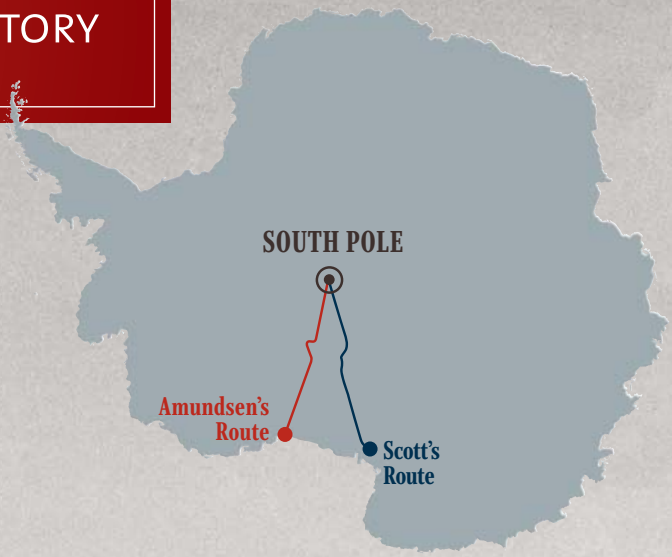
American Museum of Natural History



RACE

to the End

OF THE EARTH

Roald Amundsen

Robert Falcon Scott

EDUCATOR'S GUIDE

amnh.org/education/race

INSIDE:

- Suggestions to Help You **Come Prepared**
- **Essential Questions** for Student Inquiry
- Strategies for **Teaching in the Exhibition**
- **Map** of the Exhibition
- **Online Resources** for the Classroom
- Correlation to **Standards**
- **Glossary**

ESSENTIAL QUESTIONS

Who would be first to set foot at the South Pole, Norwegian explorer Roald Amundsen or British Naval officer Robert Falcon Scott? Tracing their heroic journeys, this exhibition portrays the harsh environment and scientific importance of the last continent to be explored. Use the Essential Questions below to connect the exhibition's themes to your curriculum.

What is Antarctica?

Antarctica is Earth's southernmost continent. About the size of the United States and Mexico combined, it's almost entirely covered by a thick **ice sheet** that gives it the highest average elevation of any continent. This ice sheet contains 90% of the world's land ice, which represents 70% of its fresh water. Antarctica is the coldest place on Earth, and an encircling polar ocean current keeps it that way. Winds blowing out of the continent's core can reach over 320 kilometers per hour (200 mph), making it the windiest. Since most of Antarctica receives no precipitation at all, it's also the driest place on Earth. Its landforms include high plateaus and active volcanoes. The **austral** winters and summers resemble one long night and one long day between weeks of sunrise and sunset. Although most life is concentrated on the shoreline and surrounding waters, microbes thrive in unexpected places like dry valleys and ice-capped brine lakes.

How has Antarctica changed over time?

Fossils, rocks, and **ice cores** reveal that Antarctica was once very different. Until around 30 million years ago, **temperate** conditions would have permitted plants and animals (including mammals and birds) to survive, although they would have had to adapt to a very brief summer. Today, besides a variety of **microbial** life, few species (which include penguins, seals, seabirds, and **tundra**-like vegetation) have characteristics that enable them to live there. These traits include fur and physiological **adaptations** such as the "antifreeze" molecules in the blood of certain fish.

Why explore Antarctica?

Early sightings of the continent were made by maritime explorers, whalers, and seal hunters. By the mid-1800s, drawn by trade, imperialism, or curiosity, a number of expeditions had braved the icy continent's brutal conditions. Exploration was a symbol of national pride, and in 1910 two very different men staked their fortunes on a race to the South Pole. One was Norwegian Roald Amundsen, an experienced polar explorer who sought the recognition in order to garner support for further voyages. The other, British Naval officer Robert Falcon Scott, hoped to advance both his career and scientific understanding of this strange territory. Scientists who accompanied Scott laid the groundwork for discoveries in fields ranging from magnetism to ornithology.

What do explorers need to survive during polar expeditions?

Roald Amundsen in loose fur clothing adopted from his time in the Canadian Arctic. "I find it excellent," he reported. "Am always warm, without sweating."

Exploring Antarctica involved great danger and unimaginable physical hardship. Hazards included snow blindness, malnutrition, frostbite, **crevasses**, and howling **blizzards**. With ground and sky often merging into a featureless plain, navigation was difficult. To deal with these challenges, Scott and Amundsen adopted very different strategies. Scott brought ponies, dogs, and motorized vehicles, and once on the polar plateau relied on men in harnesses to pull long, heavy sleds. Adopting technologies learned from the Inuit in the Arctic, Amundsen and his men skied alongside custom-designed dog sleds. Today's travelers arrive in airplanes instead of wooden ships, navigate by GPS instead of sextant, wear moisture-resistant and windproof clothing instead of wool and reindeer fur, and communicate via satellite.

Why is Antarctica important today?

Known as "the continent of science," this vast natural laboratory is protected from military and commercial use by the **Antarctic Treaty**. Ice cores contain a record of how the ice sheets formed and moved, and how climate changed in the past. The unpolluted atmosphere at the bottom of the world is superb for astronomy. Fossil finds help paleontologists chart the **biogeography** of the southern hemisphere, and support the theory of continental drift. Biologists are finding organisms that illuminate the history of life. It is Antarctica's unique conditions that make these explorations possible.

GLOSSARY

adaptation: a trait — physical, chemical, or behavioral — that has evolved by natural selection and enhances an organism's survival and reproduction

Antarctic Treaty: In 1961, 12 countries signed a treaty establishing that the continent belonged to all and would be used for peaceful purposes only — in particular scientific investigation and collaboration. 48 nations are now parties to this treaty.

austral: relating to the southern hemisphere. Earth rotates around the Sun on a tilted axis that creates the seasons, which are opposite at the two poles. In Antarctica the brief austral summer runs between mid-December and mid-March.

crevasse: a deep crack in the ice sheet, sometimes concealed by snow

biogeography: the distribution of plants and animals across the planet

blizzard: a violent snowstorm with high winds. In Antarctica, the snow is blown up from the ground.

fossil: remains or traces of ancient life typically preserved in sedimentary rocks

ice core: drilled through thick ice sheets, these cylindrical samples contain a climate time capsule. The record in Antarctica presently stretches back 800,000 years.

ice sheet: a thick blanket of ice formed by the accumulation and compression of thousands or millions of years of snowfall. Ice sheets that float out over water are called ice shelves.

microbial: involving microbes, single-celled life forms usually invisible to the naked eye

overwinter: to wait out the winter, as early Antarctic explorers had to do. Teams would spend a summer planning and provisioning, wait out the winter in base camp, and travel to the interior the following summer.

temperate: having a moderate climate, without extremes of hot or cold

tundra: the treeless plain of the northern hemisphere's Arctic regions, where vegetation such as lichens and mosses grows

COME PREPARED

Plan your visit. For information about reservations, transportation, and lunchrooms, visit **amnh.org/education/plan**.

Read the Essential Questions in this guide to see how themes in *Race to the End of the Earth* connect to your curriculum. Identify the key points that you'd like your students to learn from the exhibition.

Review the Teaching in the Exhibition section of this guide for an advance look at the artifacts, models, and interactives that you and your class will be encountering.

Review the activities and student worksheets in this guide. Designed for use before, during, and after your visit, these activities focus on themes that correlate to the NYS Science and Social Studies Core Curriculum:

- Environments & Adaptations (grades K–2)
- Problem Solving (grades 3–5)
- Geography (grades 6–8)
- Exploration (grades 9–12)

Decide how your students will explore *Race to the End of the Earth*. Suggestions include:

- You and your chaperones can facilitate the visit using the **Teaching in the Exhibition** section of this guide.
- Your students can use the **student worksheets** to explore the exhibition on their own or in small groups.
- Students, individually or in groups, can use copies of the **map** to choose their own paths.

CORRELATIONS TO NATIONAL STANDARDS

Your visit to the *Race to the End of the Earth* exhibition can be correlated to the national standards below. See the end of this guide for a full listing of New York State standards.

Science Education Standards

All Grades · A1: Abilities necessary to do scientific inquiry · E1: Abilities of technological design · E2: Understandings about science and technology
K–4 · B1: Properties of objects and materials · C1: Characteristics of organisms · D1: Properties of Earth materials · D2: Changes in Earth and sky · G1: Science as a human endeavor
5–8 · C2: Reproduction and heredity · C3: Regulation and behavior · C4: Populations and ecosystems · C5: Diversity and adaptations of organisms · D1: Structure of the Earth system · F1: Personal health · F4: Risks and benefits · G3: History of science
9–12 · B2: Structure and properties of matter · B4: Motions and forces · C3: Biological evolution · C6: Behavior of organisms · D1: Energy in the Earth system · D3: Origin and evolution of the Earth System · F5: Natural and human-induced hazards

Social Studies Standards

Thematic Strands · III. People, Places, and Environment · VIII. Science, Technology, and Society

TEACHING IN THE EXHIBITION

The *Race to the End of the Earth* exhibition uses artifacts, models, maps, interactives, videos, and more to help students learn about early polar exploration and the challenges of survival in Antarctica. This guide divides the exhibition into seven numbered areas, which correspond to the map and to the text below.

1. Introduction

OVERVIEW

The mean annual temperature at the South Pole is –49°C (–56°F), an environment so harsh that a small misstep can spell disaster. A century ago the margin of safety was even smaller.

GUIDED EXPLORATION

Theater: Invite students to watch the video, which sets the stage for the race to the Pole.

> **Just beyond the theater, students can "Meet the Men."** As students go through the exhibition, encourage them to pay close attention to the decisions the British and Norwegian teams made about clothing, transportation, and timing, and to the consequences of those choices.

2. First Glimpses

OVERVIEW

From the time of the early Greeks, people proposed the existence of a southern continent, perhaps habitable, perhaps a howling wasteland. Two hundred and fifty years ago men began braving the world's roughest waters to see for themselves.

GUIDED EXPLORATION

Interactive table map, historical maps and paintings, and ship's log: Invite students to see how early maps and globes depicted the mysterious continent, and to track the first journeys southward. Ask students to imagine what it was like to be an explorer in the 18th or 19th century. What's surprising about what these early voyagers knew (and didn't know) about geography?

Answers may include: Antarctica was long thought to be as large and livable as Asia. It wasn't until the mid-1800s that ships got close enough to observe the ice-covered land.

3. The Race Begins

OVERVIEW

As the exploration of Antarctica captured the imagination of the British public, they clamored for Naval officer Robert Falcon Scott to claim the final frontier: the South Pole. At the same time, but in secret, veteran Arctic explorer Roald Amundsen set his sights on the prize for his native Norway.

GUIDED EXPLORATION

Cross-sections, models, and photos of the *Fram* and the *Terra Nova* and objects from the voyages: Have students examine and contrast the two vessels and their crews. How do the motivations of the two leaders compare?

Answers may include: A career naval officer, Scott knew that he would be well paid and that the hazardous journey might earn him a promotion. He was also keen to carry out scientific investigations. Amundsen's lifelong dream was to be a professional polar explorer and he trained steadily for it.

4. Two Teams, One Goal

OVERVIEW

In January, 1911, the two parties set up very different base camps on opposite edges of the Ross Ice Shelf. There they spent ten months — four in utter darkness — and planned their trips to the Pole.

GUIDED EXPLORATION

Antarctica's Seasons wall: Students can learn about Earth's axis and how it affects seasons in each hemisphere. Ask students why Antarctica's seasons resemble one long day and one long night.

Answer: The Earth has seasons because its axis is tilted and because it revolves around the Sun once every 365 days. During the austral summer, the Earth's tilt exposes most of the southern polar region to the Sun's rays all of the time — even though Earth is rotating daily on its axis. Six months later, during the austral winter, the South Pole is perpetually dark because it is now maximally tilted away from the Sun, while the North Pole soaks up twenty-four hours of sunlight a day. Consequently, weeks of sunrise precede the austral summer, and winter follows weeks of sunset.

How does this affect the planning of an expedition?

Answers may include: Expeditions had to be carried out during the brief summer's light and relative warmth, before the long, frigid winter set in.

Replica of Scott's hut: Have students consider what these objects reveal about overwintering in Antarctica, and how Scott and his team put this time to use.

Answers may include: In addition to planning and preparing for the journey to the Pole, they spent time listening to music on the gramophone, playing chess, writing and drawing, giving lectures and attending Sunday church services led

by Scott. Along with bunks, kitchen, and dining tables, the room contained scientific laboratories, a darkroom, and a player piano. The scientists on the British team researched weather, wildlife, and geology of this unexplored land's.

Captain Scott spent much of the Antarctic winter recording his impressions of the continent, writing letters, and working out a strategy for reaching the Pole.

Polar clothing: Have students compare the way the two teams were outfitted. Ask them what informed each team's decisions.
Answers may include: During the race to the South Pole, the British team relied mainly on woolen clothing. The Norwegians dressed in furs, based on Inuit designs that Amundsen had studied during his time in the Arctic.

Compass interactive: Invite students to manipulate the compass. What does it show about the response of the needle to the magnetic pole?
Answer: In Antarctica, because the magnetic pole is so close, a compass needle will dip down instead of pointing north.

Replica of Amundsen's carpentry workshop: Ask students to look at the way the Norwegians spent the dark winter months. How does this network of under-snow tunnels compare to Scott's winter quarters?
Answers may include: Both teams brought pre-fabricated wooden huts. Amundsen's smaller one, used for sleeping and eating, was connected by tunnels to what he described as "a whole underground village" that was insulated by the snow.

5. To the Pole!

OVERVIEW
The austral summer (December to March) with its long days and somewhat warmer temperatures, was the only window for the grueling round-trip journey of 2,900 kilometers (1,800 mi). The explorers knew that every hour would count.

GUIDED EXPLORATION
Scott vs. Amundsen wall panels and Race Timeline: Students can compare factors such as transportation, clothing, food, and shelter that each team relied upon. Ask students which proved the most effective for surviving, and succeeding, under the harsh conditions. What logistics helped the team that reached the Pole first?
Answers may include: Amundsen used dogs to pull the sleds, while his men skied alongside, or even rode. The British used experimental motorized vehicles and horses, neither of which performed well in the extreme cold. Once up on the polar plateau, the men pulled the sleds themselves, as planned.

"Man-hauling" required men strapped into harnesses to drag heavy sleds. Henry "Birdie" Bowers said, "I have never … so nearly crushed my inside into my backbone by the everlasting jerking with all my strength."

Hauling sleds interactive: Students can push a model sled across two different surfaces. Ask them how temperature affects the task.
Answer: As the temperature sinks below -20oC (-4oF), friction no longer heats the snow enough to create or maintain a liquid film. As a result, the ice surface feels rougher and the sled becomes harder to pull.

6. Back From the Pole

OVERVIEW

After reaching the Pole on December 14, 1911, one team hurried back to base camp. In contrast, the other team took a full month longer to reach their goal. Exhausted and starving, the men were still struggling back as the light began to dim and the weather to turn bitter cold.

GUIDED EXPLORATION

Race Timeline (cont'd.): What factors contributed to Amundsen's team's return to base camp 10 days ahead of schedule? What led to the death of Scott and his men?

Answers may include: Better provisioned and in better health, the Norwegian team traveled fast and escaped the onset of winter. Having set out on their return trip a month later, Scott and his men soon ran into stormy weather. They found themselves increasingly short of food and fuel, and slowed during the last leg of the journey as temperatures dropped rapidly.

Reaching the South Pole on January 17/18, 1912, the Scott party found the three-man tent the Norwegians had left behind.

7. Antarctica Today

OVERVIEW

Forty-eight nations are parties to the Antarctic Treaty agreeing to peaceful, scientific exploration of the continent. The continent's only long-term occupants — 4,000 in summer, 1,000 in winter — are researchers, students, and support staff.

Flags in front of the new Amundsen-Scott South Pole Station, the latest U.S. scientific station at the southernmost end of the Earth.

GUIDED EXPLORATION

Life in Antarctic Seas video: Ask students to describe the marine environment around Antarctica, the organisms that live there, and their adaptations.

Answers may include: The ocean around Antarctica teems with life. The top predators are marine mammals—seals and whales. There are many sea birds, and five species of penguin, which can dive 550 meters (1800 feet) deep to feed and hold their breath for over 20 minutes. The sea is home to fish found nowhere else in the world, and to vast quantities of the shrimp-like crustaceans called krill. Some polar invertebrates are much larger than their warm-water relatives, perhaps because there's more food and/or more oxygen in the water.

Fossil specimens (reptiles, birds, teeth of early mammals, wood): Have students observe these specimens and consider what they tell us about Antarctica's climate in the past.

Answers may include: These fossil specimens tell us that Antarctica was once warm enough for reptiles, mammals, birds, and trees to live there. They also tell us that the continent was once connected to what is now South America.

Modern clothing and equipment: Ask students to imagine what it's like to live and work in Antarctica. How have modern technologies changed the experience? What did present-day explorers learn from Scott and Amundsen?

Answers may include: Today, people who go to the Antarctic can make the trip by air, wear clothing that keeps them dry and warm, and stay in contact with the rest of the world.

Most ECW—Extreme Cold Weather—clothing is now made of synthetic materials that allow the body's moisture to escape but keep out wind and rain.

Science of Antarctica interactive map: Have students use the interactive map to explore the continent's weather, the land under the ice, and the impact of global warming.

Polar Personality Test: Have students take this quiz to see if they have what it takes to winter over at the bottom of the Earth.

ONLINE RESOURCES

Race to the End of the Earth Exhibition Website
amnh.org/race
Access featured content from the exhibition, including an interactive map and photo gallery.

Race to the End of the Earth for Educators
amnh.org/education/race
All exhibition-related resources are listed on this page, including tips on planning your visit and links to resources that include the complete Educator's Guide in PDF form.

Polar Mammals
beyondpenguins.nsdl.org/issue/index.php?date=January2009
Focused on polar regions, this issue of an online magazine for K–5 educators features a podcast of AMNH Curator Ross MacPhee talking about mammals.

As Antarctic Ice Melts, Wildlife Shifts
sciencebulletins.amnh.org/?sid=b.s.antarctic_web.20090323
The Antarctic Peninsula is warming far faster than anywhere else on Earth. This interactive explores the effect on the local food web.

Finding Life at the Frozen Poles: Antarctica
sciencebulletins.amnh.org/?sid=b.s.antarctica_life.20071210
Aimed at middle- and high-school students, this interactive describes recent ecological discoveries.

Global Ozone: 2004–2008
sciencebulletins.amnh.org/?sid=e.v.ozone08.20090101
This dynamic visualization of changes in Earth's ozone shield between 2004 and 2008 focuses on levels over Antarctica.

The Endurance: Shackleton's Legendary Antarctic Expedition
amnh.org/exhibitions/shackleton
Text, animations, and historic photographs tell one of history's greatest tales of survival: Sir Ernest Shackleton's 1914 voyage to the Antarctic.

Antarctica Curriculum
amnh.org/resources/antarctica
This award-winning curriculum connects students to the continent's biology and geology, and helps them master important science skills. Easily tailored to your time frame and grade level.

Expeditions OLogy
amnh.org/ology/expeditions
Kids ages 7 and up can meet Ross MacPhee, scientist and curator of *Race to the End of the Earth*, go on virtual expeditions, and make their own compasses and field journals.

ANTARCTIC FACTS

- Antarctica is on average the coldest, driest, windiest, and highest continent on Earth.
- A continent surrounded by ocean, Antarctica is the opposite of the Arctic, which is an expanse of ocean surrounded by continents.
- If melted, the ice sheets covering Antarctica would raise global sea level by almost 70 meters (230 feet).
- In the long, dark winter, temperatures at the South Pole may plunge to –58°C (–73°F). Even in the summer, temperatures of –26°C (–16°F) can lead to frostbite and hypothermia.
- Antarctica's harsh climate is similar in some respects to that of Mars. NASA tests equipment there to prepare for planetary expeditions.
- Once Scott and his men left, it was 44 years before another person set foot at the South Pole.

CREDITS

Race to the End of the Earth is organized by the American Museum of Natural History, New York (www.amnh.org), in collaboration with Musée des Confluences, Lyon, France, and Royal BC Museum, Victoria, British Columbia, Canada.

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British Consulate-General New York

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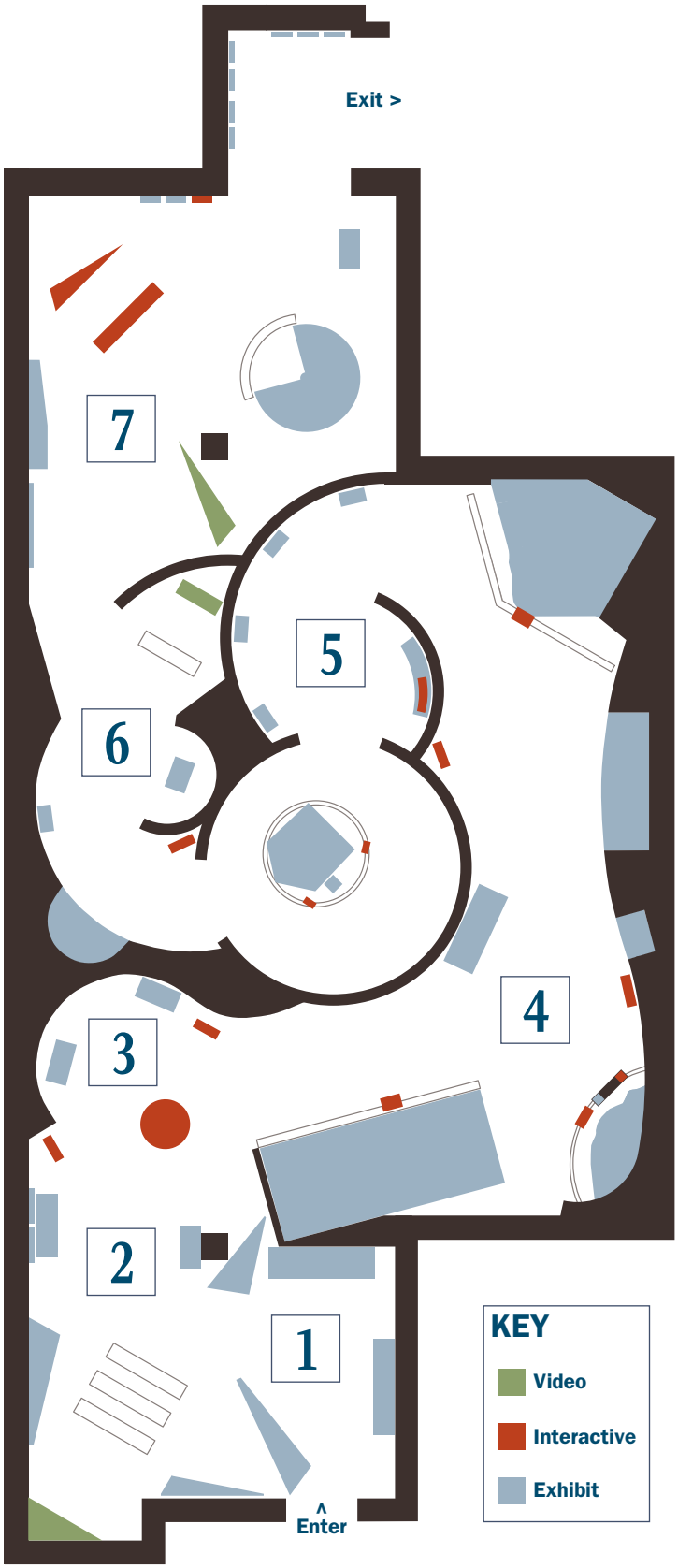


MAP OF THE EXHIBTION

This exhibition uses artifacts, models, maps, interactives, videos, and more to help students learn about early polar exploration and the challenges of survival in Antarctica.

1. Introduction

The mean annual temperature at the South Pole is –49°C (–56°F), an environment so harsh that a small misstep can spell disaster. A century ago the margin of safety was even smaller.

2. First Glimpses

From the time of the early Greeks, people proposed the existence of a southern continent, perhaps habitable, perhaps a howling wasteland. Two hundred and fifty years ago men began braving the world's roughest waters to see for themselves.

3. The Race Begins

As the exploration of Antarctica captured the imagination of the British public, they clamored for Naval officer Robert Falcon Scott to claim the final frontier: the South Pole. At the same time, but in secret, veteran Arctic explorer Roald Amundsen set his sights on the prize for his native Norway.

4. Two Teams, One Goal

In January, 1911, the two parties set up very different base camps on opposite edges of the Ross Ice Shelf. There they spent ten months — four in utter darkness — and planned their trips to the Pole.

5. To the Pole!

The austral summer (December to March) with its long days and somewhat warmer temperatures, was the only window for the grueling round-trip journey of 2,900 kilometers (1,800 mi). The explorers knew that every hour would count.

6. Back From the Pole

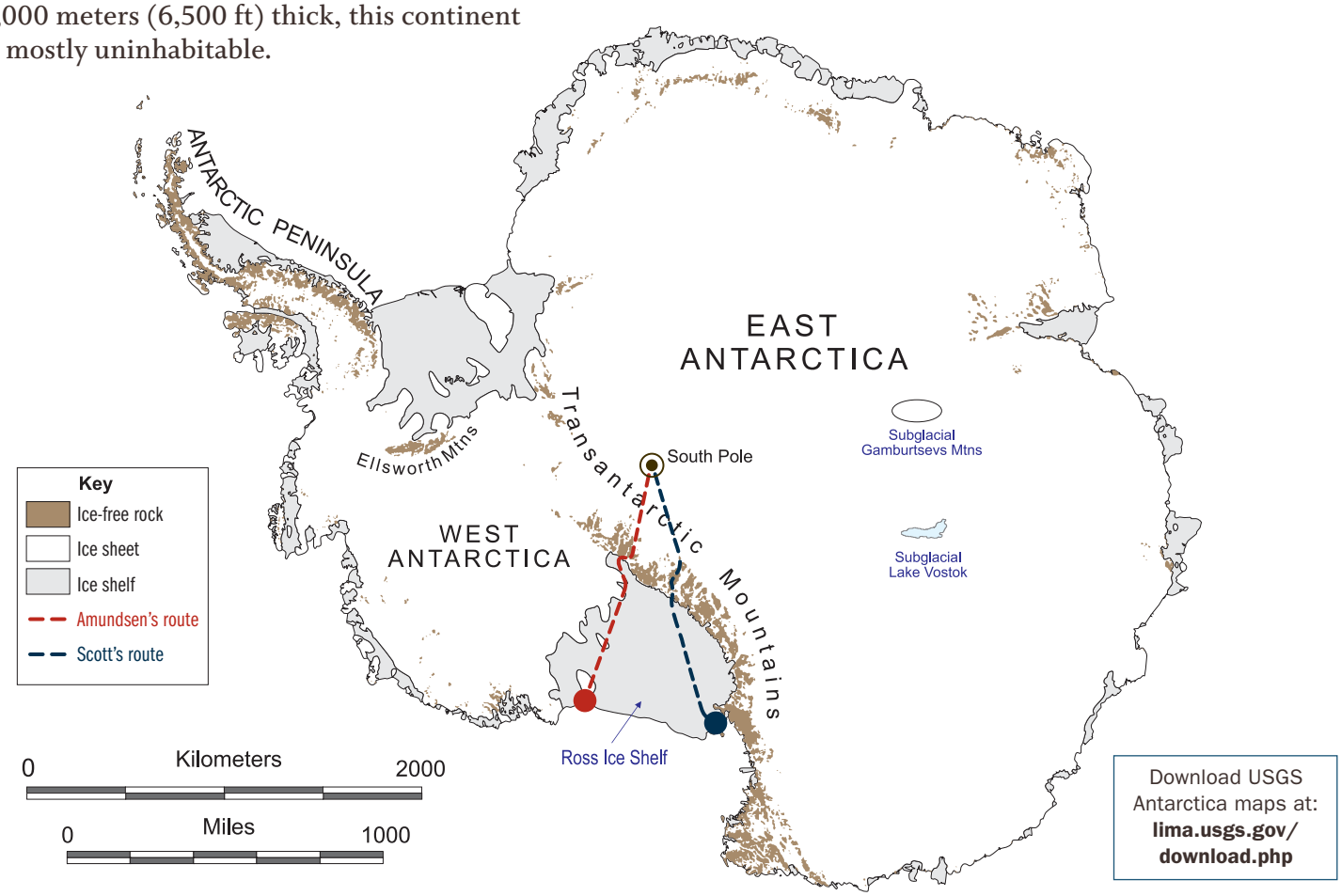
After reaching the Pole on December 14,1911, one team hurried back to base camp. In contrast, the other team took a full month longer to reach their goal. Exhausted and starving, the men were still struggling back as the light began to dim and the weather to turn bitter cold.

7. Antarctica Today

Forty-eight nations are parties to the Antarctic Treaty agreeing to peaceful, scientific exploration of the continent. The continent's only long-term occupants — 4,000 in summer, 1,000 in winter — are researchers, students, and support staff.

ANTARCTICA: A CONTINENT OF EXTREMES

Antarctica is on average the coldest, driest, windiest, and highest continent on Earth. Covered by ice 2,000 meters (6,500 ft) thick, this continent is mostly uninhabitable.



Two Landmasses

Antarctica is really two distinct landmasses. East Antarctica is a "shield"—a dome of very ancient rocks within a continent. Geologically younger West Antarctica was formed in part by the same mountain-building processes that created the Andes.

High Peaks & Deep Valleys

Fifty years ago, scientists were stunned to discover a mountain range, the Gamburtsevs, completely buried under the ice. Now, new imaging has also revealed deep valleys, in a landscape some compare to the European Alps.

Broad Plateau

Composed entirely of ice, the plateau sits 4,000 meters (13,000 ft) above sea level and covers all of East Antarctica.

Under-Ice Lakes

An interconnected network of lakes, large and small, is being discovered under the polar ice sheet. The largest of these lakes, Lake Vostok has been sealed for millions of years. Scientists want to sample this environment but worry about contamination.

Katabatic Winds

Ferocious katabatic winds occur when dense, frigid air builds up on the polar plateau. The air spills over, gathering speed like an "avalanche" as it tumbles toward the coast.

Sea Ice

Every fall and winter, the amount of sunlight falling on Antarctica decreases. As the surrounding ocean chills, it develops a coating of sea ice. In spring, as the Sun returns, the sea ice begins to retreat.

Powerful Current

The ocean current circling Antarctica is the most powerful current on the planet. Driven by strong winds from the west, this swirling moat of cold water stretches more than 20,000 kilometers (12,400 mi) around the continent and has isolated it for about 30 million years.

Ice Shelves

An ice shelf is a thick, floating mass of ice that forms as the ice sheet flows outward under its own weight. The shelves dam the flow of glaciers to the sea. As global temperatures rise, ice shelves on the Antarctic Peninsula seem to be collapsing more often, and more quickly, than in the past. Their loss may speed sea-level rise.

EXPLORE ENVIRONMENTS & ADAPTATIONS

OVERVIEW

Students will explore the environment of Antarctica and identify how animals, including humans survive in Antarctica's extreme environment.

NYS Science Core Curriculum

LE Standard 4, 3.1c: In order to survive in their environment, plants and animals must be adapted to that environment.

BACKGROUND FOR EDUCATOR

Antarctica is Earth's southernmost continent. It is the coldest place on Earth with temperatures that can fall below –57 degrees Celsius (–70°F). Winds that can reach over 322 kilometers per hour (200 mph) make it the windiest. Most life is concentrated on the shoreline and surrounding waters, although some microbes thrive in unexpected places like dry valleys and ice-capped brine lakes. The few species, including penguins, seals, seabirds, and tundra vegetation, that can live in Antarctica have features that help them survive extreme conditions. For example, penguins and seals have a thick layer of insulating fat called blubber.

For humans, living and working in Antarctica's extreme cold presents challenges. They must wear extreme weather gear to protect themselves against frostbite, ice, severe winds, and snow blindness.

BEFORE YOUR VISIT

Class Discussion: How Do We Dress for the Weather?

Invite students to describe the weather they experience throughout the year. Ask:

- What clothes do you wear when it's sunny and very hot outside? *(Answers may include: light-weight and light-colored clothing, shorts, tee-shirts, sandals, etc.)*
- How would you dress for a very cold, snowy winter day? *(Answers may include: heavy clothes, sweater, down coat, boots, gloves, scarf, hat, etc.)*

Tell students that Antarctica is the coldest, windiest place on Earth. Display photos of people working in Antarctica. (You can search for and download photos from **photolibrary.usap.gov**) Ask:

- What do the photos show about the Antarctic environment? *(Answers will include: It's a cold place with a lot of snow and ice.)*
- How do people in Antarctica dress for the cold climate? *(Answers may include: They wear heavy winter clothing.)*

Have students imagine that they will go to Antarctica to study penguins.

For older students: Have students work in groups to come up with a list of what clothing they would bring. Call on groups to share their lists and compare their items with other groups.

For younger students: Create a poster in the shape of a suitcase. Ask students to name things they would pack to go to Antarctica. Have them draw and cut out pictures of what they would bring and paste them on the suitcase.

Plan how your students will explore *Race to the End of the Earth*. In the exhibition, students will use their **student worksheets** to investigate how penguins and humans survive in the harsh environment of Antarctica.

Distribute copies of the student worksheets to students before coming to the Museum. You may want to review the worksheets with students to make sure they understand what they are to do.

Activity: How Do Penguins Stay Warm?

Explain that some animals live on Antarctica. Ask: How do you think they are able to live in such a cold place? *(Answers will vary.)* Tell students they will watch a video about one Antarctic animal, the Emperor penguin. As they watch, have students identify how the penguins stay warm, keep their young warm, and find food.

Show the video from National Geographic Kids:
kids.nationalgeographic.com/Animals/CreatureFeature/Emperor-penguin

After showing the video, have students share their ideas with the class. Elicit that one way Emperor penguins stay warm is by huddling together. Create a class huddle. Call on volunteers to walk like penguins and try to find the warmest spot. Ask: Which penguins in the huddle will stay warmest? *(Answer: Penguins in the center)* Tell students they will have the opportunity of seeing a penguin diorama when they visit the *Race to the End of the Earth* exhibition.

DURING YOUR VISIT

Race to the End of the Earth Exhibition

4th floor (30–45 minutes)

Visit the Emperor penguin diorama. Call on students to share what they notice about the penguins. Have them focus on the body shape, feathers, wings, beak, claws, and pouch. Ask:

- How does its body shape help the penguin? *(Answers may include: A streamlined body shape enables penguins to slide along the ice and to swim quickly through water.)*
- How do feathers help the penguin? *(Answers may include: Thick layers of feathers keep the penguin warm. They have a waterproof waxy oil coating.)*
- Penguins don't fly, so how do the wings help them? *(Answers may include: They act like flippers and enable penguins to "fly" through the water.)*
- How does the penguin use its beak? *(Answers may include: the long beak helps the penguin catch fish.)*
- How do you think the claws help the penguin? *(Answers may include: They help the penguin grip the ice.)*
- How do penguins use their pouches? *(Answers may include: the pouches keep the eggs and chicks warm.)*

Just beyond the theater, students can "Meet the Men." As students go through the exhibition, encourage them to pay close attention to the decisions the British and Norwegian teams made about clothing, transportation, and timing, and to the consequences of those choices.

On their **student worksheets**, have students draw and label a picture of the penguin.

Visit the *Living in Antarctica Today* display near the end of the exhibition. Have students examine the clothing worn by scientists living and working in Antarctica. Call on students to suggest other items they might add to their list of what to bring or to add to their suitcase. Have students note the number of layers of clothing people in Antarctica have to wear. Ask them, if they were to live in Antarctica, how long it would take them to get dressed.

Stop by the brightly colored igloo satellite cabin used by scientists working in remote locations. Have students share what they think living in the cabin would be like. On their **student worksheets**, have students draw a picture showing polar gear and/or housing.

Millstein Hall of Ocean Life

1st floor (15–20 minutes)

Visit the Polar Ice diorama on the upper level of the hall. Have students look for the organisms that Emperor penguins eat (krill, squid, and fish). Have students point to the krill. Explain that almost all Antarctic sea animals depend on this tiny animal to live. Have students select any organism that lives under the ice and look for it in the video above the diorama. Point out that without krill, this animal could not survive. Direct students to the blue whale in the center of the hall. Explain that krill is the only thing the enormous blue whale eats.

BACK IN THE CLASSROOM

Discussion: Survival in Antarctica

Talk about the Museum experience with your class. Ask: What did you learn about penguins? *(Answers will vary.)* How do they live in Antarctica? *(Answers may include: They have features that enable them to live in the harsh climate.)* Have students revisit the list of items or polar suitcase they made before the Museum visit. Ask: What did you learn about polar clothing? *(Answers may include: It is designed for extreme cold and windy conditions.)* What other items would you now include in your list of clothing to take to Antarctica? *(Answers will vary.)*

Activity: Rubber Blubber Gloves

amnh.org/ology/rubber_blubber_gloves

In this hands-on experiment, students investigate how blubber keeps marine mammals warm in cold ocean waters.

Activity: Create a Polar Creature

amnh.org/resources/rfl/pdf/aa_a10_polar_creature.pdf

In this hands-on activity students will create a polar creature with features that will allow it to live in Antarctica's harsh climate. Simplify this activity to meet the needs of your students.

SUGGESTED READINGS

Letter from Stephanie: Antarctic Adaptations

amnh.org/resources/rfl/pdf/aa_ss08_adaptation.pdf

Antarctica by Helen Cowcher

Penguins by Seymour Simon

The Emperor's Egg by Marten Jenkins

Mrs. Chippy's Last Expedition by Caroline Alexander

ONLINE RESOURCES

Antarctica: The Farthest Place Close to Home

amnh.org/resources/antarctica

This award-winning curriculum connects students to the continent's biology and geology, and helps them master important science skills. Easily tailored to your time frame and grade level.

National Geographic Kids

kids.nationalgeographic.com/Animals/CreatureFeature/Emperor-penguin

This site provides information, photos, and video footage of Emperor and Adelie penguins.

United States Antarctic Program

photolibrary.usap.gov

This photo library has thousands of photos that feature people, stations, scenery, transportation, and wildlife.

Penguin Science

penguinscience.com/media.php

Hundreds of still Antarctic pictures, including images of the landscape, people, and animals.

STUDENT WORKSHEET

Grades K–2

In Antarctica, animals, including humans, must protect themselves from the harsh environment.

1 How Do Penguins Live in Antarctica?

Find the penguin diorama. Pick a penguin and draw a picture of it in the box.

Draw a line to connect each body part with its name.

BODY PARTS

beak

feathers

wings

pouch

claws

2 How Do Humans Survive in Antarctica?

Find the bright red polar clothing and shelter.

Draw a picture of a polar clothing or shelter in the box.

PROBLEM SOLVING

OVERVIEW

Students will investigate and compare the variety of technologies used by explorers Amundsen and Scott as they each attempted to be the first to reach the South Pole. They will also contrast technologies used by Scott and Amundsen to the technologies used by scientists in Antarctica today.

NYS Science Core Curriculum

Interdisciplinary Problem Solving Standard 7.1c: Design solutions to problems involving a familiar and real contest, investigate related science concepts to determine the solution, and use mathematics to model, quantify, measure, and compute.

BACKGROUND FOR EDUCATOR

Totally cut off from the outside world, early Antarctic explorers faced great danger and unimaginable physical hardship. Scott and Amundsen adopted completely different strategies to deal with challenges that exploring Antarctica presented. Scott brought ponies and motorized vehicles, and, once on the polar plateau, relied on men in harnesses to pull long, heavy sleds. Adopting technologies learned from the Inuit, Amundsen wore loose-fitting fur clothing and skied alongside custom-designed dog sleds. Today's travelers to Antarctica arrive in airplanes instead of wooden ships; navigate by GPS instead of sextant and compass; wear moisture-resistant and windproof clothing instead of wool, canvas, and reindeer fur; and communicate with the world via satellite.

BEFORE YOUR VISIT

Plan how your students will explore *Race to the End of the Earth*. In the exhibition, students can use their **student worksheets** to investigate the technology of one of these four categories: clothing, food, transportation, shelter. You may divide the class into four teams before you come to the Museum, or prefer to let them choose on site.

Distribute copies of the student worksheets to students before coming to the Museum.

Class Discussion: What is Technology?

Discuss the meaning of technology with students. Ask:

- When we talk of technology in today's world what do we mean? *(Answers may include: It refers to high technology—use of computers, cell phones, space travel, etc.)*
- Now think back to humankind's early history—the use of controlled fire, the invention of the wheel, the first tools, such as hand axes. Would you consider this technology? Why or why not? *(Answers will vary, but may include: Yes, because these innovations allowed humans to complete tasks in a better way than they had before.)*
- Considering the innovations people developed thousands of years ago and those people are developing today, how would you define technology? *(Answers should include the idea that: the application of scientific knowledge for a variety of purposes, which has given rise to innovations ranging from stone tools to wind-proof clothing to telecommunications.)*

Class Discussion: Cold Technology

Have students share what they know about the climate of Antarctica. Point out that at one weather station in Antarctica the yearly temperature ranges from a low of –61ºC (-78ºF) to a high of –24ºC (-11ºF). To further their understanding of the temperature ranges you might want to access Antarctic Weather Reports (**amnh.org/education/resources/rfl/web/antarctica/weather).** Click on one of the stations to view temperature data for that area of Antarctica. Ask:

- How do these extreme temperatures affect how people travel, what they wear, what they eat, and what shelters they make for themselves? *(Answers will include: They would need to travel over snow and ice so sleds rather than cars would be suitable. Their clothing would need to be warm and windproof to withstand the cold and high winds. They would burn more calories because of the cold so they would have to eat more. Their shelters would need to be well insulated.)*

Call on students to suggest items they would need in order to survive on a journey to the South Pole. Write their responses on the board. Ask:

- What on the list is an example of a technology? *(Answers will vary.)*

Explain that the explorers Scott and Amundsen knew the challenges they faced in Antarctica and spent months planning their trips. Both explorers, for example, designed clothing to deal with the cold. Scott's team wore windproof trousers and tunics made of canvas over heavy wool clothing. Based on what he learned from the Inuit in the Arctic, Amundsen's men wore loose-fitting Arctic furs. Ask:

- How do the fabrics used in winter clothing today differ from those used in Scott and Amundsen's time?
  (Answers will include: Today's fabrics include synthetic and natural materials, such as wools, fleece, down, thinsulate, lined gloves and boots, etc.)

Tell students that in the *Race to the End of the Earth* exhibition, they will explore how both teams of explorers used different technologies to solve the problems of clothing, transportation, food, and shelter.

Activity: Fabric Test

amnh.org/resources/rfl/pdf/aa_a11_fabric.pdf

In this hands-on experiment, students test the insulation and waterproof properties of a variety of fabrics in order to understand how protective gear is chosen for people working in Antarctica. Based on their findings, have students determine which fabric would be best suited for Antarctic clothing.

DURING YOUR VISIT

Race to the End of the Earth Exhibition

4th floor (30–45 minutes)

Have students explore the exhibition and select one of the following categories to explore: clothing, transportation, food, or shelter for their **student worksheet** investigation. Students can explore clothing and shelter in the *Two Teams: One Goal* section; food and transportation can be examined in the *To the Pole!* Section.

Just beyond the theater, students can "Meet the Men." As students go through the exhibition, encourage them to pay close attention to the decisions the British and Norwegian teams made about clothing, transportation, and timing, and to the consequences of those choices.

Hall of Northwest Coast Indians

1st floor (15–20 minutes)

Here students can observe how the Northwest Coast people devise technology using natural resources to live in their environment. Have students observe the model of the Kwakiutl village, the clothing worn by the Kwakiutl, Thompson, and Tsimshian people, the canoe and snowshoes, and curing of salmon in the Kwakiutl of Vancouver Island display. Have students work with a partner to explore the hall and look for technologies used by the Northwest Coast people, and to compare and discuss their findings.

BACK IN THE CLASSROOM

Class Activity: Technology at the South Pole

Have students who have chosen the same category work in small groups to compare that used by Scott and that used by Amundsen. As they discuss their findings they should answer the following questions:

- How did the technology work for Scott's team? What could have Scott done better?
  (Answers may include: Clothing: Worked well, but the wool made the men sweat. Cotton clothing under the wool would have been less sweaty. Transportation: The motorized sledges, and the ponies did not work at all. Man-hauling was exhaustive and wore the men down. The dogs and sleds did work. Scott should have considered skis. Food: The food rations were adequate, but the men burned more calories when man-hauling, so they needed almost double the amount they were rationed. Only 4 men should have gone to the pole. Taking 5 men depleted the food supply. Shelter: Scott's shelter met all the needs of the people living there.)

- How did the technology work for Amundsen's team? What could have Amundsen done better? *(Answers may include: Clothing: the fur clothing worked well, but at times proved to be too warm and not windproof. Amundsen might have looked at additional covering for the wind. Transportation: The sledges pulled by the dogs with men skiing proved to be the most efficient way to travel. Amundsen could not have done better. Food: The food was adequate. Amundsen didnít believe in loading down the sledges with food so they often ate dog meat which prevented them from getting scurvy. Shelter: The system of tunnels under the snow provided good housing. They even had a sauna and bathroom.)*

When students are done create a chart on the board listing the four categories: transportation, clothing, shelter, food and two columns showing what each explorer used. Fill in the chart as groups share their findings. Discuss with students what role technology played in the race to the Pole. Ask:

• Suppose you were a member of one of the teams, what changes would you make and why? *(Answers will vary.)*

Activity: Research on the Web: Living and Working in Antarctica
amnh.org/resources/rfl/web/antarctica/r_living.html
Students will examine images of living and working spaces in order to understand the technology that humans have developed for living and working in extreme Antarctic conditions.

SUGGESTED READINGS

Letter from Stephanie (from her friend Carole): Antarctic Hazards
amnh.org/resources/rfl/pdf/aa_ss09_hazards.pdf

Let's Talk with David Nold about Safety and Wintering Over in Antarctica
amnh.org/resources/rfl/pdf/aa_i03_nold.pdf

Let's Talk with Donal Manahan about Antarctica's Early Explorers
amnh.org/resources/rfl/pdf/aa_i10_manahan_expl.pdf

Excerpt: The Last March by Robert Falcon Scott
amnh.org/resources/rfl/pdf/aa_e02_scott.pdf

Excerpt: At the Pole by Roald Amundsen
amnh.org/resources/rfl/pdf/aa_e03_amundsen.pdf

ONLINE RESOURCES

Antarctica: The Farthest Place Close to Home
amnh.org/resources/antarctica
This award-winning curriculum connects students to the continent's biology and geology, and helps them master important science skills. Easily tailored to your time frame and grade level.

RACE *to the End* OF THE EARTH

STUDENT WORKSHEET

Grades 3–5

1 Explore the Technology that Amundsen and Scott Used

Both Scott and Amundsen used the newest technology available when planning their journeys to Antarctica. Check the box of the category that you will investigate in the exhibition.

- ☐ Transportation
- ☐ Clothing
- ☐ Shelter
- ☐ Food

Find objects in the exhibition in your category. (For example, if you chose transportation, you might look for the sleds.)

What did Scott's team use?

Pick an object. Sketch and label it.

How is this technology suited for Antarctica?

_____

_____

_____

_____

What did Amundsen's team use?

Pick an object. Sketch and label it.

How is this technology suited for Antarctica?

_____

_____

_____

_____

2 Explore Modern Technology

Go to the *Antarctica Today* section. Pick a modern technology in your category. How does it compare to the ones used by Amundsen and Scott?

_____

_____

_____

_____

Sketch and label it.

STUDENT WORKSHEET

Grades 3–5

ANSWER KEY

1 Explore the Technology that Amundsen and Scott Used

Both Scott and Amundsen used the newest technology available when planning their journeys to Antarctica. Check the box of the category that you will investigate in the exhibition.

- ☐ Transportation
- ☐ Clothing
- ☐ Shelter
- ☐ Food

Find objects in the exhibition in your category. (For example, if you chose transportation, you might look for the sleds.)

What did Scott's team use?

Pick an object. Sketch and label it.

How is this technology suited for Antarctica?

(Sample answer: clothing: British wore mostly wool— like woolen shirts with long woolen underwear. A large knitted piece covered their chests to their hips. On top they wore woolen wind-proof shirts and pants. They used wool mittens underneath fur mitts. On their feet they wore 3-4 pairs of socks and reindeer skin fur boots.)

What did Amundsen's team use?

Pick an object. Sketch and label it.

How is this technology suited for Antarctica?

(Sample answer: transportation: Hickory wood sledge had broad runners that acted like skis. The rest of the sledge was made of ash wood. It was tied together with cord rather than nails or screws. That allowed the sledge to "give" as is traveled over the ice. A sledge meter made from bicycle wheels recorded the distance the team traveled each day.)

2 Explore Modern Technology

Go to the *Antarctica Today* section. Pick a modern technology in your category. How does it compare to the ones used by Amundsen and Scott?

(Answers will vary. Boots are waterproof and have treads on the bottom to prevent slipping. They have double walls for insulation and there is room for three to four layers of socks.)

Sketch and label it.

GEOGRAPHY

OVERVIEW

Students will explore the geographic features of Antarctica and create planar and cylindrical map projections of the continent.

NYS Social Studies Core Curriculum

Standard 3: Students will use a variety of intellectual skills to demonstrate their understanding of the geography of the interdependent world in which we live—local, national, and global—including the distribution of people, places, and environments over the Earth's surface.

BACKGROUND FOR EDUCATOR

Antarctica is Earth's southernmost continent with landforms that include high plateaus, active volcanoes, and massive ice sheets that cover most of the continent. Early sightings of the continent were made by maritime explorers, whalers, and seal hunters. By the mid-1800s, drawn by trade, imperialism, and/or curiosity, a number of expeditions had braved the icy continent's brutal conditions. As expeditions to this mysterious continent became more frequent, maps became more detailed and accurate.

BEFORE YOUR VISIT

Plan how your students will explore *Race to the End of the Earth*. In the exhibition, students will investigate early maps, globes, and navigation of Antarctica using the **student worksheets**. You might choose to have students work in small groups as they explore the exhibition.

Distribute copies of the student worksheets before coming to the Museum.

Class Discussion: Geography of Antarctica

Call on students to share what they know about the geography of Antarctica. Ask:

- Where is Antarctica?
  (Answer: It's in the southern hemisphere; the southern most continent.)
- If you were to compare Antarctica to another country or continent, how big would you say it was?
  (Answer: about the size of the United States and Mexico combined.)

Display a topographic map of Antarctica or have students examine one online. (You can view one online at **maps.grida.no/go/graphic/antarctica-topography-and-bathymetry-topographic-map**)

Discuss what challenges the continent's location and geography posed for early explorers. Ask:

- On their quests to reach the South Pole what type of terrains would the explorers have encountered?
  (Answers may include: mountains, glaciers, and the polar plateau.)

Activity: Antarctica in Images

photolibrary.usap.gov

Have students view photographs from the United States Antarctic Program. Have them use what they observe in the photographs to draw conclusions about the geography of the continent.

Activity: Which Map is the Best Map?

amnh.org/resources/rfl/pdf/aa_a06_best_map.pdf

This classroom activity helps students understand the benefits and drawbacks of globes, Mercator maps, and polar map projections. After closely examining all three, students can discuss how a spherical object like Earth is represented on a flat surface. Have students decide which of the three maps is the best to use in Antarctica and why. *(Answer: The polar projection map is the best map to use because it provides an entire view of the continent. The Mercator map and the globe offer only partial views of the Antarctic continent.*

Mercator map: **amnh.org/resources/rfl/web/antarctica/mercator.html**

Polar map: **amnh.org/resources/rfl/web/antarctica/polar.html**

DURING YOUR VISIT

Race to the End of the Earth Exhibition

4th floor (30–45 minutes)

Have students use their **student worksheets** as they investigate the early maps, globes, and navigation of Antarctica. Students should pay special attention to the longitude and latitude display, the compass interactive, Scott's and Amundsen's planned route to the Pole, and the Antarctica Today map interactive.

Just beyond the theater, students can "Meet the Men." As students go through the exhibition, encourage them to pay close attention to the decisions the British and Norwegian teams made about clothing, transportation, and timing, and to the consequences of those choices.

Hall of North American Mammals

1st floor (20–30 minutes)

In this hall students can explore the geography of North America. Have each student choose each one of the following dioramas to focus on: the mountain goat, Alaskan brown bear, musk ox, white sheep, Grant caribou, or bighorn sheep. Have them explore the geographic landscapes shown in the dioramas and note keywords used to describe landscapes mentioned in the exhibit text. *(Keywords [with diorama locations] include: glacier [mountain goat and bighorn sheep dioramas], tundra [grant caribou and musk ox dioramas], cirques [Alaskan brown bear diorama], and moraines [white sheep and mountain goat dioramas])*. On the back of their worksheets have them describe the diorama, its location, and its geographical features.

BACK IN THE CLASSROOM

Class Discussion: Geography of Antarctica

Discuss with students what they learned during their visit. Ask:

- What challenges did Scott and Amundsen face as they journeyed to the Pole? *(Answers may include: much of their journey was over uncharted territory, geographical features, such as mountains and dangerous terrain (crevasses) slowed them down, they faced extreme cold and wind.)*
- What did these explorers use to navigate? *(Answers may include: They used the Sun's location, along with compasses (which were often inaccurate), sextants, sledge-meters, and chronometers.)*
- What were the advantages and disadvantages of the route Scott chose? *(Answer: Advantage: a previous explorer had chartered most of the Scott's route. Disadvantage: It was a longer route than the one chosen by Admundsen.)*
- What were the advantages and disadvantages of the route Admundsen chose? *(Answer: Advantage: The route was a direct route to the Pole and shorter than Scott's route. Disadvantage: The route was totally uncharted, so Amundsen did not know what he might encounter.)*

Activity: Geography of North America

Call on students to describe the geography of the dioramas they viewed in the Hall of North American Mammals. Review vocabulary associated with the geographic landscapes (cirque, glacier, moraine, and tundra). Distribute copies of the North America map. Have each student plot the location of each diorama using the following latitude and longitude coordinates:

1. Musk Ox: North Ellesmere Island: 81°N, 72°W
2. Alaskan Brown Bear: Canoe Bay, Alaska Peninsula: 56°N, 163°W
3. Grant Caribou: Sand Point and Tundra of Alaska Peninsula: 60°N, 150°W
4. Mountain Goat: Fords Terror Inlet, Endicott Arm, Alaska: 57°N, 133°W
5. Bighorn Sheep: Jasper Park, Alberta, Canada: 52°N, 118°W
6. White Sheep: Mt. McKinley National Park, Alaska: 63°N, 151°W

As an extension, students can measure the distance between two diorama locations using the map scale. Have them cut out the scale and then fold it along the indicated edges to measure out distance either in miles or in kilometers. Students can confirm their distances in miles with Google Maps enabling 'Latlng' tooltip and marker under Google Map Labs, then using place markers to plot their locations and the distance between them with the Distance Measurement tool.

Activity: Making Map Projections

amnh.org/resources/rfl/pdf/aa_a07_map_projection.pdf

In this activity students will work in groups to create planar and cylindrical map projections of Antarctica.

SUGGESTED READINGS

Let's Talk with Jane Ferrigno about Using GPS in Antarctica
amnh.org/resources/rfl/pdf/aa_i08_ferrigno.pdf

Letters from Stephanie: Maps
amnh.org/resources/rfl/pdf/aa_ss05_maps.pdf

ONLINE RESOURCES

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RACE *to the End* OF THE EARTH

STUDENT WORKSHEET

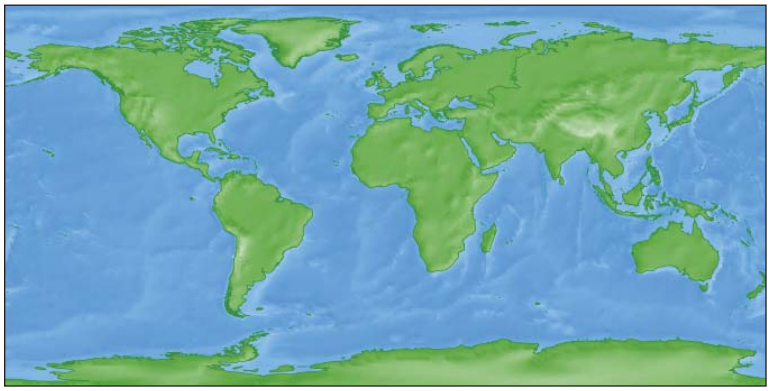
Grades 6–8

The *Race to the End of the Earth* exhibition follows two explorers, Norway's Roald Amundsen and England's Robert Falcon Scott, as they race to be the first to reach the South Pole. In the exhibition you will investigate the geology of Antarctica, and the maps of this continent and how they changed over time.

1 Maps of Antarctica

In the *First Glimpses* section, find the panel titled "Antarctica Imagined" (it's located under two paintings).

On the left side of the panel, you'll find a map from the 1500s titled "TYPVS ORBIS TERRARVM." Compare this map to the modern flat map to the right. How have people's perception of Antarctica changed since the 1500s?



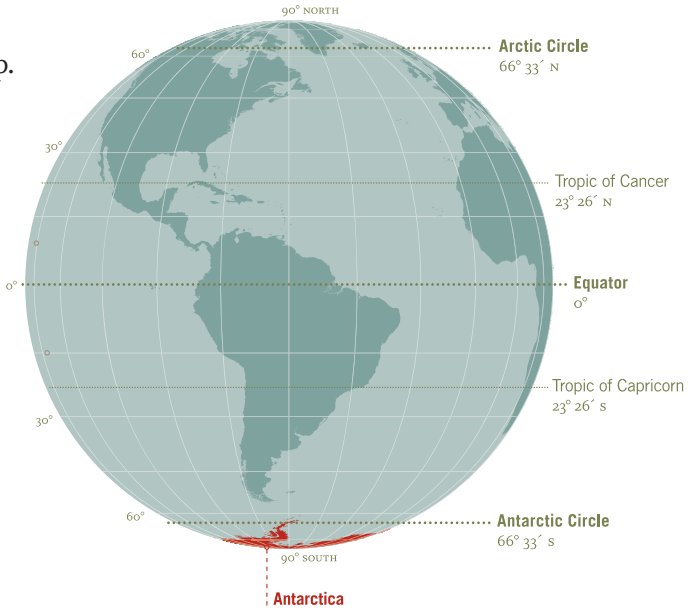
On the right side of the panel, you'll find a circular map of Earth today. Compare it to the flat map above. Which one do you think is the most accurate, and why?

Look closely again at the spherical map on the right side of the panel. Locate your home state and mark it on this map.

What is the approximate latitude of where you live?

Locate Antarctica on the spherical map. What is its latitude?

How were longitude and latitude helpful to explorers going to Antarctica?



2 Quirky Compass

In the *Two Teams, One Goal* section, locate the compass display.

Slowly slide the compass towards the South Pole. Describe what happens to the compass needle.

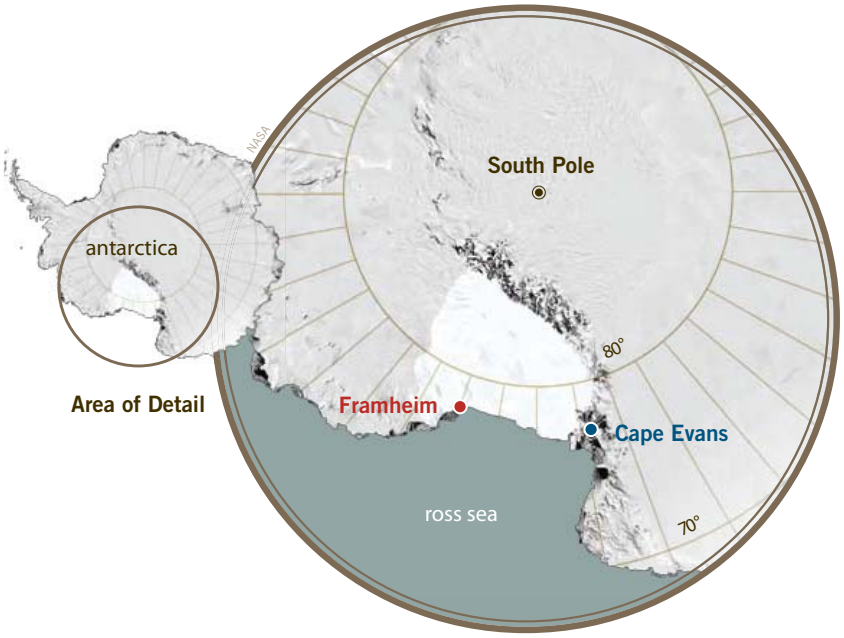
Why do you think the needle behaves this way?

3 Geographic Features

In the *To the Pole!* section, look for the wall panel that compares "Amundsen's Polar Team" and "Scott's Polar Team." Draw the route of each team on the map to the right.

What geographic features did the teams travel through?

List other geographic features of Antarctica that you have seen in this exhibition.



4 Antarctica Interactive Map

In the *Antarctica Today section*, explore the interactive map. List two facts about the continent that are interesting to you.

RACE *to the End* OF THE EARTH

STUDENT WORKSHEET

Grades 6–8

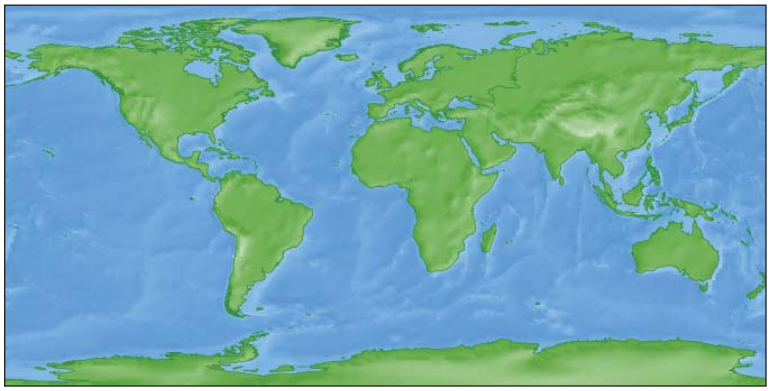
ANSWER KEY

The *Race to the End of the Earth* exhibition follows two explorers, Norway's Roald Amundsen and England's Robert Falcon Scott, as they race to be the first to reach the South Pole. In the exhibition you will investigate the geology of Antarctica, and the maps of this continent and how they changed over time.

1 Maps of Antarctica

In the *First Glimpses* section, find the panel titled "Antarctica Imagined" (it's located under two paintings).

On the left side of the panel, you'll find a map from the 1500s titled "TYPVS ORBIS TERRARVM." Compare this map to the modern flat map to the right. How have people's perception of Antarctica changed since the 1500s?



(Answers may include: Antarctica is not the huge land that people once thought it to be.)

On the right side of the panel, you'll find a circular map of Earth today. Compare it to the flat map above. Which one do you think is the most accurate, and why?

(Answers may include: A globe provides the most accurate representation of the Earth because it is the same shape – a sphere. Because of its bulkiness a globe is not practical for the many functions for which we require maps. The flat rectangular map projection is only accurate along the equator, and becomes more distorted into the high latitudes and the poles. The circular projection is the most accurate as it is the closest representation to a globe.

Look closely again at the spherical map on the right side of the panel. Locate your home state and mark it on this map.

What is the approximate latitude of where you live?

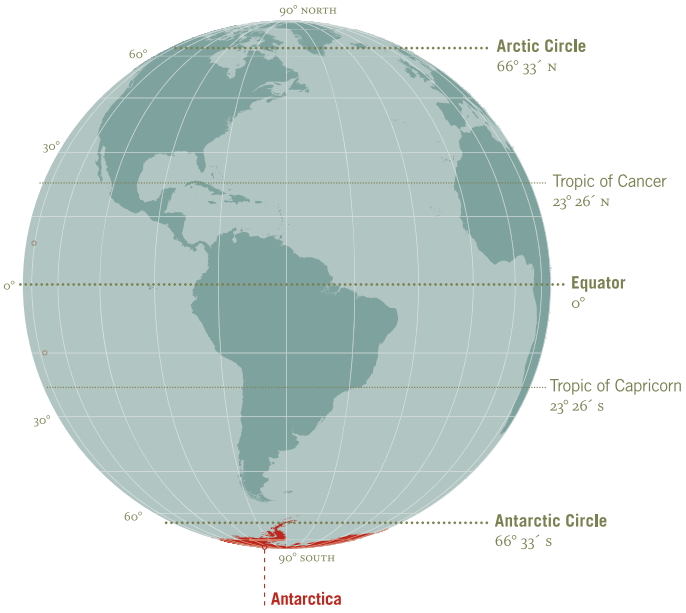
(Sample Answer: New York 40°N)

Locate Antarctica on the spherical map. What is its latitude?

(Answer: 90°S)

How were longitude and latitude helpful to explorers going to Antarctica?

(Answer: Using longitude and latitude they could determine when they had reached the South Pole.)



ANSWER KEY

2 Quirky Compass

In the *Two Teams, One Goal* section, locate the compass display.

Slowly slide the compass towards the South Pole. Describe what happens to the compass needle.

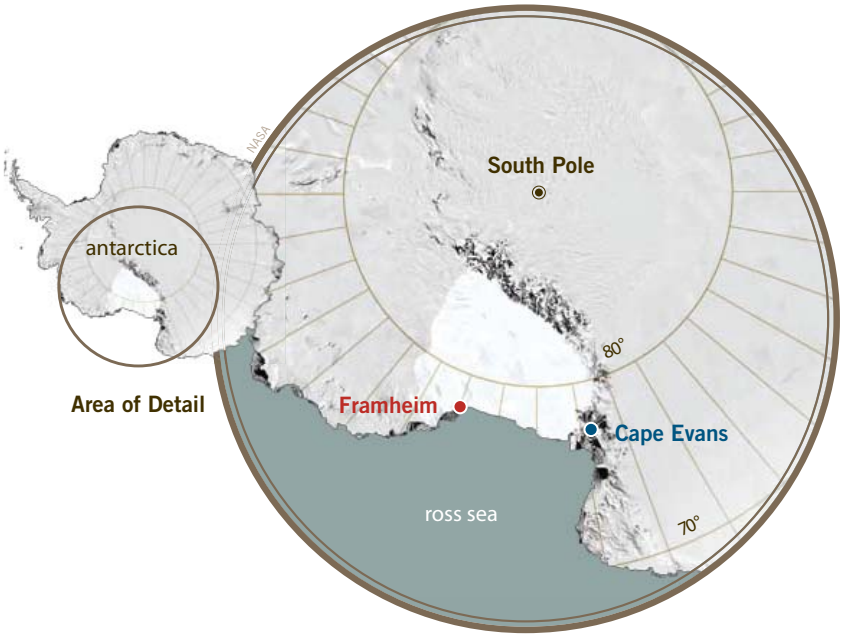
(Answer: The compass needle dips steeply down.)

Why do you think the needle behaves this way?

(Answer: In Antarctica, Earth's magnetic field lines curve steeply downward. So a compass needle will dip steeply down, too, instead of pointing north and south.)

3 Geographic Features

In the *To the Pole!* section, look for the wall panel that compares "Amundsen's Polar Team" and "Scott's Polar Team." Draw the route of each team on the map to the right.



What geographic features did the teams travel through?

(Answers include: ice shelf, mountains, ice sheets.)

List other geographic features of Antarctica that you have seen in this exhibition.

(Answers may include: glaciers, icebergs, sea ice, ghost mountains – the Gamburtseys – completely buried under the ice Lake Vostok – the largest of Antarctica's under ice lakes)

4 Antarctica Interactive Map

In the *Antarctica Today section*, explore the interactive map. List two facts about the continent that are interesting to you.

(Answers will vary: for example: Katabatic winds: These ferocious winds occur when dense frigid air builds up on the polar plateau. As the air spills over the plateau it gathers speed like an avalanche as it races towards the coastline. The Gamburtseys, a whole mountain range that is completely buried under the ice.)

EXPLORATION

OVERVIEW

Students will analyze the roles and contributions to the history of exploration of two Antarctic explorers: England's Robert Falcon Scott and Norway's Roald Amundsen. Students will observe tools and other objects the teams used, collect information on the role of team members, and learn about the backgrounds of Scott and Amundsen. They will use what they learn to make inferences about each explorer's motivation and planning strategies for being first to the South Pole, and for understanding the outcome of the race.

NYS Social Studies Core Curriculum

Standard 2.3: Study of the major social, political, cultural, and religious developments in world history involves learning about the important roles and contributions of individuals and groups.

BACKGROUND FOR EDUCATOR

By the end of the 1800's Antarctica was the last remaining unknown in continental exploration. For some explorers being the first to the South Pole was the ultimate triumph. While the Pole was goal of many expeditions, others also included scientific teams that studied meteorological conditions, ocean currents, magnetism, geology, and biology. In 1909, two very different men, England's Robert Falcon Scott and Norway's Roald Amundsen, vied to be first to the South Pole. Each man utilized different strategies to travel overland, and to deal with the challenges of the extreme cold, malnutrition, frostbite, and howling winds.

BEFORE YOUR VISIT

Class Discussion: What is Exploration?

Use the following questions to stimulate a class discussion about exploration:

- Why do people explore? *(Answers may include: to discover new places, to learn more about places we know about, to be the first to make a discovery.)*
- Where have humans explored and where are we exploring today? *(Answers may include: In the past people set out to find new lands and explore them [Columbus, Lewis and Clarke], expeditions to discover animals/fossils [Gobi Desert dinosaurs]. Today, people explore the ocean depths [Sulfide chimneys], the Moon, Mars, etc.)*
- What does it take to be an explorer? *(Answers may include: curiosity, a desire know or find out, courage, leadership, ability to plan strategically, etc.)*

Plan how your students will explore *Race to the End of the Earth*. In the exhibition, students will analyze the contributions of Scott and Amundsen in the history of geographic exploration. Using the **student worksheets**, students will interpret and analyze documents and artifacts to make inferences about the explorers' motivation for reaching the South Pole. Students will work independently to compare and analyze several aspect of the teams' journey: team members, transportation, clothing, food, housing, and planning.

Distribute copies of the student worksheets before coming to the Museum. Review the worksheet with students. Make sure they understand what they are to do.

Activity: Explorations in the Early 1900s

Call on students to share what they know about life in the early 1900s. Ask students to think about culture, politics, explorations, technology, and social developments during that time. Tell students they will work together to create a timeline showing developments in these areas from the 1900 to 1910, the year Scott and Admundsen left for Antarctica. Divide the class into four groups. Assign one topic to each group to research: culture, technology, politics, or social developments. Ask groups to find at least one entry per year. *(Examples: Culture—silent movies; Technology—First Model T Ford; Politics—British Empire includes Australia, Canada, India, Pakistan and many other countries; Social Developments—advocates fight for children's labor laws and welfare.)* When groups are ready have them create one timeline showing all the developments. Discuss with students how this might give them a different perspective on the journeys that Admundsen and Scott made.

Explain to students that at the turn of the last century, Antarctica was the last continent to be explored. Have them share what they know about its geography, seasons, climate, and wildlife. Ask:

- What do you think explorers hoped to find in Antarctica? *(Answers may include: wanted to be the first to discover the South Pole, wanted to learn about the geography of the continent, wanted to learn about the organisms there, study weather.)*

Point out that early expeditions to Antarctica often took several years. Ask:

- What planning would you need to do for an expedition of that length of time and under those harsh conditions? *(Answers may include: need to plan for clothing, shelter, food, navigation equipment, fuel, and transportation. Explorers would also have to carefully map out a plan for going to and returning from the Pole.)*

Tell students that in the exhibition, *Race to the End of the Earth*, they will follow the in the footsteps of two explorers, Robert Falcon Scott and Roald Amundsen, who vied to be the first to reach the South Pole.

DURING YOUR VISIT

Race to the End of the Earth Exhibition

4th floor (30–45 minutes)

As students explore the exhibition have them compare Scott and Amundsen's teams. Each student should focus on these aspects: transportation, clothing, food, fuel and planning. Have students note details on their **student worksheets**.

Just beyond the theater, students can "Meet the Men." As students go through the exhibition, encourage them to pay close attention to the decisions the British and Norwegian teams made about clothing, transportation, and timing, and to the consequences of those choices.

Cullman Hall of the Universe

Lower Level (15–20 minutes)

In the Cullman Hall of the Universe students can examine a full-scale replica of a NASA Mars Exploration Rover, a robotic geologist with a mission to discover the history of water on Mars. Have students identify the technological tools aboard the Rover and how they collect information about the Martian landscape.

BACK IN THE CLASSROOM

Class Discussion: Scott vs. Amundsen

Have students work in small groups to share and discuss what they learned. Then have groups present their findings to the rest of the class. Ask:

- What motivated Scott and Amundsen, and how did their differences in planning affect the outcome? How would you characterize each leader? *(Answers will vary. Students should support their responses to this question.)*

- How would you characterize each leader? *(Answers may include: Amundsen was an efficient, detail-oriented planner with just one goal in mind—getting to the pole and back. Scott's goal was to get to the pole, but to also do scientific investigations. His planning was more complicated, but he often did not pay attention to details and made bad decisions.)*

Activity: Apsley Cherry-Garrard Journal

amnh.org/resources/rfl/web/antarctica/ej_cherry_garrard.html

Explain that Apsley Cherry-Garrard was a member of Scott's team who made a side trip with two team members to collect Emperor penguin eggs. His journal describes the harshness of the Antarctic climate. Have students read the journal entry. Ask:

- What does this excerpt tell you about the harshness of the Antarctic climate? *(Answers may include: It describes how brutal the climate is.)*
- Why do you think explorers wanted to go to Antarctica despite the challenges? *(Answers will vary. They wanted to do scientific investigations, they wanted to be the first to reach the Pole, etc.)*

SUGGESTED READINGS

Letter from Stephanie: Antarctic Exploration
amnh.org/resources/rfl/pdf/aa_ss06_exploration.pdf

Let's Talk with Donal Manahan about Antarctica's Early Explorers
amnh.org/resources/rfl/pdf/aa_i10_manahan_expl.pdf

Excerpt: The Last March by Robert Falcon Scott
amnh.org/resources/rfl/pdf/aa_e02_scott.pdf

Excerpt: At the Pole by Roald Amundsen
amnh.org/resources/rfl/pdf/aa_e03_amundsen.pdf

Excerpt: Crevasses by Edmund Hillary
amnh.org/resources/rfl/pdf/aa_e07_hillary.pdf

Excerpt: The Voyage of the James Caird by Ernest Shackleton
amnh.org/resources/rfl/pdf/aa_e04_shackleton.pdf

The Last Place on Earth
Huntford, Roland
(Modern Library Paperback Edition), New York: Random House, Inc. 1999
An account of Scott and Amundsen's race to the Pole, a masterpiece of scholarly research and an extraordinarily rich reading experience.

I May Be Some Time: Ice and the English Imagination
Spufford, Francis
New York: Picador U S A (distributed by St. Martin's Press), 1999.
A thrilling cultural history that offers new insights into the immense philosophical and cultural implications of the British love affair with ice.

ONLINE RESOURCES

Antarctica: The Farthest Place Close to Home
amnh.org/resources/antarctica
This award-winning curriculum connects students to the continent's biology and geology, and helps them master important science skills. Easily tailored to your time frame and grade level.

RACE *to the End* OF THE EARTH

STUDENT WORKSHEET

Grades 9–12

As you walk through the *Race to the End of the Earth* exhibition you will examine the roles and contributions of two explorers, Robert Falcon Scott and Roald Amundsen. You will identify aspects of each team's journey and analyze the results.

	AMUNDSEN'S TEAM	SCOTT'S TEAM
1 Look at the **shelter** each team constructed. How did they differ? Which would you have preferred to live in and why?		
2 Describe the **clothing** each team wore. How was each team's clothing suited to Antarctic conditions?		
3 What mode(s) of **transportation** did each team use? Which was most effective and why?		
4 How did the **food** each team brought differ? What impact did bringing a fifth man to the pole have on Scott's food supply?		
5 What role did **planning** play in the success or failure of reaching the South Pole? Who do you think was the better planner? Support your answer.		
6 How would you characterize each **leader**?		

RACE *to the End* OF THE EARTH

STUDENT WORKSHEET

Grades 9–12

ANSWER KEY

As you walk through the *Race to the End of the Earth* exhibition you will examine the roles and contributions of two explorers, Robert Falcon Scott and Roald Amundsen. You will identify aspects of each team's journey and analyze the results.

	AMUNDSEN'S TEAM	SCOTT'S TEAM
1 Look at the **shelter** each team constructed. How did they differ? Which would you have preferred to live in and why?	*(Sample Answers: A wooden hut but during the winter Amundsens and his men dug a network of tunnels and rooms under the snow, including a bathroom and sauna.)*	*(Sample Answers: above ground, prefabricated hut with kitchen, darkroom, men's quarters (bunks), Scott's study, dining area.)*
2 Describe the **clothing** each team wore. How was each team's clothing suited to Antarctic conditions?	*(Sample Answers: Clothing made of fur, which at times was too warm and was not wind-proof)*	*(Sample Answers: Layers of clothing made of tightly woven wool with wind-proof canvas pants and tunics.)*
3 What mode(s) of **transportation** did each team use? Which was most effective and why?	*(Sample Answers: Dogs, sledges and skis* *Amundsen's mode of travel proved most effective, because skis and sledges proved to be faster than manhauling.)*	*(Sample Answers: Dogs, sledges, ponies, motorized sledge, manhauling.* *Scott's use of ponies and the motorized sledges failed.)*
4 How did the **food** each team brought differ? What impact did bringing a fifth man to the pole have on Scott's food supply?	*(Sample Answers: biscuits, crackers water, stew of pemmican or dog meat, crumbled biscuits and water.)*	*(Sample Answers: pemmican and biscuits made into a stew called "hoosh." Tea, cocoa, butter, and sugar. The food supply was planned to last a four-man team for 5 weeks. Adding a fifth man meant the food would last only 4 weeks.)*
5 What role did **planning** play in the success or failure of reaching the South Pole? Who do you think was the better planner? Support your answer.	*(Answers may include: Planning played a crucial role in reaching the pole.* *Students may choose Amundsen as the better planner, because he reached the pole first. Some students may choose Scott, pointing out that he was not only planning for the pole, but also conducting scientific investigations.)*	
6 How would you characterize each **leader**?	*(Answers will vary. Students should support their answers.)*	

Race to the End of the Earth • New York State Science Core Curriculum

KEY: LE = Living Environment
PS = Physical Setting

● = Content alignment addressed in-depth in exhibition section
o = Contnet alignment addressed in some depth in exhibition section

ELEMENTARY SCHOOL

Standard	Major Understandings	Introduction	First Glimpses	The Race Begins	Two Teams: One Goal	To the Pole!	Back from the Pole	Aftermath	Antarctica Today
LE 4	1.1a: Animals need air, water, and food in order to live and thrive.								●
	3.1a: Each animal has different structures that serve different functions in growth, survival, and reproduction.	●			●				●
	3.1c: In order to survive in their environment, plants and animals must be adapted to that environment	●			●				●
	5.1b: An organism's external physical features can enable it to carry out life functions in its particular environment.	●			●				●
	5.3a: Humans need a variety of healthy foods, exercise, and rest in order to grow and maintain good health.					o	o		
PS 4	1.1a: Natural cycles and patterns include the length of daylight and darkness varying with the seasons.				●				
	3.1b: Matter has properties color, hardness, odor, sound, taste, etc. that can be observed through the senses.	●			●				
PS 7	Connections: The knowledge and skills of mathematics, science, and technology are used together to make informed decisions and solve problems, especially those relating to issues of science/technology/society, consumer decision making, design, and inquiry into phenomena.				●	●	●		
	Strategies: Solving interdisciplinary problems involves a variety of skills and strategies, including effective work habits; gathering and processing information; generating and analyzing ideas; realizing ideas; making connections among the common themes of mathematics, science, and technology; and presenting results.				●	●	●		

MIDDLE SCHOOL

Standard	Major Understandings	Introduction	First Glimpses	The Race Begins	Two Teams: One Goal	To the Pole!	Back from the Pole	Aftermath	Antarctica Today
LE 4	3.2b: Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to permit its survival. Extinction of species is common. Fossils are evidence that a great variety of species existed in the past.								●
	3.2c: Many thousands of layers of sedimentary rock provide evidence for the long history of Earth and for the long history of changing life forms whose remains are found in the rocks. Recently deposited rock layers are more likely to contain fossils resembling existing species.						O		●
	5.1g: The survival of an organism depends on its ability to sense and respond to its external environment.					O	O		
	5.1a: Animals and plants have a great variety of body plans and internal structures that contribute to their ability to maintain a balanced condition.	O			O				●
	5.1b: An organism's overall body plan and its environment determine the way that the organism carries out the life processes.	O			O				●
	5.1f: Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required for survival. Regulation includes a variety of nervous and hormonal feedback systems.								●
	5.1g: The survival of an organism depends on its ability to sense and respond to its external environment.					O	O		
	5.2b: Foods contain a variety of substances, which include carbohydrates, fats, vitamins, proteins, minerals, and water. Each substance is vital to the survival of the organism.					●			
	5.2d: Energy in foods is measured in Calories. The total caloric value of each type of food varies. The number of Calories a person requires varies from person to person.					●			
	5.2e: In order to maintain a balanced state, all organisms have a minimum daily intake of each type of nutrient based on species, size, age, sex, activity, etc. An imbalance in any of the nutrients might result in weight gain, weight loss, or a diseased state.					●			
	6.1b: Food webs identify feeding relationships among producers, consumers, and decomposers in an ecosystem.								●

PS 4	1.1f: The latitude/longitude coordinate system and our system of time are based on celestial observations.		●		●				
	1.1i: The tilt of Earth's axis of rotation and the revolution of Earth around the Sun cause seasons on Earth. The length of daylight varies depending on latitude and season.				●				
	2.1f: Fossils are usually found in sedimentary rocks. Fossils can be used to study past climates and environments.								●
	2.2d: Continents fitting together like puzzle parts and fossil correlations provided initial evidence that continents were once together.								●
	2.2e: The Theory of Plate Tectonics explains how the "solid" lithosphere consists of a series of plates that "float"on the partially molten section of the mantle. Convection cells within the mantle may be the driving force for the movement of the plates.								●
	2.2m: Most local weather condition changes are caused by movement of air masses.								O
	2.2n: The movement of air masses is determined by prevailing winds and upper air currents.								O
	3.1a: Substances have characteristic properties. Some of these properties include color, odor, phase at room temperature, density, solubility, heat and electrical conductivity, hardness, and boiling and freezing points.					●			
	3.1h: Density can be described as the amount of matter that is in a given amount of space. If two objects have equal volume, but one has more mass, the one with more mass is denser .					●			
PS 7	Connections: The knowledge and skills of mathematics, science, and technology are used together to make informed decisions and solve problems, especially those relating to issues of science/technology/society, consumer decision making, design, and inquiry into phenomena.			●	●	●	●		
	Strategies: Solving interdisciplinary problems involves a variety of skills and strategies, including effective work habits; gathering and processing information; generating and analyzing ideas; realizing ideas; making connections among the common themes of mathematics, science, and technology; and presenting results.			●	●	●	●		

HIGH SCHOOL

Standard	Major Understandings	Introduction	First Glimpses	The Race Begins	Two Teams: One Goal	To the Pole!	Back from the Pole	Aftermath	Antarctica Today
LE 4	3.1l Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on Earth no longer exist.						O		●
	5.2a Homeostasis in an organism is constantly threatened. Failure to respond effectively can result in disease or death.					●	●		
	5.2h Disease may also be caused by inheritance, toxic substances, poor nutrition, organ malfunction, and some personal behavior. Some effects show up right away; others may not show up for many years. .					●	●		
	5.3b Feedback mechanisms have evolved that maintain homeostasis. Examples include the changes in heart rate or respiratory rate in response to increased activity in muscle cells, the maintenance of blood sugar levels by insulin from the pancreas, and the changes in openings in the leaves of plants by guard cells to regulate water loss and gas exchange.								●
PS 4	1.1c Earth's coordinate system of latitude and longitude, with the equator and prime meridian as reference lines, is based upon Earth's rotation and our observation of the Sun and stars.			●		●			
	1.2i The pattern of evolution of life-forms on Earth is at least partially preserved in the rock record.						O		●
	1.2j Geologic history can be reconstructed by observing sequences of rock types and fossils to correlate bedrock at various locations.						O		●
	2.1c Weather patterns become evident when weather variables are observed, measured, and recorded. These variables include air temperature, air pressure, moisture relative humidity and dewpoint, precipitation rain, snow, hail, sleet, etc., wind speed and direction, and cloud cover.				●		●		O
	2.1d Weather variables are measured using instruments such as thermometers, barometers, sychrometers, precipitation gauges, anemometers, and wind vanes.				●		●		O
	2.1o Plate motions have resulted in global changes in geography, climate, and the patterns of organic evolution.								●

PS 7	Connections: The knowledge and skills of mathematics, science, and technology are used together to make informed decisions and solve problems, especially those relating to issues of science/technology/society, consumer decision making, design, and inquiry into phenomena.			●	●	●	●		
	Strategies: Solving interdisciplinary problems involves a variety of skills and strategies, including effective work habits; gathering and processing information; generating and analyzing ideas; realizing ideas; making connections among the common themes of mathematics, science, and technology; and presenting results.			●	●	●	●		

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ELEMENTARY SCHOOL

Standard	Major Understandings	Introduction	First Glimpses	The Race Begins	Two Teams: One Goal	To the Pole!	Back from the Pole	Aftermath	Antarctica Today
2: World History	2.1a: Read historical narratives, myths, legends, biographies, and autobiographies to learn about how historical figures lived, their motivations, hopes, fears, strengths, and weaknesses.		●	●	●	●	●		
	2.2d: Compare important events and accomplishments from different time periods in world history		●	●	●	●	●		●
	2.3a: Understand the roles and contributions of individuals and groups to social, political, economic, cultural, scientific, technological, and religious practices and activities.		●	●	●	●	●	●	
	2.4c: View historic events through the eyes of those who were there, as shown in their art, writings, music, and artifacts.		●	●	●	●	●		
3: Geography	3.1c: Locate places within the local community, State, and nation; locate the Earth's continents in relation to each other and to principal parallels and meridians		●	●	o				●
	3.2a: Ask geographic questions about where places are located; why they are located where they are; what is important about their locations; and how their locations are related to the location of other people and places.	●	●	●					

MIDDLE SCHOOL

Standard	Major Understandings	Introduction	First Glimpses	The Race Begins	Two Teams: One Goal	To the Pole!	Back from the Pole	Aftermath	Antarctica Today
2: World History	2.1c: Interpret and analyze documents and artifacts related to significant developments and events in world history		●	●	●	●	●		
	2.4a: Explain the literal meaning of a historical passage or primary source document, identifying who was involved, what happened, where it happened, what events led up to these developments, and what consequences or outcomes followed.		●	●	●	●	●		
	2.4c: View history through the eyes of those who witnessed key events and developments in world history by analyzing their literature, diary accounts, letters, artifacts, art, music, architectural drawings, and other documents		●	●	●	●	●		

3: Geography	3.1a: Map information about people, places, and environments		•	•	o				•
	3.1b: understand the characteristics, functions, and applications of maps, globes, aerial and other photographs, satellite-produced images, and models		•	•	o				•

HIGH SCHOOL

Standard	Major Understandings	Introduction	First Glimpses	The Race Begins	Two Teams: One Goal	To the Pole!	Back from the Pole	Aftermath	Antarctica Today
2: World History	2.2c: Analyze evidence critically and demonstrate an understanding of how circumstances of time and place influence perspective		•	•	•	•	•		
	2.4b: Interpret and analyze documents and artifacts related to significant developments and events in world history		•	•	•	•	•		
3: Geography	3.1a: Understand how to develop and use maps and other graphic representations to display geographic issues, problems, and questions		•	•	o				•
	3.1b: Describe the physical characteristics of the Earth's surface and investigate the continual reshaping of the surface by physical processes and human activities			•					•
	3.1e: Analyze how the forces of cooperation and conflict among people influence the division and control of the Earth's surface								•