

Topics

Seaweed, Properties of Matter

Grades

3-5

Site

Indoors

Duration

45 minutes (minimum)

Materials

See page 3

Vocabulary

algae, emulsifier, extract, mixture

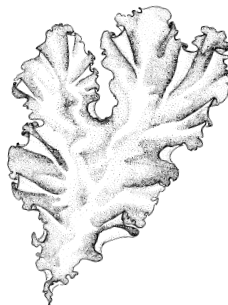
National Science Education Standards

Physical Science (K-4)
Properties of objects and materials

Physical Science (5-8)

Properties and changes of properties in matter

Edible Algae



Overview

What is seaweed? Why is it in ice cream? Students find out by exploring the characteristics of seaweed and making seaweed extract. They then make ice cream with and without the extract to find out why seaweed is added to so many foods and personal products.

Objectives

Students will be able to:

- Compare and sort various seaweeds.
- Understand that properties of substances can change when they are mixed, cooled or heated.
- Describe the importance of seaweed and why it is used in food and household products.

Background

Kelp and other seaweeds not only provide habitat for ocean animals but are also used in many foods and household products. Some toothpastes, sauces, medicines and cosmetics contain seaweed **extracts**.

Seaweeds are types of large multicellular **algae** that occur in the ocean. Algae are simple chlorophyll-containing organisms. Sometimes algae are called plants; sometimes they are called protists or protoctists. Algae range from microscopic one-celled diatoms to the large, multicellular seaweeds. Unlike plants, algae do not have true roots, stems and leaves. However, like plants, algae are producers that use the sun's energy and the pigment chlorophyll to convert water and carbon dioxide into sugars and oxygen through the process of photosynthesis.

Seaweeds play a very important role in an ecosystem. As primary producers, they create oxygen and are the first link in almost all aquatic food webs. Seaweeds also provide important habitat for many plant and animal species. For example, kelp forest seaweeds provide a three-dimensional living space where species may find food and protection from rough open water waves and predators. Even seaweeds pulled loose during storms may end up on the beach or in the deep sea providing important habitat and food sources for beach-dwelling and deep sea animals.



VOCABULARY

Algae: mostly aquatic plants or plant-like organisms

Emulsifier: an agent that stabilizes or thickens a mixture

Extract: concentrated preparation of essential parts of a substance

Mixture: a physical combination of two or more kinds of matter



Seaweeds are an important part of the human food web, too. Some are eaten in soups or used for sushi wraps. Alginates, agar, carrageenan and beta carotene are extracted from different seaweeds and used in a variety of products. In a **mixture**, these extracts often act as thickeners and help hold ingredients together. For example, without seaweed extract or another **emulsifier**, ice cream would be coarse and icy.

Seaweeds are found in three phyla described by predominant color:

- **Red Algae (Rhodophyta)**

There are 6000 known species of red algae. Red algae are red or pink, but can also appear purple, yellow, green or brown. *Porphyra* is a seaweed used in sushi. *Botryocladia* (red sea grape) and *Gigartina* (Turkish towel) are often seen in tide pools.

Human uses: Gels such as agar and carrageenan are extracted from red algae. Agar is used in foods and in microbiology. Carrageenan is used as an emulsifier in ice cream and other dairy products, cosmetics, toothpaste and medicines.

- **Brown Algae (Phaeophyta)**

There are 1800 species of brown algae. Most all are marine. Brown algae include the intertidal rockweeds and the kelps. *Fucus* and *Pelvetia* are rockweeds. *Macrocystis* is giant kelp. *Nereocystis* is bull kelp and *Egregia* is the feather boa kelp.

Human uses: Alginates are extracted from brown algae for use as highly efficient thickening, stabilizing, suspending and gelling agents. Alginates are used to bind oily and watery fluids together and to suspend particles in mixtures. These gels are used in desserts, dairy products, canned and frozen foods, salad dressings, toothpaste, paint, livestock and poultry feed, cosmetics, building materials, fertilizers and beer foam. Dried seaweeds are also used to add delicious flavor to soups!

- **Green Algae (Chlorophyta)**

There are 8000 known species of green algae which are found both in water and on land. Many green algae are bright green. *Ulva* (green sea lettuce), *Codium* (dead-man's fingers) and *Cladophora* (which looks like fine green hair) can be found in tide pools.

Human uses: Green algae like *Ulva* (green sea lettuce) is often eaten whole in salads and soups.

Materials

For the class:

- various products containing carrageenan, agar and alginates
- samples of seaweeds from Asian foods section of a grocery store
- hot/boiling water in a pan/bowl
- newspaper to cover stations
- measuring cups and spoons
- plastic spoons for tasting
- permanent markers for labeling
- rulers
- a strainer
- freezer or ice chest
- images of seaweed in natural habitat (optional)

For each lab group:

- notebooks or copies of Edible Algae data sheets
- hand lenses
- 1 finger-sized piece of red seaweed such as nori (*Porphyra*) in a small zipper plastic bag
- 1 cup whole milk
- 4 tablespoons of sugar
- 1/2 teaspoon cocoa powder (not mix)
- 1/4 teaspoon vanilla (optional)
- 2 clear plastic cups
- 2 quart-sized plastic bags with zippers
- small wire whisk or plastic spoon
- measuring cup and 3 spoons

Teacher Preparation

1. Make copies of the three **Edible Algae** data sheets for each student group or ensure students have science notebooks to use instead. Gather a few seaweed images (see *Resources* for possibilities) or from ocean-themed magazines and calendars.
2. Place a two-inch square piece of red seaweed, such as nori (*Porphyra*), into a small, zippered plastic bag for each student group.
3. Use the enclosed recipe to make a trial batch of ice cream so as to better troubleshoot or prevent problems when students try it.
4. Gather the materials to create three seaweed stations. You may choose to have students visit each station or provide station materials for each student group.
 - *Seaweed Exploration Station:* Provide hand lenses and a variety of seaweeds for students to touch, smell and illustrate. You may provide seaweeds for them to eat, too. Look in the Asian foods section of the grocery store to find different seaweeds used in cooking.
 - *"Kelp in your Cupboard" Station:* Find products at home containing seaweed extracts (carrageenan, agar or alginates) to bring into class. You may want to buy a few additional products to add variety. Shampoos, ice creams, toothpastes, cake mixes, fruit snacks, cosmetics and medicines may all contain seaweed.
 - *Seaweed Extract and Cooking Station:* Bring in a hot plate or electric kettle to provide hot and boiling water. Each group will need a plastic bag with the seaweed sample, two tablespoons of hot water to make seaweed extract, a strainer and a pot or bowl of hot water large enough to hold two baggies. The groups will also need to eventually simmer two quart-sized plastic bags of ice cream mixture in a large pot.
 - *Ice Cream Making Station:* Supply measuring cups and spoons and ingredients for making ice cream. Each group will need two quart-sized plastic bags, 2 clear plastic cups, 1 cup of whole milk, 4 tablespoons of sugar, 1/2 teaspoon cocoa powder (for baking) and 1/4 teaspoon of vanilla.



TEACHER TIP

Develop students' science notebooking skills AND save paper! Use an overhead projector to display student data sheets, instead of making copies.



CONSERVATION TIPS

Beach wrack or seaweed collected from the beach can be a great way to show students actual algae. Contact your local fish and wildlife department to see if collection is allowed for educational purposes. And always look through the sample to be sure you don't bring living things into the classroom!



TEACHER TIP

You will need to place the ice cream samples in a freezer or ice chest for a minimum of 2 hours (overnight is ideal). Ice cream makers and rock salt can be used, if available, for faster freezing. You may want to make some ice cream samples in advance so students don't have to wait too long for final results.

Procedure

1. SET THE STAGE FOR A SEAWEED INVESTIGATION.

Generate interest in seaweed. *What is seaweed? (plant-like organisms called algae) Where does seaweed grow? (mostly in water, although some other algae grow on land)* Share images of a kelp forest or seaweed in its natural habitat. *Why is it important? (animal habitat, human use in various products)* You may give them hints by asking who likes ice cream or brushed their teeth that morning. Tell students they are going to investigate why seaweed is in toothpaste and various other products.

2. EXPLORE THE PROPERTIES OF SEAWEEDS IN SMALL GROUPS.

Divide students into small groups. Pass out the three **Edible Algae** data sheets. Have students use the *Seaweed Exploration Station* to investigate various kinds of seaweed. Encourage them to use as many senses as possible and make accurate illustrations on their data sheet.

3. STUDENTS MAKE SEAWEED EXTRACT AND RECORD THEIR OBSERVATIONS.

Pass out the small plastic bags with 2-inch red seaweed samples to each group. (The seaweed may not look red when it is dried out because it also has the green pigment chlorophyll.) Have students go to the *Seaweed Extract and Cooking Station* and assume the role of a "measurer," data recorder and timer and finish the **Edible Algae #1** data sheet. Students will need two tablespoons of very hot water to add to their bags of seaweed. Then they will need to place the bag in hot water for 20 minutes. Students should go to the *Kelp in Your Cupboard Station* while they wait.

4. STUDENTS IDENTIFY SEAWEED EXTRACTS IN A VARIETY OF FOODS AND PRODUCTS.

Have students explore various products that contain seaweed extracts at the *Kelp in Your Cupboard Station* and record observations on the **Edible Algae #2** data sheet. When the 20 minutes are up, help groups finish making the seaweed extract at the *Seaweed Extract and Cooking Station* by using a strainer to remove the seaweed and capture the solution.

5. STUDENTS MAKE ICE CREAM MIXTURES.

Have students follow the instructions on **Edible Algae #2**. They will make and compare two ice cream mixtures; a control sample (without extract) and an experimental sample (with extract). You will need to then simmer the students' mixtures for about eight minutes and then place them in the freezer or ice chest until frozen.

6. STUDENTS COMPARE ICE CREAM SAMPLES TO OBSERVE HOW EXTRACT AFFECTS ICE CREAM.

Pass out the frozen ice cream samples and spoons to students. Have them complete the **Edible Algae #3** data sheet.

7. AS A CLASS, DISCUSS STUDENTS' FINDINGS.

Have students share their observations with the class. Discussions questions may include; *What is extract? Why is seaweed extract added to ice cream? What can you infer about other mixtures seaweed extract is added to? How can you change the properties of a mixture? Why is seaweed important?*

Extensions

- Use ice cream makers or large baggies of ice with rock salt to lower the freezing temperature of the liquid ice creams. Keep a record of temperature versus time.
- Use metric units to make the recipe.
- Have students bring in empty packages from products that contain seaweed extract or do a household inventory.

Resources

Website

Monterey Bay Aquarium. www.montereybayaquarium.org

Find related activities and background information about seaweeds and their importance.

SeaNet: Common Marine Organisms of Monterey Bay. www.seanet.stanford.edu

Discover a variety of images and information on seaweeds and algae.

Recommended Books

Asian Ingredients. Cost, Bruce. William Morrow Cookbooks, 2000.

Cooking with Japanese Foods. Belleme, Jan and John. Avery, 1993.

A Natural History of the Monterey Bay National Marine Sanctuary. Monterey Bay Aquarium, 2006.

Standards

California Science Standards

Grade 3: 1e, f, g; 3a; 5a, c, e, f

Grade 4: 2a; 3a; 6b, f

Grade 5: 1g; 2f; 6a, d, f, g, i

California Language Arts Standards

Reading and Comprehension

Written and Oral English Language Conventions

Listening and Speaking



ELL TIPS

Investigating products at home and sampling different types of algae may encourage students to share their cultural experiences. Perhaps their families make a favorite food with algae that they could bring to school to share.

**THE MISSION OF THE
MONTEREY BAY
AQUARIUM
IS TO INSPIRE
CONSERVATION OF THE
OCEANS.**

Name: _____

Edible Algae #1

Seaweed Exploration Station

Record your observations about samples of seaweed below.

Name of Seaweed	Illustration	Observations

Seaweed Extract and Cooking Station: Make a Seaweed Extract

Describe your seaweed sample in the data chart below.

Stage I: Observe the seaweed as it appears in the plastic bag. Record your observations.

Stage II: Add two tablespoons of hot water, wait 2 minutes and record new observations.

Stage III: Place the bag with water and seaweed in a hot water bath for 20 minutes. Visit other stations while you wait. Once all the seaweed is dissolved, strain extract into a small container.

Stage	Time	Drawing	Observations
I			
II			
III			

Name: _____

Edible Algae #2

Kelp in your Cupboard Station

Use the table below to record your observations of various products. Look at each list of ingredients to find these seaweed extracts:

- **Agar (red algae):** Used instead of gelatin to hold substances like sour cream and marshmallows together. Also used in laboratory Petri dishes to culture bacteria.
- **Carrageenan (red algae):** Helps change liquids into gels and are used to “keep the shape” of many products.
- **Algin/Alginates (brown algae):** Helps sauces and syrups pour smoothly and keep their texture. Also used in dry mixes, like pancake mix, to help product absorb liquid and keep ingredients from separating once mixed.

Product Name	Seaweed Extract	Appearance and Texture

Ice Cream Making Station

1. Get two plastic cups. Add 1/2 cup milk, 2 tablespoons of sugar and 1 teaspoon cocoa to each cup. A drop of vanilla extract is optional. Mix the liquid until the sugar dissolves.
2. Label one cup “with” and one cup “without.” Add your seaweed extract to the cup labeled “with” and mix gently.
3. Compare the two mixtures and record your observations in the table below.
 - How does each mixture drip from the spoon?
 - What does each mixture look like?
 - Pick up the cups to observe the mixture settled on the bottom. What do you notice?

State	Without Extract	With Extract

4. Write your names on two quart-size plastic bags. Label one “with” and one “without.” Transfer your mixtures into the bag. Give it to your teacher to simmer for eight minutes and then freeze.
5. Predict what you think will happen to the liquids. How will the mixtures be the same? How will they be different?

