# Rocky Shore / Tidepool: Background Information & Pre and Post Activities

## BACKGROUND INFORMATION

### BASIC ECOLOGICAL CONCEPTS

Ecology is the study of the relationships between organisms and their environments. An ecologist asks questions like: Where does this organism live and what characteristics make it particularly suited for that location? How does this organism get its food? What other organisms eat it? By asking questions such as these some basic principles have emerged. Understanding the following basic ecological concepts help us appreciate the complexity of life residing in and around the Bay.

Everything is related to everything else

Perhaps the easiest place to see interdependence in the environment is to look at food. All food on this planet is essentially made by plants through the process of *photosynthesis. Herbivores* are animals, which depend directly on plants for food. *Carnivores* eat herbivores. Take away all of the plants and there would be no animals. Can a plant, then, exist independently of all other organisms? No. Although it doesn't eat, a plant needs *nutrients* and is dependent on *decomposers* (bacteria and fungi) to break down dead organisms, thereby releasing these nutrients for use by the living plant.

Everything depends on something else

All organisms are also dependent on factors in the physical environment. They must have a source of water. Animals must have oxygen to breathe. Plants must have sunlight to perform photosynthesis. You can probably think of many more examples of how organisms are dependent on their environments.

Everything must go somewhere

No object ever disappears completely from the face of the earth. It may be broken down into atoms and be used to build something else, but those atoms are still there. In this way, nature deals with waste by recycling. Any plant or animal that does not become food for some animal becomes food for decomposers, which free the nutrients to be used again. Anything that cannot be decomposed must remain in the environment as it is. What are some examples of this kind of waste? The next time you throw something away, you might remember that there really is no "away" to throw it to.

Earth's resources are limited

How often do you run out of time to do what you want or need to do? Everyone knows that each day only has so much time in it, and that we have to be careful how we use it if we are going to accomplish everything we need to. The earth's available resources are like time in that we have to be careful how we use them, or they might run out. There is only so much gold, so much




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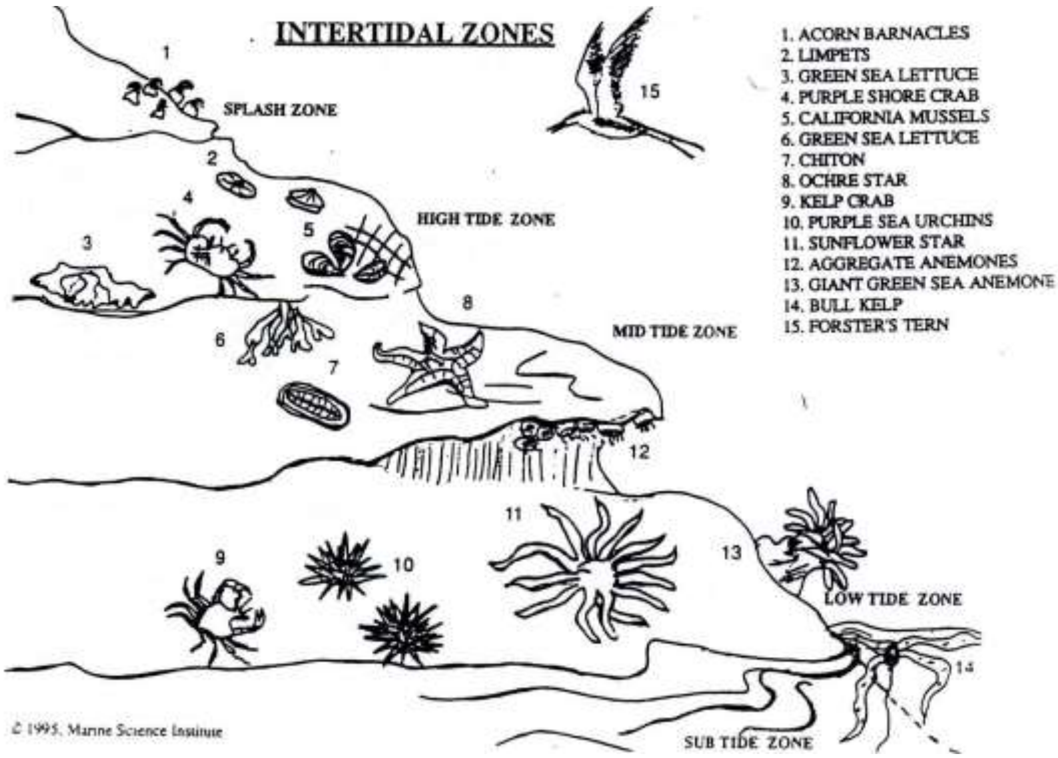
petroleum, so much fresh water, so much food, and so much space. All organisms are limited by the availability of resources, but humans have a special opportunity and a special responsibility. Although plants cannot make a decision to conserve clean water, humans can. To do this intelligently we must find out how much of each resource is available and then we must budget our use. We must also think about recycling. The earth can recycle its components naturally but humans must make special efforts to preserve the natural resources.

# THE ROCKY SHORE

The rocky shores along the Pacific Coast have some of the world's richest intertidal life. The animals brought to your classroom are found mostly between Santa Cruz and San Francisco. These rocky shores consist of layered shale leading up to steep cliffs. The changing tide levels often form tidepools, which are home to a huge diversity of marine invertebrates.

**THE INTERTIDAL ZONES**

Intertidal animals, by definition, live between the high and low tide zones. These are regions of constant and radical change. During high tide the animals and plants are underwater, but during low tide they are exposed to pounding waves, drying wind, rain that dilutes salinity, and air, which can be very hot or extremely cold. In addition to these problems, intertidal animals are also exposed to predation from the land animals such as sea gulls, sandpipers, and humans. It's a tough life, and in order to survive, intertidal dwellers have gradually adapted to these kinds of adversities. The intertidal zones extend from the highest wave-splashed rocks down to levels that are only uncovered by extreme low tides. There are five basic zones: the splash zone, high tide zone, middle tide zone, low tide zone, and subtidal zone.




The splash zone is the uppermost zone that is closest to the cliff area, and is only partially covered during very high tides. It receives wind-blown spray, which moistens animals such as blue-green algae, periwinkles, limpets and acorn barnacles.

The high tide zone, bordering the splash zone, may be exposed for 12 hours at a time. This area may have large rocks and boulders, which during winter storms can pound the animals at this level. Animals found here include lined shore crabs, California mussels, hermit crabs, and turban snails.

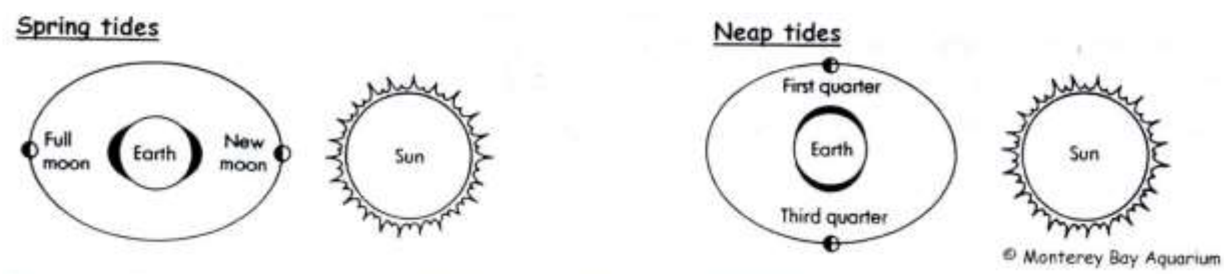
The middle tide zone covers the area between the high tide zone and the "zero" tide line. This zone is less physically stressful, as exposure may last for 12 hours or less. The animals found in this zone are adapted to the daily tidal rhythms and may actually require it to survive. Ochre sea stars, mussels, gooseneck barnacles, and purple sea urchins are a few of the species found here.

The next level is the low tide zone, and is often only exposed during times of the new or full moon. It is during this period of the lunar cycle that the tides are most extreme. Consequently, the low tide zone is exposed during only the lowest tides. This zone is often the largest and has a complex diversity of animals competing for food and room to grow. Here, clinging animals are again apparent. Anemones resist drying at low tide by contracting their delicate feeding tentacles. Sea stars can be found in clumps under rocks, using their tube feet to hold on. Mussels attach themselves to rocks by secreting tough byssal threads.

The subtidal zone, as the name implies, is almost never uncovered by water; therefore animals that are unable to tolerate air exposure for any length of time live in this area. The space is crowded with animals and competition for food and space is fierce.

**ABOUT TIDES**

What can be found along the shoreline, and even what the shore looks like will depend a great deal on the tides. The rhythmic rise and fall of the ocean and other large bodies of water are due mostly, but not exclusively, to the pull exerted on the water by the moon's gravity. Tides are influenced by additional forces including the sun's gravity, the earth's centrifugal force, the shape of the coast, and the ocean bottom. The highest and lowest tides, called spring tides, occur every two weeks near the times of either full or new moon. These extreme tides occur because the moon and sun are in line with the earth and the gravitational pull from each combine. Between periods of spring tides there are less extreme tides, called neap tides. During this time, the sun and the moon are at right angles to each other, and their pull tends to cancel each other. The low spring tides are the best for exploring the intertidal zone, since most of the area will be exposed.




**GENERAL INTERTIDAL INVERTEBRATE CHARACTERISTICS**

An invertebrate is an animal without an internal supporting structure, better known as a backbone. As a group, the invertebrates are highly successful in the natural world and well adapted. They are found everywhere: on land and in the soil, in freshwater, in saltwater, and in the bodies of other animals. In fact, invertebrates make up 97% of all the animals on the earth.

Rocky-intertidal animals are numerous, easy to find, and very spectacular with bright colors and strange shapes. They appear in such abundance in the intertidal zone that the main limiting factor is space or room for organisms to attach, cling, crawl, hide, and burrow. They are characterized by features that help them to do the above, and also ways to survive the cruel daily battles of living in a tidepool.

# GLOSSARY

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| **ADAPTATION** | Modification of an organism in order to survive within its habitat. |
| **ALGAE** | Primitive aquatic plants that lack true stems, roots and leaves. They are in their own kingdom. |
| **ALGINATE** | A derivative of brown algae. |
| **BEACH WRACK** | Seaweed that has washed ashore. |
| **BENTHOS** | The substrate at the bottom of a body of water; the adjectival form of benthos is benthic. |
| **BERM** | A flat, terrace-like area of sand just above the high-tide zone on a beach. |
| **BETA CAROTENE** | A derivative of green algae. |
| **BIODEGRADABLE** | Something capable of being broken down to simple compounds, especially into harmless products, by the action of microorganisms. |
| **BIODIVERSITY** | The richness, abundance and variety of life across all trophic levels of which all ecological systems, including the planet earth, are comprised. |
| **BIVALVE** | A Mollusk having two shell hinged together. e.g. clam, oyster and mussel. |
| **BLADE** | The leaf-like part of a seaweed. |
| **BYSSAL THREAD** | Tough threads of protein secreted by a gland in the foot of the mussel and used to attach it to rocks, piers etc. |
| **CAMOUFLAGE** | Method of hiding in which organisms blend in with their surroundings. |
| **CANOPY** | The top layer of the kelp forest where fronds float on the surface. |
| **CARAGEENAN** | A derivative of red algae. |
| **CARAPACE** | In crustaceans, a hard portion of the exoskeleton that covers the fused head and thorax. |
| **CARNIVORE** | An animal that consumes other living animals. |
| **COMMUNITY** | A group of plants or animals living in the same area and depending on one another for survival. |
| **CONSUMER** | An organism that gets its nutrients by eating other organisms. |
| **CRUSTACEAN** | An animal with a hard outside shell, antennae, mandibles and compound eyes. e.g. crabs, shrimps and barnacles. |
| **DECOMPOSER** | An organism that breaks down organic material and releases simple substances usable by other living things. Examples of decomposers are bacteria and fungi. |
| **DECOMPOSITION** | The breakdown of substances into inorganic forms. |
| **DEPOSIT FEEDER** | An animal that feeds by ingesting substrate and filtering out the small organic particles on the substrate. |
| **DETRITIVORE** | An animal that eats detritus. |
| **DETRITUS** | Dead plant and animal material. |
| **DISSOLVED OXYGEN** | Oxygen that has dissolved in water and can be used for respiration. |

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| **ECOLOGY** | The study of relationships between organisms and their environment. |
| **EDGE COMMUNITY** | A productive area where land and sea interface. This community, because of its proximity to land, receives huge inputs of sediment, nutrients and freshwater, which in turn supports a diversity of plants and animals. |
| **ENDANGERED** | An organism that is threatened with extinction. |
| **ENVIRONMENT** | The sum of all physical and biological factors that affect an organism. |
| **EXOSKELETON** | A hard encasement deposited on the surface of an animal, such as the outer covering of arthropods that provides protection from abrasion, predation, desiccation, etc. |
| **FILTER FEEDER** | An animal which extracts food particles by straining the water. Examples of filter feeders are clams, oysters, sponges and some fish. |
| **FOOD CHAIN** | A sequence of living organisms in an ecosystem in which members of one level feed on those in the level below and in turn are eaten by those in the level above them. |
| **FOOD WEB** | An assemblage of organisms in an ecosystem, including plants, herbivores and carnivores, which shows the relationship of "who eats whom." |
| **FOOT** | The wide, flat or wedge-shaped muscle of mollusks used for crawling, adhering and/or digging. |
| **GEOLOGY** | The study of the composition and structure of the earth. |
| **GILL** | An organ used for underwater breathing or respiration by fishes and some invertebrates. |
| **HABITAT** | The particular area in which an organism normally lives. |
| **HERBIVORE** | An animal that eats plants. |
| **HOLDFAST** | The root-like part of a seaweed that anchors it to the seafloor. |
| **ICHTHYOLOGY** | The study of fish. |
| **INVERTEBRATE** | An animal without a backbone. |
| **MANTLE** | An outer sheet of fleshy tissue (in mollusks) secreting the shell and forming the chamber to enclose the internal organs. |
| **MOLLUSK** | The second largest Phylum of animals. Mollusks have soft bodies, a foot, visceral mass, and a mantle. Most also have a shell made of calcium carbonate. Snails, clams, slugs, squid and octopus are examples of mollusks. |
| **NEAP TIDES** | Low amplitude tides that occur during quarter moons, when the moon's pull is at a right angle in relation to the pull of the sun. |
| **NEMATOCYST** | In cnidarians, stinging capsules used in defense and gathering food. |
| **NUTRIENTS** | The raw materials necessary for continuing life processes. |
| **OMNIVORE** | An organism that eats both plant and animal material. |
| **OVOVIVIPAROUS** | Reproductive strategy where mother bear young that develop internally but are unattached to a placenta inside the mother (born live from an egg). |
| **PELAGIC** | Living or occurring in the open ocean. |

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| **PHOTOSYNTHESIS** | The process used by plants to make food; in this process light energy is used to combine carbon dioxide and water to make carbohydrates (sugar and starch); oxygen gas is given off as a by-product. |
| **PHYTOPLANKTON** | Algae, usually microscopic, which freely drift in the sunlit portions of the water column. |
| **PLANKTON** | Drifting aquatic plants and animals; the adjectival form of plankton is planktonic, and a planktonic organism is called a plankter. |
| **POLLUTION** | Harmful impact on the environment resulting from human activities. |
| **PREDATOR** | An animal that captures other animals for food. |
| **PREY** | An animal caught for food. |
| **PRODUCER** | An organism that makes its own food; an example of a producer is a green plant. |
| **RESPIRATION** | Process used by animals and plants to release energy from food; this process requires oxygen and releases carbon dioxide and water. |
| **SALINITY** | The amount of salt in the water. Measured in parts per thousand. |
| **SAND** | Sediment particle which can be distinguished with the naked eye; particle diameters range from 1/16 (.0625) mm. |
| **SCAVENGER** | An organism that is an opportunistic feeder; scavengers usually include dead and decaying animal flesh in their diets. |
| **SIPHONOPHORES** | A siphonophore is a relative of jellies. It is a translucent chain of specialized parts, each of which carries out a unique function. Siphonophores can reach lengths of up to 95 feet or more! |
| **SIPHONS** | The feeding tubes used by some bivalves (clams and oysters) to filter plankton. |
| **SPECIES** | A population of plants or animals that are able to produce viable of with each other and not with other species. |
| **SPRING TIDES** | Occurs every two weeks near the times of either the full or new moon. These are high amplitude tides that occur when the sun, moon, and the earth are lined up. |
| **STIPE** | The stem-like part of a kelp plant. |
| **SYMMETRY** | Correspondence in size, form, and arrangement of parts. |
| **TENTACLE** | A slender, flexible appendage. |
| **TIDES** | The daily rise and fall of the sea level along a shore, occurs twice a day on our local shores. |
| **TUBE FEET** | In echinoderms, hollow appendages filled with water and operated by the water-vascular system. Used for attachment, movement and the capture of water. |
| **TUBERCLE** | Small, round bumps that increase the surface area of the skin. |
| **VERTEBRATE** | An animal with a backbone. The back bone can be made of bone or of cartilage like in some fish (sharks and rays). |
| **VIVIPAROUS** | Reproductive strategy where mothers bear young that are nourished through a placental attachment (live birth). |
| **WATER-VASCULAR** | A system of canals, bulbs and appendages filled with sea water. This system is involved in locomotion in echinoderms. |

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| **ZOOPLANKTON** | Animal plankton. |

# PRE-VISIT ACTIVITIES

You may want to ask your librarian to set aside ecology or marine science books for your class, or ask students to bring books and magazines from home to share.

**ANIMAL ADAPTATIONS**

Have your class research and discuss how marine animals protect themselves from their predators or what adaptations they have to become better predators. Have the class team up in small groups and be responsible for researching one phylum. Within each group, each student can choose one animal from this phylum. They can use books or any other resources to put together a report.

**SCIENTIFIC CLASSIFICATION**

Demonstrate the meaning of scientific classification by having students categorize inanimate objects according to their own framework. You could use fruit, or something ordinary such as different kinds of nails (wood, standard, aluminum, galvanized, ringed, headless), to each small group. Have them categorize and then share their results with each other to start a general discussion on classification. Do we need it? Is any one type of classification better than another? Is there a benefit to sticking to one standardized system of classification?

**CAMOUFLAGE CRITTERS**

Discuss the concept of camouflage, its usefulness to an animal, and perhaps how it evolved through natural selection. Have students draw an animal camouflaged for a particular environment (forest, meadow, stream bottom, etc.) Or, choose environments on the school grounds and create a critter (from paper, clay, pipe-cleaners, even raw vegetables!) that is camouflaged in those surroundings.

**Activities/Curriculum links:**

http://aswc.seagrant.uaf.edu/kindergarten/investigation-1.html

https://coast.noaa.gov/estuaries/curriculum/

# POST-VISIT ACTIVITIES

**WEB OF LIFE**

Have the students stand in a circle. Ask the students about the habitat they just saw (this will work for any habitat). Ask them where in that habitat all energy begins, (sun).

- Hand the student who answered correctly a ball of yarn.
- Ask what uses the sun's energy to create food (plants). Have them name a plant they saw.
- Have the student with the ball of yarn (still hanging on to the end of the string) toss the ball itself over to the "plant" student.
- Ask, "Who uses plants for energy?" And continue this discussion using herbivores, carnivores, decomposers, and of course, humans,
- With each completed step, students continue to toss the yarn to each other around the circle, creating a complex and interrelated food web.

- Now pick a random student. Because of hunters, or pollution, or loss of habitat (several reasons apply), the component he or she represents has died and must sit down. As he does so, he inadvertently creates a tug on the yarn, thus affecting other aspects of the web of life. Every student, then, who feels a tug on the yarn they are holding is affected in some way by the death of that one individual, and must sit down and tug on their own yarn.

Eventually, all students will be seated and you can discuss the results

## ACTIVITY: Creative Classification

**Objective:**
To create an animal by using physical characteristics to categorize that animal in a classification system.

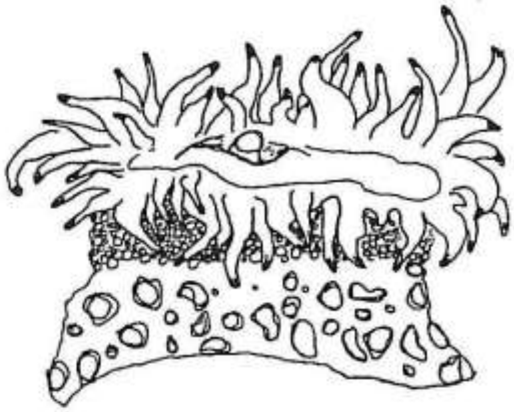
**You will need**

- Clay
- Paper
- Markers

**Procedure:**

1. Each student chooses a phylum, class, order, and family in the animal kingdom after which to model their animal. Write down main characteristics. You may want to limit choices.
2. Separate clay into medium sized balls.
3. Give time to design an imaginary animal following the main characteristics of the chosen phylum, class, order and family.
4. Name animal with an original genus species name. Genus is a larger group for similar species. Species category is for organisms with similar structures.
5. Compare "new critters" to the others in the same families.
6. Discuss differences between animal characteristics, habitats, and diets that create *biodiversity*.

***NOTE:*** *You may change this lesson by asking the students to create an animal based on the physical parameters of a given habitat. They can use the same materials and assign their critter a genus & species name as before!*



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## ACTIVITY: Rocky Shores Creature Feature

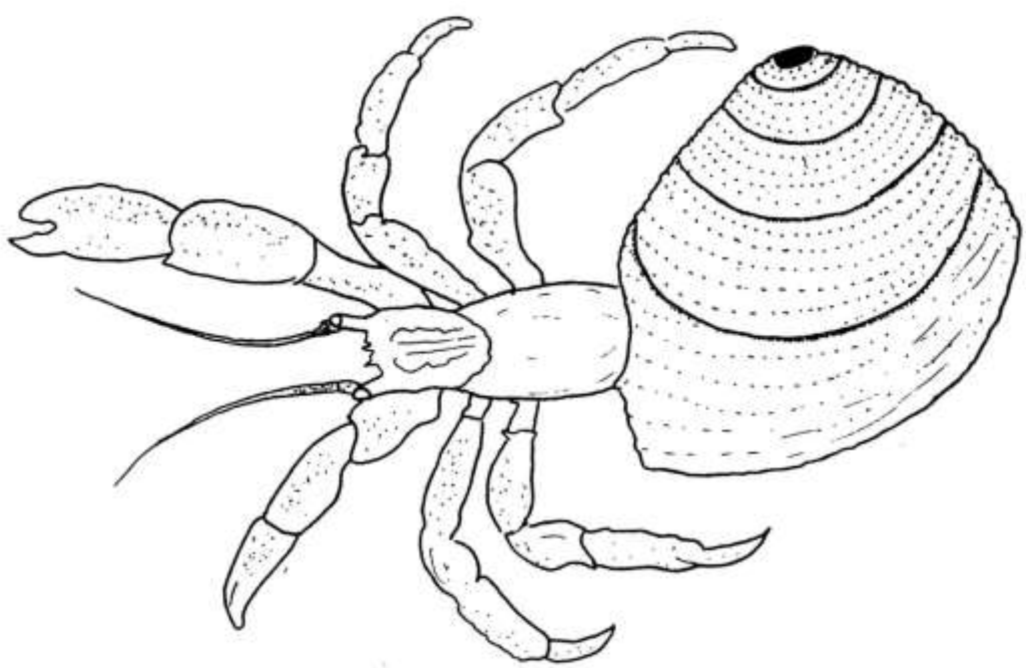
**Objective:**
The objective of this activity is to familiarize and excite students about the creatures that live at the rocky shores.

**Procedure:**
There are many possibilities for classroom activities using the "Creature Feature" information cards.

You may wish to conduct an "Each One – Teach One" with your students. Make enough copies of the creature information cards so that there is one featured animal per student when pages are cut apart. Let students choose a creature card randomly. Give students time to read the card or further research their chosen organism. Props and pictures are fun additions to this activity. Then, let the each one – teach one begin. Set up teaching "stations" around the room. Devise an organized way to have the students teach and learn from each other as they move between teaching stations.

Alternate activities could include :

a. The creation of a rocky intertidal food web using the creature information cards and poster boards.
b. Human Impact Activity: Have students pick a creature information card and research the impacts that humans have on that specific organism.



# ROCKY SHORES CREATURE FEATURE

### Turban Snail

**Description:** Their shell can be brown or black with a spiral coiling shell. The snail's soft, muscular foot is black on the sides.

**Food:** It scrapes algae off rocks with a texture tongue, called a radula.

**Predators:** Shore birds, fish, crabs, other snails, and humans.

**Zone:** Found in the middle to low intertidal zone.

**Fun Facts:** The black turban is one of the best

### Acorn Barnacle

**Description:** Barnacles are white and volcano shaped. They glue themselves to rocks, pier pilings, whales, and ships.

**Food:** Plankton and particles suspended in water.

**Predators:** Their enemies include worms, snails, sea stars, fish, shorebirds, and oil spills.

**Zone:** They live in colonies in the high and middle intertidal zones.

**Fun Facts:** When submerged, they stick out

### Purple Sea Urchin

**Description:** Urchins have round shells with short spines. Its body is reddish to purple. Juveniles are pale green. They often burrow into rocks.

**Food:** They are herbivores that graze on algae.

**Predators:** Their predators include sea otters, fish and humans. Pollution is also a threat to urchins.

### Ochre Star

**Description:** These stars have rows of white tipped spines covering the back. They are rough to the touch. The color may be purple, brown, orange, red or yellow.

**Food:** Mussels, barnacles and certain snails.

**Predators:** Shorebirds and humans

**Zone:** They live in middle to low intertidal zones.

**Fun Facts:** This sea star needs only a 0.1 m m

### California Mussel

**Description:** The mussel is a black bivalve. It attaches to rocks by secreting a liquid that quickly hardens to form strong threads.

**Food:** Detritus, living plankton.

**Predators:** Ochre stars and humans

**Zone:** Found in dense colonies on wharf piles and surge exposed rocks in the middle to high intertidal zone.

### Nudibranch

**Description:** Soft body - not protected by a shell. The color is orange on the back with bright light blue lines. They have their gills on their back.

**Food:** Small sea anemones, worms, small crustaceans, tiny clams and even dead animals.

**Predators:** Few animals eat slugs because of their brightly colored warnings. The exceptions are sea hares, inexperienced fish and people.

### Purple Shore Crab

**Description:** These are a dark wine color with purple spots on their claws.

**Food:** It is a scavenger and eats dead plants, detritus, or small animals.

**Predators:** Fish, sharks, and shorebirds.

**Zone:** It is found in the high intertidal zone.

**Fun Facts:** They use camouflage and their claws for defense. They also hide under rocks. Gently

### Giant Green Anemone

**Description:** The column is olive green and the tentacles and disc are emerald green. The column is covered with wart-like tubercles.

**Food:** These animals use their stinging tentacles to catch detached mussels, crabs, sea urchins and small fish.

**Predators:** Sea slugs, snails, fish and sea stars.

**Zone**
zone

Turban Snail

*Tegula spp.*

Ochre Star

*Pisaster ocraceous*

Purple Sea Urchin

***Strongylocentus purpuratus***

Sea Slug

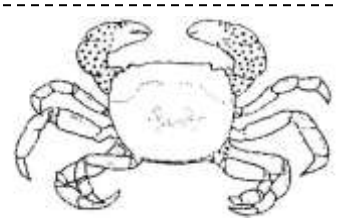
***Hermissenda crassicornis***

California Mussel

***Mytilus californicus***

Giant Green Anemone

*Anthopleura xanthogrammica*



Purple Shore Crab

***Hemigrapsus nudus***

**WRITING THANK YOU LETTERS**

Write letters to the instructors and/or your class sponsor to tell them about the trip. When we receive letters and pictures back from the kids our instructors remember what a thrill it is to be teachers. The sponsors also enjoy getting direct feedback from the class and teacher to reinforce that they are making a difference for kids learning science. Please include the day, date and time of your trip so we can try to remember your group a little better.

**Activities/Curriculum links:**

http://aswc.seagrant.uaf.edu/kindergarten/investigation-1.html

https://coast.noaa.gov/estuaries/curriculum/





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