

University of Southern California Sea Grant Program

Help with Kelp

I. What is kelp?

What's that waving back and forth in the ocean? It looks like a tree - a tree in the ocean?! No, it's kelp! Kelp is a type of marine algae, or seaweed. Seaweeds come in three different color varieties, red, green and brown. Kelp is a kind of brown seaweed that grows to be very large. Although kelp resembles a kind of weed or tree, it is quite different from plants that grow on land. First of all, kelp has no roots. Kelp does have a way to anchor itself to the bottom of the ocean floor, but this anchoring system, called the holdfast, does not take in nutrients like plant roots do. The other parts of the kelp also have different names. The "leaves" of a kelp plant are called blades and the "stem" is called the stipe. Another structure unique to kelp is the air bladder, which looks like a small balloon at the base of each blade. The stipe of the kelp is very flexible and cannot stand up on its own - the air bladders help the stipe and blades of the kelp float in the water, which allows the kelp plant to grow up toward the surface of the water, where the sunshine is brightest.

II. How does it grow?

Kelp is very good at growing - the giant kelp off the coast of California can grow up to 1 or 2 feet per day!! Like land plants, kelp uses energy from sunlight to make its own food. This process is called photosynthesis. Sunlight is captured by the plant and the energy particles in sunlight (photons) are used to drive a chemical reaction that produces sugar. This sugar is the food for the plant. In a land plant, usually only the leaves are capable of photosynthesis, but all parts of the kelp plant can photosynthesize. A kelp plant starts out as a single flat blade attached to the bottom and then grows into a mature plant. Giant kelp can grow to be over 150 feet long! Kelp sometimes grows in dense patches of many individual kelp plants - these dense patches are called kelp forests, because they resemble a forest of trees.



Photo courtesy of Chuck Kopczak



III. Who eats Kelp? Circle animals who might and check your answers!



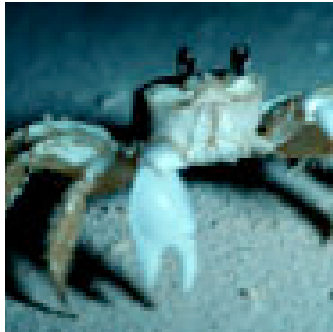
worms



snails



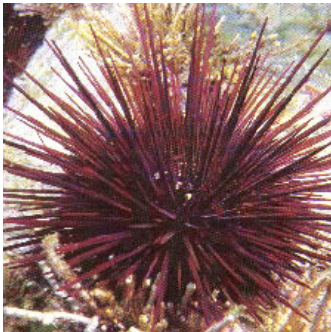
clams



crabs



lobsters



sea urchins



sea stars



fish



sharks



seals



sea lions



otters

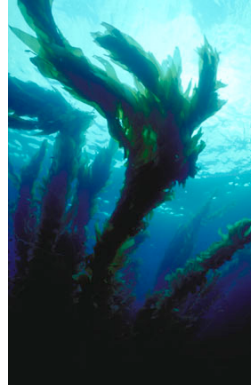
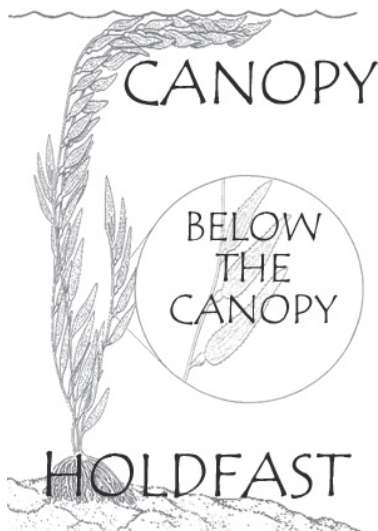


humans

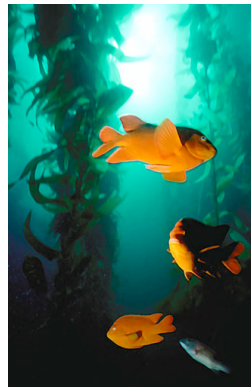
Worms No
snails Yes - Sea hares, Norris snails and abalone.
clams No
crabs Yes - Kelp crabs live on and eat kelp.
lobsters No
fish Yes - Fish like the halibut and the opaleye.
sea stars No
sharks No
seals No
sea lions No
otters No
humans Yes - Have you ever eaten ice cream, chocolate milk, apple pie or salad dressing? If so, then you have eaten kelp! Unlike other kinds of seaweed, like red algae, which are used directly as food, kelp is not usually eaten directly by humans. Instead, certain compounds are extracted from the kelp and then used in other foods. Algin is one of these compounds and is used to help make different ingredients stick together and form gooey gels.

IV. Living In The Forest

In addition to providing food for some organisms, kelp is an important habitat for many organisms. Can you guess which organisms might live in a kelp forest? Let's start from the top to the bottom. The structure of giant kelp (*Macrocystis*) affects which organisms live where. The blades and stipes of the kelp are handy homes or 'hanging out' places for other small species. A variety of fish live in the whole water column from the top to the bottom and are attracted to sections of the kelp where their favorite meal lives or spends time hanging out.



Canopy: Did you know there are nurseries in the kelp forest? There certainly are. The canopy of the kelp, the mass of blades and stipes at the top of the kelp that are seen on the surface of the ocean, can go down a meter or more below the surface. Since the canopy slows the water currents, this is the perfect spot for tiny organisms like floating (planktonic) eggs, larvae and very small organisms to gather. The organisms grow easily here due to the warmth and light and are protected from hungry predators by the thick kelp growth. The canopy is often called the nursery or brood area for 'nearshore' fishes and invertebrates. Small seniorita fish the tiny topsmelt like to dine in this area!



Below the canopy: Below the canopy the waters are filled with fish life! Surfperches may feed in a variety of places in the canopy, in the water between the plants or around the holdfasts (on the bottom). However, most fish prefer certain sections of the forest and are usually found in the area of the kelp forest that harbors their prey. Kelp bass find the middle of the kelp forest to be a good hunting area, while Sheephead, a boldly colored fish, like to feed on the larger invertebrates that live among the kelp stipes and tend to hang out towards the bottom of the kelp forest. A variety of species of rockfishes feed on other fishes near the bottom, as well as on invertebrates.



Holdfast and rocky bottom dwellers: More little creatures live down here! It's the spot where a variety of attached (non-moving) invertebrates (animals without a backbone) live: Sponges, sea anemones, sea squirts, and barnacles. Among these attached animals, motile or moving animals can be found...by the millions! Brittle stars, snails, and small crustaceans are abundant. The large amount of plant material attracts plant-eaters (herbivores) like sea urchins, sea hares and abalones. Sea stars, such as sea bats and sunflower stars, also are found in the kelp bed, often eating sea urchins, other sea stars and many other invertebrates. Many organisms actually live inside the kelp plant! Many small animals, and certain types of algae, make the kelp holdfast their home. The inside of the holdfast provides protection from predators and from strong ocean currents. Animals that you might find in a holdfast include worms, baby sea urchins, snails, brittle stars, tiny crustaceans, and maybe even mussels or barnacles. During storms, kelp plants may be ripped up from the bottom and be washed ashore onto the beach. The tiny organisms that live in the holdfast will also be transported onto the beach, or they may fall off and land in a another habitat.

And..Some animals like sea otters and sea lions hunt through all areas of the kelp. Sea lions consume vast quantities of fish, and find all areas of the kelp forest to be an abundant "fish market." They find good shopping there! The sea otter, however, may spend almost its entire life in the kelp bed. While they also eat fish, their favorite meals are two invertebrates: abalone and sea urchins. If the population of sea otters gets too low, the number of sea urchins can easily increase; sea urchins eat kelp. Scientists have found that in Southern California kelp beds that were once inhabited by sea otters have gradually disappeared. Without their natural predators, sea urchins increased in number and moved through the kelp in an "urchin front," eating all the plants in their path. Even when the kelp beds were gone, young kelp plants could not get started due to the hungry urchins. So, the sea otter plays an important role in the health of the kelp forest habitat!

VI. Fun with Kelp!

Recipes

Seaweed Sweets

Did you know that you probably eat a bit of the ocean every time you eat some of your favorite foods? A substance called algin is found in the cell walls of the kelp plant. Algin makes the kelp plant flexible enough to withstand the pressure of the ocean's movement. When it is processed, algin can be used to thicken, gel, and stabilize. For this reason, alginates are used in making pudding, ice cream, salad dressing and non-food items like shampoo, paint, toothpaste, and fertilizer.

Make a batch of these delicious kelp cookies* to share with a friend.

You will need:

- 1 c. margarine (2 sticks)
- 1 t. almond flavoring
- 1 c. white sugar
- 1 t baking soda
- 1 c brown sugar
- 1 t. salt
- 2 eggs
- 1 t powdered kelp**
- 3 c. flour
- 1 t. vanilla
- 2 large mixing bowls & spoons
- measuring spoons
- baking sheets
- stove
- hot pads
- wire cooling racks

Follow these steps:

1. In a large mixing bowl, combine the margarine, sugar, eggs, vanilla, and almond flavoring. Blend well.
2. Combine the flour, kelp, salt, and baking soda in another bowl. Combine the ingredients in the two bowls and mix well.
3. Drop the dough by teaspoonfuls onto greased baking sheets. Bake at 400 for 8 minutes. Lift the cookies off the baking sheets onto wire cooling racks. When cool, store in an airtight container. The cookies will be chewy, and will stay fresh for several days.

* Recipe by Ernie Mae Campodonico of Nipomo, California.

** Available at natural food stores.

Hand-Rolled Sushi

Sheets of nori cut in half lengthwise
2 c. cooked rice, cooled to room temperature
1 T. rice vinegar
1 medium carrot, peeled and cut into 3- to 4-in pieces
1 medium cucumber, peeled and cut into 3- to 4-in pieces
1/2 c. soy sauce

1. Slice the carrot and cucumber pieces into narrow strips.
2. Add rice vinegar to cooked rice, stirring thoroughly.
3. Take a sheet of nori in the palm of your hand and spoon a heaping teaspoon of rice onto its center and add carrots and cucumbers.
4. Wrap nori around rice and vegetables to make a roll.
5. Dip sushi roll in soy sauce.

Laver Soup

1 c. dehydrated nori
2 c. water
one 10 1/2-oz can beef consommé
juice of 1/2 lemon (or less, to taste)

1. Tear dried nori into pieces.
2. Simmer in water until soft.
3. Bring the water to a boil, then add the consommé and lemon juice. Heat just to boiling.
4. Add a twist of lemon peel in each serving bowl.
5. Serve with crackers or toast.

Pressing

The study of marine plants, or seaweeds, attracts students and professional biologists alike. The larger plants of the sea are almost exclusively members of a diversified assemblage known as algae, and their study is known as algology. Some scientists are interested in their physiology (life processes), others work on ecology, distribution reproductive activities. Basic to much of this is the field of taxonomy, or identification and categorization of the many species. All of the other study areas rely on taxonomists to identify the plants upon which they do their observations or experiments.

In order to prepare the plants for examination and identification, there are several standard processes and procedures which must be followed. These methods are similar to those used by professional collectors. The plants are collected, preserved, mounted on special paper and dried. Then they are catalogued for future reference and identification. By using these methods, you may wish to begin a small personal collection, or merely to press some plants for framing or for greeting cards.

Collection and Preservation:

The greatest abundance of marine algae is found in the relatively shallow, sunlit nearshore waters (40 feet or less). They can be observed and collected using scuba or by snorkeling. A number of the more resistant species are in the large piles of seaweed found on the beach after a storm.

Once collected, the plant material may either be mounted and pressed while fresh (almost immediately), or preserved and kept in a suitable container, away from the light, for longer periods of time. The fresh material may retain slightly more color than the preserved, but drying will take longer. It is best to collect specimens in a plastic bag, then transfer them to a container of seawater and formaldehyde mixed in a 19:1 ratio. Small amounts of formaldehyde may be obtained at a drugstore, while large quantities can be ordered from a biological or chemical supply house. If specimens are to be kept some time before mounting, storage is best in a tightly closed metal can or in a glass jar, in the liquid, away from light.

Mounting and Drying

Mounting is easy, but also requires some special materials. The specimens are floated onto a special high quality, acid-free rag paper (herbarium paper) then pressed and dried in a plant press or by using weighted plywood. The addresses of suppliers are listed at the end of this activity.

Materials you will need:

several specimens of fresh marine algae
shallow baking pan or plastic painter's drip tray or broad enamel pan
thin piece of masonite cut to fit the pan
heavy white mounting paper--high quality acid-free paper is best (herbarium paper) *Scroll down to see suppliers addresses.
newspapers
clean fabric to cover masonite
corrugated cardboard
rope
two 12" X 20" pieces of plywood
seawater
bricks or rocks

waxed paper
white glue (optional)

Directions:

1. A small amount of tap water is placed in a painter's drip tray and a piece of herbarium paper is laid in the bottom.. (If using a baking pan, also place the masonite in the pan and the herbarium paper.)
2. A fresh or pickled plant is floated in the water and allowed to settle down on the paper.
3. Place some sheets of newspaper on top of a piece of corrugated cardboard.
4. After it has been spread out and suitably arranged, the paper and plant are carefully slid out of the tray (and off the masonite, if it has been used), drained momentarily, and laid on the corrugated cardboard that has newspaper on top.
5. Waxed paper or clean fabric is placed over it, then another newspaper and top with cardboard, and then another paper with its specimen.
6. Place a piece of newspaper over the cloth and top with another piece of corrugated cardboard. You can stack several different specimens for mounting using this same layering procedure: cardboard, newspaper, mounting paper with specimen, newspaper, cardboard.
7. Place the finished stack between the two pieces of plywood. Tie together securely with rope and weight down with bricks or rocks. Place near a heater or a warm, open window. After 24 hours, change the cloth, newspapers, and cardboard.
8. After 48 hours remove the cloth. Change the newspapers and cardboard daily until the specimens are dry to the touch. Delicate plants will take about 48 hours to dry completely; coarse plants may take up to 5 days.
9. When the pressing is complete, the algae is usually stuck to the paper. If not, use white glue to fasten it permanently to the paper. Do some research about the specimens of algae. Label your specimens with the species name, place and date of collection, collector's name.
10. Stored flat in albums or in herbarium cabinets.

Suppliers:

Unissource West Inc., Carpenter/Offutt
Paper, Inc., Div.
Herbarium Dept.
927 Thomas Ave., SW
Renton, WA 98055-2931

Herbarium Supply
705 Bridger Dr, Unit D
Bozeman, MT 59715-2292
Tel: 800.348.2338
Tel: 406.994.0006
Fax: 406.994.9211
Email info@herbariumsupply.com
Website: <http://www.herbariumsupply.com>