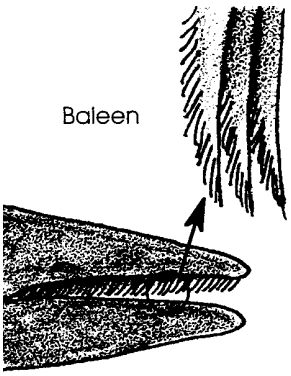
Feast Waters - April 20

Key Concepts

1. Whales have special feeding adaptations to help them survive in the marine environment.

2. Baleen is an adaptation that allows baleen whales to strain plankton out of the water.



Background

Baleen whales, the group of whales which includes the California gray whales, have no real teeth. Instead, they have parallel rows of stiff, brush-like plates called baleen to filter large quantities of small food animals (plankton) from the ocean water. The two or three hundred flat baleen plates are set crosswise along the edge of the upper jaw and hang from it.

Baleen plates are fibrous and tough but flexible. They are made of keratin a material similar to human fingernails. On the inside of the mouth the edges of the plates are frayed into long bristles or strands resembling the strands of a horse's tail. The strands of baleen from adjacent plates overlap forming a "hairy" mat which serves as a strainer to trap the food while letting the water flow through.

Several different feeding strategies are found within the baleen whales. Some baleen whales skim at the surface, others "gulp" or bottom feed. Skimmers, like the bowhead or right whales, have long baleen plates (graduating up to 10 feet or more length). The skimmers feed by swimming at the surface with their mouths open. The plates, short in the front and long in the middle, passively trap the plankton as the water passes through.

Gulpers include the swift and active rorquals like the blue and humpback whales. These whales have long grooves or pleats on their throats. As they gulp in hundreds of gallons of water, their pleats expand like an accordion. When the mouth is full, muscles contract around these pleats and push the water out through the sides of their mouths. The strainer mats created by their three to four feet long baleen plates trap the plankton.

Unique among the baleen whales, gray whales are primarily bottom feeders (occasionally they "skim for their supper"). To feed, gray whales roll on their side and bite chunks out of the sediment. They then swish the sediment around to filter out the benthic organisms.

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Materials

Part 1

For each student:

- a small cup
- cake decorative sprinkles
- 1/8 teaspoon measure
- water

Part 2

For each group of four students:

- paint brush
- pepper shaker
- 1/8 teaspoon measure
- tub, dishpan, or plastic shoebox
- water

Teaching Hints

In "Feast Waters - April 20", your students will try to strain "food" out of the water with their own teeth and then with paint brushes. Since the first part of this activity which involves straining with teeth can get messy, you might want to conduct it outside.

"Feast Waters - April 20" is the first of several lessons dealing with feeding, sediment organisms, plankton, and food chain dynamics.

Key Words

baleen - an elastic, hair like material growing in place of teeth in the upper jaw of certain whales and forming a series of thin, parallel plates used to strain food out of the water, also called whalebone

keratin - a protein material found in fingernails, baleen, hair, horns, etc.

mysid - one of a group of small, shrimp-like crustaceans

Extensions

1. Have students research the number of baleen plates found in each species of whale and how large the whale mouths must be to hold them.

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Answer Key

Text Questions

1. Gray whales roll on one side and use the baleen on that side to stir up bottom sediments and strain out tiny organisms. The fact that one side is usually more worn down than the other suggests that they prefer one side over the other. Perhaps whales are "left-handed" or "right-handed" like we are!

2. Members of the group are called "skimmers" because these whales skim plankton off the surface of the water by swimming with their mouths open and straining out plankton as they swim.

3.a. A physical adaptation shared by "gulpers" is the highly expandable throat grooves which allow rorqual whales to take in and filter a much greater volume of water than their mouth cavity would hold otherwise.

b. A behavioral adaptation found in some rorqual whales is the utilization of a "bubble net" which acts almost like a real net in trapping and concentrating small animals. By doing this they can catch much more food in a smaller area of water.

4. An animal which has only one source of food can be more easily threatened by food shortages than one which eats from a variety of sources.

Procedure Questions

4.,5. Descriptions of successful strategies will vary.

Analysis and Interpretation

1.a. Answers will vary regarding success of using teeth as baleen.

b. Answers will vary regarding changes made.

2.a. Answers will vary, but hopefully the paint brush is better than their teeth.

b. Answers will vary regarding changes made.

3. Answers will vary regarding how to change the paintbrush so it could collect more pepper plankton.

4. Answers will vary but once the whales have the plankton in their baleen they use their tongue, saliva, and mucus to get it out.

5. Answers will vary but whales get the energy they need to live during the winter from the food they ate in the summer, stored as fat.

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Food For Thought: Polar regions are rich in whale food (plankton) because of the long days and significant nutrient upwelling. (Most nutrients are on the bottom where decomposers are recycling the dead organisms that drift down.) Lots of nutrients, lots of light cause plankton blooms. On the other hand, very few nutrients are found in warm tropical waters because there is less mixing and upwelling of nutrients from below. In the tropics, a permanent layer of warm water at the surface resists the upward mixing of nutrients from below. (The FOR SEA activity "Ocean Currents" may be used to teach about water density differences and their affect on plankton blooms.)

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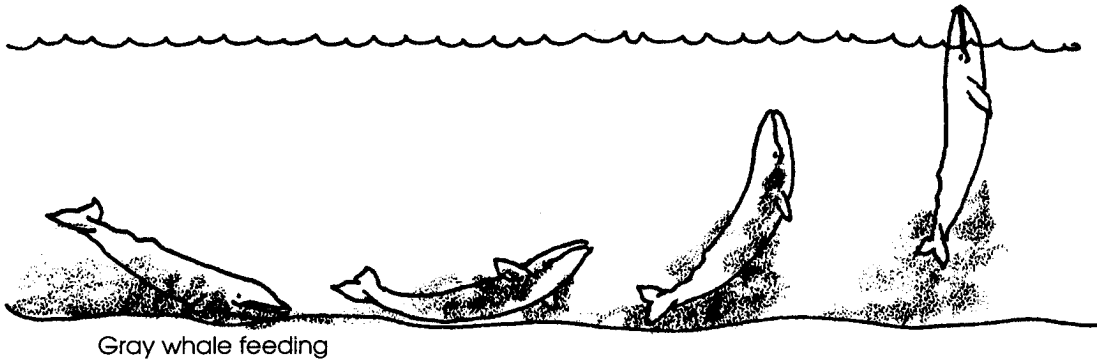
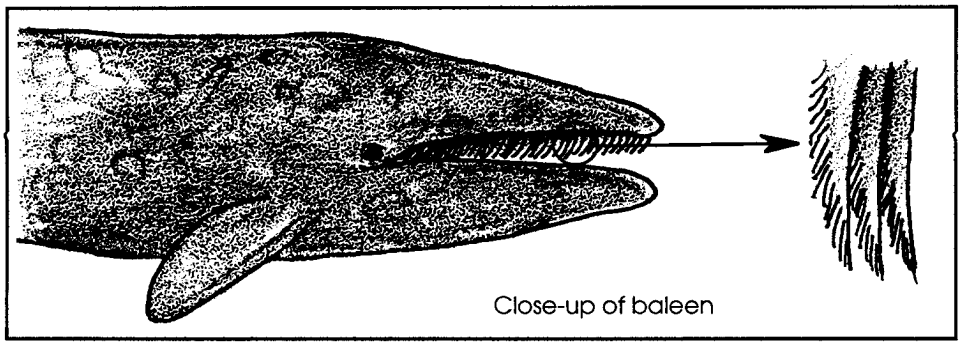


Gray whale feeding



Close-up of baleen

Once again the cliffs of Cape Flattery, Washington appear out of the mist. Our whales short detour into Puget Sound is over. They turn to the north and join other whales moving along the Washington coast. As the whales move along the coast, some of the adults begin feeding for the first time in many months. Their stored energy from the summer before is low. Many whales are thin and weak.

They move in close to the shore, near the crashing surf. Here many small shrimp-like animals, called mysids, scurry in and out of the sand as the water surges past. The whales roll on their sides. As they do, the pull in mouths full of sandy water. They press it out again through their baleen plates. Tasty mysids are trapped against the baleen and swallowed eagerly. The whales pass back and forth along the beach, repeating their motions again and again.

1. Scientists have studied the baleen in gray whales. They noticed that often there is more wear and tear in the baleen on one side of the mouth than the other. This seems to be especially true in older whales. What might account for the unevenness of baleen plates?

Gray whales are the only baleen whales known to feed in this manner. Gray whales sift most of their food from bottom sediments. Other baleen whales feed entirely on plankton. Let's take a look at how whales use their baleen strainers in different ways.

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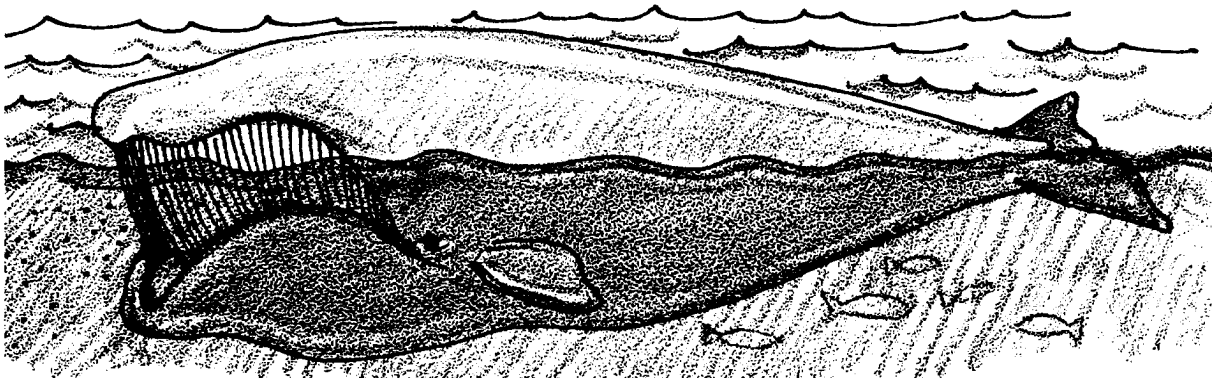
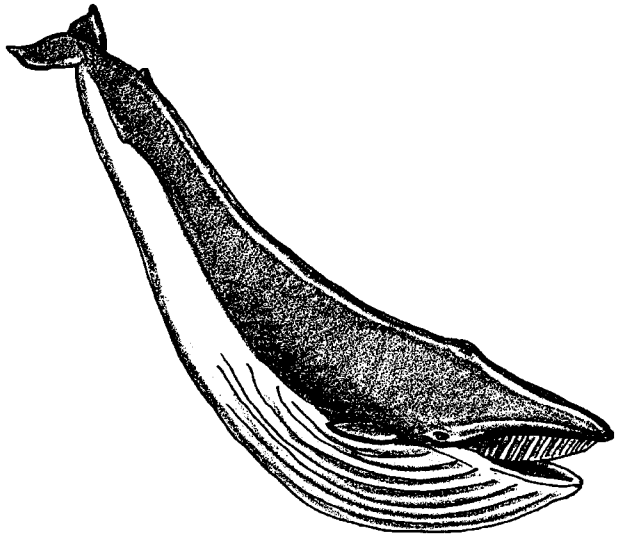


Some whales are known as “skimmers.” They swim near the surface with their mouths open. Their baleen plates on the right and left sides don’t quite meet. This leaves a gap in the center. As “skimmers” swim, water is funnelled into the mouth through the gap. The water passes out through the sides of the mouth. Plankton is trapped on the long baleen plates which hang there. Whales which feed in this way are members of the family of Right Whales.

2. Why are members of this group called “skimmers?”



Other whales are called “gulpers.” “Gulpers” take in vast “gulps” of water and plankton. Their throats are grooved to allow them to expand to hold even more water. A gulper doesn’t actually swallow the water. Instead, it uses its enormous tongue to force the water out through the baleen plates. Plankton is trapped on the inside of the baleen. Whales which feed in this way are members of the Rorqual Whale family. Rorquals include the Blue whale and fin whale.

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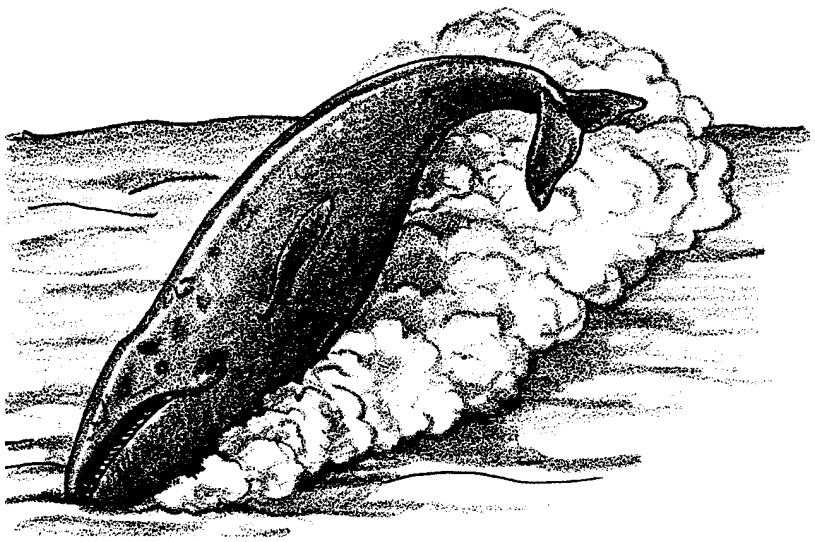
Some rorquals, like the humpback whale, have developed other ways to help them feed. These whales eat small fish or shrimp. As they swim near their food, they release streams of tiny bubbles into the water. The bubbles form a "net" which "herds" the plankton into dense swarms. The whales can then "gulp" a huge school in a very short time. Some whales also have been known to stun or confuse their prey with intense underwater sounds.

3. Plankton feeders from whales to clams face lots of problems. One of the biggest is that their food is so spread out through the water. Rorqual whales have two adaptations for increasing their "catch."

   a. One is a physical adaptation of their body. What is it?

   b. Another is a behavior. What is that?

Gray whales have much shorter baleen than either skimmers or gulpers. They also have a special way of feeding. To feed, a gray whale dives to the bottom and turns on its side. There it bites chunks out of the mud or sand. Also stirred up are the buried small shrimp-like animals. The whale sucks this water mixture into its mouth. Forcing the water through the baleen strains out the small shrimp-like animals.



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Gray whales actually seem to eat a variety of foods. Besides bottom animals, they sometimes feed on plankton. Other times they even strain seaweeds through their mouths to rub off crabs and shrimp. Scientists think their flexible feeding behavior is important for their survival. It may have helped them recover quickly from near extinction. Other whales which eat fewer kinds of food have been slower to increase in numbers.

4. Think about an animal which eats a number of different kinds of food. Why might such an animal increase in numbers more rapidly than one which eats only one food?

How effective is baleen as a way to catch food? Baleen whales are the largest animals that have ever lived. The blue whale can reach 100 feet long. They eat tons of shrimp-like krill, crab larvae, copepods, and small schooling fish. A single blue whale can easily eat a ton of food a day during the summer. They must make good use of their baleen! In this activity you will see how well you can catch "food" as you study how baleen works.

Materials

Part 1

- a small cup
- candy sprinkles
- 1/8 teaspoon measure
- water

Part 2

- paint brush
- pepper shaker
- 1/8 teaspoon measure
- tub
- water

Procedure:

Part 1 - On Your Own

1. Fill your cup with water and add 1/8 teaspoon of candy sprinkles.

2. Put some water from the cup in your mouth (DON'T SWALLOW!). Try to squish the water out between your teeth. What happens to the sprinkles?

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3. Try different ways of trapping the sprinkles inside your mouth.

4. Describe your most successful method of extracting the sprinkles from the water.

Part 2 - With A Little Help From Your Group

1. Fill your tub with water.

2. Add 1/8 teaspoon of pepper to the water.

3. Use your paint brush to try and collect the pepper “plankton”.

4. Try different ways of trapping the pepper.

5. Describe your most successful strategy:

Analysis and Interpretation

1. a. How successful were you at using your teeth as baleen?

   b. What changes did you make to improve your success?

2. a. How successful was the paint brush?

   b. What changes did you make to improve your success?

3. How would you change the paintbrush so it could collect more pepper plankton?

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4. Once the whales have the plankton in their baleen, how do you suppose they get it out? (Hint, how did you get it out of your teeth?)

5. In the summer, baleen whales feed in plankton rich polar waters. The whales spend the winter in the tropics. During the winter, they eat very little. Where do you think whales get the energy they need to live during the winter?

Food For Thought: Recall what you know about plankton. Why is there so much food for whales in the summer in polar regions? (Hint: What do the plant plankton need to grow?) Why is there not much food for whales in the tropics? (Same hint!)

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