Seals, Sea Lions, and Walruses

4–8 Teacher's Guide

A SEAWORLD EDUCATION DEPARTMENT PUBLICATION

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To the Teacher

The ***Seals, Sea Lions, and Walruses*** Teacher's Guide for grades 4–8 was developed at SeaWorld to help you teach your students—in an active, hands-on way—about pinnipeds and the ecology of the ocean. Our goal is to integrate science, mathematics, art, geography, and language. SeaWorld curriculum supports the *National Science Education Standards*.

The brief background information in this Guide was written for you, the teacher. It will help you do these activities with your students. We suggest you also refer to some of the resources listed on page 24 for more in-depth information. SeaWorld strives to provide teachers with up-to-date information and activities that motivate students to appreciate and conserve wildlife, the oceans, and the natural world.

Do you have comments or suggestions regarding the activities in this Teacher's Guide? We'd love to hear your opinion. Write the SeaWorld San Diego Education Department, email us at *SWC.Education@SeaWorld.com* or call 1-800-380-3202.

Goals of the Seals, Sea Lions, and Walruses Unit

Students will explore the natural history of seals, sea lions, and walruses and recognize that humans are an interconnected part of these animals' ecosystems.

Objectives

After completing the SeaWorld Seals, Sea Lions, and Walruses unit, the student will be able to…

1. Identify six members of the order Pinnipedia.
2. Explain how sea lionls are adapted for an ocean environment.
3. Compare how warm-blooded pinnipeds lose heat to air and water environments.
4. Locate the distribution of two pinniped species.
5. Identify important food sources for pinnipeds and explain one foraging strategy.
6. Express a concern for how human activities may impact pinnipeds' survival.
7. Use problem-solving approaches to investigate and understand pinniped management situations.
8. Share their learning experiences with family and friends.

Vocabulary

blubber — a layer of fat between the skin and muscle of most marine mammals.

colony — a group of organisms of the same kind living together.

ecosystem — a unit of plants, animals, and nonliving components of an environment that interact.

endangered — in danger of becoming extinct.

flippers — broad, flat limbs supported by bones and adapted for swimming.

food chain — a diagram showing the transfer of energy via "who eats whom" in an ecosystem.

habitat — the normal, usual, or natural place where a plant or animal lives.

haul out — to leave the water to get on land.

herd — a group of certain large animals that associate together.

marine mammal — a mammal adapted to live in the marine environment and dependent on the ocean for food.

molt — *n.* The shed exoskeleton, hair, feathers, or skin of an animal. *v.* To shed the exoskeleton or the outer layer of hair, feathers, or skin.

Pinnipedia — the scientific order that includes seals, sea lions, and walruses.

predator — an animal that eats other animals.

prey — *n.* an animal eaten by another animal. *v.* to hunt and eat other animals.

pup — the young of certain animals such as seals, sea lions, and otters.

threatened — likely to be in danger of becoming extinct.

vibrissae — stiff, tactile whiskers on the face of certain mammals.

What Are Seals, Sea Lions, and Walruses?

These animals are pinnipeds.

Scientists group seals, sea lions, fur seals, and walruses together in the scientific order called *Pinnipedia.* All pinnipeds have four *flippers*—one pair in front (foreflippers) and one pair in back (hind flippers), a thick layer of *blubber*, and sensitive whiskers called *vibrissae*.

Pinnipeds are divided into three families—the walruses, the true seals, and the eared seals. The eared seals, which include both sea lions and fur seals, have visible, external ear flaps.

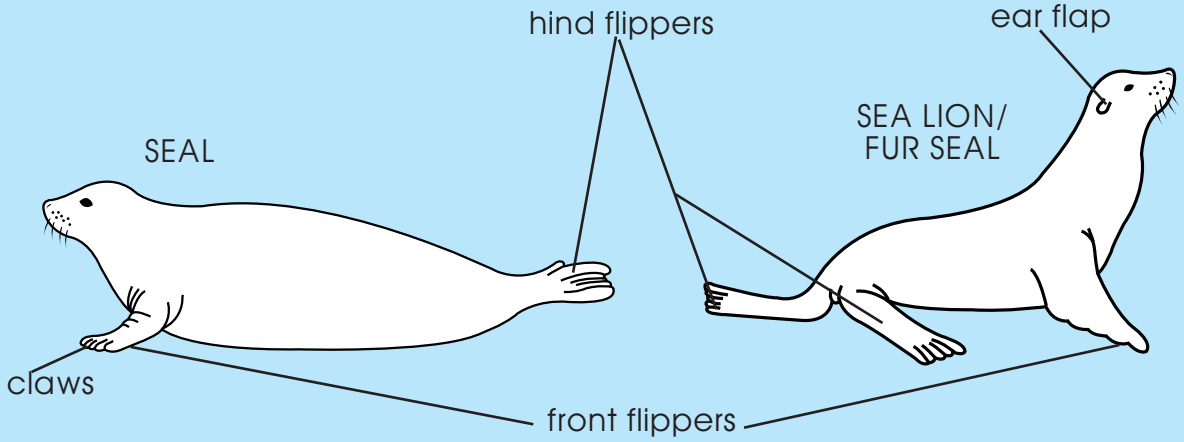
Pinnipeds are mammals.

Pinnipeds share five characteristics with other mammals. They are warm blooded (maintain a high and constant body temperature independent of the surroundings), give live birth, nurse their young, breathe air, and have hair.

Pinnipeds live on land and in the sea.

Because these animals live in the marine environment and they find their food at sea, pinnipeds are *marine mammals*. Other marine mammals include whales and sea otters. Although pinnipeds spend most of their lives in the water, they come ashore to rest, give birth, and *molt*. Once each year, usually in the spring, they gather on beaches or sea ice to give birth and breed. After the pupping season, adults often come ashore again to molt: they shed the outer skin layers with old fur and hair. They also *haul out* on shore to rest and bask in the sun throughout the year.

What's the difference between a seal and sea lion/fur seal?



Seals and sea lions/fur seals differ in a number of ways, but here are four that are easy to spot. Sea lions/fur seals show external ear flaps; seals show only ear holes. Sea lions/fur seals have long, hairless, front flippers with short nails; seals have short, fur-covered front flippers with long claws. Sea lions/fur seals can rotate their hind flippers forward to walk on land; seals hold their hind flippers straight and move on land with a forward rolling motion of their bellies. Sea lion/fur seal whiskers are smooth; most seal whiskers are beaded or crimped.

Where Do Pinnipeds Live?

You'll find pinnipeds around the world.

Seals, sea lions, and walruses live along the shorelines of the world's continents, from Antarctica to Greenland. Each species is adapted to live in its particular *habitat*. The smallest fur seal, the Galápagos fur seal, lives in hot weather close to the equator. Some large pinnipeds, like the southern elephant seal, swim in the chilly waters of the south pole region.

Pacific walruses play it cool.

Walruses swim in cold Arctic waters and prefer to haul out on snow-covered moving pack ice or ice floes rather than mainland beaches. *Herds* of walruses also come ashore on small rocky islands when ice isn't present. Because walruses eat mostly animals that live on the ocean bottom, they're generally found where the water is less than 100 m (325 ft.) deep. They prefer a habitat with a gravelly bottom.

California sea lions hit the beaches.

California sea lions inhabit the rocky and sandy beaches of coastal islands and mainland shores of the eastern North Pacific Ocean. During the spring breeding season, they gather on land in large groups called *colonies*. In autumn and winter, adults range off the west coast of North America from the islands off Baja California, Mexico to the northern tip of Vancouver Island in Canada.

Harbor seals lie low.

Harbor seals inhabit shallow areas of estuaries, rivers, and places where sandbars, beaches, or rocks are uncovered at low tide. They prefer flat spots because unlike a sea lion, a seal can't rotate its hind flippers forward. On land, a seal moves by undulating its body in a caterpillarlike motion. In the water, it often rests floating vertically.

Pups and calves grow fast.

A baby seal or sea lion is called a *pup*. A baby walrus is called a *calf*. Pups and calves are born on land or sometimes in the water. They grow rapidly on their mother's fat-rich milk. Soon they enter the sea to develop their survival skills. They learn to swim, dive, catch *prey*, and haul out.

The first year of life at sea is often the most difficult. Finding enough food, surviving storms at sea, escaping *predators*, and withstanding disease, are all challenges these young animals face.

Most pinnipeds, like this California sea lion, have good eyesight under water.

Why Do Scientists Study Pinnipeds?

There's a lot to learn from pinnipeds.

Scientists study pinnipeds to learn about their natural history, reproduction, and behavior. The information helps when scientists try to save species that are *endangered*.

Most studies observe pinnipeds when they're on land while pupping, breeding, or molting. What are they doing the rest of the year? And where are they doing it? Little is known about pinniped behavior at sea including diving, migrating, habitat use, feeding strategies, and social interactions.

New technology helps scientists study seals at sea.

Scientists at Hubbs-SeaWorld Research Institute (H-SWRI) are using compact satellite transmitters to track seal movements. With this new technology, scientists can virtually dive and swim with seals, learning more about pinniped behavior.

Time-depth recorders reveal hidden secrets.

H-SWRI scientists use a small computer called a time-depth recorder (TDR). The TDR is temporarily glued to the hair on the back of a seal or sea lion. It falls off when the animal comes ashore later in the year to molt. The TDR records time and depth measurements and stores the data until it is transmitted to a satellite. The satellite calculates the seal's position and then sends all the data to the H-SWRI laboratory for analysis.

Elephant seals dive deeply.

Scientists have used TDRs to document the year-round diving patterns and foraging migrations of northern elephant seals in the Southern California Channel Islands. Elephant seals gather on the Channel Islands in the winter to breed and again in the spring and summer to molt. Scientists weren't sure what the seals did during the eight to nine months the seals are at sea.

Dr. Brent Stewart is a H-SWRI scientist who uses TDRs to study the diving patterns and movements of elephant seals during the months they spend at sea. He documented diving depths, dive durations, and the amount of time the seals spend resting at the surface between dives. His study revealed some fascinating information.

For example, twice each year, male northern elephant seals (*Mirounga angustirostris*) migrate from the Channel Islands 4,025 km (2,500 miles) north to Alaska's Aleutian Islands, where they spend 40 to 50 days feeding before returning to Southern California (another 4,025 km). Each leg of the migration takes about 40 days.

The diving depths of northern elephant seals was also surprising. Some seals dove deeper than 1,800 m (6,000 ft.) and several dives lasted 80 minutes or more. Elephant seals are some of the deepest divers of any marine mammals.

This study's results helped in planning future studies of elephant seal movements at sea using satellite systems.

Pinniped Picks

Use these cards to help your students get started exploring pinnipeds. Here are some ideas for ways to use these cards in your classroom:

- Use the facts on the cards to help you prepare lesson plans and lead discussions in class.
- Copy and cut apart the cards. Distribute a different card to each cooperative learning group. Visit the school library to learn more about the animals. Groups may even adopt that animal as their "mascot" while working on this unit.
- Copy and cut apart the cards. Distribute a complete set to each student or group of students. Students compare similarities and differences among various pinnipeds.
- Copy and cut apart the cards. Use the cards to sort endangered or threatened species from those that are not. Visit the library to find more species to add to your "endangered list." Do some of these animals live in your area?

Pacific walrus
Odobenus rosmarus divergens

size: M 2.7 to 3.6 m (9–11.8 ft.)
800 to 1,900 kg (1,760–4,189 lb.)
F 2.3 to 3 m (7.5–10 ft.)
400 to 1,200 kg (880–2,646 lb.)

distribution: northeastern Pacific and Arctic oceans

prey: clams, mussels, fishes, snails, crabs, shrimps, and squids. Some eat seals and small whale carcasses

predators: killer whales, polar bears

population: 240,000 (1980s)

status: not endangered but regulated in international trade to restrict harvest

California sea lion
Zalophus californianus californianus

size: M to 2.4 m (7.9 ft.)
to 390 kg (860 lb.)
F to 2 m (6 ft.)
to 110 kg (240 lb.)

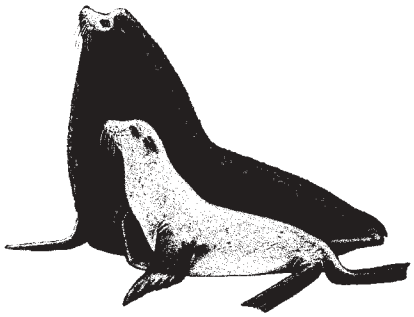
distribution: British Columbia to northern Mexico

prey: fishes, squids, octopuses

predators: killer whales, sharks

population: 185,000 (1993)

status: not endangered or *threatened*



harbor seal
Phoca vitulina

size: M about 1.9 m (6.2 ft.)
70 to 159 kg (150–351 lb.)
F about 1.7 m (5.6 ft.)
60 to 110 kg (132–242 lb.)

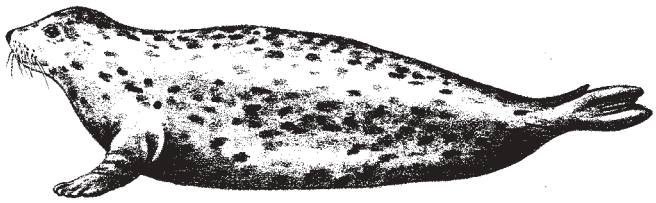
distribution: Pacific (Arctic to Baja California, Mexico), Atlantic (Greenland to Florida), and European waters

prey: fishes, shrimps, squids, octopuses

predators: killer whales, sharks, and Steller sea lions. Coyotes and eagles eat juveniles on beach.

population: 500,000 (1981)

status: not endangered or threatened



northern elephant seal
Mirounga angustirostris

size: M 4 m (13 ft.); 2,000 kg (4,410 lb.)
F to 3 m (10 ft.); 600 kg (1,323 lb.)

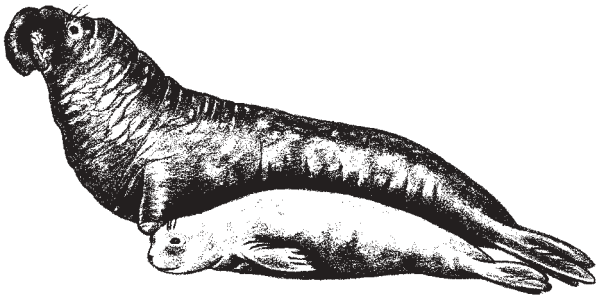
distribution: California to Baja California, Mexico

prey: squids, octopuses, deep-water fishes, small sharks, and skates

predators: killer whales, sharks

population: 150,000 (late 1990s)

status: not endangered or threatened



Hawaiian monk seal
Monachus schauinslandi

size: to 2.4 m (8 ft.); 270 kg (600 lb.) females slightly larger than males

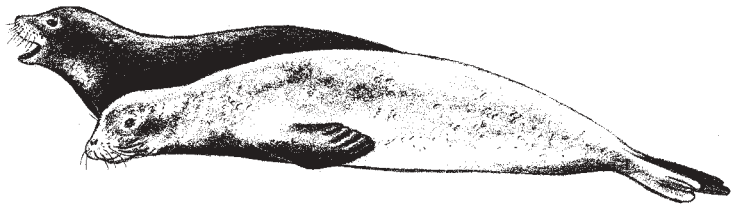
distribution: northwestern Hawaiian Islands (leeward chain)

prey: eels and other fishes, octopuses, lobsters

predators: sharks

population: about 1,500 (early 1990s)

status: classified as endangered under the Endangered Species Act



Steller sea lion
Eumetopias jubatus

size: M 3.3 m (10.8 ft.); 1,000 kg (2,200 lb.)
F 2.5 m (8.2 ft.); 270 kg (600 lb.)

distribution: central California north to the Arctic and across to Japan

prey: fishes, squids, octopuses. Some eat seals.

predators: killer whales, sharks

population: 95,000 to 122,000

status: Gulf of Alaska and Bering Sea populations endangered under the Endangered Species Act. Eastern stock is threatened.

Guadalupe fur seal
Arctocephalus townsendi

size: M 1.8 to 1.9 m (5.9–6.2 ft.); 160 to 170 kg (353–375 lb.)
F 1.2 to 1.4 m (3.9–4.6 ft.); 45 to 55 kg (99–121 lb.)

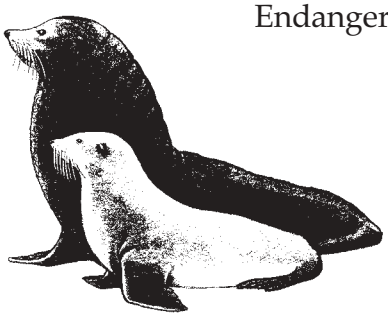
distribution: central California south to Guadalupe Island, Mexico

prey: fishes, squids

predators: killer whales, sharks

population: 6,000 (1987)

status: classified as threatened under the Endangered Species Act



Design a Sea Lion

OBJECTIVES

Given a list of the steps for drawing a sea lion, the student will be able to complete a sketch. The student will be able to list four characteristics of a sea lion and compare and contrast marine animal adaptations.

MATERIALS

per student:

- ❑ drawing paper
- ❑ pens or pencils
- ❑ copy of ***Design a Sea Lion*** funsheet on page 9

ACTION

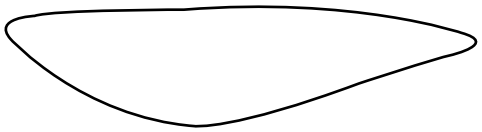
1. As a class or in cooperative learning groups, brainstorm challenges students would face if they were put in the middle of the ocean. (Think of all the elements important to scuba divers.) How would a person stay warm in cold water, see in the dark ocean, and find food?
2. With these challenges in mind, discuss the adaptations sea lions have to survive in the ocean…
   - pointed teeth to capture prey
   - vibrissae (whiskers) to explore surroundings and detect prey
   - a mucous tear to protect eyes from sea water and sunlight
   - blubber for insulation, streamlining, and a reserve energy source
   - fur as a body covering
   - pectoral flippers for swimming and walking on land
   - hind flippers for steering in the water and walking on land
3. Distribute ***Design a Sea Lion*** funsheets to students along with paper and pens or pencils. Direct students to read the directions and try to duplicate a sea lion on their paper.
4. Ask students or groups to describe sea lion adaptations for an ocean environment. Draw an environment around the sea lion.

DEEPER DEPTHS

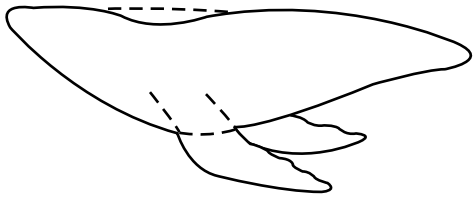
Expand this activity by creating a drawing sheet for a harbor seal and a Pacific walrus. Do these animals face the same challenges as a sea lion? Compare and contrast the adaptations and body shapes of a sea lion and other marine mammals.

Design a Sea Lion

First draw the torpedolike shape of the sea lion. Blubber helps streamline the sea lion. A streamlined shape produces less resistance and helps a sea lion conserve energy as it swims.

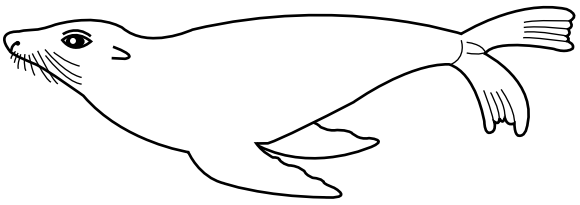


Add the front or pectoral flippers. These are broad, furless, and very strong. The sea lion uses these flippers to swim in the water and to walk on land.



The hind flippers come next. Like the front flippers, each has five toes or digits similar to those in our hands and feet. Hind flippers help a sea lion walk on land. And don't forget the tail!

Finally, add eyes, which are large; whiskers, which are sensitive; and a nose. Sea lions are able to open and close their nostrils. Remember ear flaps, for all sea lions have ear flaps.



Seals In-depth

OBJECTIVE

Given data, students will use math skills to organize, analyze, and interpret the results from a research project tracking elephant seals.

MATERIALS

per student:

- ❑ graph paper
- ❑ pencil
- ❑ pens or markers
- ❑ copy of ***Seals In-Depth*** funsheet on page 11

BACKGROUND

Recent research on the diving patterns of male elephant seals has revealed amazing data. In 1989, a small microprocessor-based time-depth recorder attached to a male elephant seal recorded a dive of 1,800 m (6,000 ft.). Male elephant seal dives can last as long as 80 minutes.

ACTION

1. Divide students into cooperative learning groups. Distribute materials and ***Seals In-Depth*** funsheet.
2. Ask each group to select one data set (dive depth, dive duration, or surface time). They complete the blanks on the funsheet; then design graphs or charts to represent the information. Groups should determine how to use the data in their graphs or charts (percentages, averages, frequency, or other). Groups then create two to three questions and two to three statements about the data and their work. (For example: does the data clump?)
3. After the groups have completed their data organization and analysis, have them present their work to other "scientists" in the class. Class scientists compare and contrast their work. Which graphs or charts represent the data? Are there other ways to show the information?
4. When review is completed, ask the class, "Why do scientists want to know this information?" *Scientists seek to understand natural history, behavior such as diving and migrating, feeding strategies, habitat use, and to determine if competition exists between humans and the animals for natural resources. Research like this helps people make decisions on fishery management, land use, water recreation use, and other policies.*

ANSWERS

1. diving depth: about 389 meters
2. dive duration: about 23 minutes
3. surface time: about 3:08 minutes

Name _____

Seals In-Depth

Note: Treat each data box separately; numbers do not correlate. Numbers represent only a portion of data collected.

DIVE DEPTH (m)
75
410
118
379
210
105
362
978
402
357
382
713
541
349
451

DIVE DURATION (min)
77
8
12
19
24
49
9
28
18
23
10
22
6
20
14

SURFACE TIME (min:sec)
1:56
2:25
3:30
3:45
7:21
0:30
5:47
2:19
2:31
3:22
2:56
0:41
3:31
5:02
1:18

ESTIMATE AVERAGES

1. diving depth: _____ meters
2. dive duration: _____ minutes
3. surface time: _____ minutes: seconds

CALCULATE AVERAGES

1. diving depth: _____meters
2. dive duration: _____minutes
3. surface time: _____minutes: seconds

What scientists learned from the diving patterns of six male elephant seals.

- Seals were at sea for an average of 130 days. They made a total of 36,233 dives. Seal one: 7,137 dives. Seal two: 4,292. Seal three: 5,961. Seal four: 3,812. Seal five: 7,714. Seal six: 7,317.
- Seals were submerged 21 hours out of the day. They spent 15 hours either ascending or descending and 6 hours at the bottom.
- Bottom time (time spent at the bottom of a dive) accounted for about 29% of the durations of each seal's dive. Only 140 dives exceeded 1,000 m and of these, 73% had bottom times of 1 minute or longer. Of the 40 dives that lasted 40 minutes or more, bottom time accounted for about 25%.
- The seals shared a diving depth mode of 350 to 450 m. An average of 41% of dives were to this depth. About 30% of dives were shallower. About 6% of dives were greater than 700 m.

This information is only a portion of the data obtained.

Hypothesize This!

OBJECTIVE

Students will be able to predict, measure, collect, and analyze data to investigate heat loss in water.

BACKGROUND

Scientists explore our world by objectively testing hypotheses using the scientific method: define the problem/ ask a question, collect background information, formulate a hypothesis, test the hypothesis, make and record observations, and draw conclusions. In this exercise, students will act as laboratory scientists trying to determine if walruses stay warmer in water or in air. In other words, in which environment might walruses lose less body heat? (Heat loss occurs about 22 times faster in water than in air.

MATERIALS

per class:

- ❑ smooth peanut butter
- ❑ crockpot or microwave
- ❑ large spoon
- ❑ tape

per student group:

- ❑ 1 pan or bowl of room-temperature water
- ❑ 2 beverage cups
- ❑ 2 thermometers
- ❑ 2 popsicle sticks
- ❑ pencil
- ❑ copy of ***Hypothesize This!*** funsheet on page 13

ACTION

1. Before beginning activity, heat peanut butter in crockpot or microwave to between 80° and 90°F.
2. Tell students that for this exercise they are laboratory scientists. They are trying to solve the question, "Do walruses stay warmer in water or in air?" Explain the scientific method of stating a testable hypothesis, then devising an experiment to confirm or disprove the statement.
3. Divide class into student groups and distribute copies of ***Hypothesize This!*** funsheets and pencils. Ask students to state their hypothesis and write their team members' names. One possible hypothesis would be "Heat loss occurs at the same rate in water and in air."
4. Distribute pans or bowls of water, thermometers, popsicle sticks, cups, and tape. Students tape a popsicle stick to each thermometer so that one end of the stick extends slightly past the thermometer bulb (don't tape the bulb). This technique will help students stir without the thermometer bulb touching the bottom or sides of the cup or pan.
5. Students record the temperature of the water in the pan or bowl.
6. Fill the cups half-full with peanut butter. Each student group has two half-full cups of peanut butter.

7. Students record the initial temperature of the peanut butter in each cup. Then, one student in each group holds one cup of peanut butter in the pan of water (but don't touch the bottom of the pan). Another student holds the cup in the air. Students use thermometers to continuously stir the peanut butter in each cup to ensure a uniform temperature throughout. A third student in each group records temperatures at 30-second intervals, for 4 minutes. Students analyze the results and answer the questions on the funsheet.

DEEPER DEPTHS

Given the question, ask students to devise their own experiment. Students should include materials needed, hypothesis, and procedure in addition to any handouts.

Hypothesize This!

Our hypothesis statement:_____

Our scientific team members:_____

Our data:

Temperature changes in peanut butter

cup in	0 min	0.5 min	1.0 min	1.5 min	2.0 min	2.5 min	3.0 min	3.5 min	4.0 min
air									
water									

Our results:_____

Our conclusion:_____

Answer the following questions.

Did heat loss occur faster in water or in air? _____

Is your hypothesis still viable?_____

Use the back of this sheet to create a graph displaying your results.

Evaluate the testing procedure. Was it effective? How could it be improved?_____

Can you design a different experiment to test your hypothesis?

How might the results of your investigation help field scientists studying walruses?

Just Squidding Around

OBJECTIVE

Given directions and a squid, the student will be able to identify the squid's external anatomy and internal body parts.

MATERIALS

per student pair:

- ❑ fresh or frozen and thawed whole squid (not bait squid)
- ❑ scissors
- ❑ tweezers
- ❑ paper towels
- ❑ photocopy of ***Just Squidding Around*** funsheet on page 15

BACKGROUND

Squids are an important food item for many pinnipeds. To avoid being eaten, squids have many adaptations. Squids can change color by expanding or contracting pigmented skin cells. They can confuse predators by shooting a jet of ink that forms a dark cloud in the water. To capture prey, a squid uses its two long front tentacles and eight arms. Its jawlike beak bites prey.

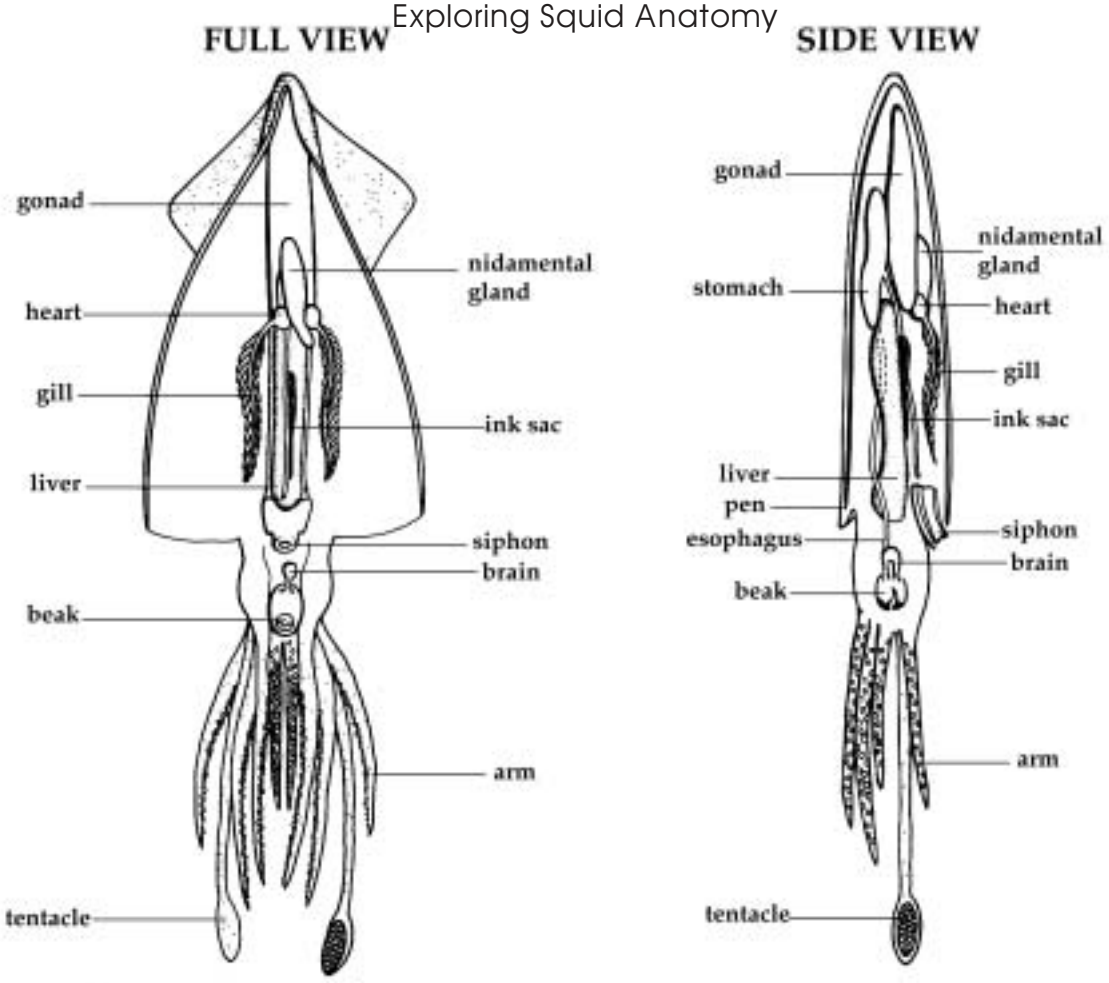
ACTION

1. Rinse and dry squids. Distribute materials and squids.
2. Begin with external anatomy by having students extend and straighten the arms, tentacles, and body. Use the ***Just Squidding Around*** funsheet to identify these parts and the mantle, pen, siphon, fins, and chromatophores.
3. Have students prepare the squid for cutting by positioning the squid siphon-side up with the fins placed against the table.
4. For best results, students should lift, then cut the mantle from the base near the head to the tip between the fins. Place mantle flaps to the side.
5. Use the funsheet illustration to identify internal body parts: gills, heart, ink sac, stomach, liver, and gonads.
6. After identifying the internal body parts, students can remove the pen by firmly grasping it at the tip (near the squid's head) with the tweezers and pulling it straight out. Also, they can gently remove the two beak halves for a closer look.

Name _____

Just Squidding Around

Exploring Squid Anatomy



Make a check next to the name as you identify different parts of the squid.

- ❑ arms — seize prey.
- ❑ beak — cuts prey into bite-sized pieces.
- ❑ brain — controls movement. A squid's brain is highly developed for an invertebrate. The brain appears as a small white ball just behind the beak.
- ❑ chromatophores — pigment-bearing cells that expand or contract to change the skin color (dark spots on mantle).
- ❑ esophagus — carries food from the mouth to the stomach.
- ❑ eyes — form an image, detect changes in light.
- ❑ fins — stabilize squid while swimming.
- ❑ gills — absorb oxygen from the water.
- ❑ gonad — the male gonad (testis) is a white filamentous mass that produces sperm. The female gonad (ovary) is an opaque mass that produces eggs.
- ❑ hearts — circulate blood.
- ❑ ink sac — holds thick, black ink that the squid releases to confuse predators.
- ❑ liver — secretes digestive enzymes. The liver is salmon colored and is often found under the ink sac.
- ❑ mantle — body, holds internal organs.
- ❑ nidamental gland — females only; secretes a gelatinous mass that surrounds the eggs in the mantle cavity.
- ❑ pen — remnant of shell.
- ❑ siphon — squirts water to propel squid.
- ❑ stomach — digests food.
- ❑ tentacles — seize prey.

Sharing the Sea

OBJECTIVE

The student will investigate the interrelationships of predator and prey and the diversity of food items in the sea.

MATERIALS

per student:

- ❑ copy of ***Sharing the Sea*** funsheet on page 17
- ❑ copy of ***Pinniped Picks*** cards on pages 6 and 7
- ❑ pen or pencil

BACKGROUND

Many animals eat similar food items, depending on the location and availability of prey. People also eat some of the same animals as pinnipeds. To ease competition, animals may feed at different times of the day (nocturnal versus diurnal feeders) or may catch different sizes of prey (young larval stages versus full-grown adults).

ACTION

1. Distribute ***Sharing the Sea*** funsheet and ***Pinniped Picks*** animal cards.
2. Working in groups, students read the prey item portion of the ***Pinniped Picks*** cards. On the funsheet, they checkmark what food items each species eats. Students also checkmark the food items that people might eat.
3. In their groups, students look for species that share the most food items.
4. As a class discuss how competing species could share ocean resources. How can humans share resources with pinnipeds?

DEEPER DEPTHS

Have students research some of the commercial fisheries that have declined or collapsed. For example, the cod fishery in the northwestern Atlantic, the anchovy fishery off the Pacific coast of South America, and the salmon fishery in the northeastern Pacific.

How does overfishing by humans affect the animal populations that also prey on these items? The November 1995 issue of *National Geographic* has an excellent article, "Diminishing Returns. Exploiting the Ocean's Bounty," that addresses some of these concerns.

Name _____

Sharing the Sea

food items	harbor seal	California sea lion	Guadalupe fur seal	Steller sea lion	northern elephant seal	people
Crustaceans						
shrimps						
lobsters						
crabs						
Molluscs						
squids						
octopuses						
clams						
snails						
mussels						
Fishes						
skates						
sharks						
deepwater fishes						
eels						
Mammals						
seals						
whale carcasses						

Polar Passport

OBJECTIVE

The student will be able to find locations on a map or globe by using longitude and latitude coordinates.

MATERIALS

- ❑ copies of the ***Polar Passport*** map on page 19
- ❑ pens or pencils
- ❑ globe or atlas

ACTION

Do this activity as a class or in learning groups. After finding a location, identify the pinniped(s) that live(s) there.

1. Distribute copies of ***Polar Passport*** to students or learning groups. Have students find the thin, black lines that run up and down the globe (from North Pole to South Pole). These lines are called lines of longitude. Longitude is expressed in degrees east or west (°E or °W).
2. Next have students find 0° longitude. Follow this line to find and label the Mediterranean Sea, north of the continent of Africa. What pinniped lives here? (*Mediterranean monk seal*)
3. Students then count lines to the right of 0° until they reach 165° longitude. What ocean is here? (*Arctic Ocean*) Follow 165° to find and label New Zealand. What pinniped lives here? (*New Zealand fur seal*)
4. Ask students to find the equator. All lines running parallel to the equator are lines of latitude. Latitude is expressed in degrees north or south (°N or °S). The equator is 0° latitude. Follow the equator to find and label the Galápagos Islands off the west coast of South America. What pinniped lives here? (*Galápagos fur seal*)
5. From the equator, have students count two lines of latitude toward the North Pole. What latitude is this line? (*20°N*) Next count five lines below the equator. What latitude is this? (*50°S*)
6. Ask students to find the Arctic region. The North Pole is at 90°N altitude. (*Not shwon on flat map.*) Where is the South Pole? *(90°S latitude)*
7. Now that students are familiar with longitude and latitude, ask the following questions:

   What country is found at about 30°W longitude and between 60° and 70°N latitude? *(Iceland)* What pinniped is found there? (*harbor seal*)

   What continent is found at 135°E longitude and 20°S latitude? (*Australia*)

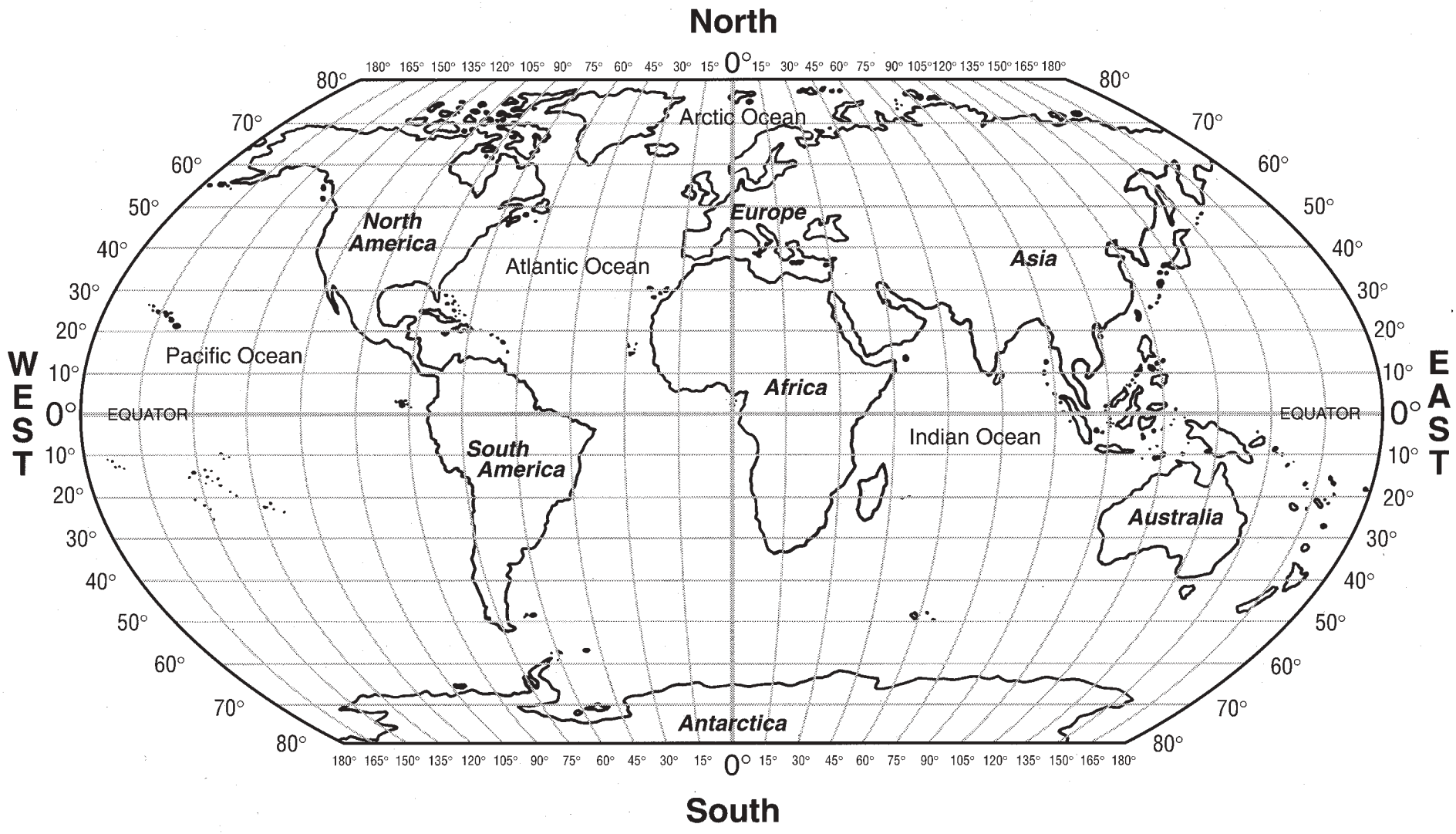
   What U.S. state is found at 165°W longitude and between 60° and 70° N latitude? (*Alaska*)

   What country is at 140°E longitude and between 30° and 40°N latitude? (*Japan*)

   What continent lies at 0° longitude and 80°S latitude? (*Antarctica*)

Name_____

Polar Passport



Milk Makeup

OBJECTIVES

Students will investigate the nutritional composition of cow milk and pinniped milk. They will create charts showing the amount of fat, protein, sugar, and water in cow and pinniped milk.

MATERIALS

per student group:

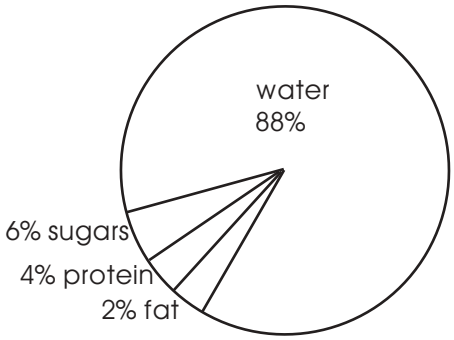
- ❑ various milk cartons (nonfat, 1%, 2% and whole) with nutritional information listed
- ❑ metric weight scale
- ❑ measuring cup
- ❑ paper
- ❑ pencil

BACKGROUND

Pinnipeds have very fat-rich milk. Rich, creamy milk contains a lot of calories (energy) and helps pups grow quickly. Pinnipeds with a short (one month) nursing period generally produce milk with a higher fat content than pinnipeds who have an extended (six month) nursing period.

ACTION

1. Help students read nutritional information on the milk cartons. Explain the meaning of serving size and values for fat, protein, and sugars (carbohydrates).
2. Have students determine the percentages of water, fat, protein, and sugar by following this procedure. Determine the serving size (such as 8 oz. or 236 ml). On a metric scale, weigh the measuring cup then fill the cup with a serving size of milk. Determine how many grams the liquid weighs. Look at the nutritional label and add the weight values for fat, sugar, and protein. Subtract that value from the total weight value to get the weight of water.
3. Demonstrate how to present this information in the form of a pie chart by copying the pie chart at right onto a chalkboard or writing surface.
4. Write the following information on the board regarding pinniped milk.
   - Harbor seal milk contains 45% fat, 45% water, 9% protein, 1% sugar.
   - Walrus milk contains 60% water, 30% fat, 10% protein, and traces of sugars.
5. Have students create new pie charts for each pinniped milk data and create a new milk carton for listing ingredients. Would anyone like to buy harbor seal milk?



Nutrient values for 2% fat cow milk.

Fur Seal Survey

OBJECTIVE

Given a current environmental situation, the student will be able to gather information, organize, analyze, and present data. They will participate in a decision-making process.

MATERIALS

per student group:

- ❑ copies of the ***Seal Survey Cards*** on pages 22 and 23

per class:

- ❑ maps of Antarctica
- ❑ markers
- ❑ graph paper
- ❑ library or Internet references

ACTION

1. Divide class into three student groups. Each group represents a different group of scientists and naturalists studying the Antarctic fur seal.

   Group 1—studying habitat destruction caused by fur seals

   Group 2—studying pollution in the Antarctic

   Group 3—documenting the fur seal's recovery from near extinction

2. After each student group has received a card, allow time (maybe one week) for students to become familiar with the situation and gather additional resources. Students may also want to gather information about the Antarctic Treaty, Antarctic fur seal, and other species at South Georgia Island (tussock grass, hair grass, king penguin, northern fur seal, subantarctic fur seal). In preparing the data, have each student group set objectives and goals, and organize information and data They then design graphs, charts or other visuals to support their situation.
3. When students are ready, set up a "meeting of the minds" with all three groups. Allow each group three minutes to introduce their survey and suggestions.
4. After each group has spoken, compare and contrast ideas and goals of each one. Does a group need to change its orginal plans after hearing the other group's presentation? Discuss new solutions.
5. As a class, write final reports for each situation including comments or information from the other groups' situation.

FUR SEAL SURVEY GROUP 1 (THE TUSSOCK TEAM)

You are scientists investigating the Antarctic fur seal (*Arctocephalus gazella*) on South Georgia Island (54°S, 36°W). About 95% of the world's Antarctic fur seals use South Georgia Island as their rookery (breeding area). The Antarctic fur seal population has rapidly increased since 1958. It's estimated that 1.8 million Antarctic fur seals live on South Georgia Island.

Population increases in indigenous species is usually good news. But not this time. The seals are trampling the native plants (tussock and hair grass) as they travel from the shore to the rookery. According to once source, more than 60% of the grass habitat has been destroyed. Birds, like the pipit and pintail, need the tussock grass for nesting. The destruction of the grasses is also adding to the erosion of the area.

Research and investigate the natural history of the area. Discuss what may happen if the Antarctic fur seal population continues to grow.

- How will it affect the *ecosystem* of the island?
- What other animal species live on South Georgia Island? How will they be affected?
- What's the effect on the local predators and prey of the fur seal? The effect on birds? The effect on tussock grass consumers?
- Is there a way to estimate if the Antarctic fur seal population is at carrying capacity (maximum number of individual species which the ecosystem can support)?
- Should the scientific community step in? If so, how? If not, why not?
- Do you think controlled hunting should be allowed?

FUR SEAL SURVEY GROUP 2 (DEBRIS CAN BE DEADLY)

You and your colleagues are concerned about the excessive amount of *debris* in the Antarctic and subantarctic. At this time you are focusing your attention on how debris is affecting the Antarctic fur seal (*Artocephalus gazella*) on South Georgia Island (54°S, 36°W). The Antarctic fur seal population has increased since 1958. It's estimated that 1.8 million Antarctic fur seals live on South Georgia Island.

As many as 1% of the Antarctic fur seals on South Georgia Island may have "debris collars" of plastic packing bands, nylon string, or broken fishing nets around their necks. As a seal grows, the plastic cuts into the skin causing lacerations which can lead to infection, strangulation, and even death.

You wonder how many of these animals may be dying from entanglement. You know that the northern fur seal (*Callorhinus ursinus)* population is declining in part due to entanglement in debris. In fact, some estimate that up to 30,000 northern fur seals die each year due to entanglement in nets or other debris.

You and your colleagues must hypothesize how the debris is getting to this area. Investigate ocean currents, current fishing activities in the area, and nearby human populations to determine where the debris is coming from. How could it affect the Antarctic fur seal population?

Make some suggestions about how to control pollution. What other information is needed to make decisions?

FUR SEAL SURVEY GROUP 3 (BACK FROM THE BRINK CLUB)

You are members of a unique organization that celebrates the regrowth of populations of animals that were once reduced due to human influences. For example you highlight animals such as the gray whale and northern elephant seal because the populations have grown from near extinction to large, thriving populations.

One of the animals on your "winners" list is the Antarctic fur seal (*Arctocephalus gazella*). The Antarctic fur seal hunting trade began in 1790 and during its 117-year history caused this species to become nearly extinct, twice.

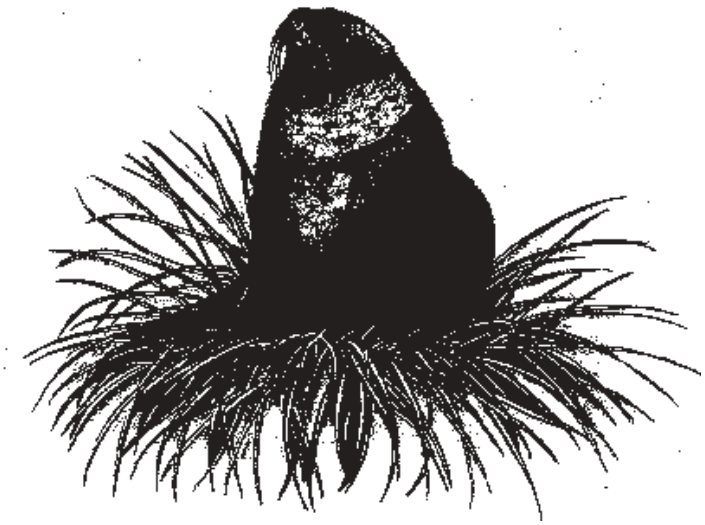
From 1790 to 1820 Antarctic fur seals were hunted on South Georgia Island (54°S, 36°W) to near extinction. During the period from 1870 to 1907 all Antarctic fur seals on South Georgia Island were killed. Scientists estimate that as many as 1.2 million fur seals had been killed by this time. Fur seals were not seen on South Georgia Island again until 1915 when one was shot during an elephant seal hunt.

In 1820 fur seals were also discovered on the South Shetland Islands (62°S, 58°W) and in 1821 nearly 250,000 seals were killed. They were also discovered on the South Sandwich (57°S, 26°W) and South Orkney (60°S, 45°W) Islands. These populations were quickly depleted. Only a few hundred fur seals survived throughout their range.

By 1907 the Antarctic fur seal was "commercially extinct" (and the species itself was thought by many to be extinct). Since 1958 the Antarctic fur seal population has increased. Today, 1.8 million Antarctic fur seals (95% of the world's population) live on South Georgia Island.

You and your colleagues need to make some graphs and charts, such as timelines, to show the original decline and eventual growth of this population. Discuss why the fur seal might have been hunted. What treaties and conventions protect the Antarctic fur seals?

What other information is needed to make decisions?



Some Antarctic fur seals have "debris collars" on their neck made of packing bands, nylon string, and broken fishing nets. If not removed, the "collars" can cause open wounds.

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