

Goals of the SeaWorld and Busch Gardens Education Departments

Based on a long-term commitment to education and conservation, SeaWorld and Busch Gardens strive to provide an enthusiastic, imaginative, and intellectually stimulating atmosphere to help students and guests develop a lifelong appreciation, understanding, and stewardship for our environment. Specifically, our goals are ...

- To instill in students and guests of all ages an appreciation for science and a respect for all living creatures and habitats.
- To conserve our valuable natural resources by increasing awareness of the interrelationships of humans and the environment.
- To increase students' and guests' basic competencies in science, math, and other disciplines.
- To be an educational resource to the world.

“For in the end we will conserve only what we love. We will love only what we understand. We will understand only what we are taught.” — B. Dioum

Penguins

4–8 Teacher’s Guide

PART OF THE SEAWORLD EDUCATION SERIES

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Front: Adélie penguins (*Pygoscelis adeliae*) leap from the antarctic sea.

Back (clockwise from upper left): Humboldt penguin (*Spheniscus humboldti*) chicks, a rockhopper penguin (*Eudyptes chrysocome*), a SeaWorld aviculturist feeds Humboldt penguins, a SeaWorld Adventure camper meets a Magellanic penguin (*Spheniscus magellanicus*).

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Penguins

4–8 Teacher’s Guide

A SEAWORLD EDUCATION DEPARTMENT PUBLICATION

CONTENTS

Goals and Objectives	2
Vocabulary	2
What is a Penguin?	3
Penguin Parents	4
Penguin Survival	5
A Peek at Penguins	6
Going on an Expedition	9
Penguin Exploration	10
Penguin Soap Surprise	12
Jump or Be Lunch!	14
Penguin Ice Cream Parlor	16
Poster Persuasion	19
Population Calculations	20
Full of Hot Air	22
Bibliography	24
Pre/Post Assessment	inside back cover

To the Teacher

The ***Penguins*** Teacher’s Guide for grades 4–8 was developed at SeaWorld to help you teach your students—in an active, hands-on way—about penguins and the ecology of the ocean. Our goal is to integrate science, mathematics, art, 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 materials 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 *Penguins* Unit

Students will explore the natural history of penguins and recognize that humans are an interconnected part of penguins' ecosystems.

Objectives

After completing the SeaWorld *Penguins* unit, students will be able to...

1. Distinguish between the Northern and Southern Hemispheres and show or tell where various penguin species live.
2. Describe four penguin *adaptations*.
3. Describe how penguins reproduce and care for their young.
4. Discuss how bird experts care for and feed penguin chicks.
5. Express a concern for how human activities may impact penguin populations.
6. Describe the contributions of antarctic explorers and scientists.
7. Share their learning experience with family and friends.

Vocabulary

adaptation — a modification of a species, occurring as a result of natural selection. Adaptations enhance a species' ability to survive.

antarctic — of, at, or near the continent of Antarctica.

countershading — a type of protective coloration in which the dorsal (top) surface is darker than the ventral (underneath) surface. When lighting is from above, the animal appears inconspicuous.

endangered — in danger of becoming extinct.

down — the covering of fine, soft feathers of a young bird; also the soft underfeathers of adult birds.

hypothermia — below-normal body temperature.

predator — an animal that eats other animals. An introduced predator is a predator that doesn't naturally occur

in a particular environment, but was brought there by people.

preen — to clean, arrange, and oil feathers.

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

Species Survival Plan — a program for managing the captive populations of certain threatened or endangered animals, administered by the American Zoo and Aquarium Association (AZA).

threatened — facing a possible threat of extinction, but not facing as great a threat as an endangered species. Threatened species are likely to become endangered.

vulnerable — a category used by the IUCN (International Union for Conservation of Nature and Natural Resources) to refer to species that are not endangered, but that face a high risk of extinction in the medium-term future. Vulnerable species are likely to become endangered.

What is a Penguin?

A penguin is a bird.

All birds have feathers. Penguins have more feathers than most other birds—nearly 11 feathers per square centimeter (about 71 feathers per square inch).

Penguins *preen* their feathers to keep them in good condition, so that they keep water away from their skin. A penguin preens with its bill. A gland near the base of the tail secretes oil that a penguin distributes throughout its feathers.

A fine *down* covers most newly hatched chicks. Down feathers are not waterproof. Adult waterproof feathers grow in after several weeks or months.

Penguins “fly” only under water.

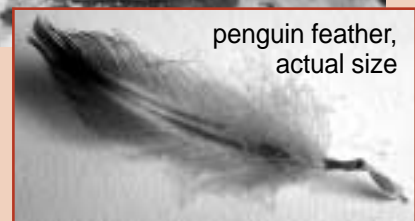
While many birds are lightweight so they can fly, penguins are heavy so they can swim and dive for food. A penguin’s wings are modified into paddlelike flippers. Although these flippers can’t get a penguin off the ground, they’re great for swimming. Webbed feet help a penguin steer as it swims.

Color me countershaded.

All penguins are dark on their backs and white on their chests. How does this *countershading* provide camouflage? Looking down into the dark sea, you might not notice a dark-colored penguin. And if you were below the penguin looking up, the light color of its chest could blend in with the filtered sunlight shining through the water.

Don’t look for penguins in the Arctic.

The earth is divided in half by the equator. All 17 species of penguins live south of the equator. Two species, the emperor and the Adélie, breed only on



penguin feather,
actual size

Overlapping, waterproof feathers cover this chinstrap penguin. Feathers trap a layer of air that helps a penguin keep warm.

the frozen *antarctic* continent. At the other extreme, the Galápagos penguin lives almost astride the equator—on the Galápagos Islands off the coast of Ecuador, South America. The rest live along the Antarctic Peninsula, subantarctic islands, and coastal areas of South America, Africa, Australia, and New Zealand.

Penguin Parents



Penguin chicks “pip” by poking a small hole in the egg. They chip at the shell until they can push off the top. Chicks may take as long as three days to chip their way out.

Which came first, the penguin or the egg?

Like other birds, penguins lay eggs. Some species such as the Humboldt, Magellanic, and fairy penguins nest underground in burrows. These are species that breed in regions where temperatures can range from very cold to quite hot. The temperature of an underground burrow stays relatively constant for the eggs and chicks.

Adélies, chinstraps, and some other species use stones, vegetation, and other materials to make nests.

Some species never build nests. A king or emperor penguin incubates a single egg on the top of its feet. A featherless patch of abdominal skin keeps the egg warm.

Are you my mother?

Penguin chicks require attentive parents for survival. Parents brood (keep warm) chicks by covering them with their brood patch. Both parents feed the chick regurgitated food. Sometimes parent birds cannot take care of their chicks. When this happens at SeaWorld, keepers hand-raise penguin chicks.



An emperor penguin parent holds its chick on the top of its feet, keeping the chick warm under a loose fold of abdominal skin. A fine down covers the newly hatched chick.

Penguin Survival

What do penguins eat?

Penguins eat mostly squids, fishes, and krill. Krill are small crustaceans—relatives of shrimps, crabs, and lobsters. Penguins feed at sea. They catch prey with their strong bills and swallow it whole.



The antarctic krill (illustrated here at actual size) is about 5 centimeters (2 inches) long—and prey for penguins.

Not just penguins eat krill.

Blue whales, right whales, crabeater seals, leopard seals, fishes, and many antarctic seabirds also eat krill. A colony of 5 million Adélie penguins may eat nearly 8 million kg (17.6 million lb.) of krill and small fishes daily.

Several nations already harvest krill as a source of protein. The commercial value of krill may encourage large-scale harvesting of this resource in south polar waters, which would impact penguins and other marine animals that rely upon krill as a food source.

Are penguin populations safe?

All penguins are legally protected from hunting and egg gathering. But other threats still remain. Introduced land *predators* such as cats and dogs prey on penguins. Overeager sightseers and photographers may come too close to breeding areas. Probably the most important problems that penguins face are habitat destruction, oil spills, pollution, and reduction of food resources from overfishing.

The future looks brighter than the past.

SeaWorld is a participating institution in the American Zoo and Aquarium Association *Species Survival Plan* (SSP) for the Humboldt penguin. Since the early 1970s, more than 100 Humboldt penguins have hatched at SeaWorld San Diego.

Through breeding efforts at zoological parks such as SeaWorld and by careful regulation of human interactions, the penguins' future looks secure. If we all continue to act responsibly, we can keep it that way. You can do your part by recycling, saving energy, supporting research on penguins, and learning all you can about penguins and their world.



Humboldt penguins are endangered, and SeaWorld San Diego participates in the Humboldt penguin Species Survival Plan.

A Peek at Penguins

There are 17 species of penguins. Use these cards to help your students identify each penguin species. Copy and cut apart the cards. Distribute a set to each student or group. Have them find out —

- Which is the tallest penguin?
- Which is the heaviest penguin?
- Which is the most numerous penguin?
- Which is the most *endangered* penguin?

NOTE: *Distribution* indicates breeding distribution. *Population* may be expressed as number of individuals or number of breeding pairs, which is estimated by counting penguin nests during the breeding season.

emperor penguin

Aptenodytes forsteri

size: 112 cm (44 in.), 27–41 kg (60–90 lb.)

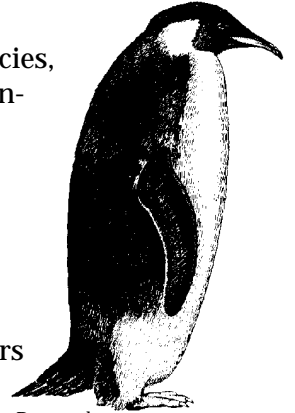
distribution: Antarctica

ID: Largest of the 17 species, emperors have lemon-yellow ear patches that open out onto the chest.

prey: fishes, squids

predators: leopard seals, killer whales, skuas

population: 218,000 breeding pairs



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king penguin

Aptenodytes patagonicus

size: 94 cm (37 in.), 13.5–16 kg (30–35 lb.)

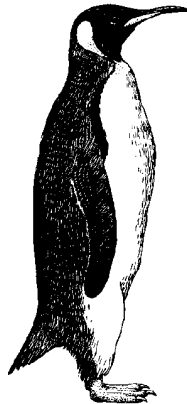
distribution: subantarctic islands

ID: A king penguin's vivid orange, teardrop-shaped ear patches are closed off from the white chest.

prey: squids, fishes

predators: leopard seals, skuas, giant petrels, gulls, sheathbills

population: 1.6 million breeding pairs



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Adélie penguin

Pygoscelis adeliae

size: 46–61 cm (18–24 in.), 3.5–4.5 kg (8–10 lb.)

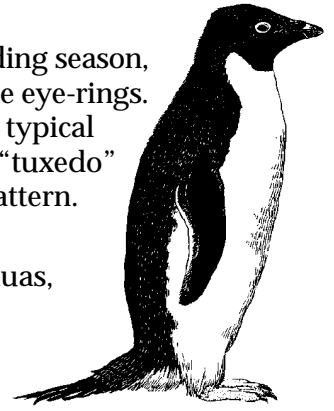
distribution: Antarctica

ID: During the breeding season, adults have white eye-rings. Adélies have the typical black and white "tuxedo" penguin color pattern.

prey: mainly krill

predators: leopard seals, skuas, sheathbills

population: 2.5 million breeding pairs



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gentoo penguin

Pygoscelis papua

size: 61–76 cm (24–30 in.), 5.5–6.5 kg (12–14 lb.)

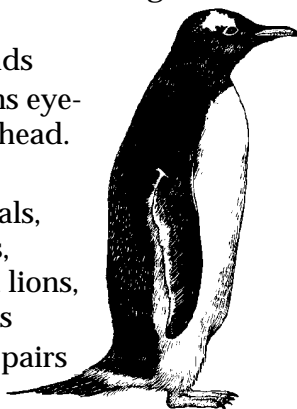
distribution: antarctic and subantarctic islands

ID: A white band runs eye-to-eye across the head.

prey: krill, squid

predators: skuas, leopard seals, antarctic fur seals, New Zealand sea lions, Southern sea lions

population: 317,000 breeding pairs



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chinstrap penguin

Pygoscelis antarctica

size: 46–61 cm (18–24 in.), 4 kg (9 lb.)

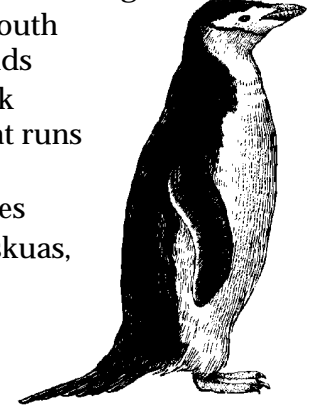
distribution: antarctic and South American islands

ID: Look for a black "chinstrap" that runs under the chin.

prey: krill, small fishes

predators: leopard seals, skuas, sheathbills

population: 7.5 million breeding pairs



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rockhopper penguin*Eudyptes chrysocome*

size: 41–46 cm (16–18 in.), 2.5 kg (5–6 lb.)

distribution: subantarctic islands

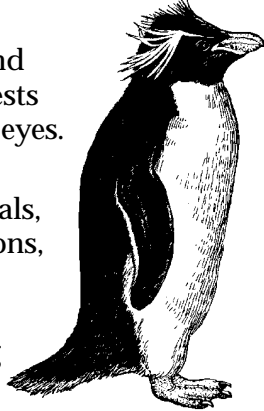
ID: Look for red eyes and drooping yellow crests that start behind the eyes.

prey: fishes, squids, krill

predators: New Zealand fur seals, New Zealand sea lions, Southern sea lions, skuas, gulls

population: 1.8 million breeding pairs—*vulnerable*

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**macaroni penguin***Eudyptes chrysolophus*

size: 51–61 cm (20–24 in.), 4.5 kg (10 lb.)

distribution: subantarctic islands in the Atlantic and Indian oceans

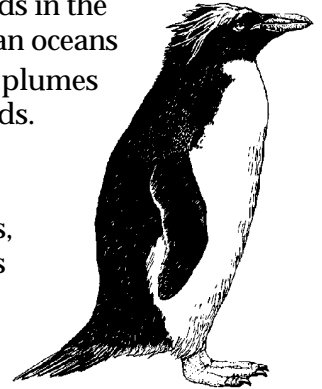
ID: A crest of orange plumes extends backwards.

prey: squids and krill

predators: leopard seals, antarctic fur seals, skuas, sheathbills

population: about 9 million breeding pairs—*near threatened*

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**royal penguin***Eudyptes schlegeli*

size: 66–76 cm (26–30 in.), 5.5 kg (12 lb.)

distribution: Macquarie Island

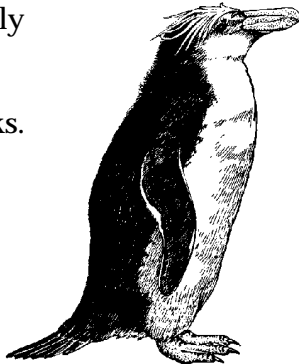
ID: Royals are the only crested penguins that have white throats and cheeks.

prey: krill, squids

predators: New Zealand fur seals, skuas, giant petrels

population: 850,000 breeding pairs—*vulnerable*

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**Fiordland crested penguin***Eudyptes pachyrhynchus*

size: 61 cm (24 in.), 2.5–3 kg (6–7 lb.)

distribution: subantarctic islands and New Zealand

ID: Yellow crests above the eyes and a stout bill.

prey: small fishes, crustaceans, cuttlefish

predators: New Zealand fur seals, stoats (weasel relatives)

population: 2,500 to 3,000 breeding pairs—*vulnerable*

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**erect-crested penguin***Eudyptes sclateri*

size: 64 cm (25 in.), 2.5–3.5 kg (6–8 lb.)

distribution: Australia; New Zealand; Bounty, Campbell, and Auckland Islands

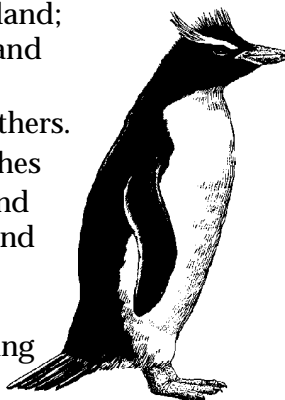
ID: An erect crest of feathers.

prey: probably squids, fishes

predators: possibly New Zealand sea lions, New Zealand fur seals, Australian sea lions

population: 50,000–60,000 breeding pairs—*endangered*

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**Snares Island penguin***Eudyptes robustus*

size: 64 cm (25 in.), 2.5–3 kg (6–7 lb.)

distribution: south of New Zealand in the Snares Islands

ID: Darker and larger than the similar Fiordland crested penguins, with a heavier bill.

prey: squids, fishes

predators: New Zealand sea lions

population: 23,000 breeding pairs—*vulnerable*

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yellow-eyed penguin

Megadyptes antipodes

size: 76 cm (30 in.), 6 kg (3 lb.)

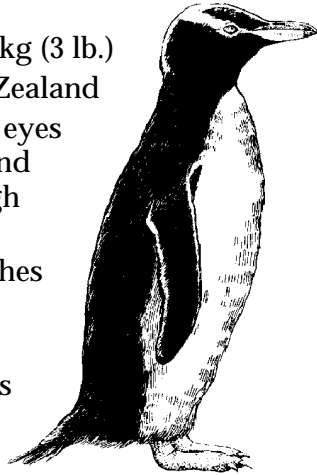
distribution: southeast New Zealand

ID: Look for yellow eyes and a yellow band that runs through each eye.

prey: squids, small fishes

predators: New Zealand sea lions

population: 6,000 individuals
—*vulnerable*



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fairy penguin

Eudyptula minor

size: 41 cm (16 in.), about 1 kg (2 lb.)

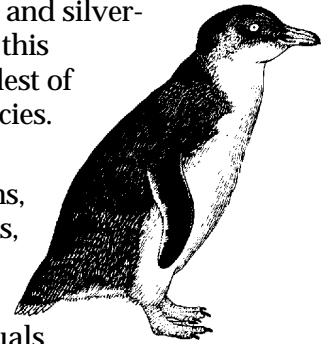
distribution: southern Australia and New Zealand

ID: Slate blue feathers and silver-gray eyes identify this penguin, the smallest of all 17 penguin species.

prey: small fishes

predators: Australian sea lions, fur seals, dogs, cats, stoats, ferrets

population: about 700,000 to 1,200,000 individuals



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Magellanic penguin

Spheniscus magellanicus

size: 61–71 cm (24–28 in.), 5 kg (11 lb.)

distribution: Falkland Islands and Chile and Argentina coasts

ID: Look for two distinct brown chest stripes.

prey: small fishes, cuttlefish

predators: Southern sea lions, leopard seals, Patagonian foxes

population: 1,300,000 pairs
—*near threatened*



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Humboldt penguin

Spheniscus humboldti

size: 56–66 cm (22–26 in.), 4 kg (9 lb.)

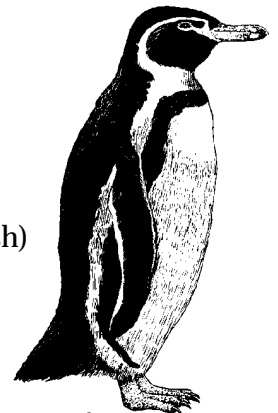
distribution: islands off western South America, and along the coasts of Peru and Chile

ID: Look for just one chest stripe.

prey: anchovetta (small fish)

predators: possibly sharks and Southern sea lions

population: 33,000 individuals
—*endangered*



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African penguin (formerly black-footed penguin)

Spheniscus demersus

size: 61–71 cm (24–28 in.), 3 kg (7 lb.)

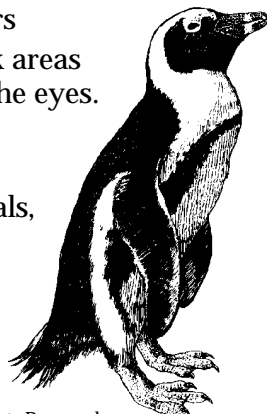
distribution: South African waters

ID: Look for fleshy pink areas around and above the eyes.

prey: squids, crustaceans, fishes

predators: South African fur seals, Southern sea lions, octopus, sharks, sacred ibis, gulls

population: 180,500 individuals
—*threatened*



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Galápagos penguin

Spheniscus mendiculus

size: 53 cm (21 in.), about 2.5 kg (5–6 lb.)

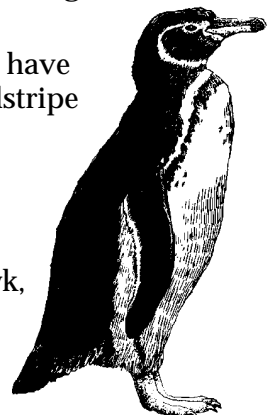
distribution: Galápagos Islands

ID: Galápagos penguins have a narrow white headstripe and almost totally black flippers.

prey: small fishes

predators: sharks, eared barn owls, Galápagos hawk, feral cats, dogs

population: 1,500 to 4,000 pairs
—*endangered*



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Going on an Expedition

OBJECTIVES

Students will use a variety of reference materials to research a subject and will relate the results of their research orally and in writing. They will describe the accomplishments of antarctic explorers and scientists.

MATERIALS

- reference materials (*Use your library and a computer with Internet access.*)
- paper
- pencils or pens

BACKGROUND

The ability to use the Internet and library references to do research is a critical skill for students. This activity gives students practice using these investigative skills.

Antarctica is a continent without any native human inhabitants. At least for now, Antarctica is protected by the Antarctic Treaty. This Treaty bans military activity, nuclear testing, and radioactive waste dumping in Antarctica. It protects the continent's plant and animal species. Antarctica is open to all nations for scientific investigation. The antarctic ecosystem is a strong and healthy one, but it is extremely sensitive to outside disturbance. Life has adapted to survive in one of the world's harshest environments.

ACTION

Individually or in groups, students use reference materials and the Internet to research the accomplishments of an antarctic explorer or scientist. Ask students to create written "logs" of the explorer's trip, and to present verbal news accounts. Invite students to relate their findings to the class as if they were the explorers.

DEEPER DEPTHS

Research the work of penguin scientists such as David Ainley, Gerald Kooyman, Frank Todd, Bernard Stonehouse, or Wayne Trivelpiece. Can students find other penguin researchers?

<i>explorer</i>	<i>country</i>	<i>accomplishment</i>
Roald Amundsen	Norway	first man to reach the south pole, 1911
Richard E. Byrd	USA	first to use aircraft in the Antarctic, 1929
Jules Dumont D'Urville	France	traveled closest to magnetic south pole, 1840
Douglas Mawson	Australia	geographic and scientific discoveries, 1909-1929
Nathaniel Palmer	USA	discovered mainland of Antarctica, 1820
James Clark Ross	England	antarctic expeditions, 1841
Robert Falcon Scott	England	second man to reach the south pole, 1911
Ernest Shackleton	Ireland	attempted to cross Antarctica, 1914-1916
Charles Wilkes	USA	led first American expedition to Antarctica, 1838

Penguin Exploration

OBJECTIVES

Students will be able to identify on a globe or map the location of the Southern Hemisphere, Antarctica, the Southern Ocean, and several areas inhabited by penguins. They will describe two environments where penguins live and discuss the interaction of humans and penguins in two habitats.

MATERIALS

- map pins, flags, or stickers
 - butcher paper
 - opaque projector or photocopier
- per student group:*
- Southern Hemisphere map on page 11

ACTION

1. Divide your class into cooperative learning groups. Each group uses an opaque projector to magnify and transfer continents from the penguin species distribution onto butcher paper. (Or do this ahead of time for each group.)
2. Have students label maps. Include the equator, latitude and longitude numbers, names of the islands and peninsulas inhabited by penguins, and other geographical landmarks.
3. Create a map legend: assign a different color flag, pin, or sticker to each penguin species.
4. Use pages 6–8 to learn where each species lives. Have students place pins on the map to show areas inhabited by each species.



This gentoo penguin is at home in the ice and snow of the Antarctic and subantarctic.

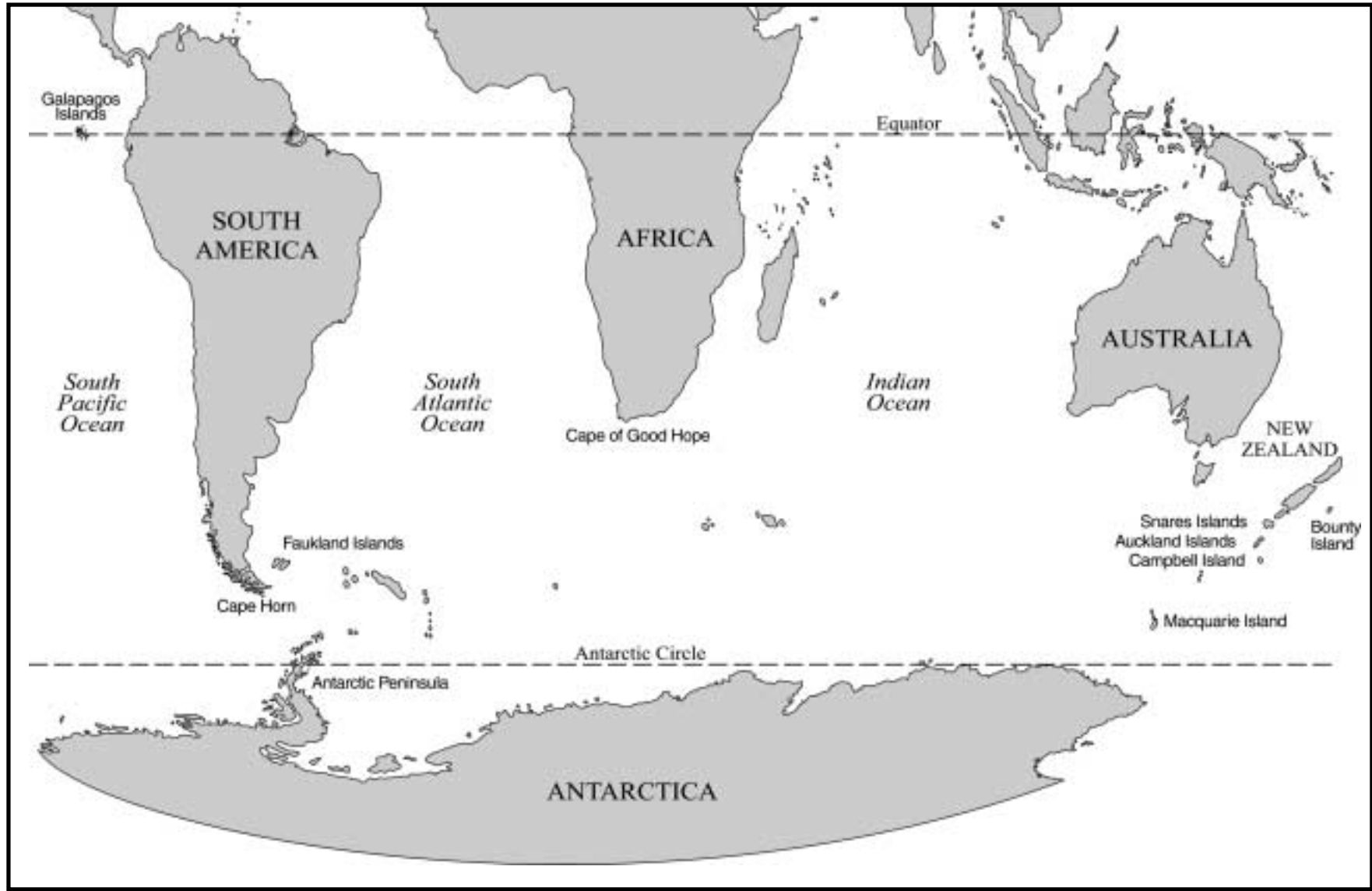
DEEPER DEPTHS

Assign each student group an island or continent where penguins live. Allow the groups time to research their region. They should include habitat, animal inhabitants, human inhabitants and cultures, and food sources for animals and humans.

Have each group estimate the distance from their assigned land mass to others nearby.

Give each group a chance to share their information with the class.

Southern Hemisphere



Penguin Soap Surprise

OBJECTIVES

Students will make a penguin egg from soap and use the soap egg to practice charting and approximation skills.

BACKGROUND

Penguins and other birds hatch from eggs. The time between egg-laying and egg-hatching is called the incubation period. During incubation the parent keeps the egg warm. Incubation periods for penguins range from one to two months. A chick “pips” the egg when it pokes a small hole in the shell with its beak. Penguin chicks may take up to three days to chip out of the shell.

MATERIALS

per student:

- plastic or ceramic penguin figurines (under 2½")
- one white bar soap
- small plastic sandwich bag
- cheese grater (or students can share)
- waxed paper (12" x 12")
- Penguin Soap Surprise*** chart on page 13

per class:

- water (in cups or bowls)
- paper towels
- newspaper



ACTION

1. Set up work area: cover tables with newspaper and lay out waxed paper, graters, water, and paper towels.
2. Distribute one penguin and one soap bar to each student.
3. Students use the cheese grater to grate their soap into flakes, then mix the flakes with a small amount of water until they form a soft dough.
4. Students wet the penguins and their hands. They form the soap dough around the penguin, packing the soap firmly and shaping it into an egg. Place the soap eggs aside to dry.
5. When the soap eggs are dry, place them in plastic bags. Students take home their soap eggs and a copy of the ***Penguin Soap Surprise*** chart. Students return charts when their penguin “hatches” (in about two weeks).
6. Compare and chart student results. To make a chart, use number of hand washings and number of days as your variables.
7. Discuss how the size and shape of the soap egg determines how fast the egg seems to dissolve.

DEEPER DEPTHS

Present each student with an award such as “Cleanest Hands” or “Most Efficient Use of Soap Egg.”

Investigate the sizes, shapes, and colors of other bird eggs.

Find out why soap is used to clean hands and kill germs.

Name _____ Start date _____

Penguin Soap Surprise

Put your penguin egg soap in your bathroom at home. Each time you wash your hands with the soap egg, mark your chart. Try to keep the time and amount of soap you use the same each time. Note the first appearance (pipping) of the penguin and when the soap is all used up (chick hatches). Ask other family members not to use your soap unless they want to help you with your study.

STARTING PREDICTION

I predict it will take _____
(number) hand washings for my penguin to “hatch.”

PENGUIN SOAP SURPRISE — WEEK ONE							
	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7
<i>hand washings</i>							

END OF WEEK ONE TALLY

day/date _____ total number of hand washings _____

END OF WEEK ONE PREDICTION

I predict it will take _____
(number) more hand washings for my penguin to “hatch.”

PENGUIN SOAP SURPRISE — WEEK TWO							
	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7
<i>hand washings</i>							

END OF WEEK TWO TALLY

day/date _____ total number of hand washings _____

FIRST APPEARANCE OF PENGUIN

My penguin “pipped” (first appearance) on (day/date) _____

My penguin “hatched” (all soap was used) on (day/date) _____

Total number of days to penguin chick hatching: _____

Total number of times penguin soap was used in hand washing: _____

Jump or Be Lunch!

OBJECTIVES

Students will predict how high they can jump and then compare the height of their jumps to how high a rockhopper penguin can jump out of the water. They will practice mathematical skills for determining averages.

MATERIALS

- measuring tape (inch and centimeter)
- chalk
- Jump or Be Lunch!*** funsheet on page 15
- pens or pencils

BACKGROUND

To avoid predators along the shore, penguins can jump up onto rocks and ice for safety. A 43-centimeter (17-inch) rockhopper penguin can jump 0.9 to 1.2 meters (3–4 feet) out of the water to escape predators—a jump nearly three times the penguin's height!

ACTION

1. For this activity you will use an outside wall of your classroom, handball wall, or another smooth outside wall.
2. Students work with partners and take turns. First, each student, holding a piece of chalk, stands facing the wall with his or her toes almost touching it. Keeping both heels on the ground, the student raises both hands overhead and marks with chalk the highest point he or she can reach. The student's partner records this number (in inches and centimeters) on the funsheet. Each student reaches three times, recording each reach.
3. Students predict how high they can jump. They record this number.
4. From a standing position, each student jumps and marks the wall with chalk. The partner records the measurement. Each student jumps three times, recording each jump.
5. Students calculate an average measured reach and an average measured jump. (Add together the numbers from the three trials and divide by 3.)
6. Students calculate how high they can jump (average jump height - average reach height = total jump). How do their jumps compare to their predictions?
7. Have students calculate how high they would have to jump to reach three times their height.



Adélie penguins can jump onto shore to escape marine predators.

Jump or Be Lunch!

Student 1 name: _____

jump prediction: _____ in. _____ cm.

	measured reach		measured jump	
<i>trial one</i>	in.	cm.	in.	cm.
<i>trial two</i>	in.	cm.	in.	cm.
<i>trial three</i>	in.	cm.	in.	cm.
<i>AVERAGE</i>	in.	cm.	in.	cm.

actual jump height: $\frac{\text{_____}}{\text{(average measured jump)}} - \frac{\text{_____}}{\text{(average measured reach)}} = \text{_____}$

“rockhopper” jump potential: $\frac{\text{_____}}{\text{(student's height)}} \times 3 = \text{_____}$

Student 2 name: _____

jump prediction: _____ in. _____ cm.

	measured reach		measured jump	
<i>trial one</i>	in.	cm.	in.	cm.
<i>trial two</i>	in.	cm.	in.	cm.
<i>trial three</i>	in.	cm.	in.	cm.
<i>AVERAGE</i>	in.	cm.	in.	cm.

actual jump height: $\frac{\text{_____}}{\text{(average measured jump)}} - \frac{\text{_____}}{\text{(average measured reach)}} = \text{_____}$

“rockhopper” jump potential: $\frac{\text{_____}}{\text{(student's height)}} \times 3 = \text{_____}$

Penguin Ice Cream Parlor

OBJECTIVES

Students use math skills and formulas to convert metric quantities to English equivalents. They practice measuring ingredients to prepare a simulated animal formula.

BACKGROUND

Both male and female penguins feed their young by regurgitating partially digested fish and krill. In zoological parks like SeaWorld, bird experts feed hand-raised penguin chicks a formula that imitates their natural diet.

MATERIALS

per student group:

- kitchen scale
- kitchen blender
- kitchen measuring cups and spoons
- copy of ***Penguin Ice Cream Parlor*** funsheet on pages 17–18
- milkshake ingredients in amounts given in ANSWERS box below, plus 1 tsp. chocolate syrup.

ACTION

1. Divide class into student groups. Distribute a ***Penguin Ice Cream Parlor*** funsheet to each group. As a class, read “Penguin Chick Formula” recipe. Discuss ingredients. How does the formula imitate regurgitated fish and krill fed by adults?
2. Have groups read “Student Formula (No Fish!)” recipe and complete the ingredient conversions.
3. Students are now ready to create their recipes. Display formula ingredients on a classroom table and have a student from each group measure milkshake ingredients.
4. As a class, check conversion values and discuss calculation differences. Why is precise measuring important in preparing animal formulas?

ANSWERS

1. $220 \times 0.035 = 7.7$ **ounces**
peeled bananas
2. $220 \times 0.035 = 7.7$ **ounces** ice cream
3. $0.420 \times 4.226 = 1.8$ **cups** milk
4. four malted milk balls
5. $0.275 \times 0.035 = 0.01$ **ounce** cocoa powder
6. 1 jellybean
7. two chocolate chips
9. $1 \times 0.204 = 0.2$ **teaspoons** vanilla extract

DEEPER DEPTHS

Have students research and compare nutritional needs of dogs and cats by reading pet food labels. Is there a difference? Why? Students design their own specialty pet food.

Penguin Ice Cream Parlor

Student names _____

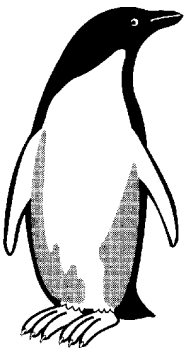
Penguin Chick Formula Recipe

Blend ingredients thoroughly. Strain through large colander and discard large particles. Mark container with date and time. Refrigerate. Use within 24 hours.

To feed chicks, warm formula in a double-boiler pot to 32.2°C (90°F). Fill feeding syringe with formula. Solicit feeding response in a chick by placing two fingers (forming a "V") over the chick's bill. Gently position feeding syringe over the chick's mouth and slowly give formula. Make sure that the chick continues to swallow the formula as you deliver it. Note the penguin chick's weight both before and after feeding, and the amount of food given.

INGREDIENTS

- 220 grams whole herring (with head, tail, fins, and skin removed before weighing)
- 220 grams krill (squeeze off excess water)
- 0.420 liters bottled drinking water
- four Brewer's yeast tablets
- 0.275 grams vitamin B1 (thiamine)
- one seabird multivitamin
- two calcium carbonate tablets
- 600 I.U. (International Units) Vitamin E
- 1 milliliter liquid multivitamin (pediatric) drops with iron



Converting metric units to English units

<i>to convert</i>	<i>into</i>	<i>multiply by:</i>
grams (g)	ounces (oz.)	0.035
liters (l)	cups (c)	4.226
milliliters (ml)	teaspoons (tsp.)	0.204

Penguin Ice Cream Parlor

STUDENT FORMULA (NO FISH!)

Use your math skills to convert the “Penguin Chick Formula” recipe to one you will enjoy. Use the worksheet below and the equivalent values listed under the “Penguin Chick Formula” box. When finished, use the ingredients in the amounts you calculated to blend your “Student Formula.” Round up answers when necessary.

1. 220 grams herring 220 g x _____ =	_____ ounces peeled bananas
2. 220 grams krill 220 g x _____ =	_____ ounces ice cream
3. 0.420 liters water 0.420 l x _____ =	_____ cups milk
4. 4 Brewer’s yeast tablets substitute	_____ malted milk balls
5. 0.275 grams vitamin B1 0.275 g x _____ =	_____ ounces cocoa powder
6. 1 sea bird multivitamin substitute	_____ jellybean
7. 2 calcium carbonate tablets substitute	_____ chocolate chips
8. 600 I.U. Vitamin E substitute	_____ <i>1</i> _____ teaspoon chocolate syrup
9. 1 milliliter multivitamin 1 ml x _____ =	_____ teaspoons vanilla extract

Collect your ingredients in the amounts you calculated. Use a blender to combine ingredients. How does your formula taste? Does it taste the same or different than formulas created by other student groups?

Poster Persuasion

OBJECTIVES

The student will be able to show an understanding of how human activities may impact penguins' survival. The student will be able to demonstrate an ability to use elements and principles of design to bring about public awareness in a creative way.

MATERIALS

- posterboard (one per student or student group)
- art materials
- reference materials

BACKGROUND

The goal of effective advertising is to persuade someone to do something. In this activity, students encourage people to change a behavior.

ACTION

1. Begin this project by discussing information and conservation issues addressed in this Guide. *(Also look for additional reference materials such as those on page 24, or search the Internet).* Identify endangered penguin species and discuss environmental threats such as oil spills.
2. Students will create “advertising” posters. They can work individually or in groups to develop and design posters to increase public awareness of threats to penguins and associated conservation solutions.
3. Before you begin, ask students to identify their audience and what they want their audience to do. Encourage students to create new ways to get public attention



Sightseers are careful not to interfere with normal penguin activity.

DEEPER DEPTHS

Display posters in your school or community, or have students share their posters with other classrooms.

Have students create public service radio or TV spots to encourage public awareness of penguins and associated conservation issues. Students write scripts; operate recording equipment; and provide lighting, props, and voices.

Population Calculations

OBJECTIVES

Students make decisions about how to solve problems using math skills.

MATERIALS

- Population Calculations*** funsheet on page 21
- calculators
- pencils and paper

BACKGROUND

In June 2000 an iron ore carrier, the *MV Treasure*, sank off the coast of South Africa, leaking tons of oil into the sea. The oil spill threatened the African penguins inhabiting Dassen and Robben Islands, which comprise about 40% of the total African penguin population. The Southern African National Foundation for the Conservation of Coastal Birds (SANCCOB) coordinated rehabilitation efforts for nearly 19,000 oiled penguins and the rescue of another 19,000 un-oiled penguins that were relocated until the area was cleaned up. SeaWorld penguin experts flew to Cape Town, South Africa to assist with the cleaning and care of the oiled penguins.

ACTION

Distribute the ***Population Calculations*** funsheet. Review new concepts or words before starting. Students work individually or in small cooperative learning groups. They use another sheet of paper for calculations.

ANSWERS

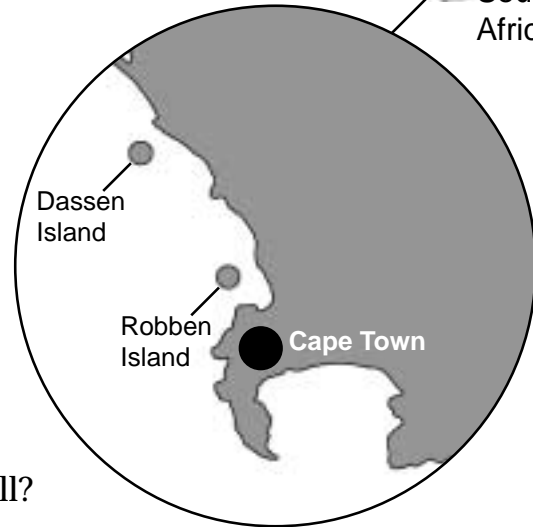
1. $55,000 \div 182,500 = 0.301$ or **30%**
2. $18,000 \div 182,500 = 0.099$ or **10%**
3. $30\% + 10\% = \mathbf{40\%}$
[Or, $(55,000 + 18,000) \div 182,500 = 40\%$]
4. $3,516 + 14,825 + 500 = \mathbf{18,841}$ penguins
5. $18,841 + 19,506 = \mathbf{38,347}$ penguins
6. $38,347 \div 182,500 = 0.21$ or **21%**
7. $2,000 \div 182,500 = 0.01$ or **1%**
8. $182,500 - 2,000 = \mathbf{180,500}$ penguins



SeaWorld bird experts flew to Cape Town, South Africa to help clean and care for oiled African penguins after a devastating oil spill.

Population Calculations

You are a member of a team of scientists studying African penguins off the coast of South Africa. In early 2000 your team estimated that there were 55,000 African penguins on Dassen Island and 18,000 penguins on Robben Island.



1. If the total African penguin population is 182,500 penguins, what percentage of the world's African penguins inhabit Dassen Island?
2. What percentage of African penguins inhabit Robben Island?
3. On June 23, 2000, a huge ship sank off the African coast near Dassen and Robben Islands. The ship leaked fuel oil, diesel, and lube oil into the sea. Ocean currents spread the oil toward Dassen and Robben Islands. What percentage of the African penguin population was threatened by this oil spill?
4. Bird rescue experts worked quickly to collect oiled penguins and move them to an emergency rehabilitation facility. They collected 3,516 oiled penguins from Dassen Island, 14,825 oiled penguins from Robben Island, and another 500 oiled penguins from other nearby areas of the coast. At the rehabilitation facility bird experts washed and cared for the oiled birds. How many birds arrived at the rehabilitation facility?
5. Wildlife experts also collected another 19,506 healthy, un-oiled penguins from Dassen and Robben Islands and moved them about 800 kilometers (about 500 miles) out of harm's way until the oil could be cleaned up. How many total penguins were removed from the oil spill area?
6. What percentage of the total African penguin population was handled during the oil spill?
7. Remarkably, bird rehabilitation experts were able to save most of the penguins that were rescued. Experts estimate that about 2,000 penguins died as a result of the oil spill. What percent of the population is this?
8. What was the population of African penguins after the oil spill?

Full of Hot Air

OBJECTIVES

Students will demonstrate the insulating qualities of trapped air and infer how feathers help insulate birds.

BACKGROUND

Why are oil spills so devastating for penguins? Penguins rely on clean feathers for waterproofing and insulation. When fouled with oil, they try to clean their feathers. Oiled penguins often die of *hypothermia* or from ingesting the toxic oil.

MATERIALS

per student group:

- Full of Hot Air** funsheet on page 23
- clay
- two student lab thermometers
- newspaper
- two small zip-top plastic bags
- waterproof tape
- ice and water
- one 5-inch-deep plastic container

ACTION

1. Distribute **Full of Hot Air** funsheet and other materials to student groups.
2. Clay and thermometers must be at room temperature. Form the clay into two equal-sized solid balls about 2 inches in diameter. Check thermometers to make sure that they are both the same temperature and record the readings. Put thermometer ends into the centers of each clay ball.
3. Put a clay ball in each bag, with thermometers extending out the bag top. Tear newspaper into thin strips. Surround the clay ball in one bag with newspaper strips. Fill the bag, but don't pack it too tightly.
4. Seal the bag without newspaper strips, forcing air out of the bag as you seal it. Use tape to seal both bags tightly around thermometer stems.
5. Fill the tub or bucket with ice and water. Have students predict how thermometer temperature will change once bags are immersed in ice water. Will both bags stay the same temperature? Will one be colder than the other?
6. Immerse both bags in the ice water up to the tape level. After five minutes, read the thermometers and record the temperatures. Which bag lost the least amount of heat?
7. Discuss how the newspaper strips trap air and provide insulation. Discuss how penguins depend on air trapped in their feathers for insulation. What would happen if a penguin's feathers were soiled by an oil spill?

DEEPER DEPTHS

Use the Internet to find out how bird experts clean oiled penguins.

Full of Hot Air

Student names _____

	beginning temperature	predicted end temperature	actual end temperature
bag with newspaper			
bag without newspaper			

1. Which bag's thermometer reading was the coldest after 5 minutes—the bag with newspaper strips or the bag without newspaper strips?

2. Hypothesize what kept the clay in this bag warmer.

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Penguin Predicament, 2000

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*Available through SeaWorld San Diego. Call 1-800-380-3202 for prices.

Penguins Pre/Post Assessment

Use this assessment to discover how much your students already know about penguins before you begin this unit, and later as a conclusion to your study.

- Draw a penguin and label four parts of a penguin's body. Tell how these parts help a penguin survive on land or in the ocean.
- Name all the different kinds of penguins you know. Can you name all 17 species?
- Using a globe or world map, identify the equator, Northern and Southern Hemispheres, and Antarctica. If you were a scientist studying penguins, where would you go to find them?
- Name the body covering of penguins. How does this body covering help keep them warm?
- Describe the contributions of an antarctic explorer or scientist.
- Imagine you had a penguin chick. How would you feed and care for it?
- Describe the effects of an oil spill on a penguin population.

National Science Education Standards Connections in this Guide

*Connections to National Science Education **Life Sciences** Standards include:*

- Structure and function of living systems
- Populations and ecosystems
- Reproduction and heredity
- Diversity and adaptations of organisms
- Regulation and behavior

*Connections to National Science Education in **Personal and Social Perspectives** Standards include:*

- Population, resources, and environments
- Science and technology in society

*Connections to National Science Education **History and Nature of Science** Standards include:*

- Science as a human endeavor
- History of science
- Nature of science

*Connections to National Science Education **Science as Inquiry** Standards include:*

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Unifying Concepts and Processes to help students understand the natural world include:

- Systems, order, and organization
- Evolution and equilibrium
- Evidence, models, and explanation
- Form and function
- Change, constancy, and measurement

National Research Council. *National Science Education Standards*. Washington, D.C.: National Academy Press, 1996.

Want more information?

If you have a question about aquatic animals, call **1-800-23-SHAMU** (1-800-237-4268). TDD users call **1-800-TD-SHAMU** (1-800-837-4268). These toll-free phone numbers are answered by the SeaWorld Education Department.

The SeaWorld Education Department has books, teacher's guides, posters, and videos available on a variety of marine animals and topics. Call or write to request an Education Department Publications catalog.

Visit the SeaWorld/Busch Gardens Animal Information Database at www.seaworld.org

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