Kelp Forest: 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 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.

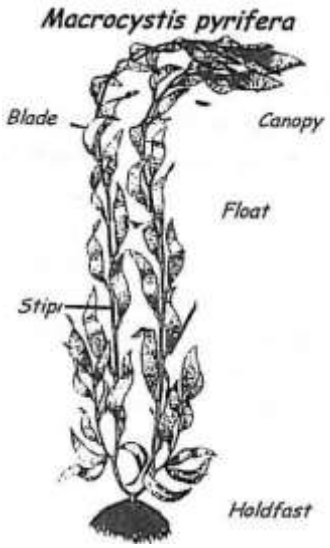
KELP FOREST ECOSYSTEM

The kelp forest is the area close to the shore where dense forests of giant brown algae grow. The kelp forest is an important ecosystem because 1) it provides protection and food to a huge diversity of animals, 2) it is considered an edge community where land and sea interface creating an extremely productive area in the ocean environment and 3) it is harvested and used in many food and cosmetic products.

We are lucky here in California to have such a unique marine environment right in our own backyards. Kelp forests require specific environmental characteristics in order to grow and thrive. Kelp can only grow in nutrient rich, chilly (50-68 °F), offshore (35-100ft) environments with strong currents and a nice rocky bottom. Therefore, kelp is not found south of the Baja Peninsula in tropical or subtropical waters, but may be found again south of the equator along the temperate coasts of South America.

THE KELP PLANT

All kelp is a type of marine plant called algae. Algae are similar to, but simpler, than most land plants. Algae have no leaves, stems, roots, or flowers. For this reason, all algae are grouped into the Kingdom Protista. There are three different types of algae: green, red, and brown. Though all three types of algae occur in abundance along the California coast, particular species of brown algae are what make up the tall forests of kelp. The most common plant in the kelp forest is *Macrocystis pyrifera,* also known as giant kelp.



A kelp plant has three main components. These parts include the following: the holdfast, stipe, blade and float. The holdfast acts as an anchor for the kelp plant. One adult holdfast can harbor more than 500,000 sea creatures living within the root-like structure. The holdfast helps the plant withstand the pull and surge of currents and waves. The stipe is like the stem of the plant. It is not rigid like the stem of a terrestrial plant, but instead can bend with the waves without breaking. The blade of a kelp plant is the factory or workplace of the plant where most of the photosynthesis takes place (specifically in the chloroplasts). Photosynthesis is the process by

which plants convert carbon dioxide and water to produce their own food, a simple sugar known as glucose. It is important to note that oxygen is merely a byproduct of this complex chemical reaction just as it is with land plants. The float is an air bladder attached to the blade, which helps to keep the blades near the water's surface for sunlight. The gas in the air bladder is made by the kelp itself and not absorbed from the atmosphere.

The kelp plant has other adaptations that ensure its survival in the often turbulent nearshore waters. Some of these adaptations include the following:

- Wrinkled leathery blades, which increase the surface area of tissue exposed to the water and sun.
- Possession of extra efficient photosynthetic pigments.
- Ability to thrive as deep as 100 feet below the surface if the water is clear.
- Ability to grow more than 18 inches per day in optimal conditions.

Kelp has been harvested and used commercially since the early 1900's. Today, approximately 300,000 pounds of kelp are harvested annually in California. Algin, a derivative of kelp, forms the basis of this multi-million dollar industry. It is used in ice cream, gels, beer, dental molds and fertilizer. The algin helps make these products thicker, creamer and/or more stable over extreme differences in time or temperature. Kelp is harvested by large ships, which have blades similar to a lawn mower on the back of the ship. They trim off the top 3-6 feet of the canopy using these massive blades.

LIFE IN THE KELP FOREST

Kelp forests provide a habitat for entire communities of plants and animals. Over 200 species of plants and animals call the kelp forest home. The plant and animal communities of this near shore habitat rival rainforests and tropical coral reefs for species diversity and richness. The kelp plant itself is only the beginning of that diversity. The plants define the underwater forest much like the Redwoods define the forests of the California coastal ranges. Like a forest on land, a kelp forest can be divided into layers. You can find different kinds of animals in different layers. At the top of the kelp forest, many fish swim among the fronds. The top layer of a kelp forest, like that of a forest on land, is called the canopy. Marine mammals, young fish and seabirds spend time in this area. In the middle of the kelp forest, snails and other creatures crawl on the blades and stipe. At the bottom of the kelp forest, brittle stars, sea urchins and many other creatures live among the holdfast. The forest of underwater plants creates a physical barrier for the currents and waves passing through it. This in turn slows down the plankton drifting in the water, which helps to support a protected nursery and feeding area for young fish and invertebrates.

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GLOSSARY

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.
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.
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 arid 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.
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.
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.
NUTRIENTS	The raw materials necessary for continuing life processes.
OMNIVORE	An organism that eats both plant and animal material.
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.

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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.
SCAVENGER	An organism that is an opportunistic feeder; scavengers usually include dead and decaying animal flesh in their diets.
SPECIES	A population of plants or animals that are able to produce viable of with with each other and not with other species.
STIPE	The stem-like part of a kelp plant.
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.
VERTEBRATE	An animal with a backbone. The back bone can be made of bone or of cartilage like in some fish (sharks and rays).
WATER-VASCULAR	A system of canals, bulbs and appendages filled with sea water. This system is involved in locomotion in echinoderms.
ZOOPLANKTON	Animal plankton.

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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.

Activities/Curriculum links:

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

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

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.

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