea stars, shorebirds, crabs, and fishes.  
**Life cycle:** Mate throughout the year. Egg capsules are deposited on small stones/rocks with up to 4,200 eggs laid over a six week period. Eggs hatch after 10 – 28 days. Snails live to between 8 and 15 years.



**Common name:** Beach wrack.  
**Range:** Seashore coasts worldwide.  
**Habitat:** Found at the high-tide line along the beach.  
**Identifying features:** A general term used to describe the seaweeds and debris washed up by the waves and brought into the area by the currents. Beach wrack includes seaweeds, crustacean molts, shells, and trash.  
**Purpose:** Provides food for wide range of organisms; breaks up to become part of the sand; provides area for kelp flies to lay eggs, whose maggots help break down the seaweed, producing food for other animals.  
**Life cycle:** The drift kelp beach wrack decomposes and becomes food for filter feeders such as sand crabs and part of the organic matter found in sand.





**Common name:** Grunion.  
**Phylum:** Chordata, member of the smelt family of fish.  
**Range:** Point Conception to Baja California.  
**Habitat:** Nearshore waters from surf to 20 meters (66 ft.) depth.  
**Identifying features:** 13-18 cm (5-7 in.) long fish that are silvery in color. Between March and August of each year they spawn on the beaches of southern California during the high tide 2-4 nights following the new moon or full moon.  
**Prey:** Plankton at or near the surface.  
**Predators:** Shore birds, isopods, flies, sand worms, beetles, and other fish prey on the adult grunion and/or its eggs.  
**Life cycle:** A few hundred to 3,000 eggs are laid by each female, males deposit milt to fertilize the eggs. 9-12 days after they are laid, the eggs are hatched by high-tide waves. Fish are mature within one year and live up to 3 years.



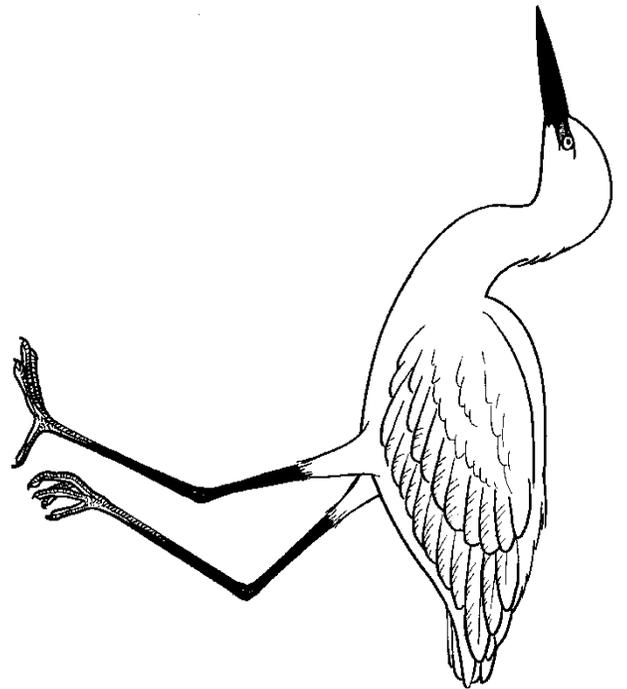
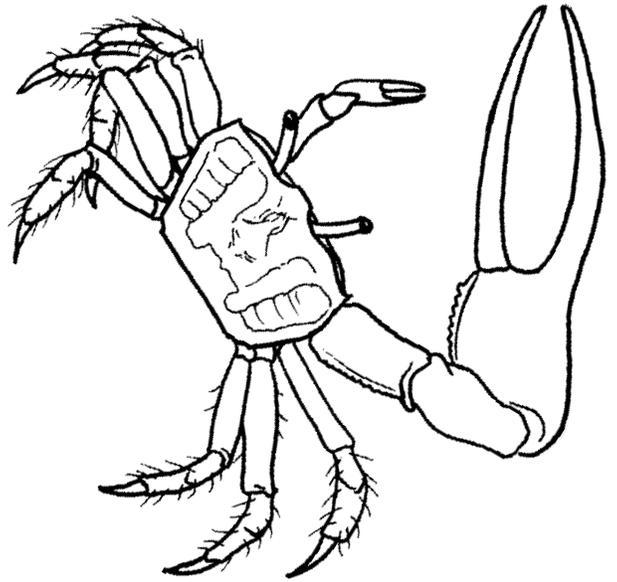
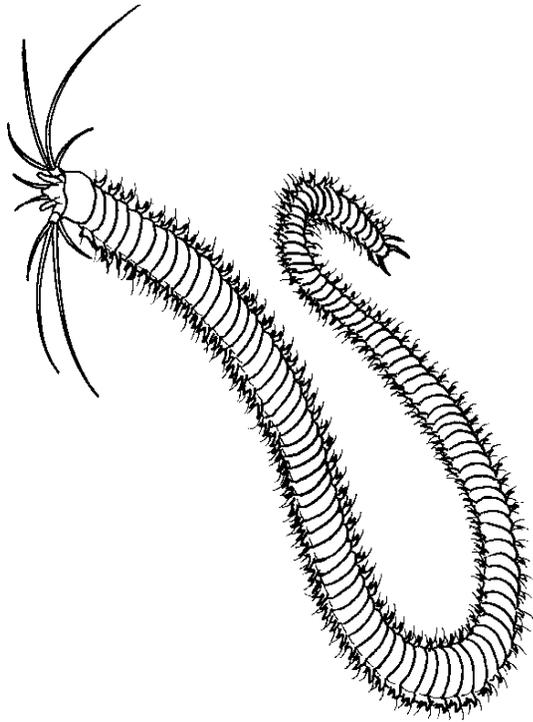
**Common name:** Sand dollar.  
**Phylum:** Echinodermata.  
**Range:** Alaska to Baja California.  
**Habitat:** Sandy bottoms of sheltered bays, surf-swept open coasts from the extreme low-tide line to depths of 40 meters (131 ft.).  
**Identifying features:** Gray or purplish flattened body with densely packed short spines and small tube feet; can grow to 75 mm (3 in.) in diameter. When dead, the white test, or shell, with 5-petal design washes up on beaches.  
**Prey:** Traps organic particles, small larvae, copepods, plankton, detritus, decaying plant and animal matter on tiny tube feet and spines. The food is passed to the mouth located on the bottom at the center of the shell.  
**Predators:** Fishes, such as sheephead and starry flounder; pink sea star, gulls, and white sand urchins.  
**Life cycle:** Females produce 350,000-379,000 eggs per year. They spawn from May-July; eggs that are fertilized go through metamorphosis after 68-162 days. Live up to 13 years.



**Common name:** Ring-billed gull.  
**Phylum:** Chordata.  
**Range:** Coastal North America; inland plains during the summer.  
**Habitat:** Along beaches, in school yards, in garbage dumps.  
**Identifying features:** A common smaller gull. As an adult has white head and under parts and a pale gray mantle. Bill yellow with dark ring, yellowish or greenish legs.  
**Prey:** Scavenges at the shore. When inland, lives on small rodents, grasshoppers, worms, grubs, and other insects in freshly plowed fields.  
**Predators:** Unknown.  
**Life cycle:** Eggs are laid in May-June, usually 3 light brown with darker spots of lavender, brown and gray. Incubated for 21 days. Have lived to 21 years of age.



**Common name:** California halibut.  
**Phylum:** Chordata.  
**Range:** British Columbia to Baja California and Gulf of California.  
**Habitat:** Nearshore to 100 meter (328 ft.) depths, on sand and mud bottoms.  
**Identifying features:** Up to 1.5 meters (5 feet) long and weighing up to 33 kg. (72 pounds). Sand colored to dark gray or black on top. High arch in lateral line.  
**Prey:** Fish (especially anchovies) and squid that it ambushes from below.  
**Predators:** Sea lion, electric ray.  
**Life cycle:** Larval fish spend time in protected bays, live up to 30

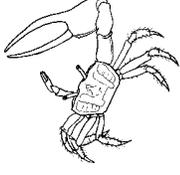


years of age.



**Common name:** Snowy egret.  
**Phylum:** Chordata.  
**Range:** Central California to Mexico, Georgia to Mexico.  
**Habitat:** Coastal areas, marshes, river valleys, and lake edges.  
**Identifying features:** White body; black bill; black legs with bright yellow feet, grows to 56-66 cm (22-26 inches) with 96.5-114 cm (38-45 in.) wing span.  
**Prey:** Active feeder uses feet to stir, rake, or probe food from bottom; shrimp, fish, crabs, amphibians, snakes, and insects.  
**Predators:** Unknown.  
**Life cycle:** Nests in large colonies on a platform of sticks and twigs in a tree or shrub. Lays 3 to 5 eggs that incubate for 20-29 days, lives up to 16 years old.

cm (16 in.).



**Common name:** Fiddler crab.  
**Phylum:** Arthropoda.  
**Range:** Los Angeles to Baja California.  
**Habitat:** Sand and mud flats, high and middle intertidal zone in protected bays and estuaries.  
**Identifying features:** Up to 19.7 mm (.78 in.) wide carapace in males, 17 mm (.67 in.) in females. Males have one small claw and the other greatly enlarged.  
**Prey:** Minute plants and animals contained in the sand.  
**Predators:** Shore birds, fish.  
**Life cycle:** Male attracts female to burrow that he guards. Female broods eggs under her tail.

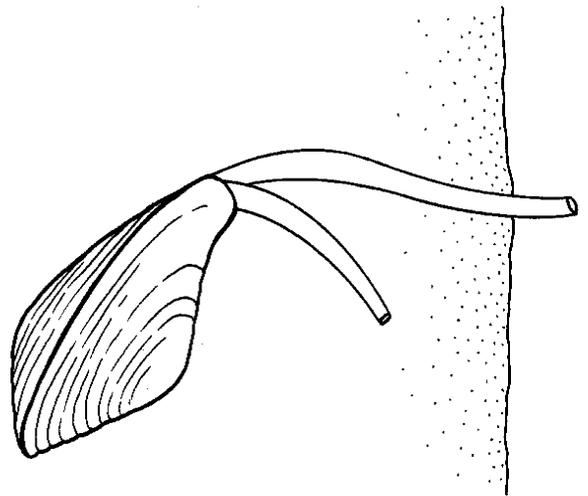
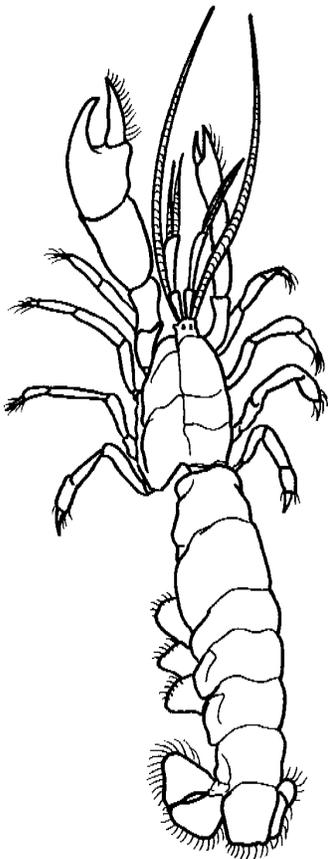
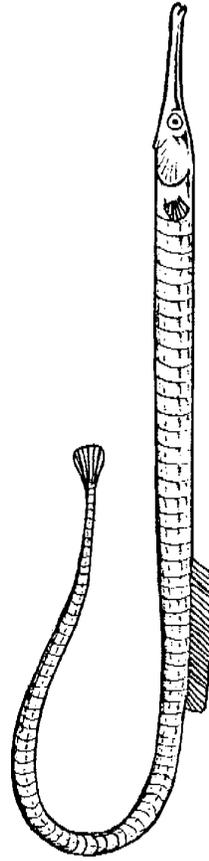
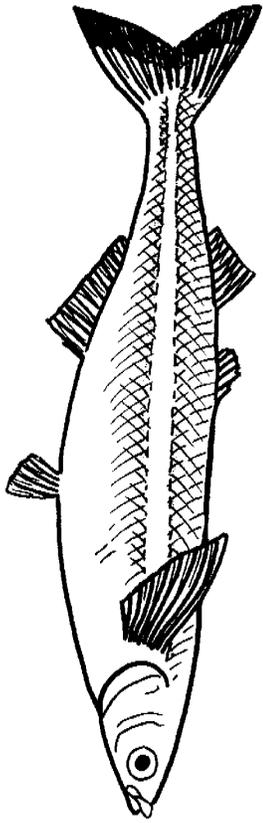


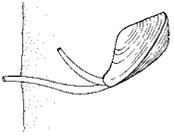
**Common name:** Eel grass.  
**Range:** Alaska to Mexico.  
**Habitat:** Protected beaches and quiet bays where the bottom is mud and sand.  
**Identifying features:** Long, thin, bright green grass that grows to a meter (3.28 ft.) or more. Provides critical habitat for a wide variety of plants, algae, and animals, including amphipods, snails, shrimps, crabs, fish and nudibranchs.  
**Producer:** A vascular plant, generating oxygen and its own food through photosynthesis.  
**Predators:** Snails, waterfowl, and fishes.  
**Life cycle:** Reproduces using flowers. It grows to lengths of 41

**Common name:** Polychaete worm.



**Phylum:** Annelida.  
**Range:** All oceans.  
**Habitat:** Muddy and sandy bottoms in low intertidal zone.  
**Identifying features:** Wide-spread, abundant worm up to 350 mm (14 in.) in length.  
**Prey:** Detritus and organic materials found in the mud taken in by everting the proboscis.  
**Predators:** Fish, invertebrates, and shore birds.  
**Life cycle:** Eggs are typically fertilized externally, larva are planktonic, settling after several stages of metamorphosis.





**Common name:** Bent-nosed clam.  
**Phylum:** Mollusca.  
**Range:** Alaska to Baja California.  
**Habitat:** Gravel, sand, mud or muddy clay 10-20 cm (4-8 in.) below the mud's surface to 50 meter (164 ft.) below the water's surface.  
**Identifying features:** 60-110 mm (2.4-4.3 in.) long thin flattened shell bent toward the right posterior end. Burrows by rocking shell and extending foot.  
**Prey:** Sweeps the bottom with its siphons, sucking up detritus, bacteria, and plankton as well as mud and sand.  
**Predators:** Moon snail, shore birds.  
**Life cycle:** Spawns year-round.

can year-round.



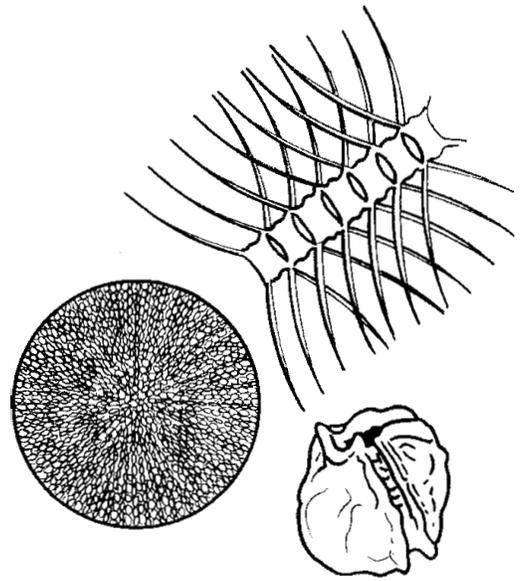
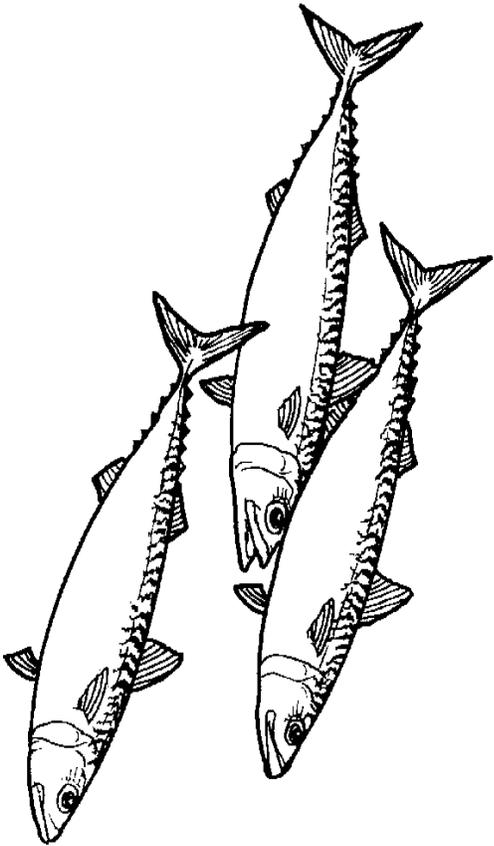
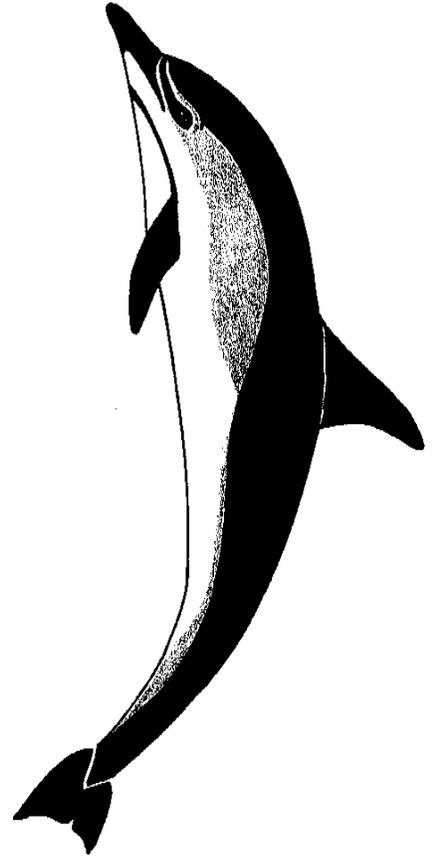
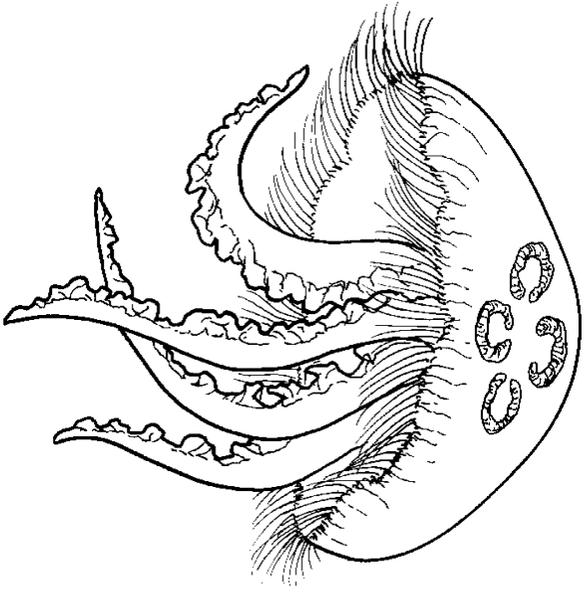
**Common name:** Pipefish.  
**Phylum:** Chordata.  
**Range:** Alaska to Baja California.  
**Habitat:** Eelgrass beds in calm bay areas.  
**Identifying features:** Pale olive green to dark green or brown to lengths of 33 cm (13 in.); matches surrounding algal growth in color and shape.  
**Prey:** Small invertebrates found on nearby plants.  
**Predators:** Larger fish, shore birds.  
**Life cycle:** Females lay eggs in male's "pouch;" male broods eggs until they hatch.

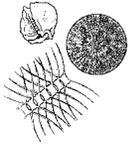


**Common name:** Ghost shrimp.  
**Phylum:** Arthropoda.  
**Range:** Southern Alaska to Baja California.  
**Habitat:** In mixed sand and mud burrows; forming tunnels with many branches; middle intertidal zone on flats of bays and estuaries.  
**Identifying features:** Whitish body to lengths of 115 mm (4.5 in.); the adult males have one larger claw. Moves water into its burrow for respiration.  
**Prey:** Organic detritus sifted from the soft substrate by hairs on the 2nd and 3rd pairs of legs; also feeds on plankton.  
**Predators:** Shorebirds, corbina, round rays, turbot.  
**Life cycle:** Females carry eggs primarily in June and July but

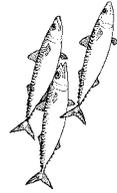


**Common name:** Topsmelt.  
**Phylum:** Chordata.  
**Range:** Vancouver Island, British Columbia, to Baja California.  
**Habitat:** Bays, sloughs, and kelp beds.  
**Identifying features:** Bright green above, silvery below with a midline stripe. Reaches lengths of up to 36.5 cm (14.4 in.) long.  
**Prey:** plankton, algae, insect larvae.  
**Predators:** Sea lions, double-crested and Brandt's cormorants, pelicans.  
**Life cycle:** Lays eggs on eelgrass plants; live to 8 years.





**Common name:** Plankton.  
**Phylum:** All.  
**Range:** All oceans of the world.  
**Habitat:** All zones; largest amount of phytoplankton found nearshore at the surface.  
**Identifying features:** Drifters and wanderers of the ocean, moving where currents take them.  
**Prey:** Phytoplankton are producers; zooplankton eat smaller plankton.  
**Predators:** Plankton, fish, birds, whales.  
**Life cycle:** Varies; most benthic invertebrates start their lives as plankton.



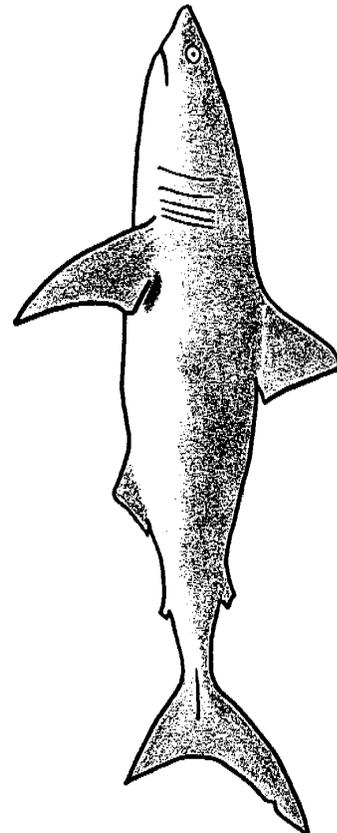
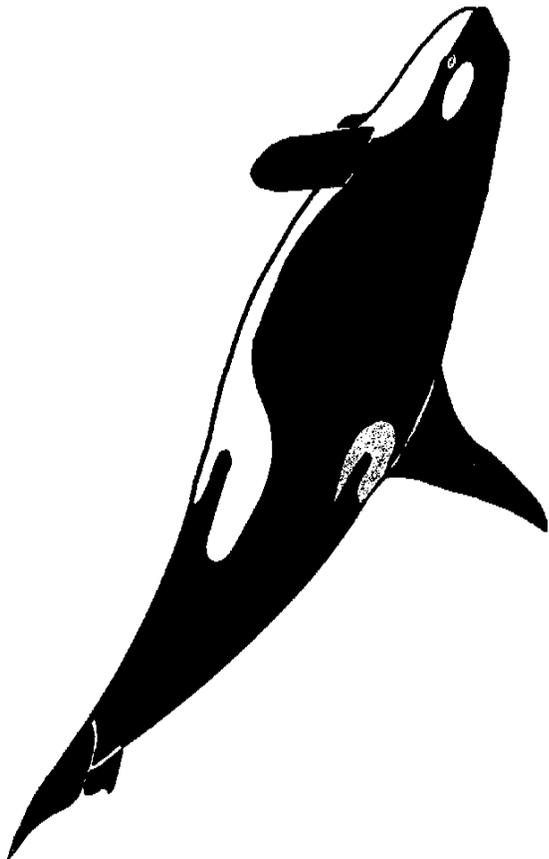
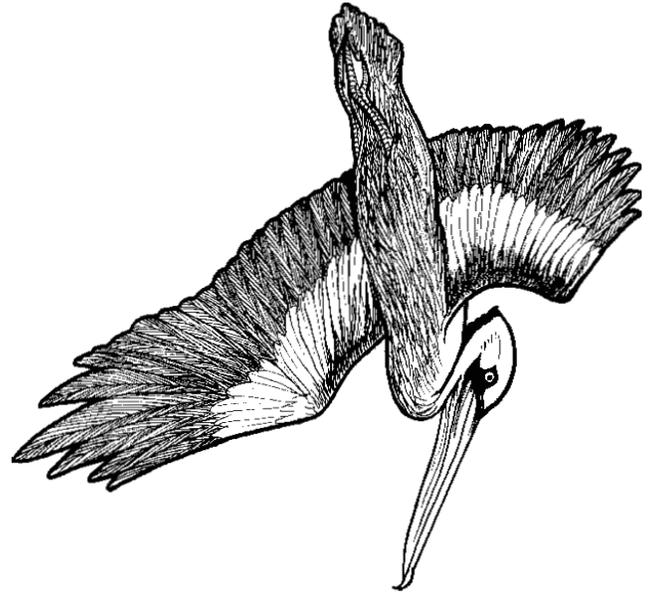
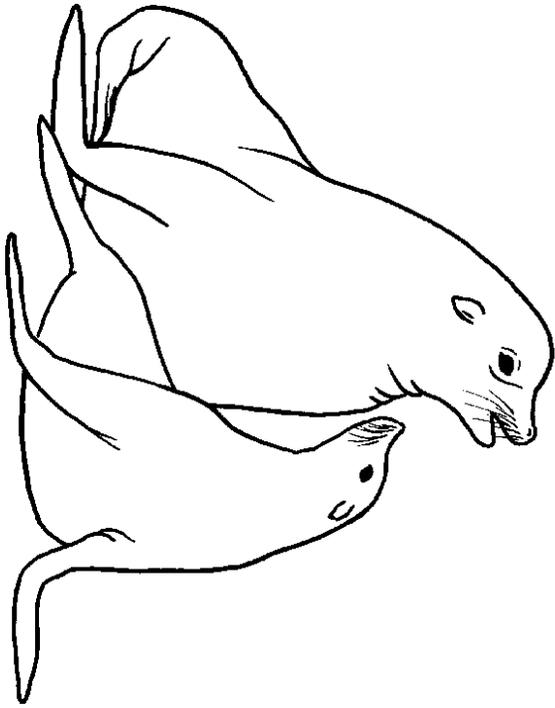
**Common name:** Mackerel.  
**Phylum:** Chordata.  
**Range:** Gulf of Alaska to Chile.  
**Habitat:** Surface to 46 m (150 ft.) depths.  
**Identifying features:** Head dark blue with dark wavy lines, silver-green below. Up to 63.5 cm (25 in.) long.  
**Prey:** Squid, anchovies, sardines, krill.  
**Predators:** Eaten by sea lions, fur seals, eagles, least tern, larger fish.  
**Life cycle:** Spawn 4 times a season, live to be 11 years of age.



**Common name:** Common dolphin.  
**Phylum:** Chordata.  
**Range:** All oceans with tropical and temperate waters.  
**Habitat:** Pelagic offshore.  
**Identifying features:** Back black or brownish black with chest and belly white or cream. Up to 2.5 m (8.2 ft.) long; newborn 80 cm (31.5 in.) long. Very gregarious in herds of hundreds to thousands; rides bow waves.  
**Prey:** Feed at night, diving to depths of 280 m (918 ft.); feed on squid, flying fish, deep-sea smelt and lantern fish as well as anchovies, and other fish.  
**Predators:** Orcas.  
**Life cycle:** Gives birth every 2 or 3 years, 10-11 month gestation, young 79-105 cm (31-41 in.) long at birth, weaned after 19 months; live over 20 years.



**Common name:** Moon jelly.  
**Phylum:** Cnidaria.  
**Range:** Worldwide.  
**Habitat:** Low intertidal and shallow subtidal zones in bays and harbors.  
**Identifying features:** Medusa bell is dish-shaped to 40 cm (16 in.) in diameter, scalloped into eight lobes with small, short marginal tentacles.  
**Prey:** Plankton, in captivity live well on brine shrimp.  
**Predators:** Blue rockfish.  
**Life cycle:** Alternation of generations, with one stage attached as polyps and one stage as free-floating medusae; less than a full year to complete life cycle.





**Common name:** Great white shark.  
**Phylum:** Chordata.  
**Range:** Alaska to Chile.  
**Habitat:** Inshore areas, commonest from cold to temperate seas; young found in temperate waters.  
**Identifying features:** Slate gray above and gray-white below; may occur in pairs but do not school; up to 6.4 m (21 ft.), possibly larger.  
**Prey:** Young sharks feed on fish; mature sharks feed on fish, sharks, baleen whales, squid, crabs, gastropods, seals, sea lions, sea otters, and sea birds.  
**Predators:** Top predator. Protected in California.  
**Life cycle:** Oviviparous (give birth to live young), can live to 40 years.



**Common name:** Brown pelican.  
**Phylum:** Chordata.  
**Range:** Southern Washington to Mexico; South Carolina to Louisiana.  
**Habitat:** Coastal.  
**Identifying features:** Gray-brown body and wings, large dark bill with dark throat pouch. Adults with white head, yellow breeding plumage. Breed, roost, and feed in flocks; often fly in formation.  
**Prey:** Dives from up to 9 m (30 feet) high, scooping up fish (anchovies, sardines, mullet, topsmet), and crustaceans.  
**Predators:** Endangered species. Has been heavily impacted by DDT in the food chain, resulting in thinning of egg shells.  
**Life cycle:** Nests on coastal islands in a saucer-like nest of sticks, grass and reeds; 2 to 4 eggs white in color incubated for 28-30 days. Known to live over 30 years.



**Common name:** Orca (killer whale).  
**Phylum:** Chordata.  
**Range:** All oceans except where there is ice cover.  
**Habitat:** Within 800 km (497 mi.) of coasts.  
**Identifying features:** Tall, wide dorsal fin, striking black and white pigmentation pattern with white patch above and behind eye. Males grow to 9.5 meters (31 ft.), females to 7 meters (23 ft.). Strong social bonds living in groups or pods.  
**Prey:** Cetaceans, pinnipeds, penguins, sea birds, sea turtles, and fish (herring and salmon).  
**Predators:** Top predator.  
**Life cycle:** At birth 2.1-2.4 meters (7-8 ft.) long; gestation is at least a year, calves dependent for a year. Males live over 40 years, females up to 80 years or more.



**Common name:** California sea lion.  
**Phylum:** Chordata.  
**Range:** Vancouver Island, British Columbia, to western Mexico and Galapagos Islands.  
**Habitat:** Coastal animal, frequently hauling out on shores, buoys, and docks.  
**Identifying features:** Males up to 2.5 m (8 ft.), weighing 400 kg (880 lbs.) and brown in color, females to 2 m (6.5 ft.), weight 110 kg (242 lbs.) and tan in color. Males have noticeably raised forehead. Pull hind flippers under selves to "walk" on land. Have external ear flaps.  
**Prey:** Fish, squid.  
**Predators:** Sharks, orcas.  
**Life cycle:** Breed on the Channel Islands between mid-May to late June, single pup each year about 75 cm (29.5 in.) long and weighing 6 kg (13.2 lbs.), carried for 11-12 months. Have lived to 30 years.

# Extending Marine Science at Home

**A**ctivities that involve students' families help them to integrate learning into their lives. Below are extensions of activities that allow parents to be involved in learning with their child.

***Is it Alive?*** (These observations will help your child to understand the adaptations animals have for survival and the changes animals go through during their life cycles.)

- With your child, observe different plants and animals you see in your yard, neighborhood, or park. Discuss whether what you're watching is alive or once was alive. Notice that many of the animals move slowly, or may not move at all, during your child's observation.
- Watch an animal (an ant, a bird, a pet, etc.) for 10 minutes. Discuss the behavior you observe and how this behavior helps it get what it needs to survive.
- Discuss what animal in the ocean might be similar to the one you observed on land.

***How Do I Connect to the Ocean?*** (These activities help your child discover that we all have an impact upon the ocean.)

- Talk with your child about any experience you might have had at the ocean or about products that you use from the ocean (over 60% of the oxygen we breathe comes from the ocean, algae are ingredients in many of the foods we use, fish are harvested for food, etc.).
- Discuss how keeping the ocean clean helps ensure that the things we get from the ocean are healthy.
- One connection we all have with the ocean is through the gutters along the sidewalks. Urban runoff water flows directly from the gutter to the ocean. With your child, look along the sidewalk in your neighborhood for signs or stencils by the catch basins that indicate "No Dumping – Drains to the Ocean."
- Talk to your child about how we can all make a difference by keeping trash out of the ocean by keeping the gutter clean; picking up after pets and never putting trash in the gutter.
- You may keep track of what you remove from the gutter and discuss how it might have affected sea life if you left it there. Keeping track of the amount or weight of trash can help to build math skills as well.

***Be a Small Part of a Larger Solution*** (Help your child to make a daily difference.)

Plan together to improve the environment by reducing the amount of goods you consume, selecting items that have less impact upon the environment and recycling whenever possible. Plant a native garden. Help reduce and reuse items when possible.

***Finding Out More***

Take your child to the public library to check-out books about the ocean, read stories relating the experience of others who have studied the ocean, or search the internet to find out more about our water planet.

***Check It Out Together***

Visit the beach or aquarium. Cabrillo Marine Aquarium is located in San Pedro and is open Tuesday – Friday, 12 noon – 5 pm, and on weekends from 10 am – 5 pm. Programs and festivals occur throughout the year. To get directions, a schedule of events, or to find out more, call (310) 548-7562 or check the website at [www.cabrilloaq.org](http://www.cabrilloaq.org).

## RESOURCE ORGANIZATIONS

### KEY:

C = classes for school groups

F = field programs

G = gift shop/curriculum avail.

O = outreach to school site

P = public programs

S = student materials

T = teacher resources

V = volunteer opportunities

W = teacher workshops

**American Cetacean Society.** San Pedro, CA. (310) 548-6279. [www.acsonline.org](http://www.acsonline.org) (G,F,P).

**Cabrillo Marine Aquarium.** San Pedro, CA. (310) 548-7562. [www.cabrilloaq.org](http://www.cabrilloaq.org)  
(C,F,G,O,P,S,T,V,W).

**California Department of Fish and Game.** Los Alamitos, CA. (562) 342-7100. [www.dfg.ca.gov/](http://www.dfg.ca.gov/)  
(C,F,O,P,T).

**California Science Center.** Los Angeles, CA. (213) 744-7444. [www.casciencectr.org](http://www.casciencectr.org)  
(C,G,P,S,T,V,W).

**Center for Marine Conservation.** San Francisco, CA. (415) 391-6204. [www.cmc-ocean.org/](http://www.cmc-ocean.org/)  
(F,G,S,T,V).

**Channel Islands National Marine Sanctuary.** Ventura, CA. (805) 966-7107.  
[www.cinms.nos.noaa.gov/](http://www.cinms.nos.noaa.gov/) (F,O,P,S,T,V).

**Chula Vista Nature Center.** Chula Vista, CA. (619) 409-5900. [www.chulavistanaturecenter.org/](http://www.chulavistanaturecenter.org/)  
(C,F,G,P,S,T,V,W).

**El Dorado Nature Center.** Long Beach, CA. (562) 570-1745. [www.ci.long-beach.ca.us/park/el\\_dorado\\_nature\\_center.htm](http://www.ci.long-beach.ca.us/park/el_dorado_nature_center.htm) (C,F,G,O,P,S,T,V,W).

**Heal the Bay.** Santa Monica, CA. (800) 453-0395. (310) 581-4188. [www.healthebay.org](http://www.healthebay.org) (F,T,V,W).

**Inside the Outdoors.** Costa Mesa, CA. (949) 548-1175. [www.ocde.k12.ca.us/ito](http://www.ocde.k12.ca.us/ito) (F,O).

**Jet Propulsion Laboratory.** Pasadena, CA. (626) 744-5508. [www.podaac.jpl.nasa.gov](http://www.podaac.jpl.nasa.gov) (O,S,T).

**Lawrence Hall of Science,** University of California Berkeley, CA. (510) 642-7771. (C,G,P,T,W).

**Long Beach Aquarium of the Pacific.** Long Beach, CA. (562) 951-1603.  
[www.aquariumofpacific.org](http://www.aquariumofpacific.org) (C,G,S,T,V,W).

**LAUSD Sea Education Afloat Program.** Los Angeles Harbor. (714) 761-2489. (C).

**Los Angeles City Stormwater Program.** Los Angeles, CA. (800) 974-9794. [www.LAstormwater.org](http://www.LAstormwater.org)  
(S,T).

**Los Angeles County Marine Science Programs.** Downey, CA. (562) 922-6111.  
[www.commpages.com/roundhouse/](http://www.commpages.com/roundhouse/) (C,F,P,V).

**Los Angeles County Natural History Museum.** Los Angeles, CA. (213) 763-3466. [www.nhm.org](http://www.nhm.org)  
(C,F,G,O,P,T,V,W).

**Marine Mammal Care Center at Fort MacArthur and Center for Marine Studies.** San Pedro, CA. (310) 548-5677, (310) 547-9888. [www.mar3ine.org/mmcc/main.html](http://www.mar3ine.org/mmcc/main.html) (C,G,P,V).

**Monterey Bay Aquarium.** Monterey, CA. (831) 648-4880. [www.mbayaq.org/](http://www.mbayaq.org/) (C,F,G,O,P,S,T,V,W).

**National Audubon Society.** Los Angeles, CA. (323) 254-0252. [www.audubon.org/educate/](http://www.audubon.org/educate/) (C,F,O,P,S,V).

**National Oceanic and Atmospheric Administration (NOAA).** Long Beach, CA. (843) 740-1200. [www.csc.noaa.gov](http://www.csc.noaa.gov) (T,S).

**Ocean Institute of Orange County.** Dana Point, CA. (949) 496-2274. [www.ocean-institute.org/](http://www.ocean-institute.org/) (C,F,P,T,V,W).

**Santa Monica Bay Restoration Project.** Los Angeles, CA. (213) 576-6615. [www.smbay.org](http://www.smbay.org) (T).

**Sea World.** San Diego, CA. (800) 257-4268, (800) 380-3202. [www.seaworld.com/index.html](http://www.seaworld.com/index.html) (C, G,O,P,S,T,V,W).

**Stephen Birch Aquarium/Scripps Institute.** La Jolla, CA. (858) 534-3474. [www.aquarium.ucsd.edu/](http://www.aquarium.ucsd.edu/) (C,F,G,O,P,S,T,V,W,).

**The SEA Laboratory.** Redondo Beach, CA. (562) 529-7397. (C,F,O,P,T,V,W).

**Southern California Marine Institute.** Terminal Island, CA. (310) 519-3172. [www.-bcf.usc.edu/~scmi](http://www.-bcf.usc.edu/~scmi) (C,F,O,W).

**Surfrider Foundation.** San Clemente, CA. (800) 743-7873. [www.surfrider.org/](http://www.surfrider.org/) (O).

**UCLA Ocean Discovery Center.** Santa Monica, CA. (310) 393-6149. [www.odc.ucla.edu/](http://www.odc.ucla.edu/) (C,F,G,P,S,TV,W).

**Upper Newport Bay Ecological Reserve and Interpretive Center.** Newport Beach, CA. (949) 648-6746. [www.newportbay.org/](http://www.newportbay.org/) (C,F,P,V,W).

**U.S. Fish and Wildlife Service.** (800) 344-9453. [www.fws.gov](http://www.fws.gov) (O,S,T,V,W).

**USC Sea Grant Program.** Los Angeles, CA. (213) 740-1961. [www.usc.edu/go/seagrant](http://www.usc.edu/go/seagrant) (S,T,W).

**Wrigley Center for Environmental Studies.** Catalina Island, CA. (213) 740-6780. [www.wrigley.usc.edu/](http://www.wrigley.usc.edu/) (C,F,G,P,T).



## GLOSSARY of terms **bolded** in text

**adaptation/adaptación:** the modification of characteristics of a species of organism over time to adjust to a new condition.

**algae/alga:** aquatic plants of fresh or sea water from microscopic to 200 feet in length; simple photosynthetic plant-like organisms.

**annelids/anélidos:** segmented worms; examples include feather duster and sandcastle worms.

**beach wrack/arrojadas por el mar** (beach cast): organic matter and debris washed up on the beach by waves.

**camouflage/camuflaje:** any device, structure, behavior, action, disguise, or coloration that serves to hide or conceal an object or animal in patterns merging with the background.

**carnivore/carnívoro:** an animal that feeds primarily on other animals.

**cnidarians/cnidarias:** invertebrates with stinging structures that may occur as polyps and medusas; examples include sea anemone, jellyfish, gorgonian, and sea pansy.

**community/comunidad:** all of the plants and animals living in a specific area (habitat).

**countershading/tonalidad:** a type of protective coloration in which an animal is light on the under-side and dark on top.

**crustaceans/crustáceos:** invertebrates in the phylum Arthropoda, with jointed legs, exoskeleton, jaws, gills, and two pairs of antennae; examples: crabs, lobsters, barnacles, copepods.

**current/corriente:** the mass movement of water produced and maintained by the rotation of the earth, the winds, the heat of the sun, and water density.

**detritivore/detrítivoro:** an animal that feeds chiefly on bottom deposits.

**echinoderms/equinodermo:** spiny-skinned invertebrates with radial symmetry (typically 5-sided); examples include sea stars, sand dollars, sea cucumbers, and sea urchins; an exclusively marine phylum.

**ecology/ecología:** the study of the interactions of plants and animals with the environment.

**endangered species/especie en peligro:** an animal or plant at risk of becoming extinct as a result of overharvesting, habitat destruction, or other causes.

**endemic/endémico:** occurring naturally only in a specific area, habitat, or region.

**filter-feeder/conductor de alimentación:** an animal that eats small particles of food from water by passing the water through a filtering structure.

**fish/pez; peces:** vertebrate with fins that uses gills to respire in the water.

**gills/agalla:** respiratory structures in aquatic organisms through which exchange of oxygen and carbon dioxide takes place.

**grazer/pacer:** an animal that feeds on algae, including many snails, slugs, and sea urchins.

**habitat/habitación:** natural home or dwelling of an organism; the environment in which specified organisms live.

**herbivore/herbívoro:** an animal that feeds chiefly on plants.

**intertidal/intercorriente:** area on shore between high and low tides.

**invertebrate/invertebrado:** an animal without a backbone of bone or cartilage.

**kelp forest/bosque de alga marina:** an ocean community composed of stands of giant kelp (*Macrocystis*) and other large kelp. It provides shelter and camouflage for many animals such as fish, snails, crabs, and other invertebrates.

**mammal/mamífero:** a vertebrate animal that is warm-blooded, has live young, feeds its young milk, has hair or fur, and breathes air.

**migrate/migrar:** to pass periodically from one region to another for purpose of feeding or breeding.

**mollusca/molusco:** phylum of soft-bodied, usually non-segmented, invertebrates possessing a mantle; examples include chitons, octopus, squid, nudibranchs, sea hares, clams, mussels, and snails.

**mudflat/comunidad de lodo:** coastal community composed of mud, salt-tolerant plants, and a variety of animals that is daily nourished by the tides and seasonal freshwater runoff.

**nekton/necton:** strong swimmers not at the mercy of currents.

**nocturnal/nocturno:** animals that are active at night, resting during the day.

**photosynthesis/fotosíntesis:** the synthesis by plants of carbohydrates from carbon dioxide and water by chlorophyll, using light as energy with oxygen as a by-product.

**pinnipeds/sirenia:** “feather footed” aquatic carnivorous mammals, including seals, sea lions, and walrus.

**plankton/plancton:** floating or weakly swimming organisms that move with the currents in all natural waters; can be photosynthetic (phytoplankton) or animals (zooplankton).

**pollution/contaminación:** contamination of water, soil and/or air from the discharge of wastes, gases or chemicals.

**predatory/predatorio:** living by killing and eating other animals.

**protista/protista:** a collective name for bacteria, algae, and protozoa.

**rookeries/colonia de grajos:** roosting and/or breeding grounds for birds and pinnipeds.

**salinity/salinidad:** the concentration of dissolved minerals, including salts, in the water.

**scavenger/basurero:** an animal which devours dead animals or feeds on dead organic matter.

**substrate/medio:** the solid material upon which an organism lives or to which it is attached.

**tidepool/reflujo del mar; costa racosa:** a depression in the rocks forming an intertidal reservoir of water which remains when the tide goes out.

**tides/corriente:** the daily rise and fall of ocean waters produced by the gravitational pull of the earth by the moon and sun and rotation of the earth.

**upwelling/corriente ascendente:** the rise of nutrient-rich waters from deeper areas of the ocean to the surface of the sea.

**urban runoff/agua contaminada urbana:** water containing pollutants (oil, grease from leaking cars, soaps, pesticides from gardens, animal waste, street debris) which washes into storm drains and rivers and gets carried out to the ocean.

**vertebrate/vertebrado:** an animal with a spinal column, or backbone.

**watershed/cañería de agua:** the area that drains naturally into the ocean; a region bounded by geographical features causing rainfall to flow toward a particular body of water.

**wave/ola:** a moving flow of energy through water which causes the up and down movement called swells; generally caused by wind.

**wetland/estero; tierra húmeda:** a transitional habitat between upland and aquatic environments where the water is the primary controlling factor for the environment, including both plant and animal life; wetlands have fluctuating water levels and include saltmarshes, mudflats, swamps, estuaries, and bogs.

**zonation/zona:** the location and distribution of organisms in definite levels or areas.

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