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).
## 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.

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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.

derangered — 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 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

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.

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.

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

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.

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.
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.

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.
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

**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

**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

**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

**chimstrap 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 “chimstrap” that runs under the chin.
- **prey:** krill, small fishes
- **predators:** leopard seals, skuas, sheathbills
- **population:** 7.5 million breeding pairs
**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

**Macaroni Penguin**
*Eudyptes chrysolophus*
- **Size:** 51–61 cm (20–24 in.), 4.5 kg (10 lb.)
- **Distribution:** Subantarctic islands and New Zealand
- **ID:** A crest of orange plumes extends backwards.
- **Prey:** Squids, crustaceans, cuttlefish
- **Predators:** New Zealand sea lions, antarctic fur seals, skuas, sheathbills
- **Population:** About 9 million breeding pairs—near threatened

**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

**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

**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

**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
### 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

### 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

### 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 — vulnerable

### 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

### 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

### 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
## 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. As of 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?

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

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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.

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.

This gentoo penguin is at home in the ice and snow of the Antarctic and subantarctic.
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.
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 _____ hand washings for my penguin to “hatch.”

<table>
<thead>
<tr>
<th>PENGUIN SOAP SURPRISE — WEEK ONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAY 1</td>
</tr>
<tr>
<td>hand washings</td>
</tr>
</tbody>
</table>

**END OF WEEK ONE TALLY**
day/ date _________ total number of hand washings __________

**END OF WEEK ONE PREDICTION**
I predict it will take _____ more hand washings for my penguin to “hatch.”

<table>
<thead>
<tr>
<th>PENGUIN SOAP SURPRISE — WEEK TWO</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAY 1</td>
</tr>
<tr>
<td>hand washings</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th></th>
<th>measured reach</th>
<th>measured jump</th>
</tr>
</thead>
<tbody>
<tr>
<td>trial one</td>
<td>in. cm.</td>
<td>in. cm.</td>
</tr>
<tr>
<td>trial two</td>
<td>in. cm.</td>
<td>in. cm.</td>
</tr>
<tr>
<td>trial three</td>
<td>in. cm.</td>
<td>in. cm.</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>in. cm.</td>
<td>in. cm.</td>
</tr>
</tbody>
</table>

**actual jump height:**  
\[
\frac{\text{average measured jump}}{\text{average measured reach}} = \text{__________}
\]

**“rockhopper” jump potential:**  
\[
\text{(student’s height)} \times 3 = \text{__________}
\]

---

**Student 2 name:** ____________________________________________

**jump prediction:** _______ in. _______ cm.

<table>
<thead>
<tr>
<th></th>
<th>measured reach</th>
<th>measured jump</th>
</tr>
</thead>
<tbody>
<tr>
<td>trial one</td>
<td>in. cm.</td>
<td>in. cm.</td>
</tr>
<tr>
<td>trial two</td>
<td>in. cm.</td>
<td>in. cm.</td>
</tr>
<tr>
<td>trial three</td>
<td>in. cm.</td>
<td>in. cm.</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>in. cm.</td>
<td>in. cm.</td>
</tr>
</tbody>
</table>

**actual jump height:**  
\[
\frac{\text{average measured jump}}{\text{average measured reach}} = \text{__________}
\]

**“rockhopper” jump potential:**  
\[
\text{(student’s height)} \times 3 = \text{__________}
\]
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.

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 x 0.035 = 7.7 ounces peeled bananas
2. 220 x 0.035 = 7.7 ounces ice cream
3. 0.420 x 4.226 = 1.8 cups milk
4. four malted milk balls
5. 0.275 x 0.035 = 0.01 ounce cocoa powder
6. 1 jellybean
7. two chocolate chips
9. 1 x 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.

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.
**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**

<table>
<thead>
<tr>
<th>to convert</th>
<th>into</th>
<th>multiply by</th>
</tr>
</thead>
<tbody>
<tr>
<td>grams (g)</td>
<td>ounces (oz.)</td>
<td>0.035</td>
</tr>
<tr>
<td>liters (l)</td>
<td>cups (c)</td>
<td>4.226</td>
</tr>
<tr>
<td>milliliters (ml)</td>
<td>teaspoons (tsp.)</td>
<td>0.204</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Equivalent Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 220 grams herring</td>
<td>x ___________ = ___ ounces peeled bananas</td>
</tr>
<tr>
<td>2. 220 grams krill</td>
<td>x ___________ = ___ ounces ice cream</td>
</tr>
<tr>
<td>3. 0.420 liters water</td>
<td>x ___________ = ___ cups milk</td>
</tr>
<tr>
<td>4. 4 Brewer’s yeast tablets</td>
<td>____ malted milk balls</td>
</tr>
<tr>
<td>5. 0.275 grams vitamin B1</td>
<td>x ___________ = ___ ounces cocoa powder</td>
</tr>
<tr>
<td>6. 1 sea bird multivitamin</td>
<td>____ jellybean</td>
</tr>
<tr>
<td>7. 2 calcium carbonate tablets</td>
<td>____ chocolate chips</td>
</tr>
<tr>
<td>8. 600 I.U. Vitamin E</td>
<td>1 ____ teaspoon chocolate syrup</td>
</tr>
<tr>
<td>9. 1 milliliter multivitamin</td>
<td>x ___________ = ___ teaspoons vanilla extract</td>
</tr>
</tbody>
</table>

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.

**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.

Sightseers are careful not to interfere with normal penguin activity.
### 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. $30\% + 10\% = 40\%$
   
   [Or, $(55,000 + 18,000) \div 182,500 = 40\%$]
4. $3,516 + 14,825 + 500 = \boxed{18,841}$ penguins
5. $18,841 + 19,506 = \boxed{38,347}$ penguins
6. $38,347 \div 182,500 = 0.21$ or **21%**
7. $2,000 \div 182,500 = 0.01$ or **1%**
8. $182,500 - 2,000 = \boxed{180,500}$ 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**

<table>
<thead>
<tr>
<th></th>
<th>beginning temperature</th>
<th>predicted end temperature</th>
<th>actual end temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>bag with newspaper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bag without newspaper</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
Bibliography


Shamu TV on Video*

Penguin Predicament, 2000

Books for Young Readers


*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
- Reproduction and heredity
- Regulation and behavior
- Populations and ecosystems
- Diversity and adaptations of organisms

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
- Nature of science
- History 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
- Evidence, models, and explanation
- Evolution and equilibrium
- Form and function
- Change, constancy, and measurement


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