Family Fun

# seaweed discovery lab

**Enduring Understanding:** Producers, such as seaweeds, serve as the foundation for ocean food webs and also provide vital habitat for marine organisms.

## Materials

- Edible seaweed—found at many supermarkets (optional)
- Microscope or magnifying glass (optional)
- Google a photo of seaweed cells under a microscope (attached)
- Photos of ice cream cone and sushi roll
- Tube of toothpaste
- Jar of peanut butter
- "Seaweed Discovery Lab" worksheet
- "National Marine Sanctuaries in California" handout (attached)

## Setup:

1. Print the "Seaweed Discovery Lab" worksheets.
2. Print the "National Marine Sanctuaries in California" handout.
3. Set up the stations.

- Station 1: Piece of edible seaweed in a dish (if you have a microscope or magnifying glass, place it by the dish); photo of magnified seaweed from the internet

- Station 2: Printed photos of the sun, giant kelp, sea urchins, sea otter, Turkish towel seaweed (demonstrating diversity of seaweeds in kelp forest), abalone, fish, shark, seabird, seal, and bacteria (in random order)

- Station 3: Computer or other multimedia device with Internet connection open to and ready to play http://www.pbs.org/kqed/oceanadventures/video/kelp (Jean-Michel Cousteau: Ocean Adventures: "Kelp Forest")

- Station 4: Photos of ice cream and sushi roll; tube of toothpaste; jar of peanut butter; small pieces of edible seaweed (on napkin, plate, or other sanitary surface)

- Station 5: Several copies of the "National Marine Sanctuaries in California" handout

## Materials continued

- Writing materials
- Printed photos of the sun, giant kelp, sea urchins, sea otter, Turkish towel seaweed, abalone, fish, shark, seabird, seal, and bacteria (attached)
- Set of printed arrows (attached)
- Computer or other multimedia device with Internet access, with viewing screen and speakers (optional) (See below.)
- Video clip Jean-Michel Cousteau: Ocean Adventures: "Kelp," available for streaming on PBS website; read the PBS Customer Service notes on limited public performance rights; (Alternate activity: read the attached "An Ecosystem out of Balance" information sheet.)

## Program outline:

### Introduction to the Seaweed Discovery Lab

- Give everyone a copy of the "Seaweed Discovery Lab" worksheet and pencils.
- Spend 10 to 15 minutes at each station and answer the questions together.
- You could spread this over multiple days if you want to

### Seaweed Discovery Lab Stations

- Station 1: Seaweed Up Close
  - Discover what seaweed tissue looks like up close through (1) using a device such as a microscope or magnifying glass or (2) looking at a photo of magnified seaweed or (3) both of these options and you specify which one you want them to draw.
  - Students use the knowledge they gained from your oral explanation and write in their own words that seaweed converts energy from the sun into food and oxygen in the process known as photosynthesis.
- Station 2: Build a Kelp Ecosystem
  - Students take the series of photos and place them in proper order to represent the flow of energy in a food web. Students draw arrows between the photos to show the direction in which energy is transferred.
- Station 3: An Ecosystem out of Balance
  - Students view multimedia to explore a kelp forest ecosystem and what happens when a predator/prey balance is upset. (Alternate activity: Students will read about the history of the sea otter fur trade and how it impacted local kelp forest ecosystems.)
- Station 4: People and Seaweed
  - Students write down which of the products pictured contain some amount of seaweed (answer: all of them do). They try some edible seaweed, describing how it smells, feels, and tastes and guessing how it might provide nutrition for people consuming it.

## Program outline continued:

- Station 5: National Marine Sanctuaries in California
  - Students read about the threats facing California's kelp forests and how National Marine Sanctuaries help protect these important habitats.

# Background information:

Seaweeds are multicellular algae that are separated into three classifications: red, brown, and green. They are not actually plants, although they do share many characteristics with them. They are not grouped with true plants because they lack a specialized vascular system, roots, stems, leaves, and enclosed reproductive structures (flowers, cones, etc.). They do not need an internal conducting system because all parts of the seaweed are in constant contact with the surrounding water and are thus able to absorb nutrients and carbon dioxide. Terrestrial plants absorb nutrients and water from soil through their roots, and the nutrients and water are carried throughout the plant by specialized vascular tissue. Both plants and seaweeds get most of the materials they need for growth from carbon dioxide and photosynthesis.

## Habitat

Seaweeds are typically found in the shallow, rocky intertidal and subtidal zones, where they are able to photosynthesize. Sunlight is captured by chlorophyll and other light-absorbing pigments within their cells, which are responsible for the various colors of seaweeds. Photosynthesis is a biochemical process that uses water, carbon dioxide, and sunlight to produce sugars and oxygen. The sugars are used for food and the oxygen is released into the water.

## Role in the Food Web and Human Consumption

Just as vascular plants produce energy at the base of the terrestrial food web, seaweeds are the producers for the ocean food web. Seaweeds are a major food source for numerous invertebrates and fish. Some types of seaweeds are consumed by humans. Edible seaweed is rich in vitamins, iodine, calcium, potassium, and antioxidants. People use seaweed derivatives, such as alginates from brown algae, carrageenan from red algae, and beta carotene from green algae, as stabilizers, thickeners, and colorants. These derivatives play an important role in the manufacturing of food and other products.

## Kelp Forests

Seaweeds can form extensive ecosystems known as kelp forests, which serve as important habitat, shelter, and food for a diversity of marine organisms. Each organism—whether producer or consumer—plays a vital role within a kelp ecosystem. If a species were to diminish or completely disappear from this ecosystem due to disease or human activities, it can greatly impact the balance of the entire system.

## National Marine Sanctuaries

National Marine Sanctuaries are federally designated areas within U.S. waters that protect areas of the marine or Great Lakes environments that have special conservation, recreational, ecological, historical, cultural, archeological, scientific, educational, or aesthetic qualities. There are 14 such protected areas: 13 National Marine Sanctuaries and one National Monument. Sanctuary education programs teach the public about stewardship and helping to protect the environment. Community advisory groups provide input, and nonprofit partners help build support for effective ocean management.

## glossary:

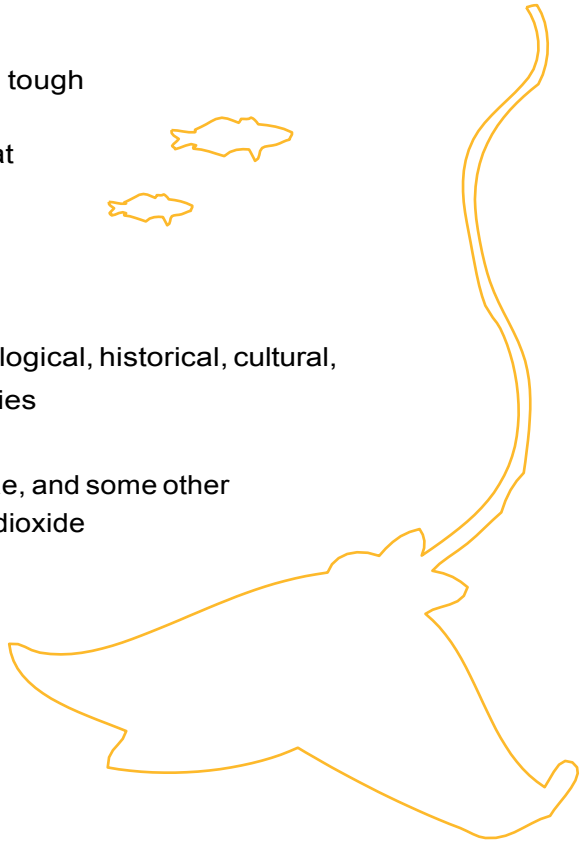
**Algae:** Any of numerous groups of photosynthetic aquatic organisms that range from single-celled forms to multicellular forms more than 100 feet long; distinguished from plants by the absence of true roots, stems, leaves, and vascular tissue

**Climate Change:** Change in global or regional climate patterns attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels

**Ecosystem:** Biological community of interacting organisms and their physical environment

**Seaweeds:** Macroscopic, multicellular, benthic algae that grow beneath the high-tide mark

**Kelp:** Large brown seaweeds that typically have a long, tough stalk with a broad frond divided into strips; some kinds grow to be very large and form underwater "forests" that support a large population of animals.



**National Marine Sanctuary:** Federally designated area within U.S. waters that protects areas of the marine environment with special conservation, recreational, ecological, historical, cultural, archeological, scientific, educational, or aesthetic qualities

**Photosynthesis:** Process by which green plants, algae, and some other organisms use sunlight to synthesize foods from carbon dioxide and water

**Rocky Intertidal Zone:** Rocky shores that lie at the edge of the ocean and land between high tide and low tide that support a tremendous amount of biodiversity

**Turkish Towel:** Type of red algae with large, broad blades with a towel-like appearance and texture; grows in low intertidal zone; found along the Pacific coast from Alaska to Mexico

Name:_____

Date: _____

# Seaweed Discovery Lab

## Station 1: Seaweed Up Close

Examine the magnified seaweed tissue and draw what you see.

What are the structures you are looking at? Why are they green?

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_____

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How does seaweed make its own food? What is the name for this process? (Hint: It's the same process that grass and trees use to make food!)

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Name:_____

Date: _____



## Station 2: Build a Kelp Ecosystem

What is an ecosystem?

Place the photos in the correct order of what consumes what. Draw an arrow showing the transfer of energy. The arrows should point in the direction of the flow of energy. For example, an arrow would point toward a plant and away from the sun, toward a deer and away from grass. (Hint: One picture can have more than one arrow pointing toward or away from it.)

Describe what you've created. How does energy flow through this system? Where does the energy come from to begin with? Where does it end?

Take away the photo of the giant kelp. What happens to the animals in the ecosystem if the kelp disappears?

Other than food, what do seaweeds provide for animals in an ecosystem?

Name:_____

Date: _____



## Station 3: Kelp Forests out of Balance

How much can kelp grow in one day?

What is the difference between a producer and a consumer? What is one example of each?

What happens when sea otters disappear from a kelp forest ecosystem?

Why is it important for a kelp forest ecosystem to stay balanced?

Name:_____

Date: _____

## Seaweed Discovery Lab continued

### Station 4: People and Seaweed

Look at these photos. Which items contain seaweed?

Why do you think they contain seaweed?

Pick up a piece of the edible seaweed. How does it smell? How does it feel?

Taste one small piece of seaweed. What does it taste like? Why do people eat seaweed? Does it have any nutrients that we benefit from?

Name:_____

Date: _____

## Seaweed Discovery Lab continued

### Station 5: National Marine Sanctuaries in California

After reading about the threats facing California's kelp forests, fill in the table below with the threats and possible solutions to help protect them.

| Threats to Kelp Forests | Solutions to Protect Kelp Forests |
| --- | --- |
| | |

Why is it so important to have protected places like National Marine Sanctuaries in our oceans?

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Name:_____

Date: _____

## Seaweed Discovery Lab continued

### National Marine Sanctuaries in California

The California coastline is home to some of the greatest biodiversity in the world. Much of this life is found within our kelp forests. Unfortunately, kelp forests face many threats. Many of these threats come from humans.

- People harvest seaweed from the ocean. They use it to use to make food and many other products, such as frozen foods, cakes, puddings, shampoos, toothpastes, and salad dressings. Without rules for harvesting, people could take too much seaweed. This wouldn't leave enough seaweed for animals to use for food and habitat.
- Pollution is a major threat to kelp forests.
  - Runoff is water that moves from the land to the ocean, usually from rainfall. It can carry pesticides, herbicides, and fertilizers that are used to control pests on crops. These are toxic to both animals and seaweeds!
  - Sewage and pollution from cities can harm seaweeds and the animals that live in the ocean. This can upset the balance of ecosystems.
- Sometimes fish, invertebrates, and even seaweeds from other countries or regions are accidentally brought to the California coast. These are called invasive species. They compete with our native species for food and habitat. They can upset the balance of our ecosystems.
- Big storms create strong winds that cause lots of water to move in the form of waves and currents. This water movement can break apart kelp forests. Scientists believe that climate change is causing bigger and stronger storms to occur more often.
- Overfishing can hurt kelp forest communities. Taking too many fish from one part of the ocean upsets the balance of predators and prey. This harms the health of the whole ecosystem.

Fortunately, we have ways to protect our kelp forests! The National Marine Sanctuaries were established to help protect the special places in America's oceans and Great Lakes. There are only 14 of these protected areas. Four of them are found in California. Our four National Marine Sanctuaries are Cordell Bank, Monterey Bay, Gulf of the Farallones, and Channel Islands. They help protect and restore our beautiful coastline.

Scientists monitor the ecosystems within our sanctuaries. They gather data about ocean health and how the kelp forest communities are doing. This allows them to see and respond quickly to any problems. The sanctuaries have rules and laws that help protect them against pollution, overfishing, and harvesting. Scientists and volunteers help clean up pollution on beaches and remove invasive species. All of the sanctuaries have educators who teach people about climate change and other threats facing kelp forests.

Name:_____

Date: _____

## Seaweed Discovery Lab continued

### An Ecosystem out of Balance

Kelp is a type of seaweed that can grow more than one foot in length per day. It forms immense underwater forests where many animals take shelter and find food. These kelp forests are intricate ecosystems. Every organism in them has a role to play, whether as a producer (like seaweed) or consumer. If even one part of this delicate balance is disrupted, the health of the entire ecosystem is threatened.

The California coastline is home to many large kelp forests. In Monterey Bay there is a small population of southern sea otters. These marine mammals live in kelp forests. Sea otters are top predators. They feed on invertebrates—animals without a backbone—such as clams, oysters, mussels, crabs, sea stars, and sea urchins. In a healthy kelp forest, sea urchins consume pieces of kelp that fall to the sea floor. They are herbivores.

During the 19th century, this important balance among kelp, sea otters, and sea urchins was upset. Fur traders hunted sea otters for their luxurious fur. With up to one million hairs per square inch, sea otter fur was prized for its softness and warmth. (By comparison, a human head has only 100,000 hairs!) The fur hunters nearly wiped out all of the sea otters.

The disappearance of sea otters had a devastating effect on the kelp forest ecosystem. Since the sea otters weren't there to eat the sea urchins, the sea urchin population grew unchecked. They began eating kelp faster than it could grow back. Eventually, some ecosystems had no more kelp. This meant that there was no more food or habitat for the sea urchins—or any other animals.

By 1911, a conservation movement formed to protect sea otters. Since then the balance has slowly been restored. The population of sea otters has increased. As the otters ate more sea urchins, they controlled the sea urchin population. In turn, the kelp forests began to grow healthy once more.