
SEAWEED SMORGASBORD

FOR THE TEACHER

Discipline

Human Interaction

Theme

Cultural Use and Values

Key Concept

People Around The World Depend On Seaweed For Many Important Everyday Uses

Synopsis

Students learn about seaweed and its uses around the world. They taste and rate their preference for a variety of foods containing seaweed or seaweed derivatives.

Science Process Skills

observing, communicating, comparing, organizing, categorizing, relating, inferring.

Social Skills

sharing and attentive listening

Vocabulary

agar, algae, algae derivative, blade, carrageenan, emulsifier, floats, holdfast, processed foods, stipe

MATERIALS

Into the Activity

- magazines with pictures of a variety of foods
- tag board for collages
- glue

Two Posters:

- Advanced Organizer
- Anticipatory Chart (samples, see INTO) **OR**

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- Chart headings and paper for sentence strips

Through the Activity

As Available:

- drift kelp found along a sandy beach (don't remove anything from a reserve or protected area) OR
- seaweed samples purchased from Carolina Biological Supply (800) 334-5551 or Wards Biology Catalog (800) 462-2660 or borrowed from the MARE library.
- algin and calcium chloride samples. Contact food processors or algae harvesters to request raw seaweed derivatives and information. (*KELCO, 1372 Cornwall Ct., Walnut Creek, CA 94596 (415)943-7510; FMC Marine Colloids, 367 Civic Dr., Suite 7, Pleasant Hill, CA 94523, (800)346-5101.*)
- visuals of seaweed (books, videos, slides and/or pictures)
- butcher, poster or flip chart paper
- spoons (*1 per student*)
- small tasting cups &/or plates (*1 per student*)
- food samples containing seaweed for tasting (*see chart below*)
- food samples containing no seaweed for tasting (some choices might be vegetables, fruit, chips or crackers for dipping)
- copy of Data Sheet I with each tasting item listed by number (*1 per student*)

OR

- copy of Data Sheet II for each tasting item **OR**
- small cups (*3 per tasting item*) and beans or other markers (*each student needs 1 per tasting item*)
- empty packages or samples of food and non-food items containing seaweed for display
- flip charts or butcher paper for bar graphs

Beyond the Activity

cookbooks and reference books on seaweed and mariculture

examples of food for smorgasbord:

Instant Breakfast

yogurt (Continental & Yoplait)

Hershey's Chocolate Milk Mix

Nestle's Quick Powder

ice cream (Dreyer's)

eggnog

Chip 'N Dale Rescue Rangers Fudge Bars

Nestle's Crunch Ice Cream Bars or Nuggets

Dole Fruit and Cream Bars

Sunny Delight fruit juice

Carnation evaporated milk

Tofutti

soy milk (Vitasoy creamy orig.)

Lucerne non-fat cottage cheese
agar or agar pudding
Hain's pudding mixes
Royal Real No-Bake Cheesecake
Jell-O Flan
Sara Lee Cheesecake
pie and bakery fillings and glaze on doughnuts
Hostess Cup Cakes and Fruit Pies
Danish Pastries (store-bought)
Horchata
Slim Fast (canned drink)
roasted seaweed (Ajitsuke Nori or Temaki Yaki Nori)
sushi
seaweed ramen soup
Shiro Miso Soup
seaweed flavored salt
Sea Seasonings Nori Granules
kelp or seaweed crackers
seaweed candy
low/no oil bottled salad dressing (Kraft Creamy Cucumber)
Aqua-fresh, Tom's and Ultra Brite toothpastes
Hidden Valley Party Dip (dry)
Lucerne Clam Dip
Velveeta Cheese
Kraft Shells and Cheese
Similac baby formula
Entenmann's Cakes

INTRODUCTION

People living by the sea have used seaweed for thousands of years. Historically, seaweed was only used whole, usually by boiling it in water or milk and combining it with other ingredients such as meat or sugar. Vikings and Celts even chewed on Irish Moss in their travels. In modern Japan, seaweeds are such an important part of the diet that mariculture sea farms are needed to keep up with the demand. Seaweed or sea vegetables as they are sometimes called can be eaten directly, either fresh or dried or made into pickles or candy.

With the advent of modern food technology, more sophisticated foods were made. A simple mix of ingredients often had too short a "shelf life", and would end up separating like oil and water or settling, such as cocoa in chocolate milk or spices in salad dressings. The need for an ingredient to stabilize, thicken and give the right "mouth-feel" to processed food became ever more important as food became more complicated.

There are three main types of algae or seaweed derivatives used in the food industry as emulsifiers, gelling agents and stabilizers. These derivatives are agar, carrageenan and alginate. These ingredients are found listed on the packages of processed or dairy foods. The list below includes examples of products that can commonly be found in grocery stores which contain these seaweed derivatives.

AGAR is a gelling agent found in the red seaweeds, including agarweed (Gelidium robustum) a species of very slender seaweed (Gracilaria), and feather branch seaweed (Pterocladia) and has been known to commerce since 1870. Agar is most important for bacteriological work as a substrate for growing samples of disease organisms. It is also used in canning fish, thickening ice cream and cream cheese and for making jams. It is used in Japan as a sweetened or flavored gel and is an important part of the Japanese diet. Japan is the largest producer and exporter of agar. South Korea is next and the remainder is produced in various parts of the world, from Norway to Australia.

CARRAGEENAN is a stabilizer produced from the red seaweeds, including turkish towel (Gigartina), iridescent seaweed (Iridaea cordata), and the east coast Irish moss (Chondrus crispus). It is used to make thick and creamy dairy products such as ice creams, sherbets, chocolate milks and whipped creams. It is used in a variety of syrups and toppings and is responsible for the foam on beer. In creamed soups and chowders carrageenan is used to get the right "mouth-feel" and body. It is also used in a variety of health food products. A major source of carrageenan comes from the algae, Irish moss, which is found extensively on rocky seashores off the coasts of Ireland, France, Portugal and the United States. It is scraped from the rocks with special long handled rakes by fishermen in small boats.

ALGINATES are obtained from the large brown algae or kelp, Macrocystis pyrifera, also called the giant kelp. Boats harvest these plants annually from dense beds growing along the southern California coast and also along the Norwegian coast. Alginates are used for thickening, gelling, emulsifying and stabilizing many different types of food products such as puddings, milk shake powders, dietetic salad dressings, icing, bakery gels, tomato sauces, gravies, frozen foods, etc.. This derivative can often be found on ingredient lists as sodium or calcium alginate or algin.

SEA VEGETABLES are often eaten directly as food and may be found in health food stores or Asian markets labeled as Nori (from Porphyra), Hijiki, Wakame, Ogo (from Gracilaria) or Kombu (from Laminaria). Many types of sushi are wrapped in seaweed and seaweeds are used in soups, stir-fries and salads.

INTO
THE ACTIVITIES
PARTNER PARADE

(see description in Teaching Strategies)

1. What is your favorite food? Why?
2. Does everyone in your family like this food? What do other members of your family like to eat?
3. What was the last new food you tried? Did you like it or not? Why?
4. Do you have any friends from different countries or who have parents that came from a different country? Which countries?
5. Think about the last time you ate lunch with that friend or ate dinner at that friend's house. Did they serve foods that were different than what you are used to eating? Did you like the food?
6. Have you ever eaten seaweed? If so, was it raw or cooked or mixed with some other food? How did you like it?

Magazine Collages

Give students magazines with pictures of food in them and a set amount of time to cut out pictures of food. Ask them to group some of their pictures according to which food items seem to go together using any categories they wish. Some ideas for category names might be: time of day eaten (breakfast, lunch, dinner); main course or dessert; sweet or bitter; meat, dairy, vegetable, etc.; favorite/least favorite foods; and culture or country of origin.

Give students tag board and ask them to glue their pictures into a food collage. Have them share their collages with others in the class and see if their classmates can guess the category represented in each.

Advanced Organizer

1. Brainstorm a list of everyone's' favorite foods on a piece of paper or an overhead projector.
2. Have students vote on the ones they think have seaweed in them. Complete the AFTER column once they've done the food sampling in the **Through** activity. (You may have to do some investigating to find out about some, but use the list to help guide you.)

LIST OF OUR

FAVORITE FOODS

example

BEFORE

AFTER

1 pizza

2 ice cream

WHICH ONES DO WE THINK HAVE

SEAWEED IN THEM?

Anticipatory Chart

Write the word SEAWEED on the board. Students in groups of four brainstorm as many words as they can come up with that describe everything that they know about the characteristics of seaweeds (e.g., pliable, slimy, strong, can dry out, and etc.). Have cooperative groups fill out the first two columns of the following chart and present their results to the class. Post their chart on the wall. At the completion of the activity have the students fill in the last column. Also, allow them to change any of their previous entries based on the new information they have discovered. As an alternative you can have students write sentence strips about what they already know and want to find out about seaweed and post them below the appropriate Anticipatory Chart heading.

WHAT I ALREADY KNOW ABOUT SEAWEED

WHAT I WANT TO FIND OUT ABOUT SEAWEED

WHAT I LEARNED ABOUT SEAWEED

Portfolio Assessment

Participation in Tea Party, Magazine Collages, Advanced Organizer and Anticipatory Chart or Sentence Strips

THROUGH THE ACTIVITIES

Images of Seaweed

Show an ocean images videotape or slide show or pictures in books depicting different types of living seaweed. The videos, "Forests of the Sea", "Ocean Realm", and NOVA'S "Kelp Forest", are excellent. Rather than use the narration on the videos have students sit in pairs and count, sketch or describe as many different seaweeds as possible in each of the images. Have a class discussion on what the various seaweeds look like and how they seem the same or different than plants you might see on land.

Nothing like the real thing

If possible bring in seaweed samples from the beach to look at and touch. Compare textures, slippery nature, appearance, size, thickness, and color. If no real seaweed samples are available you can order samples from Carolina Biological Supply, or Wards Biology Catalog, or borrow a set from the MARE library.

Seaweeds vs. Plants Poster Talk

Directions: Make a simple poster (see below) to illustrate the similarities and differences between seaweeds and land plants. Use the following background information to discuss the poster with your students.

Seaweeds vs. Plants

Seaweeds are marine algae big enough to see without a microscope. They are simple plants that have no roots, stems, leaves, flowers or adaptations

necessary for living on land. While land plants have roots for taking in water and nutrients from the soil, seaweeds live surrounded by water and nutrients. Instead of roots, seaweeds have a **holdfast** which simply anchors it to a rock or other surface. Similar to the stem of a land plant, seaweeds have a flexible, rubbery **stipe** that allows it to move freely in the water without breaking. But unlike the stems of most land plants, the stipe does not conduct water and nutrients to the rest of the plant. Certain large brown seaweeds called kelp develop floats or pneumatocysts (pronounced "new-mat-o- sists") on their stipes. These floats are filled with gas and provide the buoyancy needed to float the kelp canopy on the surface in the sunlit waters where photosynthesis can occur. The **blades** of seaweeds are leaf-like structures where most photosynthesis takes place.

LAND PLANTS	SEAWEEDES
leaves	blades
stem or trunk	stipe
roots	holdfast

Seaweed Ingredient Poster

(see "For The Teacher" for more information)

Directions: Make a simple poster (see seaweed ingredient poster below) that lists the three main seaweed types and the key words to look for when locating products containing seaweed. Use the background information below to discuss the poster with your students.

Seaweed Ingredients

Seaweed types are named generally for their color. The **red algae** (Rhodophyceae) are found nearly worldwide and are by far the most numerous of the algae types. The colors of the red algae come in a wide range from to reds to pink, purple and even yellowish! **Agar** and **carrageenan** are the words to look for when identifying products containing a red algae product. The next largest group of seaweeds are the **brown algae** (Phaeophyceae) which comes in colors ranging from golden brown to olive green. This group includes the giant kelp (Macrocystis pyrifera) found in the kelp forest habitat. Words like **alginates**, **algin**, **sodium alginate** and **calcium alginate** are all brown algae derivatives. The **green algae** (Chlorophyceae) are generally grassy green in color and are commonly found in shallow intertidal or bay waters. Green algae usually fall within the category of **sea vegetables**, or those algae eaten directly.

SEAWEED INGREDIENTS

Red Algae: Agar; used in making sweet gel, jams and jellies, canned fish, ice cream

Carrageenan; used in making chocolate milk, sherbet, whipped cream, syrups, toppings, creamed soup

Brown Algae: Alginates, algin, sodium alginate, calcium alginate; used in making puddings, salad dressings, icing, bakery gel fillings, tomato sauces, gravies, frozen foods

Green Algae: Sea Vegetables; when dried can be used in salads and as a seasoning

Note; Other red and brown seaweeds (**Nori, Hijiki, Wakame, Ogo, Kombu,** etc.) are used directly as sea vegetables for sushi, soups, salads, stir-fries, crackers, cookies

The Smorgasbord

Data Collection:

Prepare your data collection method. It can be done in a couple of different ways.

1) Data Sheet I-list each of the items to be tasted on one sheet. Provide each student with one copy.

OR

2) Data Sheet II-make a blank copy for each food item and tape it next to the item to be tasted.

3) Describe how to fill out the data sheets by checking the column which best describes how they felt about the food item. Also have them check the column to the right of those items they think contain seaweed.

NOTE: An alternative data collection method can be done using cups and beans.

1) Place three cups in front of each tasting item and mark one with a smiling face, one with a frowning face and one with a straight face. Use a fourth cup for items that students think contain seaweed.

2) Give each student a cup of beans or place a cup of beans in front of each food item. Each student should have enough beans to rate each food item by placing one bean in the cup with the face which best reflects how they felt about the food and another to indicate whether they think it contained seaweed or not.

Tasting:

1) Arrange the food items around the room. Include in your selection of food items some that do not contain seaweed derivatives.

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- 2) Place a name card with a number in front of each item. The number should correspond with the data sheet.
 - 3) Pass out spoons and tasting cups. Be sure to have serving utensils with each item so the students don't use their spoon to contaminate the sample.
 - 4) Tell the class that they get to taste many different food items and rate whether or not they like them. After they have tasted the item, have them note on the data sheet whether or not they liked it and did they think it contained seaweed or not.
 - 5) After all students have had a chance to taste the food items, collect the data sheets or cups and beans and have students complete the AFTER portion of the Advanced Organizer above. Graph the results of their taste test in a bar graph to show how the class rated the foods. Each cooperative group of 4 students can graph a few items.
 - 6) Now place the food packages next to the food items the students have tasted. Have cooperative groups travel around the smorgasbord again and use the packages to try and figure out which of the items contained seaweed and which did not. Have them look at the list of ingredients on the food packages to find out what kind of seaweed or seaweed derivative each food product contained. (Use the Seaweed Ingredient Poster to help). Have groups record their results and share them with the class.

Processed Foods

Processed foods are those foods with extra ingredients added to them. Manufacturers do this for a variety of reasons, usually to make the product more appealing or to give it a longer "shelf-life". We use seaweed in "processed" food because it makes food thicker and helps to keep ingredients mixed (emulsified). Also, especially in low or no fat foods, seaweed gives it the right texture and "mouth-feel".

Have volunteers mix algin with calcium chloride to make slimy algae "worms". This demonstrates how algae derivatives act as thickeners and keep food in suspension. This also explains why the algae derivative is often listed as calcium alginate. It is the combination of the algae and calcium which produces the results.

Group Demonstrations

Have students work in cooperative groups to complete one of the following activities comparing processed and unprocessed or "natural" foods. Have each group present their observations and results to the entire class. Each group could serve samples of their products and list observations and comments from the class. Have them explain why they think seaweed derivatives are sometimes used in each product.

Observe oil and vinegar salad dressing which has separated. Shake it up. Compare the oil and vinegar salad dressing to an oil free Italian salad dressing with carrageenan which needs no shaking.

Compare chocolate milk or fruit juice that has separated with some which has seaweed in it. Shake them up.

Make whipped cream from a carton of whipping cream and compare with canned or frozen whipped cream topping. Test what happens when the freshly whipped cream from the carton is put in the freezer and then allowed to come to room temperature.

Make fresh squeezed orange juice from whole oranges and let it sit in a refrigerator. Compare to a processed orange juice such as Sunny Delight.

Compare homemade ice cream or ice cream made without seaweed (e.g., Breyer's) to ice cream with seaweed (e.g., Dreyer's). The difference between the ice creams is especially obvious when they are allowed to melt. You might want to make "homemade" ice cream in your classroom and compare that as well.

Make yogurt in a yogurt maker or buy one with no additives. Compare to one containing a seaweed derivative. Also compare these to a yogurt containing another thickener such as guar gum, pectin or gelatin.

Seaweed Museum Display

Have students find food items on their shelves at home which contain seaweed (listed as carrageenan, agar or alginates) and then bring in the empty containers to make seaweed museum bulletin or display boards.

1. Categorize the items based on the type of food, what kind of seaweed derivative it contains and whether it is from brown, green or red algae.
2. Make graphs showing which derivative is most commonly used in each type of food.

Anticipatory Chart Completion

Have students complete the last column "What I Learned About Seaweed" of the Anticipatory Chart above. Have the groups review "What I Already Know" and "What I Want to Find Out" columns to make changes and determine if all their questions have been answered.

Portfolio Assessment

Participation in Smorgasbord data gathering and each activity; Photos of Seaweed Museum or Bulletin Board Displays; Completed Anticipatory Chart

BEYOND THE ACTIVITIES

Extended Activities/Group Projects

Each group works on a different project and then makes a presentation to the class.

- Take a poll of students (other classes or family members) to see if they think they have eaten or used algae this week. Graph the results. What are people's reactions when told they use seaweed regularly?
- Collect menus from restaurants of various ethnicity's and read them to the class (include a menu from a Japanese restaurant). Find dishes which contain seaweed. Compare how they use seaweed differently from one another. Show on the world map which countries are represented by the restaurants. Learn how to make sushi or another seaweed dish for the class to sample.
- Supermarket or (Home) Scavenger Hunt. Have parents help students find food items on their shelves at home which contain seaweed (listed as carrageenan, agar or alginates or as kelp, kombu, etc.). Students can also search supermarket shelves and write down items they found which contain seaweed. Have a contest to see who can find the most products with seaweed in them.
- Have students bring in empty packages of processed foods which don't contain seaweed. List the ingredients used in processed foods which seem to replace the seaweed derivatives. What is the difference between seaweed derivatives and other additives like BHA, BHT, and artificial coloring. Do you think one is "healthier" than another?
- Make a non-food seaweed product display. Have students bring in non-food products containing algae derivatives as follows:
SODIUM ALGINATE: shampoo, soap, cosmetics (lipstick, eye shadow), dye thickener, dental impressions (ask your dentist), paint
AGAR: dental impression molding material (ask your dentist), petri dishes or test tubes with agar-agar (ask a hospital or genetic research company or university).
- Investigate the life cycle of giant kelp.
- Look into how microscopic algae such as spirulina is grown and used for space food, health food, Third World food aid. Research mariculture of algae, explaining how algae is grown and harvested in various parts of the world. Discuss the costs of algae farming compared with growing grains and other land vegetables.

Student Posters

Have each group select one of the following topics or one of their own to discuss and to represent graphically on a poster. Have the groups share their posters with the class. Topics:

What are three ways that terrestrial forests are similar to underwater forests of kelp? How are they different from one another? What do terrestrial plants need to be successful? (water, sun, fertilizer or nutrients, protection from predators

and extreme weather) What parts of the plants serve each of these needs? What do marine plants need? What parts of the marine plants serve these needs?

In what ways does seaweed affect peoples lives? How might animals living in the kelp forest use or be affected by the seaweed?

Do you think it would be a good idea to grow and harvest algae like a crop? Do you think we would be able to feed other countries in need? Do you think they would like food from algae? What about the nutritional quality of seaweed? What do you think it means to eat low on the food chain? (Think of vegetarians). Do you think it could solve some of the problems of vanishing rain forests if people wouldn't clear them for more land crops? What are some problems that might occur in trying to grow crops in the sea?

Consequence Chart

Have students work in cooperative groups to complete a Consequence chart in which they detail consequences over time given the following scenario: What would be the **immediate, short term** and **long term** consequences to the health of the kelp and the kelp forest community including the invertebrates and the vertebrates (fish and mammals) if the water temperature off the northern California coast became very warm during Christmas time and stayed much warmer than usual all year long. (This tends to occur in El Nino years when the winds causing upwelling don't blow and currents reverse direction at the Equator). Remember that kelp needs very cold water to grow.

Field Trips

- Visit an aquarium with a tidepool or kelp forest exhibit and observe the animals living in these habitats. Wild California in the California Academy of Sciences, Golden Gate Park, San Francisco or Monterey Bay Aquarium have excellent exhibits.
- Visit the rocky seashore to see the tremendous variety and extensive carpet of algae or see the drift kelp on the sandy beach.
- Visit a marine lab (U.C. Santa Cruz or Bodega Marine Lab) where they are experimenting with growing algae.

Debriefing

- Have cooperative groups discuss what helped them accomplish their tasks successfully and what were roadblocks to their progress. Did attentive listening help?
- Have students make a class list with visual representations of "helpers" and "road blocks".