

Long Beach Marine Institute
Teacher Introduction
Guided Tide Pool Tour

Field Study Parameters

Objective

The purpose of the Guided Tide Pool tour field study program is to introduce participants to the observation methods of biological oceanographers and to instill in them an appreciation for the intertidal habitats of Southern California.

Academic Thrust

This field study program incorporates academic material from the subjects of marine ecology, marine zoology and taxonomy. The level at which this material is covered is dependent on the age and preparation of the participants. Elementary and middle school students are expected to have thoroughly examined the preparation material included in this packet.

Activities

The Guided Tide Pool Tour includes marine organism observation. The field study includes a brief lecture by a marine naturalist. The naturalist will guide the students to the observation area and help identify describe species as needed.

Field Trip Itinerary and Organization

The field study program is organized in the following manner:

- 0:00 Brief Lecture and Presentation (conducted by naturalist)
- 0:15 Safety Rules and Observation Instructions (conducted by naturalist)
- 0:20 Exploration and observation of tide pool area
- 1:20 Students are gathered for post-activity discussion
- 1:30 Conclusion of Field Study

Field Study Subject Matter

Marine Ecology

Ecology is the study of the interrelationships of living things and their environment. Ecology is a word popularized by the pioneers of the environmental movement in the late 1960's and early 70's. Marine ecology is an attempt to understand how marine organisms relate to one another and their habitat. Marine plants, animals and physical phenomenon, such as water chemistry and wave action, make up what is known as a marine ecosystem. You can think of an ecosystem like a mechanical device such as an automobile or a computer. Like a car or computer, an ecosystem has many interdependent parts. However, an ecosystem is infinitely more complicated, and a marine ecosystem is even more difficult to understand because it is under water. Exploring the ocean, even the shallow parts, is a difficult and expensive task.

One cannot discuss marine ecology without considering the marine habitat. The ocean, like the earth, is an immense biosphere made up of many different habitats. There are deep-water habitats over 40,000 feet deep. Pelagic, or "open water," habitats exist between the surface and the sea floor and contain plants and animals that never see the bottom of the ocean and, perhaps, never come to the surface. In near-coastal waters, there are many types of coastal habitats. Habitat, the physical place where an animal and plant lives, can be a part of a larger community.

For example, the coral reef community may contain several habitats including a soft sandy seabed and the coral itself.

Coastal habitats and communities in Southern California are many and varied. Tide pools are found among the rocky intertidal. Mud flats are found in bays and estuaries. Sandy beaches rocky reefs and kelp forests all provide unique habitat for marine plants and animals. Even boats and pier pilings are habitat for some creatures and algae. We find in all cases that the plants and animals that inhabit a particular community are intensely dependent on the physical characteristics of the habitat. Kelp plants cannot grow without a secure place of attachment, usually provided by the large rocks of a California reef. Sea anemones and sea urchins require a shallow place of attachment found along our rocky shores. Cusk eels and stingrays need loose sand or mud arranged in a large flat habitat to take advantage of their unique abilities to burrow and hide.

Understanding how animals relate to their habitat in this way is the thrust of ecology. Our field study will focus on a particular habitat on the shore in Corona Del Mar. In this habitat, marine organisms abound, each with their own adaptations that enable them to survive within their harsh environment. Invertebrates include all animals not belonging to the phylum Chordata, or animals without backbones (or notochord). Examples of these invertebrates are mussels, barnacles, snails, crabs, sea stars, sea anemones and sea urchins. Their survival depends on a stable, rocky substrate to which some attach themselves and some move along. Tide pools are also home to a few small vertebrates, animals with a backbone, such as the fluffy sculpin. Larger fish, of course are too large to fit in a tide pool. The rocky substrate we will encounter is a safe haven for many animals that would otherwise be prey to animals requiring a constant supply of water.

Marine Zoology

Zoology is the study of animals. In this field study, we will be exploring a bit of marine zoology, or the study of marine animals. Everyone enjoys meeting new animals, but it is only meaningful if we have some understanding of these animals, their particular habits and requirements for survival. Only in understanding marine organisms through such sciences as marine zoology can we adequately protect them and their environment. In this section, species of animals that dominate the rocky substrate of the Corona Del Mar shoreline will be discussed.

Taxonomy

Taxonomy is the scientific classification of organisms. That is, taxonomy is the method by which animals and plants are organized for the purposes of scientific investigation. The plants and animals collected as part of the field study must be classified (or catalogued) if the data is to have any lasting value. Fully understanding the marine environment requires that we also understand the common characteristics of living things and organize these characteristics via the system of taxonomy.

An organism's scientific name is derived from its taxonomic organization. That is, the first name corresponds to its genus, the second its species. The genus is commonly capitalized. The species is not. For example, the Striped Shore Crab is known to marine biologists and naturalists as *Pachygrapsus crassipes*, *Pachygrapsus* being the genus and *crassipes* being the species. Taxonomy includes the further classification of this organism as kingdom *Animalia*, phylum *Arthropoda*, subphylum *Crustacea*, class *Malacostraca*, order *Decapoda*, and family *Grapsidae*.

Student Introduction

Guided Tide Pool Tour

Your objective as a student is to observe, identify, and analyze members of the marine community explored at the tide pool at Corona Del Mar. You will be assisted and guided by a staff marine naturalist attached to the Long Beach Marine Institute. The most important part of your experience at the tide pools is accomplished long before you arrive at the tide pools. You must be prepared. For this reason, Long Beach Marine Institute has provided you with this preparation manual. Be sure to study all the material selected by your teacher and contained in this handout. Your field trip will take place at the Corona Del Mar Tide Pools

Long Beach Marine Institute is your ticket to many new discoveries into the marine environment on the shores of Southern California. You are part of a team of students who will be working together to study the interrelationships of living things and their environment. Your job as a researcher will be to determine what marine animals and plants may be found, which types of marine habitats exist and the overall health of the habitats and their residents. You will have an opportunity to study many aspects of life on the rocky shores of Corona Del Mar. By doing so, we hope you will gain an understanding of the delicate balance, beauty and specific design in nature.

There is a whole different world out there beyond our seashore, a world largely unexplored. During the time you spend on your marine life study, you will barely scratch the surface of what amounts to our planet's final frontier. You may be inspired to continue your study as a professional marine biologist or oceanographer, or you may learn something of your own relationship with the environment. Look for the order and purpose in nature, and it will change the way you look at your own life. Your experience may actually broaden the scope of your thinking, allowing you to realize just how large the world really is. In your voyage, seek out the life and livelihood of the marine ecosystems and search for the knowledge necessary if we are to deal with the environment and conservation issues we are faced with today.

Preparation

Read this booklet

Read and study this text in its entirety. If you have questions, ask your teacher to help you. This booklet describes what you will be doing, what is expected of you as a participant and what types of plants, animals and habitats you will encounter.

Learn the vocabulary

In the back of this booklet is a list of vocabulary words. Memorize as many of them as you can. Try to use as many vocabulary words as you can by discussing the subject matter with other students or in classroom exercises. If you come across a word in this handout with which you are not familiar and is not on the vocabulary list, look up the word in the dictionary and write its meaning somewhere on these pages.

Dress for success

Wear layered clothing. In other words, do not wear a heavy jacket over a tee shirt or tank top. Instead, wear a lightweight shirt or top and a sweatshirt with a light windbreaker or jacket over the sweatshirt. This will keep you warm but allow you to peel layers as necessary. Wear rubber-soled shoes like athletic shoes that can get wet. Bring an extra pair of shoes and socks in case you get splashed during your field trip.

ROCKY INTERTIDAL HABITATS

The steady rise and fall of sea level at a given location is known as the tide. Except where the tidal range is very minimal, the point where the water reaches the seashore changes perceptibly every day. In fact, in many places, the level rises and falls twice each day! These fluctuations in sea level have a profound effect on marine life living near the shore. The combined gravitational effects of the earth, moon and the sun cause the tides. As the earth and moon revolve about each other, a centrifugal force, an outward “push away from the earth and moon’s combined center of gravity, forces a bulge in the oceans on the side of the earth turned away from the moon. Low tide is the best time to explore the tide pools. You can walk around the rocks that were once covered by water. If you wanted to study the tide pool at high tide, you would have to wear a snorkel and mask to observe the area because everything would be underwater.

Organisms within the intertidal must be able to adapt to severe and complicating extreme. One such extreme is the lack of moisture and water for extended periods of time. This means that some organisms must exist with little to no consumption of oxygen for lengthy periods. Organisms that live in the tidal pools must experience increasing temperatures as the sun heats the un-circulated water, and then experience the shock of cooler water as the tide returns.

Where the land meets the sea is the sight of a fantastic fight for survival. Creatures great and small battle for food and space as they struggle against crashing surf and fierce predators. Tiny animals swim in vain against powerful currents, which carry them to their doom into the body cavities of the many filter feeders who generate the currents. Mussels, immobile by their very nature, close tight in a futile attempt to escape the ravenous ochre stars. Limpets and periwinkles huddle close to the surface of the rocks as the scorching sun evaporates the moisture and bakes their shells at low tide. As frightening as it appears to us, all the animals in the intertidal zone are specially designed to deal with these and many other seemingly fatal contingencies.

The animals and plants that inhabit this particular zone make up a precise mechanism of productivity, which provides nourishment for sea creatures and land dwellers alike. It is with this mechanism that marine biologists are concerned. We ask questions regarding the animals’ behavior, interaction, reproduction, and feeding. We must consider what happens to the intertidal ecosystem when people take action, whether the action is constructive or destructive. And finally, biologists wonder how surrounding communities are affected by changes in the intertidal habitat and its residents.

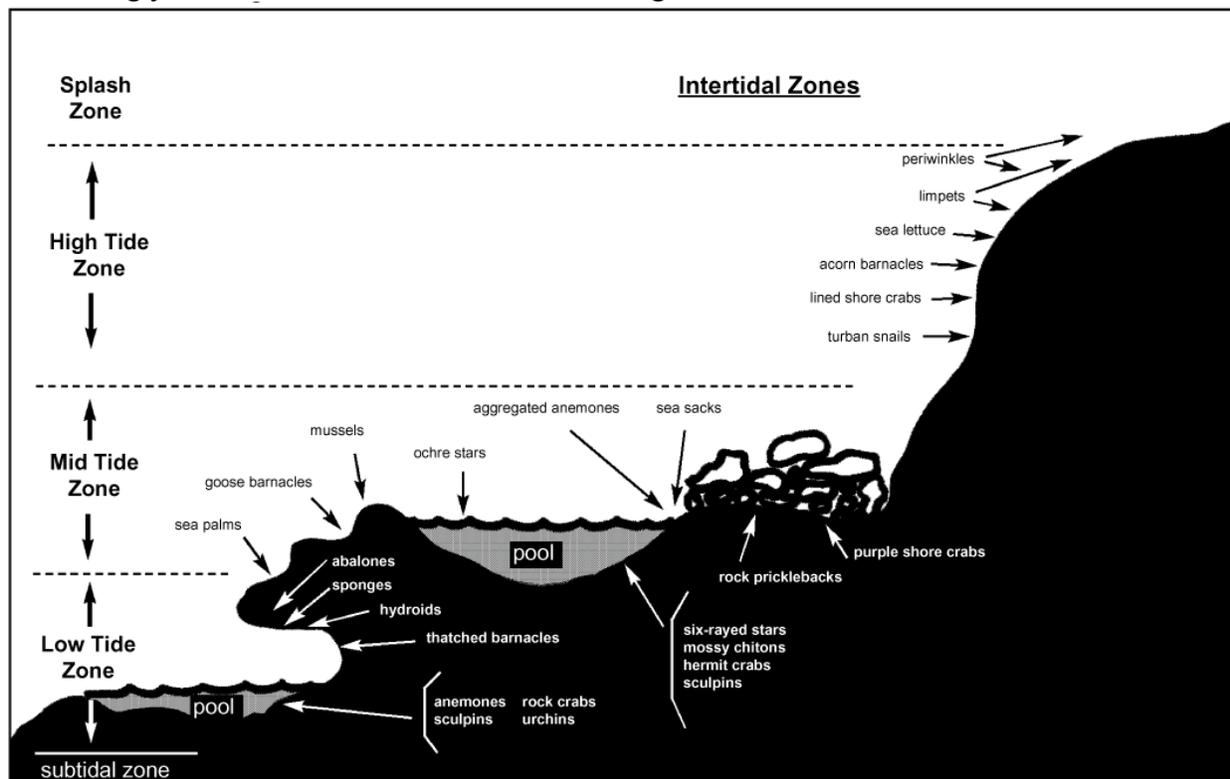
In California, we typically find four kinds of intertidal habitats. They are the sandy beaches, the mud flats (found in bays and estuaries), man-made structures (such as pier pilings) and the rocky shore. Each kind of habitat has its own unique properties, which make them ideal homes for their inhabitant. For example, a mud flat offers a place for easy burrowing and continual moisture, even at low tide. The sandy beach offers similar conveniences but has a higher permeability for oxygen and nutrients. Man-made structures provide a strong anchor for sessile (attached) organisms such as mussels and barnacles.

Exploring the rocky shore can be very interesting. It was from coastal habitats that people first drew their sea-faring sustenance, so it stands to reason that coastal habitats were the first subject of study connected with marine biology. Examination of the rocky coast should make one stop and think. On land, “rocky” usually indicates “barren”. However, in the sea, the rocks are literally covered with life. Although, on land, we typically associate a thriving ecosystem

with rich soil and abundant plant life, it is in the sea that the water itself is the nutrient carrying “soil.” Currents carry along food and nourishment to the hungry mouths of tiny, almost imperceptible, creatures – both plants and animals – which become food for larger predators. Rocks, amidst this life-giving medium, provide a place of attachment and crevices for hiding. The water carries gasses for respiration, nutrients for metabolic processes, and living drifters called “plankton” for consumption. Any adverse treatment of the coastal waters can prove fatal to entire coastal ecosystems, rich and diverse in natural conditions, such as that of the rocky shore.

The study of this ecosystem is your opportunity to become acquainted with the complex processes that occur daily in this community. You must pay close attention to any unique organisms or events that you encounter on your explorative expeditions. You must record any event in total detail so as to communicate the research that you do to others. It is a careful scientist (or naturalist) that keeps tabs on all marine plants and animals that they come across. Many trends and discoveries can be made from the review of carefully taken field notes well after the research expedition has concluded.

As you begin your observation of the rocky intertidal it is essential that you pay close attention to tidal zones. These zones are distinguished by the tide levels attained on the shoreline and the assemblage of like species of plants and animals. There are two ways to locate these zones: first by recognizing the points to which the tides rise and fall; second, by understanding what kind of marine biota exist at certain tidal levels and to recognize these organisms when you are making your observations. There are five distinguishable tidal zones.



The **splash zone** is never covered with water. Animals living here only receive moisture when the wind blows spray their way or when an occasional wave splashes their direction. Many buckshot barnacles can be seen covering the boulders of the splash zone. It is amazing that these filter feeders can survive while having the opportunity to feed only a few hours a month!

The rock louse, a scavenger, is an inhabitant of the splash zone and spends its time eating decaying organic matter. Periwinkle snails thrive in the splash zone and spend most of their time living out of water. This mollusk must remain moist to survive and they clamp tightly onto a rock to seal up the edges of their shell. This animal feeds on algae and seaweed.

The **high tide zone** is the second of four zones found on the rocky shore and is typified by many of the same species found in the splash zone. However, there is a marked increase in occurrences of the crustaceans and mollusks. That is, there are more crabs and snails here than can be found in the splash zone. The high tide zone can best be described as the area between middle tide and the splash zone. This area is covered with water less than 50% of the time. Therefore, animals and plants here have to be able to survive out of the water as well as they do in water.

The **middle tide zone** is exposed to the air only at low water. Here the variety of life found increases greatly. These animals are specially suited for survival in the pounding surf. Here one may also find several species of algae, and these plants are well anchored to hold fast against the ever-present surge and surf.

The **low tide zone** is exposed to air on rare occasions only. Generally the water level falls below this zone only one or two times each month. Diversity of species, not domination by a few, is the rule in the low tide zone.

ANIMALS THAT LIVE IN THE INTERTIDAL REGION

Among rocks, there exists a community of organisms, which range from brightly colored fish to spiny urchins to leathery sea stars. Snails and octopus share space with shrimp and crabs, barnacles and sea anemones. Since most of the creatures depend on the crevices in the rocky substrate to protect them, they can afford to be brightly colored and lavishly arrayed. In fact, bright coloration is essential if one wishes to maintain his space. Territorial animals exhibit oranges and yellows, neon pink, blue, greens and purples – whatever clearly marks their bodies as a warning to potential intruders.

Most animals found in the tide pools are specifically designed to survive in this environment. Not every animal could survive in the intertidal region because of conditions with which they must contend. For example, you would never find a whale or seal in the tide pool because they are too large and would not be able to handle the harsh conditions. A large fish like a tuna or halibut would not be found in the intertidal region either. How do the animals that are found here survive and what characteristics in particular do they possess in order to exist in such a challenging environment?

Venturing into the rocky intertidal zone

The Chumash Indians of the Channel Islands depended almost exclusively on intertidal organisms for food. Naturally, in the interest of maintaining an adequate food supply, the natives had to consider the health and welfare of the intertidal habitat. Abalone, a large shelled creature with a muscular, boneless body, was one of their staple foods. They knew well enough not to take an immature creature or a female bearing eggs. They knew that the health of one species, such as the abalone, is highly dependant on the overall health of many other species. Each type of organism is a vital link in a highly complex food web. The gathering pattern of the Chumash Indians indicated that they not only recognized the threat of over fishing the abalone, but they realized that leaving a previously fished habitat alone a few years brings the ecosystem back to equilibrium. That is, given enough time, a system regenerates itself; it grows back. Frequent

evidence of their highly productive but portable kitchen middens can be found on the hillsides of many Channel Islands. Just as the Chumash were careful with their rocky shores, we need to watch ourselves as we poke and prod our way through an intertidal habitat. If we choose to participate in the way discussed in this booklet, we can be sure that the fantastic world of tide pool organisms will be there to enjoy for years to come.

Before you begin

Go to a vantage point where you can see the area to be surveyed and answer the following questions:

What do you hear?

What are the area's physical characteristics?

What living things can you recognize from here?

Draw a map of your study area and indicate on your map the location of the rocky intertidal region. Your map should include the surrounding marine habitats and your position from where you have made your initial observations.

Do's and Don'ts

There are many rules to tide pool exploration that are unwritten but, nonetheless, reflect common sense. Consider the tide pool environment for a moment. It is the home of countless interesting and complex beings. If we are to understand these creatures, we need to observe their everyday routine. It would not be routine for these poor animals to have their homes uprooted, their bodies scarred, or their nerves stressed in fear of this great bi-peal organism hovering over them (that is, humans chasing greedily after them). If you wanted to know how your school friends spend their weekends at home, you would not enter their house and turn over furniture, empty their fridge and drag their bodies out of doors onto the streets. You would, more than likely, ask to be invited in a quietly observe the home-life as inconspicuously as possible. Similarly, observing animals in their natural habitat takes patience. Just stop, watch and listen!

The best way to observe intertidal organism is by choosing one tide pool at a time and watching it very carefully. Do not tear up plant life or leave rocks overturned where you were searching for interesting life. Be careful where you walk. More than likely, every step you take will come down on some form of life. Choose our tide pool with your study group and see who can find the most living things.

Observing the tide pool

Which species dominates the pool? Are there any fish swimming about? On what are the animals feeding? Is it algae? Take a look at the pool itself. Is it near the water's edge or high up where only high tide reaches? Feel the water in the pool. Is it much warmer than the water in the surf zone? If it is, you know that the animals in the pool have a high temperature tolerance.

Severe changes in water temperature could kill more sensitive animals.

Write down everything you see in the pool. If you and the instructor are unable to identify the organisms, then describe them in your notes. Measure everything that is measurable. If you have a thermometer, take the temperature of the water within the pool. Do this all again at another tide pool in a different zone of the intertidal area, perhaps nearer the surf zone, or you can compare your notes with those taken by another group at a different location.

Vocabulary

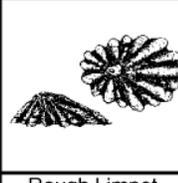
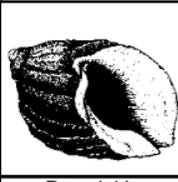
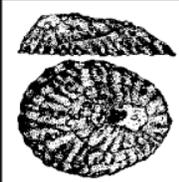
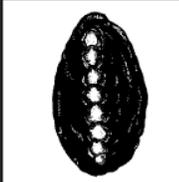
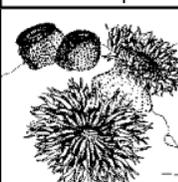
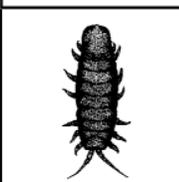
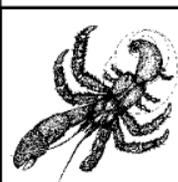
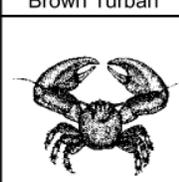
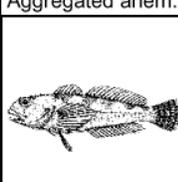
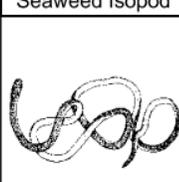
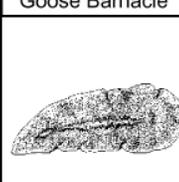
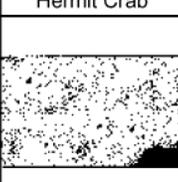
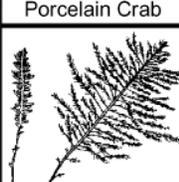
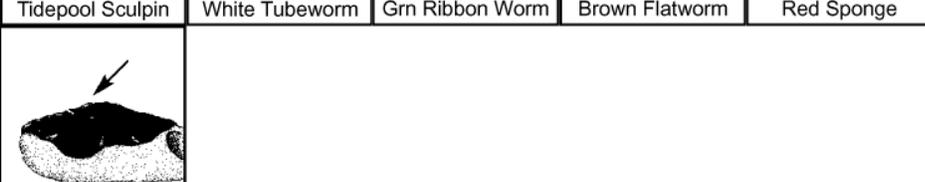
Tide Pool Tour

algae	Unicellular or multicellular simple plants that have no vascular tissue and therefore no leaves, stems or roots. (see seaweed)
arthropod	An invertebrate animal characterized by jointed legs, a segmented body and an exoskeleton. Includes crabs and insects.
Bivalvia	The class or group of animals made up of mollusks with two-part shells, such as clams, oysters and mussels.
camouflage	see <i>cryptic coloration</i>
carapace	The shield-like portion of exoskeleton that covers the head and thorax of various arthropods.
Cephalopoda	A class of mollusks containing the squids and octopi.
cryptic coloration	(crypsis) Coloration that makes animals difficult to distinguish against their background, so tending to reduce predation; The effect of cryptic coloration may be to cause the appearance of the animal to merge into its background(e.g., the absence of all color in some pelagic fish larvae) or to break up the body outline (e.g., the spotted patterns of many bottom-dwelling flatfish). Both effects often occur in the same animal.
crustacean	A class of arthropods that includes lobsters, crabs and barnacles.
desiccation	The process of drying out.
detritus	Litter formed from fragments of dead material (e.g., leaf-litter, dung, molted feathers and corpses).
echinoderm	Invertebrate animals including sea stars, sea urchins, sand dollars and sea cucumbers. Echinoderm literally means “spiny skin”. They also have radial symmetry.
ecology	The scientific study of the interrelationships among organisms and between organisms, and all aspects, living and nonliving, of their environment.
exoskeleton	The complex, layered horny skeleton that encloses the body of all Arthropoda.
filter-feed	A type of feeding method in which food particles are obtained by filtering them from a water current.

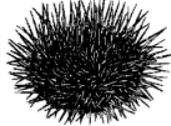
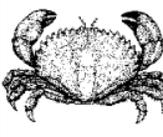
Gastropoda	A class of mollusks that includes the snails and nudibranchs.
habitat	The living place of an organism or community, characterized by its physical or biotic properties.
high tide zone	The second of four zones found on the rocky shore.
interrelationship	A mutually dependent relationship.
intertidal	The zone along the shore between high and low tides.
invertebrate	Of or relating to animals that lack a spinal column.
lateral line	A system of receptors, often embedded in special grooves in the skin of an animal, that is capable of detecting vibrations (and therefore movements) in the water surrounding the animal; in most fish, the lateral line runs along the sides of the body, but usually it forms a number of branches on the head. It is found in all lower aquatic vertebrates and some amphibians.
low tide zone	The fourth of four zones exposed to air on rare occasions only.
middle tide zone	The third of four zones found on the rocky shore, covered with water less than 50% of the time.
mollusk	A soft bodied creature that makes a shell. This category includes gastropods, bivalves and cephalopods.
radial symmetry	Having similar parts radiating (coming from) a central point, as in a sea star, sea anemone or sea urchin.
respiration	The physiochemical processes involved in the transportation of oxygen to and carbon dioxide from the tissues.
salinity	The saltiness of the water. Salinity increases as the water in tide pools evaporate in the sun.
seaweed	Marine algae that you can see without a microscope. Seaweed mostly attaches itself to rocks or another substrate. (see algae)
shell	Hard, rigid, largely calcareous covering of an animal (usually mollusks and some worms).
siphon	In Bivalvia and Gastropoda, a tube that funnels water towards and away from the gills; In bivalves (e.g., clams and oysters), siphons often occur in pairs.

splash zone	The intertidal zone that is never covered with water.
substrate	Solid material upon which an organism lives or to which it is attached; in the ocean, this can be rocks, man-made structures, the sediment or living organisms.
subtidal zone	The zone below the low tide zone that is always covered with water.
taxonomy	The scientific classification of organisms.
tentacles	1. In many invertebrate animals, a long, slender, flexible structure, often bearing sense receptors, used to obtain information about the immediate environment and often to obtain food; 2. In corals and sea anemones, a movable, tubular extension of the body cavity; tentacles are arranged in a ring around the mouth; 3. In Cephalopoda (e.g., octopus and squid), a movable modification of the soft body. Tentacles surround the mouth and are sometimes studded with sucker discs.
tidal wave	Also known as a tsunami. A huge sea wave caused by an ocean disturbance such as an earthquake. Unrelated to the tides.
tide	The steady rise and fall of sea level at a given location. Tides are caused by the gravity of the sun and moon and the rotation of the earth. These forces cause the oceans of the earth to bulge outward. As the earth rotates, the bulges change position relative to a location, giving rise to tides.
tide pool	Depression in a rock (or created by rocks)within the intertidal zone that traps water as the tide goes out.
vertebrate	Any of a comprehensive division (Vertebrata) usually held to be a subphylum of chordates comprising animals with a segmented spinal column together with a few primitive forms in which the backbone is represented by a notochords.
zoology	The study of animals.

Life in the Tide Pools

Splash Zone					
					
Rock Louse	Buckshot Barnacle	Eroded Periwinkle			
High Tide Zone					
					
Acorn Barnacles	Lined Shore Crab	Rough Limpet	Shield Limpet	Ribbed Limpet	Rough Chiton
					
Chckrd Periwinkle	Dogwinkle	Black Turban	Pelvetiopsis		
Middle Tide Zone					
					
Owl Limpet	Plate Limpet	Horned Slipper	Black Chiton	Mossy Chiton	Calif. Mussel
					
Brown Turban	Aggregated anem.	Brittle Star	Seaweed Isopod	Goose Barnacle	Hermit Crab
					
Porcelain Crab	Tidepool Sculpin	White Tubeworm	Grn Ribbon Worm	Brown Flatworm	Red Sponge
					
Moss Weed	Rock Film Algae				

Life in the Tide Pools

Low Tide Zone					
					
Kelp Limpet	Dunce Cap Limpet	Keyhole Limpet	Black Abalone	Lined Chiton	Leafy Hornmouth
					
Dogwinkle	Tube Mollusk	Two Spot Octopus	Spotted Nudibranch	Lemon Nudibranch	Spanish Shawl
					
Giant Green Anem	Brooding Anem	Bat Star	Ochre Star	Purple Sea Urchin	Red Sea Urchin
					
Thatched Barnacle	Kelp Crab	Spider Crab	Hermit Crab	Rock Crab	Shrimp
					
Fluffy Sculpin	Opaleye	Drk Ribbon Worm	Giant Flatworm	Purple Sponge	Ostrich Plume
					
Wing Kelp	Ribbed Kelp	Sea Palm	Feather Boa Kelp	Coralline Algae	Coralline Algae
					
Sponge Weed	Surf Grass				