

ANTARCTICA: 90 degrees South



Teacher Guide



<http://www.pbs4549.org/antarcti>

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Credits

Guide

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ANTARCTICA:
90 degrees South

Introduction

<http://www.pbs4549.org/antarcti>

How to Use Antarctica: 90 Degrees South

Brrrr.... How about a nice trip to sunny Antarctica?....

What's included in the package?

Teacher's Guide

Part 1: Simulation

The year is 2050. The earth has become dangerously overcrowded. New lands must be explored. You are commissioned to explore Antarctica to see if habitation is possible.

Students will be part of a fact-finding team to do research on their assigned topics. They will report their findings to the class. The class (or small group) will then collaborate on making a plan to determine how to acquire food, housing and transportation.

Part 2: Lesson Plans

Science related, hands-on lesson plans (geared to the state standards) deal with major issues about Antarctica. Lessons topics include glaciers, Arctic vs. Antarctic, food webs, insulation, penguins, core sampling, wind chill, the ozone layers and plate tectonics.

Web Site

The PBS 45 & 49 Web site for Antarctica is located at <http://www.pbs4549.org/antarcti>. The site features a hotlist for each of the fact-finding teams as well as one for the collaboration section. The course of study in PDF format, a map, a timeline for exploration, video and sound clips are also available on the Web.

Instructional Television Programs

The videos, which include footage from Antarctica and interviews with experts, provide a balance between the need for progress and the need for preservation of this important continent. The five videos are:

- **Welcome to Antarctica** — Overview
- **Antarctica Under Construction** — Geology/Geography
- **Winter? Summer? How Can You Tell?** — Weather/Seasons
- **I Thought Penguins Could Fly** — Biology/Ecology
- **Do I Need a Passport?** — Habitation

Each part of **Antarctica: 90 Degrees South** can stand alone or the entire package can be used while doing the simulation. The teacher must decide the best approach for use in his/her classroom.



Did You Know?

On December 1, 1959, the **Antarctic Treaty** was signed by 12 nations and became effective in 1961. Since then, 28 other nations have become signers. The treaty bans military activity and nuclear testing in Antarctica. It also allows nations to conduct scientific research and ensures free exchange of information between countries.

Some Records

- The **coldest temperature** ever recorded was at the South Pole: -88° Celsius (-126° Fahrenheit).
- **Winds** can reach over 300 km per hour (186 miles per hour).
- Antarctica is the **largest desert in the world**. Only about 4 cm of rain fall each year in the form of snow. No rain has fallen in the part of Antarctica called the Dry Valleys for over two million years.
- The **longest glacier** in the world in the Lamber-Fisher Ice Passage. It is 515 km (320 miles) long and 40 km (25 miles) wide.
- The **largest iceberg** ever recorded was 12,000 square miles, the size of Belgium. It broke free in 1956. Perhaps an even larger one broke free from Antarctica's Ross Ice Shelf sometime before March 2000.

About the Continent

- **Plate tectonics** indicate that Antarctica was joined to Australia about 200 million years ago. The continent separated and drifted south.
- The **Antarctic Convergence** is where the cold water of the south and the warmer water of the north meet. The water churns and many fish are drawn from the bottom, creating an area ideal for fishing. The churning is affected by the strong easterly and westerly winds.
- About 90% of the world's ice is in Antarctica. There are more than 80 different kinds of ice.
- When the Antarctic sea ice starts to grow in the winter, it eventually doubles the size of the continent, adding 20 million square kilometers or an area about 1.5 times the size of the USA.
- Only about 2% of the Antarctic **land mass** shows through the ice.
- The **average thickness** of the ice sheet is about 2,200 meters (about 1-1/3 mile).
- At its **thickest point**, the ice is 4,776 meters (about 3 miles).
- The **average temperature** in the summer is -30° Celsius (-22° Fahrenheit) and in the winter about -60° Celsius (-76° Fahrenheit).
- If all of the ice were removed, Antarctica would rise about 1,000 meters (about half a mile).
- If all of the ice on Antarctica melted, the oceans would rise 60 to 65 meters (200 to 210 feet) everywhere. Think about what would happen to cities like New Orleans that are currently at sea level.
- More than 70 freshwater lakes are known to lie beneath the Antarctic ice sheet. Lake Vostok is buried 2.5 miles below the ice. (Not all of the lakes are freshwater lakes.)
- There are only **two "seasons."** Daylight lasts six months of the year, followed by six months of darkness. Our summer is their winter and our winter is their summer.
- About 90% to 95% of the **sunlight** that reaches Antarctica is **reflected** off of the ice. This compares to 30% to 40% for grassland and 10% to 15% for forests.
- The Antarctic ice sheet holds over 70% of our planet's fresh water.



- There are **three South Poles**. The **Geographic South Pole** (also known as 90 degrees South) is the place where the longitude lines on the map radiate out. The **South Magnetic Pole** is where the compass points straight up. The **South Geomagnetic Pole** moves because of the fluid in the center of the earth.
- The **tallest mountain** in Antarctica is the Vinson Massif, which is 4,897 meters high (about 16,000 feet).
- Mt. Erebus on Ross Island is an **active volcano** and has been continuously active since 1972.
- Antarctica has no trees or bushes. It is home to about 350 plant species consisting of lichens, mosses and algae.
- **Icebergs** are made of fresh water and break off in pieces. One-eighth of the iceberg is visible and seven-eighths is underwater. Perhaps the largest iceberg broke free from Antarctica's Ross Ice Shelf before March 2000.
- The **ozone hole**, which hovers over Antarctica, is caused by manmade chlorine- and bromine-containing pollutants in the atmosphere, destroying stratospheric ozone.

About the Animals

- There are no polar bears in Antarctica — or any other land mammals (other than researchers and other human visitors).
- There are no flying insects in Antarctica — they'd get blown away. There are flea-like creatures that hop from place to place among the penguins.
- Antarctica is home to a group of fish called ice fish. They have no hemoglobin in their blood to carry oxygen. Oxygen dissolves better at low temperatures so they have no need for it. Their blood is white.
- Dog teams are no longer used in Antarctica to protect the seals from disease (canine distemper, parvovirus, etc.).
- Dinosaur fossils and other fossils have been found in Antarctica. They are believed to have been deposited about 200 million years ago when Antarctica was much farther north (warmer) and connected to Australia, India and Africa.



Exploration

About 350 BC, the ancient Greeks came up with the idea of Antarctica. They knew about the Arctic and thought that there had to be a balancing southern landmass. The name Antarctica is derived from “ant” which means opposite and arctic which comes from “arktos” or Greek for arctic. Some believe that this was a “lucky guess” on the part of the Greeks.

The Golden Age of Exploration

The “Golden Age of Exploration” took place from 1492 (when Columbus discovered America) to about 1800. During that time, several trips were made in the area of Antarctica but no one actually arrived at the continent. In 1599, Dirk Gerritsz (Dutch) was rounding Cape Horn and was blown off course. He reported seeing ice-covered mountains about 500 km (300 miles) south of South America. It is thought that these were the South Shetland Islands. In 1606, Dutch explorers believed they found this southern continent, but it was later proven to be Australia. In 1642, Abel Tasman (Dutch) proved that Australia was what was found. He also discovered New Zealand and thought that this was the southern continent. Tasmania, off the southeast coast of Australia, was named for this explorer.

In 1773 (about the time America was declaring independence from England), James Cook crossed the Antarctic circle and circumnavigated Antarctica. While he didn’t actually sight land, he did sight rock particles in the icebergs, which led him to believe the southern continent exists. He is often quoted as saying, “I make bold to declare that the world will derive no benefit from it.” Cook did report huge populations of fur-bearing seals and sea lions in the region.

The Age of Discovery

The years 1800 to 1900 were called “The Age of Discovery.” It was the ever increasing hunt for fur that brought other adventurers who finally discovered Antarctica. Between 1800 and 1822 more than 150 ships harvested seals and their oil. In 1820 British naval officers William Smith and Edward Bransfield were the first to sight the continent. In 1821, John Davis, an American sealer, became the first person to set foot upon the Antarctic continent. In 1822, the continent of Antarctica was officially discovered. Thaddeus von Bellingshausen (sometimes called Fabian von Bellingshausen), a Russian naval officer, was the second to circumnavigate Antarctica, going farther south than Cook. He also discovered offshore islands. In 1823, British whaler James Wendell discovered the sea that would be named after him and reached the most southerly point. No one traveled as far south as he did for the next 80 years.

In the 1840s separate British, French and American expeditions established the status of Antarctica as a continent. In 1840 British naval officer and scientist James Clark Ross traveled to within 80 miles of the coast and was stopped by massive ice barriers (now called the Ross Ice Shelf). He also discovered the active volcano and named it Erebus after one of his ships. In 1848 Adrien de Gerlache and his crew became trapped in pack ice off the Antarctic Peninsula and became the first scientific expedition to survive an Antarctic winter.

The Heroic Age

The years 1900-1916 became known as “The Heroic Age.” In 1902 Captain Scott (British) led the first Antarctic expedition to get very close to the South Pole. They reached 82 degrees south but were forced to turn back because of snow blindness and scurvy (a disease marked by spongy gums and loosening teeth caused by lack of vitamin C found in citrus fruit). In 1907-09, Ernest Shackleton returned to lead an expedition to within 97 miles of the South Pole. He turned back



because his supplies were depleted. In 1909, Australian Douglas Mawson reached the magnetic South Pole. In 1911, Norwegian Roald Amundsen, along with his five-man team, were the first expedition to reach the South Pole, on December 14, 1911. Amundsen returned to Norway to a triumphant welcome. A team led by Robert Falcon Scott all perished on the return trip. They were only 11 miles from a supply station. In 1915, Shackleton returned to Antarctica to complete the first crossing of the continent. What resulted was an incredible adventure.

The Age of Science

“The Age of Science” is considered to have begun in 1917. In 1928, Richard Bird and three others flew over the South Pole. In 1935, Caroline Mikkelsen of Norway was the first woman to set foot on Antarctica. She was part of a whaling expedition with her husband.

In 1947, Operation Highjump was undertaken by the United States. It was the largest expedition ever with 13 ships, 23 airplanes and 4,700 men. Their goal was to photograph the coast for map making. In 1956, the US landed an aircraft at the South Pole.

International Geophysical Year

The 18-month period from July 1, 1957 to December 31, 1958 is named the International Geophysical Year. Twelve nations established over 60 stations in Antarctica. Also, British geologist Vivian Fuchs and New Zealander Edmund Hillary made the first successful land crossing.

In 1961 the Antarctic Treaty went into effect. Boerge Ousland (Norway) became the first person to cross Antarctica unsupported. It took him 64 days, towing a 400-pound sled and using skis and a sail.

Assignment:

Make a timeline showing the exploration of Antarctica. You can do this by hand, use a Timeliner program or use this site on the Web: http://www.teach-nology.com/web_tools/materials/timelines



Timeline

1599	Dirk Gerritsz (Dutch) rounds Cape Horn and is blown off course; spots South Shetland Islands
1606	The Dutch team thinks it has found southern continent but it is actually Australia
1642	Abel Tasman (Dutch) discovers New Zealand (Tasmania named after him)
1773	James Cook (English) crosses Antarctic circle and circumnavigates Antarctica
1800	Seal harvesting begins
1820	William Smith and Edward Bransfield are first to sight continent
1821	John Davis (American) is first to set foot on continent
1822	Thaddeus von Bellingshausen (Russian): Antarctica is officially discovered
1823	James Wendell (English) discovers the sea that will be named after him
1840	James Clark Ross (English) travels to within 80 miles of the coast; discovers Ross Ice Shelf and Mt. Erebus volcano
1902	Captain Scott (English) leads first expedition to get close to the South Pole
1907	Ernest Shackleton (English) gets to within 97 miles of the South Pole
1909	Douglas Mawson reaches magnetic South Pole
1911	Roald Amundson (Norwegian) leads first expedition to reach South Pole
1911	Cook reaches South Pole one month behind Amundson
1915	Shackleton returns to complete first crossing of Antarctica — an amazing adventure
1928	Richard Bird (American) is first to fly over the South Pole
1935	Caroline Mikkelsen (Norway) is first woman to set foot on Antarctica
1947	Operation Highjump — US mounts largest expedition to South Pole
1956	US lands an aircraft at Antarctica
1957	Named International Geophysical Year; 12 nations establish 60 stations
1957	Edmund Hillary (New Zealand) and Vivian Fuchs (English) make first successful land crossing
1961	Antarctic Treaty goes into effect
1961	Boerge Ousland (Norway) is first to cross Antarctica unsupported



Glossary

- **Algae** — aquatic, non-vascular plants such as seaweed, pond scum and stoneworts
- **Altitude** — the vertical elevation of an object above the surface
- **Antarctic Convergence** — where the Antarctic surface water comes into contact with the sub-Antarctic surface water (which is warmer). The waters do not mix. The Antarctic surface water sinks below the sub-Antarctic surface water. This is also affected by winds.
- **Aurora Australis** — an aurora (light show) that occurs in earth's southern hemisphere — called also *southern lights*
- **Bacteria** — microscopic plants having round, rod-like, spiral or filamentous single-celled or non-cellular bodies often aggregated into colonies living in soil, water, organic matter or the bodies of plants and animals
- **Biodiversity** — an environment as indicated by numbers of different species of plants and animals
- **Biome** — a major ecological community type (tropical rain forest, grassland or desert)
- **Climate** — the average course or condition of the weather at a place, usually over a period of years as exhibited by temperature, wind velocity and precipitation
- **Conservation** — planned management of a natural resource to prevent exploitation, destruction, or neglect
- **Continental crust** — the land crust of the earth
- **Core samples** — drillings into the earth that show the layering of material in the earth's crust
- **Continent** — one of the six or seven great divisions of land on the globe
- **Convergence** — the act of moving toward each other and colliding
- **Crevasse** — a narrow opening resulting from a split or crack (as in a cliff)
- **Divergence** — the act of moving away from each other
- **Expedition** — a journey or excursion undertaken for a specific purpose
- **Exploitation** — to make use of meanly or unjustly for one's own advantage
- **Extinct** — no longer existing
- **Fungi** — any group of parasitic lower plants that lacks chlorophyll and includes molds, rusts, mildews, smuts, mushrooms and yeasts
- **Geology** — a science that deals with the history of the earth and its life especially as recorded in rocks
- **Glacier/ice sheet** — a large body of ice moving slowly down a slope or valley or spreading outward on a land surface
- **Global warming** — an increase in the average temperature of the earth
- **Habitat** — the place or environment where a plant or animal naturally or normally lives and grows
- **Iceberg** — a large floating mass of ice detached from a glacier
- **Insulation** — prevents transfer of heat, electricity or sound



- **International Geophysical Year** — an 18-month period from July 1957 through December 1958, during a period of maximum sunspot activity, designated for cooperative study of the solar-terrestrial environment by the scientists of 67 nations
- **Katabatic Winds** — the mountainous landscape channels and forces the air to flow down the slopes, and gravity causes it to strengthen; these are called inversion winds
- **Lichens** — any plant made up of an algae and a fungus growing in symbiotic association on a solid surface such as a rock.
- **Mosses** — a bryophytic plant having a small leafy, often tufted stem bearing sex organs at its tip
- **Native species** — belonging to or associated with a particular place or vicinity
- **Nematode worms** — parasitic worms in animals and plants or free-living in soil or water
- **Nunatak** — a hill or mountain completely surrounded by glacial ice
- **Oceanic crust** — the crust underlying the ocean basin
- **Ozone** — oxygen formed naturally in the upper atmosphere by photochemical reaction with solar ultraviolet radiation; it is a major agent in the formation of smogs
- **Penguins** — erect, short-legged, flightless aquatic birds of the southern hemisphere
- **Polar** — of or relating to a geographical pole or the region around it
- **Polar Cap/Polar Circle** — either of the two parallels of latitude, each at a distance from a pole of the earth equal to about 23 degrees 27 minutes
- **Plankton** — a passively floating or weakly swimming, usually minute, animal
- **Plate tectonics** — the lithosphere of the earth is divided into a small number of plates which float on and travel independently over the mantle; much of the earth's seismic activity occurs at the boundaries of these plates
- **Precipitation** — a deposit on the earth of hail, mist, rain, sleet or snow
- **Protozoa** — a unicellular animal with complex life cycles, represented in almost every kind of habitat and some of which are serious parasites of man and domestic animals
- **Rotifers** — microscopic, many-celled aquatic invertebrate animals that have the appearance of rapidly revolving wheels
- **South Pole** — the southernmost point of the earth
- **Species** — a class of individuals having common attributes and designated by a common name
- **Sustainable** — a method of harvesting or using a resource so that the resource is not depleted or permanently damaged
- **Tardigrades** — a microscopic arthropod with four pairs of legs that lives in water or damp moss
- **Threatened Species** — species at high risk of extinction
- **Treaty** — an agreement or arrangement made by negotiation
- **Tundra** — a level or rolling treeless plain that is characteristic of arctic and subarctic regions; consists of black mucky soil with a permanently frozen subsoil; has a dominant vegetation of mosses, lichens, herbs and dwarf shrubs
- **Viable** — capable of growing or developing
- **Wind chill** — how cold the air feels taking into account the temperature and the wind speed



Literature Connection

Troubling a Star by Madeleine L'Engle

ISBN 0-440-21950-7

Bantam Doubleday Dell Books for Young Readers 1994

In this fictional story, teenager Vicky Austin is given a birthday gift of a trip to Antarctica. She meets her fellow travelers, learning a different view of what Antarctica could and should be from each of them. Eventually she becomes the unwitting target of international and illegal intrigue and finds herself left on an iceberg to die. Although the main character of Vicky isn't particularly strong, the story does an excellent job of introducing a new reader to the environment, creatures and political and ethical questions surrounding Antarctica. It is a good starting place for discussion on the future of the continent.

Horrible Geography – Perishing Poles by Anita Ganeri

ISBN 0-439-48302-6

Scholastic, Inc. 2002

This is a paperback textbook written in a tongue-in-cheek style and packed full of information. It covers vocabulary; Scott's, Amundsen's and Shackleton's journeys; a comparison of the two poles' geography, climate, weather patterns, animal and plant life; protection facts about hypothermia and human habitation; and ecological questions and problems. Although almost half of the small book is dedicated to the North Pole, it is still a good sourcebook and starting place for intermediate and teen readers who have no background knowledge of the continent of Antarctica.

Shipwreck at the Bottom of the World – The Extraordinary True Story of Shackleton and The Endurance by Jennifer Armstrong

ISBN 0-439-10992-2

Scholastic, Inc. 1998

This is an excellent telling of the true story of Shackleton, his crew, and their journey to and survival in Antarctica. With highly readable text and many black and white photos, it covers preparation for the voyage, survival in a frozen landscape, the destruction of the ship *Endurance*, how the crew traveled and camped on the ice, the decision to separate and have some crew members try for Elephant Island, and the eventual rescue of the entire crew. Although it doesn't tell as much about the wildlife as some other books, it gives a painfully clear depiction of the hardships of life in Antarctica and the courage and character of the people who tackle it.

Trial By Ice – A Photobiography of Sir Ernest Shackleton by K. M. Kostyal

ISBN 0-439-18449-5

Scholastic, Inc. 1999

This is also a very readable text of Shackleton and his journey. The pictures are larger and more numerous than the book mentioned above, but there is less text and information.



Mapping Antarctica

Use your atlas or the Internet to find and label the following places on the Antarctica outline map:



Amundsen-Scott South Pole Station

Drake Passage

Magnetic South Pole

Ross Ice Shelf

Vostok Station

Antarctic Circle

Elephant Island

Greater Antarctica

McMurdo Station

Ross Island

Wendell Sea

Antarctic Peninsula

Geographic South Pole

Lesser Antarctica

Mount Erebus

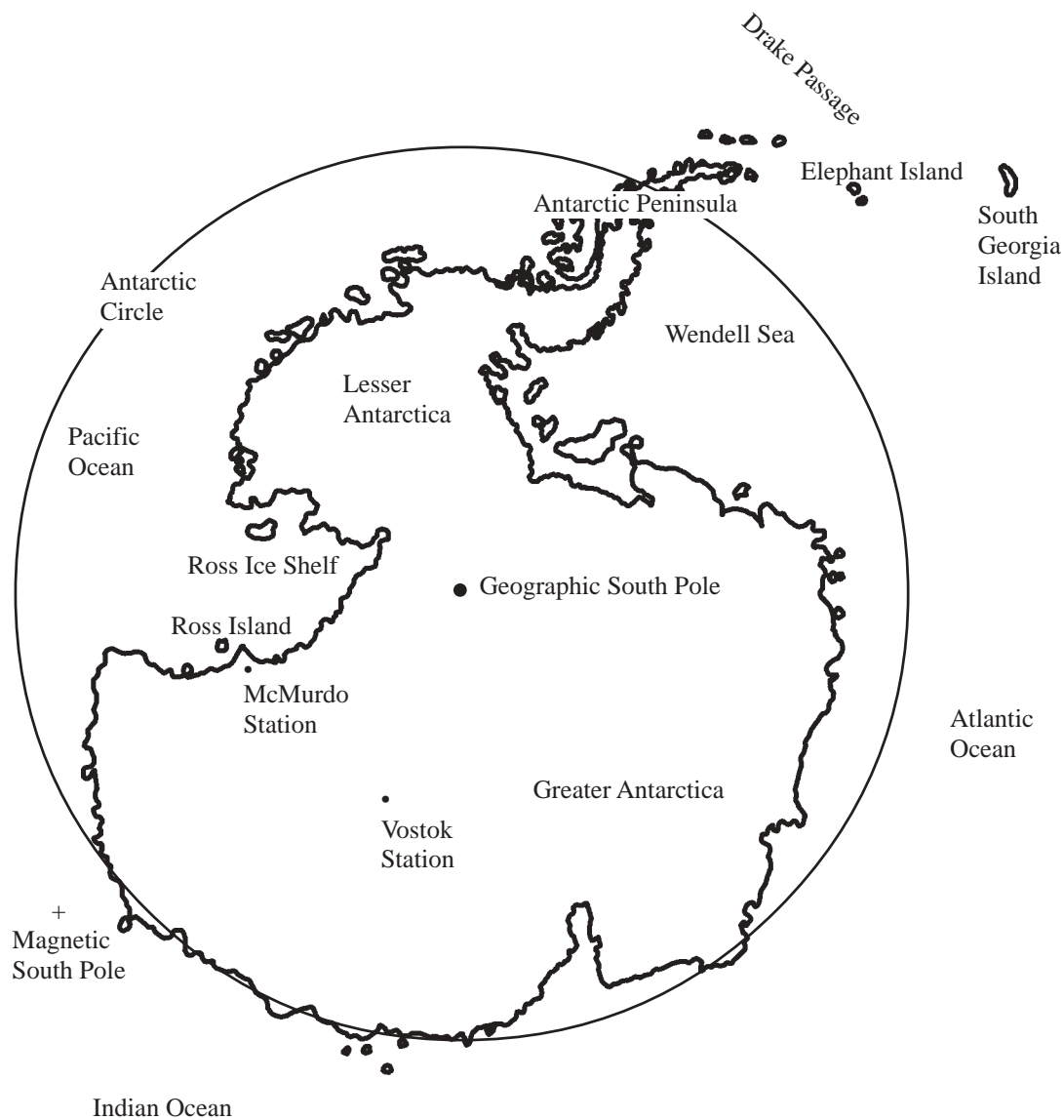
South Georgia Island

All of the oceans that surround Antarctica

**ANTARCTICA:
90 degrees South**

Mapping Antarctica

Answer Key



Amundsen-Scott South Pole Station

Drake Passage

Magnetic South Pole

Ross Ice Shelf

Vostok Station

Antarctic Circle

Elephant Island

Greater Antarctica

McMurdo Station

Ross Island

Wendell Sea

Antarctic Peninsula

Geographic South Pole

Lesser Antarctica

Mount Erebus

South Georgia Island

All of the oceans that surround Antarctica



Maps



<http://www.nationalgeographic.com/xpeditions/atlas/index.html?Parent=antarctic>





<http://www.nationalgeographic.com/xpeditions/atlas/index.html?Parent=antar&Mode=b>






ANTARCTICA:
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Simulation

<http://www.pbs4549.org/antarcti>



Wadsworth Ridge
Wilkes Coast
Fouquieria Island 4
Wadsworth
Cape Dumont
Gulf of D-10
D-10
Pet Martin
Ferguson Field
Cape Webb
S. Yonah Island

Simulation

The year is 2050. The earth has become dangerously overcrowded. You are on a team of scientists commissioned to determine if Antarctica is a place where humans could live.

First you'll be on a fact-finding mission. Based on the information you gather, your group will develop a plan for the following:

- feeding people and the impact of humans on the food chain;
- finding energy sources;
- determining the types of structures that could be built to house the people;
- and writing the laws necessary to maintain order.

ANTARCTICA:
90 degrees South

Procedures for Using the Simulation

Goal:

The main goal of **Antarctica: 90 Degrees South** is for students to investigate topics about Antarctica to determine if habitation is possible in this frigid land. This is accomplished by first having students go on a fact-finding mission and, second, synthesizing the information they gather to construct the society that would be developed in Antarctica.

Basic Design:

1. Students will watch the **Overview** video.
2. The teacher will present the problem or the scenario to the students.
3. Students will be assigned to a science exploration team to get facts about their topic.
4. Students will do research and/or perform lesson activities.
5. Teams will present findings to the class and develop a handout of the information they discovered.
6. Teams will pool information and make decisions about what could be done to allow human habitation of Antarctica.

Classroom Management:

Part 1: Fact-Finding

Students will be placed into fact-finding groups. Each group is responsible for finding information about their topic. They will both present their information to the entire class as well as make a fact sheet to be distributed to the class.

Possible topics are:

Earth Science

- Location
- Geology
- Glaciation
- Seasons
- Convergence Zone
- Extreme Conditions
- Dry Valleys
- Characteristics
- Topography
- Plate Tectonics
- Katabatic Winds
- Ozone Layer
- Global Warming
- Ice-Covered Lakes & Terrestrial Ice

Life Science

- Conditions & Adaptations
- Terrestrial Life
- Marine and Sea Life
- Life Zones
- Ecology



The Research:

There are several ways in which students can carry out research to find the answers to their questions.

- Students can go to the Antarctica: 90 Degrees South Web site at <http://www.pbs4549.org/antarcti> to find sites to help them to answer their questions.
- The videos can give students information.
- Print materials (both books and periodicals) are available in the media center of most schools and at all public libraries.
- Students can use search engines on the Internet to help them find information.
- Personal interviews are valuable resources in gathering information.

It is recommended that students find three Internet sites and three print sources. The teacher can alter this relative to the age level, time available and the ability of the students. It is important for students to cite all sources that they use in their presentation.

The Presentation:

After doing research, each team will present the information they have discovered to the large group. Presentations could employ a variety of approaches. Some examples are:

- PowerPoint or HyperStudio presentations
- Skits
- TV news reports
- A commercial or public service announcement
- A video
- Photo essays
- A newspaper
- Demonstrations using charts and graphs.

A written report that gives key information should be written by each team to be used as a resource in answering the synthesis questions.

Collaboration:

Once all the facts have been gathered, students will get into new groups (or work with the class as a whole) to develop a plan for:

- feeding people and the impact of humans on the food chain;
- finding energy sources;
- determining the types of structures that could be built to house people;
- and writing the laws necessary to maintain order.



The Decision:

Once the facts have been presented to the class, the final questions will be discussed either by the class as a whole or by once again breaking the students into groups. A plan will ultimately be made that shows how we would feed, clothe, shelter and govern people living in Antarctica.

State Standards: Benchmarks

Each student will either do research on the objectives below or be presented the information from their classmates:

Earth Science

Grades 3-5 Standards

- B. Summarize the processes that shape Earth's surface and describe evidence of those processes.
- C. Analyze weather changes that occur over a period of time.

Grade 6-8 Standards

- C. Describe the interactions of matter and energy throughout the lithosphere, hydrosphere and atmosphere (e.g., water cycle, weather and pollution).
- D. Describe the processes that contribute to the continuous changing of Earth's surface (e.g., earthquakes, volcanic eruptions, erosion, mountain building and lithospheric plate movements).

Grades 9-10 Standards

- D. Describe the finite nature of Earth's resources and those human activities that can conserve or deplete Earth's resources.
- E. Explain the processes that move and shape Earth's surface.
- F. Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of Earth and space sciences.

Life Science

Grades 3-5 Standards

- B. Analyze plant and animal structures and functions needed for survival and describe the flow of energy through a system that all organisms use to survive.
- C. Compare changes in an organism's ecosystem/habitat that affect its survival.

Grades 6-8 Standards

- B. Describe the characteristics of an organism in terms of a combination of inherited traits and recognize reproduction as characteristic of living organisms essential to the continuation of the species.
- D. Explain how extinction of a species occurs when the environment changes and its adaptive characteristics are insufficient to allow survival.

Grades 9-10 Standards

- E. Explain the structure and function of ecosystems and relate how ecosystems change over time.
- F. Describe how human activities can impact the status of natural systems.



Science and Technology

Grades 3-5 Standards

- A. Describe how technology affects human life.

Grades 6-8 Standards

- A. Give examples of how technological advances, influenced by scientific knowledge, affect the quality of life.
- B. Design a solution or product taking into account needs and constraints (e.g. cost, time, trade-offs, properties of material, safety, aesthetics).

Grades 9-10 Standards

- A. Explain the ways in which the processes of technological design respond to the needs of society.



Introductory Activity

What do you think of when you hear Antarctica? What images does it bring to mind? Fill in the table below about what you know and what you'd like to know about Antarctica.

What I know about Antarctica	What I'd like to know about Antarctica

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Developing a Definition/Freewrite

Given the word “Antarctica,” what do you associate with it? What does it mean? Include any sounds, facts, pictures, past science lessons, news reports and general impressions and feelings you have when you hear the word “Antarctica.” Remember, this is a freewrite. It is not graded. It does not have to be grammatical or spelled right. It’s just a collection of your thoughts.

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Citing Electronic Sources MLA Style

Web Page

Author(s). Name of page. Date of posting/revision. Date of access. <electronic address>

It is important to use the date of access because Web pages are often updated and information available on one day may not be available later. Be sure to include the <and> markers.

For example

The information on this page is from

Purdue OWL Handouts-Using Modern Language Association Handout.
Access August 11, 1999 <<http://owl.english.purdue.edu/files/33.html>>

Online Journals

Author(s). "Title of Article." Title of Journal Volume. Issue (year): Pages/Paragraphs. Date of Access <electronic address>

E-mail

Author. E-mail to the author. Date

This is the same format that is used for personal interviews or personal letters except that the word e-mail is changed to interview or to letter.

Listserv Postings

Author. "Title of Posting." Online posting. Date. Name of listserv. Date of access <electronic address>

Electronic Database (such as Newsbank, Ethnic News Watch, or Broadcast News)

Provide bibliographic data for the original source and then add the name of the database along with relevant data (such as version number and/or transcript).

You can also use *Citation Maker* at <http://www.oslis.k12.or.us/elementary/howto/cited>.

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Research Summaries

Name _____

Bibliographical information in correct form: (See attached sheet to know what information you need for books, newspapers, magazines, online sources, videos or CDs. You can also use *Citation Maker* at <http://www.oslis.k12.or.us/elementary/howto/cited> to make an accurate citation.

What facts did you learn that you will be able to use in your report? Just list them. It's not necessary to write sentences here.

Now it's time to write the sentences. Summarize the information you learned.

How did this information change or support what you already know?

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Pre-Interview Conference Sheet

Name _____

Who are you interviewing?

Why did you choose this person? Who led you to find this person or how did you find out about him/her? What do you expect this person to know that will help your Fact-Finding Team's point of view?

How do you intend to record the information you learn? (Note-taking, videotaping, audiotaping?)

What questions will you ask?

Date, time and location of interview?

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Post-Interview Conference Sheet

Name _____

Set up the biographical information for your interview in correct format according to the attached bibliography sheet.

What usable information did you learn? It's okay to list facts rather than write sentences.

Now it's time to write sentences. Summarize the information you learned.

How does the information you learned support or change what you already know?

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Student Worksheet to Write the Debate/ Discussion Position Notes

This is not your research paper or final project. In class, we are going to hold a debate/discussion on whether Antarctica is habitable. You will each have a chance to introduce your team and give your opinion on that question. The notes you prepare for this should be short and strong. These notes and the graph/chart you made are the only information you will be allowed to have in your possession, so include any information for yourself that you will need to argue your team's point of view correctly and convincingly. After each team has had a chance to present their opinion, students will be expected to question other participants on their views and argue their own in a general classroom discussion/debate atmosphere. Your beginning speaking time will be uninterrupted, but you'd be smart to jot down notes while others speak so that you can participate and question later.

Special notes about debating:

- Questions are not proof. You can't say, "How are we to get heat? Shall we kill the whales for their blubber to use for heat?" That's not proof. It puts the work on the other debater. You must have the information to say that your way is the best way – not put the work on another.
- Even though this will be a discussion rather than a formal debate and you will not be given precise amounts of time to speak or rebut other speakers, you need to support all of your assertions or opinions with facts. Others may call you on simple opinions, generalizations, stereotypes, information based on poor sources, biased sources and poor conclusions drawn from facts.

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Final Evaluation of Antarctica: 90 Degrees South

You have done extensive research on Antarctica and have made a plan for the habitation of it. For your final evaluation, you are to write an expository paper that follows the State of Ohio Proficiency Guidelines. List and discuss three different ways humanity influences Antarctica and three different ways that Antarctica influences the survival of humanity. Remember to include a strong opening paragraph, necessary supporting details and a solid conclusion.

You will be graded using this rubric:

_____ Introduction (10 points)

_____ Statement and explanation of three ways in which humanity influences the survival of Antarctica (40 points)

_____ Statement and explanation of three ways in the Antarctica influences the survival of humanity (40 points)

_____ A summary that illustrates your reaction to the habitation plan (10 points)



Fact-Finding Team

Location of Antarctica

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarciti/fflocat.htm>) or the **Antarctica: 90 Degrees South** video titled **Antarctica Under Construction** about the geology and geography of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Location

- Where would you be if everywhere you look is north?
- What is the latitude of the South Pole?
- What is the difference between the magnetic and geographic South Poles?
- Which pole, geographic or magnetic, were explorers like Scott, Amundsen and Shackleton trying to reach?

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Fact-Finding Team Characteristics of Antarctica

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarcti/ffcharac.htm>) or the **Antarctica: 90 Degrees South** video titled **Welcome to Antarctica**.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Characteristics

- How do we know what we know about the Antarctic continent?
- People often confuse the Arctic and Antarctica. What statement could you make that would characterize the main difference between these two cold places?
- How does Antarctica rank in size compared to the other continents?
- Are there major differences between Greater Antarctica and Lesser Antarctica?
- If you had to describe the shape of the continent, what descriptors would you use?

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Fact-Finding Team

Geology of Antarctica

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarcti/ffgeolog.htm>) or the **Antarctica: 90 Degrees South** video titled **Antarctica Under Construction** about the geology of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions – Geology

- How long ago was the bedrock that underlies the Antarctic continent formed?
- During which geologic eras were each of the rock types in Antarctica formed?
- What are the rock types (series) typically found in Antarctica?
- Is there any evidence of diastrophism (folding) in these rock layers? If so, what and when did it happen?
- Is there any history of volcanic activity in the past or the present? If so, where and when?
- What are the areas of volcanic activity today?
- Are there any natural resources found on the Antarctic continent, protected by treaty today, that might cause conflict in the future when these materials become more and more scarce? What are they? Is the quantity a significant amount and how would they be removed?
- Why are there meteorites from Mars in the Antarctic?
- Where is Antarctica's secret Lake Vida?

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Fact-Finding Team

Topography of Antarctica

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarcti/fftopog.htm>) or the **Antarctica: 90 Degrees South** video titled **Antarctica Under Construction** about the geography of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Topography

- What about the terrain has challenged explorers in the past as well as the present?
- How many square miles of Antarctica are covered with a permanent ice sheet?
- How many square miles is the actual land mass?
- What percent of the continent is visible as mountains and coastlines?
- What are the elevation extremes?
- Is it true that the bedrock at the South Pole is at or below sea level?
- What makes Antarctica the highest continent?
- What is the highest point in Antarctica?
- Identify the two major mountain ranges that make up the Antarctic continent.

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Fact-Finding Team

Glaciation

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarctiffglaci.htm>) or the **Antarctica: 90 Degrees South** video titled **Antarctica Under Construction** about the geology of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Glaciation

- Is there any place on the Antarctic continent that is ice-free? Where is it located and why isn't it covered with ice?
- Alpine glaciers can be found on the Antarctic continent. Compare them with continental glaciers.
- How does glacial ice differ from sea ice? Can glacial ice become sea ice?
- How do ships navigate through the polar ice?
- What is the temperature at which sea ice forms? Name factors that influence this phenomenon.
- If the Antarctic continent is considered a desert, where did all the glacial ice come from?
- What is pack ice and how much is too much for ships to move freely?
- Can icebergs affect Antarctica's food chain?
- Was there ever a time when Antarctica was free of permanent ice? If so, why is it so different today?
- What kind of fossils can be found on the Antarctica continent?
- What do the fossils tell us about the geologic history of this area?

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Fact-Finding Team Plate Tectonics

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarcti/ffplatet.htm>) or the **Antarctica: 90 Degrees South** video titled **Antarctica Under Construction** about the geology of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Plate Tectonics

- Did plates crash together or drift apart when the Antarctic continent was formed?
- How has the movement of the continents affected the formation of permanent ice in Antarctica?
- Construct a timeline for the formation of the Antarctic continent from Pangea (the whole land mass).
- What is Gondwanaland? Can you find it on a map today?

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Fact-Finding Team Life Zones

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarctifflifez.htm>) or the **Antarctica: 90 Degrees South** video titled **I Thought Penguins Could Fly** about the biology of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Life Zones

- What are the characteristics of living things?
- Are there more marine organisms or terrestrial organisms? Why?
- Describe the three major life zones of Antarctica—the Dry Valleys, the ice-covered lakes and terrestrial ice and the marine and sea life.
- Locate each of these life zones on a map.

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Fact-Finding Team

The Dry Valleys: Exposed Rock and Soil

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarctiffvalley.htm>) or the **Antarctica: 90 Degrees South** video titled **I Thought Penguins Could Fly** about the biology and ecology of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — The Dry Valleys: Exposed Rock and Soil

- If you were visiting the Dry Valleys, in what areas would you find life?
- Why is the biodiversity so sparse?
- What is bacteria and why is it found in Antarctica? What are the characteristics of bacteria and how are they adapted to life in Antarctica?
- What is a nematode and why is it found in Antarctica? What are the characteristics of nematodes and how are they adapted to life in Antarctica?
- What is algae and why is it found in Antarctica? What are the characteristics of algae and how are they adapted to life in Antarctica?
- What is lichen and why is it found in Antarctica? What are the characteristics of lichens and how are they adapted to life in Antarctica?
- Why are the lichens, moss, algae and the limited plant communities the only pioneer species to survive such harsh terrestrial conditions? What is a pioneer species and why would these organisms be the only ones able to survive such harsh terrestrial conditions?

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Fact-Finding Team Ice-Covered Lakes and Terrestrial Ice

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarcti/fflakes.htm>) or the **Antarctica: 90 Degrees South** video titled **I Thought Penguins Could Fly** about the biology and ecology of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Ice-Covered Lakes and Terrestrial Ice

- What life exists on or in terrestrial ice?
- What can we learn from microbes found in ancient Antarctic ice?
- How far below ice would we have to look to find microscopic life? How far under the ice can life survive?
- What is Lake Vostok? Describe that environment. What living things have been found in Lake Vostok?

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Fact-Finding Team

Marine and Sea Life

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarctic/sealif.htm>) or the **Antarctica: 90 Degrees South** video titled **I Thought Penguins Could Fly** about the biology and ecology of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Marine and Sea Life

- What are ten facts you can share about life on Antarctica?
- What are the characteristics of sea ice microbes? Identify the organisms involved.
- What role does plankton play in the marine environment? Which is the most important planktonic species to the Antarctic food web?
- As you investigate the unique Antarctic fish, find out what characteristics they have that allow them to live in Antarctica.
- Penguins are the “emperors” of Antarctica. Which varieties can be found in Antarctica? Why would penguins want to live in Antarctica?
- What are some unique characteristics of penguin life?
- What other sea birds live there?
- What is special about the Antarctic seals?
- Why are leopard seals feared?
- What are some of the variety of whales you would find in Antarctica today?
- What has happened to the whale population of Antarctica in the last 100 years?
- What are the rules or guidelines for whaling in Antarctica today?
- What unique characteristics do whales have that allow them to live in Antarctica? Why would whales want to live in Antarctica?

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Fact-Finding Team Ecology

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarcti/ffecolog.htm>) or the **Antarctica: 90 Degrees South** video titled **I Thought Penguins Could Fly** about the biology and ecology of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Ecology

- How do non-living (abiotic) factors like climate and terrain and their interactions affect what lives in Antarctica?
- Develop a food chain for the Antarctic environment:
 - Who are the producers?
 - Who are the first, second and third level of consumers?
- How does location on the Antarctic continent affect the ecosystems and the life that exists there? (Consider the Antarctic Peninsula and Greater Antarctica.)

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Fact-Finding Team

Seasons

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarcti/ffseason.htm>) or the **Antarctica: 90 Degrees South** video titled **Winter? Summer? How Can You Tell?** about the weather and seasons of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions

- I can tell you all about fall, winter, summer and spring in my neighborhood. I know the activities of man and animals during these seasons as well as things like clouds and rainfall and temperature. What are some of the things that happen during the seasons in Antarctica?
- Why are seasons in Antarctica reversed from ours? Create a drawing illustrating the sun and the tilted earth.
- How does the surface of Antarctica change with each season?
- Define the three climatic areas of Antarctica: the interior, the coastal and the peninsula.

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Fact-Finding Team

Katabatic Winds

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarcti/ffwinds.htm>) or the **Antarctica: 90 Degrees South** video titled **Winter? Summer? How Can You Tell?** about the weather and seasons of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Katabatic Winds

- What are the elevation extremes in Antarctica?
- How do these extremes affect the movement of air?
- Who was Douglas Mawson? In 1912 what did he find concerning the movement of air in Antarctica?
- What is the etymology of the word Katabatic? (hint: you might have to look under “c” instead of “k”)
- Why do these winds accelerate at the edges of the ice plateaus?

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Fact-Finding Team Convergence Zone

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarcti/ffconver.htm>) or the **Antarctica: 90 Degrees South** video titled **I Thought Penguins Could Fly** about the biology and ecology of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Convergence

- Considering the cold water surrounding Antarctica with its own ecosystem and the warmer water of the Indian, Atlantic and Pacific Oceans with its own ecosystem, what will happen when the cold and warm waters meet?
- For your fact sheet, draw or diagram the meeting of these waters and the currents that grow out of it.

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Fact-Finding Team

Extreme Conditions

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarctiffcondit.htm>) or the **Antarctica: 90 Degrees South** video titled **Winter? Summer? How Can You Tell?** about the weather and seasons of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Extreme Conditions

- Define the word desert.
- According to that definition, must a desert be hot?
- Fill out the chart below.
- What conclusions can you draw from your chart?

	My City	Sahara Desert	Great Victorian Desert	Greenland	Greater Antarctica
Average annual rainfall					
Average temperature in the coldest month					
Average temperature in the warmest month					
Average wind speed					

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Fact-Finding Team

Ozone Layer

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarcti/ffozone.htm>) or the **Antarctica: 90 Degrees South** video titled **Winter? Summer? How Can You Tell?** about the weather and seasons of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions — Ozone Layer

- What is ozone?
- What is the change in the ozone between Antarctica's summer and winter?
- What causes this damage?
- What are CFC's?
- What produces them?
- How do we know that natural sources aren't responsible for the depletion we have recorded in the ozone?
- What effect would less ozone layer have on the penguins? On us?
- Is the ozone layer recovering?
- How do we, in our city, contribute to the damage and health of the ozone layer?
- What conclusions can you draw?

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Fact-Finding Team

Global Warming

The mission of your group is to

1. Find the answers to the questions listed below. You may use books, periodical resources, the Internet (visit <http://www.pbs4549.org/antarcti/ffglobal.htm>) or the **Antarctica: 90 Degrees South** video titled **Winter? Summer? How Can You Tell?** about the weather and seasons of the continent.
2. Make a presentation of your findings to the class. You may use whatever media you choose for your presentation. Think about how YOU learn best.
3. Make a handout of the important findings of your group to distribute to the rest of the class. Be sure to cite your sources.

Questions – Global Warming

- What is global warming?
- What are greenhouse gases?
- How are they produced?
- Are they currently increasing, decreasing or staying the same?
- Are greenhouse gases good or bad for the earth and life on it?
- What could happen if the greenhouse gases increased/decreased to the life in Antarctica?
- Can greenhouse gases be controlled by us?
- What conclusions can you draw?

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Collaboration

You now have all of the facts you need to make some decisions about whether we can inhabit Antarctica and how we can do it. With your group, develop a plan for:

- feeding people and determining the impact humans will have on the food chain;
- finding energy sources;
- determining the types of structures that could be built to house people;
- and writing the laws necessary to maintain order.

Go to <http://www.pbs4549.org/antarcti/collabor.htm> for information on these topics and view the **Antarctica: 90 Degrees South** video titled **Do I Need a Passport?** on habitation.

Guided Questions

Treaties

- Who owns Antarctica?
- Are there treaties in place for settlement of Antarctica?
- What do you think is the most important element of any treaty? Can a treaty work if there is no enforcing body?

Marine Pollution

- How can we deal with marine pollution?

Environmental Impact

- What is the environmental impact of humans in Antarctica?

Waste Management

- How will we deal with waste management?

Protected Areas

- How can we manage protected areas?

Food Production

- How will we produce food for the people living in Antarctica?

Housing

- What type of housing will be appropriate for the people who live there?

Transportation

- What type of transportation system will be used?

Laws

- What laws will be needed to protect the environment?
- What laws will be needed to provide a safe environment for the people?


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Lesson Plans

<http://www.pbs4549.org/antarcti>



Wadsworth High
Wilks Child
Fouquieria Island 4
Wadsworth
Cape Darnley
Cape Darnley
Pet Martin
Penguin Field
Cape Webb
S. Young Island

Procedures for Using the Science Lesson Plans

Goal

The main goal of the science lesson plans is for students to understand the basic scientific concepts about Antarctica. These concepts include glaciers, the food chain, insulation, core sampling, wind chill, the ozone holes and plate tectonics.

All lessons can be used or they can be used independently of one another. The teacher determines the selection of topic, approach and order of the lessons. Lessons can be used to supplement weak student areas while the simulation is occurring or they can be used in place of the simulation.

Build Your Own Glacier

Students will create a glacier using water and stones.

Arctic vs. Antarctic

Students will determine the similarities and differences between the Arctic and the Antarctic regions.

Food Web

Students will research what food is eaten by a variety of Antarctic species and construct a food web.

Insulation

Students will experiment to find out what materials make good insulators.

Penguins

Students will do research on the Internet and find and write about characteristics of different penguins.

Cupcake Core Sampling

Students will model the actual taking of core samples by using a layered cupcake and a straw.

Wind Chill

Students will determine if wind does make a difference in temperature and will graph the results.

Ozone Holes

Students will become part of an expert group to find information on the ozone holes and will present their findings to the rest of the class.

Plate Tectonics

Students will make a model of the earth moving through plate tectonics and will write an explanation of the process.



Glaciers

Objectives:

As glaciers move, they create a variety of patterns on landforms by a process called glacial scour (or scraping).

The student will

- create a glacier using water and stones;
- pass the “glacier” over a piece of wood and record the shape of the “glacial grooves”;
- explain how scrapings and deposits made by glaciers could provide clues to the climate.

Standards Addressed: Benchmarks

Earth Science

- Grades 3-5: B. Summarize the processes that shape Earth’s surface and describe evidence of those processes.
- Grades 6-8: A. Describe how the positions and motions of the objects in the universe cause predictable and cyclic events.
- Grades 6-8: E. Describe the processes that contribute to the continuous changing of Earth’s surface (e.g., earthquakes, volcanic eruptions, erosion, mountain building and lithospheric plate movements).
- Grades 9-10: E. Explain the processes that move and shape Earth’s surface.

Procedure:

1. Review with the students what they have learned about glaciers — how and why they move. (Ice, under great pressure, becomes plastic and flows like a thick liquid.)
2. Ask students how they think scientists can tell if glaciers have moved over the land. Explain that rocks and gravel freeze. The weight of the glacier causes the bottom of it to be “plastic-like” and gravity pushes it down ridges and crevasses. What would happen to the land over which a glacier travels? What evidence would a glacier leave behind?
3. Tell the students they’re going to make a glacier. Divide the class into partners or groups of three.
4. Fill a paper cup with sharp pieces of gravel.
5. Cover the gravel with about an inch of water.
6. Tape plastic wrap tightly over the top of the cup.
7. Flip the cup on to a paper plate, so that the plastic wrap is next to the plate.
8. Freeze overnight.
9. When the “glaciers” are frozen solid, have students peel off the plastic wrap and scrape them, gravel end down, over a smooth piece of wood to simulate the action of a glacier. Be sure to only scrape in one direction, because glaciers move in only one direction.
10. Have students observe the patterns the gravel has made on the wood. How would this compare to patterns made on the land by real glaciers?
11. Have students sketch their patterns and write a paragraph explaining what they can infer about the way real glaciers affect the landforms over which they move.
12. Discuss how patterns of glaciations provide clues to the climate in a particular area over time. For example, if evidence of glacial scraping is found in an area that is too warm for glaciers to exist, what can we infer about how the climate in that area has changed over a long period of time?



Materials:

- Plastic or paper cup
- Sharp pieces of gravel
- Water
- Plastic wrap
- Tape
- Paper plate
- Smooth piece of wood

Evaluation:

Sketch:

- 3 points—sketches carefully and draws accurately; paragraphs clear, complete and error-free
- 2 points—sketches adequate; paragraphs sufficiently clear, but with some errors
- 1 point—sketches adequate; paragraphs lacking in clarity with numerous errors

Adapted from a lesson by Frank Weisel, Earth Science Teacher, Tilden Middle School, Rockport, Maryland



Arctic vs. Antarctic

Objective:

Student will describe the properties of the Arctic and the Antarctic.

Student will write a report citing the similarities and differences of the two regions.

Procedures:

1. Students will find the Arctic and the Antarctic on a map. They should come up with the observation that they are on the top and the bottom of the earth.
2. Students should either brainstorm what they know OR they could make a Venn diagram showing what they know about each.
3. Students will then be broken into two groups: the Arctic Group and the Antarctic group. Those groups will be further divided into pairs (or they could work individually) and find information on the following: the amount of land, the pole contained, the temperature, the land animals and the amount of sunlight. Students may use the Internet or text material available to them.
4. The groups will report back to the main group. As the reports are made, students will fill in the chart provided on the worksheet.

Category	Arctic	Antarctic
Land	No land	Is a continent
Pole	North Pole	South Pole
Temperature	Cold	Coldest Temp on Earth
Land Animals	Polar Bears	Penguins
Sunlight	Sun never sets in summer	Same but reversed season in the south

Materials:

Handout

Research material (textbooks, library material, Internet, etc.)

Assessment:

Students should report to the class the information that they found.

Writing rubric below will be used to evaluate the comparative writing piece.



Food Webs

Objective:

Students will research what food is eaten by the following organisms: penguins leopard seals, krill, elephant seals, petrels, albatross, fur seals, squid, insects and grass.

Students will make a food web using the data they have gathered.

Standards Addressed: Benchmarks

Life Science

- Grades 3-5: B. Analyze plant and animal structures and functions needed for survival and describe the flow of energy through a system that all organisms use to survive.
- Grades 3-5: C. Compare changes in an organism's ecosystem/habitat that affect its survival.
- Grades 6-8: B. Describe the characteristics of an organism in terms of a combination of inherited traits and recognize reproduction as a characteristic of living organisms essential to the continuation of the species.

Procedure:

1. Students will discuss what life forms are present in Antarctica.
2. Break students into groups and have each group go online or go to the library to find out what each of the following organisms eat:
 - Penguins (eats krill, squid and small fish)
 - Albatross (eats krill, squid and small fish)
 - Petrel — small to medium sea birds (eats plankton, krill, squid and small fish)
 - Fur seals (eats krill, fish, squid and sometimes penguin)
 - Elephant seals (eats squid —75% of its food — and fish)
 - Leopard seals (eats squid, fish, krill and penguins)
 - Sperm whales (eats squid, fish, birds, seals and other whales)
 - Blue whales (eats krill and fish)
 - Krill (eats plankton, krill eggs and krill larvae)
3. Pass out the student activity sheet so that they can fill in what each organism eats.
4. Students will then get with a partner and construct a food web using the information that they gathered. If you wish, you can give the students copies of the pictures to use in their web.

Materials:

Hotlist of Web sites

Activity sheet

Assessment:

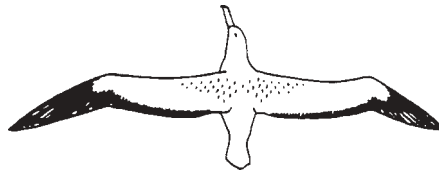
Chart is filled in correctly	10, 8, 6, 4, 0
Food chain is correct	10, 8, 6, 4, 0



Pictures are NOT to scale!



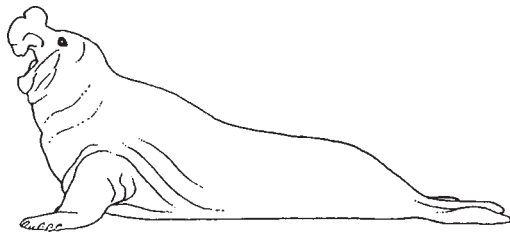
Adelie Penguin



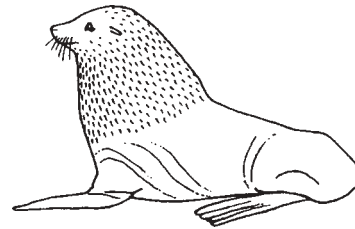
Albatross



Petrel



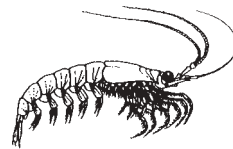
Elephant Seal



Fur Seal



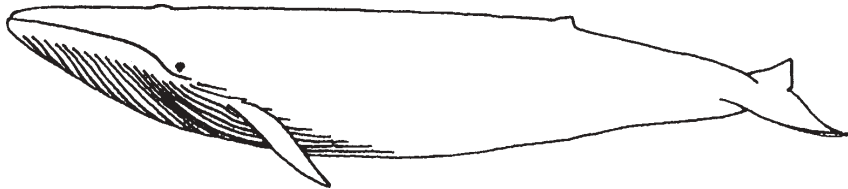
Leopard Seals



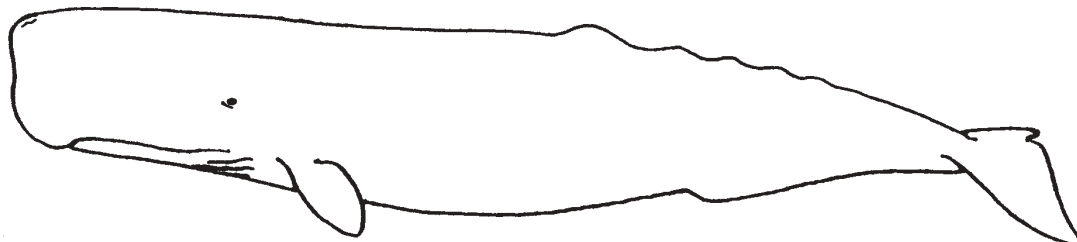
Krill



Squid



Blue Whale



Sperm Whale



Name _____

Food Web

Using the link on the hotlist, or using material from the library, fill in the chart below. On the back of this sheet, make a food web using at least three organisms. You may use plankton, phytoplankton, algae, lichens and mosses as producers.

Organism	What do they eat?
Penguins	
Albatross	
Petrel (small sea birds)	
Fur seals	
Elephant seals	
Leopard seals	
Sperm whales	
Blue whales	
Krill	

**ANTARCTICA:
90 degrees South**

Insulation

Objective:

Students will perform an experiment to determine the best insulation material.

Standard Addressed: Benchmark

Physical Science

- Grades 3-5: D. Summarize the way changes in temperature can be produced and thermal energy transferred.

Procedure:

1. Brainstorm with the students about ways they could keep warm in the winter. Write contributions on the board.
2. Divide the students into groups.
3. Explain that some ways to keep warm might be better than others and explain that they will try to determine which things would be best to help them keep warm.
4. Heat a pan of water and take the temperature of the water after it is poured into small jars (like baby food jars).
5. Have the students make a hypothesis about which material they think will keep the water the warmest.
6. Quickly, have each group wrap one of the jars in available material. Have cotton, wool, polyester, nylon, fur, fat and other materials available. Put rubber bands around the jar to keep the material on the jar.
7. After about 15 minutes, unwrap the jars and take the temperature of the water.
8. Have students record the material they used and the temperature after 15 minutes.
9. You could then invite the students to see if they can come up with the best way to insulate using more than one material. Half of the class could try two materials to see if that makes a difference. The other half of the class should try three materials. They might also try items that are not material, like feathers, down or foam.
10. Have students write a summary of their experiment and the results they achieved.
11. After discussion of results, they will find that layering the material keeps the warmth better than a single layer.
12. Finally, a discussion should be held about the best way to stay warm in very cold temperatures.

Materials:

- Pieces of a variety of fabrics large enough to cover your jar
- “Fat” from a local butcher or oil or Crisco in place of the fat
- Jars to hold the water
- Heated water
- Thermometers
- Rubber bands



Evaluation:

Points	Criteria
0, 5, 10	Contains heading, title, problem and hypothesis .
0, 5, 10	A summary of procedure .
0, 10, 30, 50	Clear and concise conclusions . Conclusion addresses problem and states knowledge gained. Answers to all questions .
0, 5, 10	Overall- neatness, grammar , adheres to format , etc.

Enrichment:

Students can go to the NASA Web site or other Antarctica sites to determine what they should wear if they were going to the Antarctic. Have them make a list of what clothes they would wear if they were taking a trip to Antarctica and why they selected them.

- What We Wear http://www.antarctica.ac.uk/Schools/Primary/pschoolsq_clothing.html
- Dressing in the Height of Fashion: Just What Should the Well-Dressed Arctic Explorer Wear? <http://www.iceberg.co.nz/files/starters/apr2000-antarcticaclothing.pdf>
- Antarctic Clothing <http://www.pageplanet.com/coolrunner/CLOTHING/Clothing.htm>



Penguins

Objectives:

Student will do research on the Internet or use other materials on the variety of penguins found in Antarctica and will write characteristics of each penguin.

Standards Addressed: Benchmarks

Life Science

- Grades 3-5: B. Analyze plant and animal structures and functions needed for survival and describe the flow of energy through a system that all organisms use to survive.
- Grades 3-5: C. Compare changes in an organism's ecosystem/habitat that affect its survival.

Procedure:

1. Review the following information:

When you think about penguins, you think about Antarctica and the area around Antarctica. There are more than 17 species of penguins and they all live in the Southern Hemisphere. All penguins are flightless birds that have adapted for life in cold water. Penguins do not fly even though they are birds. They search for food and evade predators by swimming rather than flying. Penguins have dense, solid bones and no air sacs (which reduce body weight to allow birds to fly more easily). Most penguins can be underwater for five to seven minutes.

In Antarctica, the larger species feed primarily on squid and the smaller species feed mostly on krill and fish. All penguins nest in colonies. Most use open nests lined with rocks and pebbles and both the males and females sit on the eggs and feed the young. The young are fed by regurgitation and take their food from the inside mouth of the adults.

2. Ask the students if they think all penguins are the same.
3. Break the students into groups. Give the students the worksheet on penguins and have them find both a picture and identify at least two of the characteristics for each type of penguin listed.
4. Students could use the Internet sites listed on the handout or they can use text material from the classroom or the library.
5. If students are unable to find pictures, the teacher can use the ones on page 67.



Find a picture of each type of penguin and at least two facts about them

Name of Penguin	Picture	Facts and Characteristics
Adelie Penguin		<ul style="list-style-type: none"> • Most common • Build their nest along coast of Antarctica • Very playful
Emperor Penguin		<ul style="list-style-type: none"> • Large penguins (up to 4 feet) • Quiet • Female lays her eggs on the ice and males keep them warm between the top of his feet and his body • Only birds that never set foot on dry land • Female gets food for the young
King Penguin		<ul style="list-style-type: none"> • Large penguin • Makes no nest at all • Female lays her eggs on the ice and males keep them warm between the top of his feet and his body
Macaroni Penguin		<ul style="list-style-type: none"> • Crested penguins. Have orange, yellow and black crests • Have black chins
Rockhopper Penguin		<ul style="list-style-type: none"> • Smallest crested penguins • Have a thin yellow stripe that starts behind the beak and runs toward the back of the head and then develops into a drooping crest
Chinstrap Penguin		<ul style="list-style-type: none"> • White on front and throat and have a black back • Have a thin black stripe across the bottom of the throat — the chinstrap

If the students cannot find pictures on the Web, you can distribute the pictures on the next page.





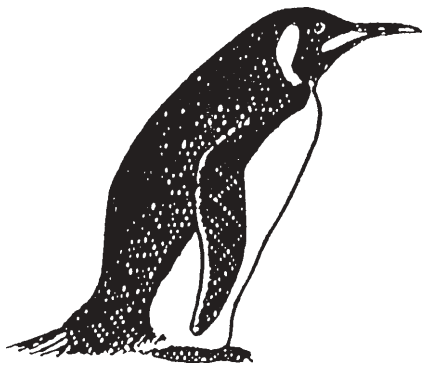
Adelie



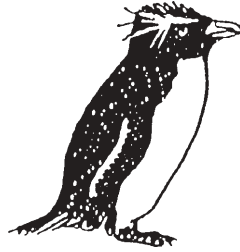
Chinstrap



Macaroni



King



Rockhopper



Emperor

Pictures are from Lindblad Expeditions <http://www.expeditions.com>

To find information about penguins, go to...

- The Wonderful World of Penguins <http://mitglied.lycos.de/pingulein/id93.htm>
- Antarctic Penguins <http://www.gdargaud.net/Antarctica/Penguins.html>
- Penguins of the Antarctic Region <http://www.siec.k12.in.us/~west/proj/penguins/antarctic.html>

Materials:

- Worksheet
- Internet access
- Text material

Evaluation:

Pictures are correctly placed	25 points
At least 2 facts are given for each penguin	25 points
Total	50 points



Penguins

When you think about penguins, you think about Antarctica and the area around Antarctica. There are more than 17 species of penguins and they all live in the Southern Hemisphere. All penguins are flightless birds that have adapted for life in cold water. Penguins do not fly even though they are birds. They search for food and evade predators by swimming rather than flying. Penguins have dense, solid bones and no air sacs (which reduce body weight to allow birds to fly more easily). Most penguins can be underwater for five to seven minutes.

In Antarctica, the larger species feed primarily on squid and the smaller species feed mostly on krill and fish. All penguins nest in colonies. Most use open nests lined with rocks and pebbles and both the male and female sit on the eggs and feed the young. They are fed by regurgitation and take their food from inside the mouths of the adults.

Find a picture of each type of penguin and at least two facts about them.

Name of Penguin	Picture	Facts and Characteristics
Adelie Penguin		
Emperor Penguin		
King Penguin		
Macaroni Penguin		
Rockhopper Penguin		
Chinstrap Penguin		

To find pictures and information about penguins, go to...

- The Wonderful World of Penguins <http://mitglied.lycos.de/pingulein/id93.htm>
- Antarctic Penguins <http://www.gdargaud.net/Antarctica/Penguins.html>
- Penguins of the Antarctic Region <http://www.siec.k12.in.us/~west/proj/penguins/antarc.html>

ANTARCTICA:
90 degrees South

Cupcake Core Sampling

Objectives:

Trying to “see” what is beneath the surface of the earth is one of the jobs of a geologist. Rather than digging up vast tracts of land to expose an oil field, or to find coal-bearing strata, core samples can be taken and analyzed to determine the likely composition of the earth’s interior.

The students will

- model core sampling techniques to find out what sort of layers are in a cupcake;
- make a core sample using cake material;
- and write an explanation what they observed from their sample and how it relates to the core samples taken from the earth.

Standards Addressed: Benchmarks

Earth Science

- Grades 3-5: B. Summarize the processes that shape Earth’s surface and describe evidence of those processes.
- Grades 6-8: D. Identify that the lithosphere contains rocks and minerals and that minerals make up rocks. Describe how rocks and minerals are formed and/or classified.

Materials:

- Cupcake mix
- Plastic knives
- Foil baking cups
- Food coloring
- Drawing paper
- Toothpicks
- Frosting
- Plastic transparent straws

Activity:

1. The teacher or the students will make cupcakes with at least three layers of colored batter.
2. Provide each student with a cupcake, straw, toothpick and drawing paper. Foil baking cups and frosting will prevent the students from seeing the interior of the cupcakes in much the same way that a geologist can’t see the interior of the earth.
3. Ask the students to fold a piece of drawing paper into four sections and in one of the sections draw what they think the inside of the cupcake would look like.
4. Ask the students how they might get more information about the cupcake without peeling the foil or cutting it open with a knife.
5. Someone may suggest using the straw to take a core sample. If not, show them how to push the straw into the cupcake and pull out a sample (straws can be cut to a length slightly longer than the depth of the cupcake.)
6. The students should make a second drawing of the cross section of their cupcake based on the information from three core samples. Each new drawing should be carefully labeled and placed in a different section of the recording paper.
7. Finally, the students should cut open the cupcakes with a knife to compare them to the drawings. **Keep relating what the students are doing to what real-life geologists do.** Nobody eats until the discussion is complete!



Evaluation:

Evaluation of diagram and report

CATEGORY	30	20	10	5
Diagrams & Illustrations	Diagrams and illustrations are neat, accurate and add to the reader's understanding of the topic.	Diagrams and illustrations are accurate and add to the reader's understanding of the topic.	Diagrams and illustrations are neat and accurate and sometimes add to the reader's understanding of the topic.	Diagrams and illustrations are not accurate OR do not add to the reader's understanding of the topic.
Organization	Information is very organized with well-constructed paragraphs and subheadings.	Information is organized with well-constructed paragraphs.	Information is organized, but paragraphs are not well-constructed.	The information appears to be disorganized.
Mechanics	No grammatical, spelling or punctuation errors.	Almost no grammatical, spelling or punctuation errors	A few grammatical, spelling or punctuation errors.	Many grammatical, spelling or punctuation errors.

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Adapted from materials provided by Women in Mining

This lesson plan can be found at <http://www.coaleducation.org/lessons/wim/4.htm>

A similar lesson titled Layer Cake Geology can be found at http://www.beloit.edu/~SEPM/Earth_Works/Layer_Cake_Geology.html



Wind Chill

Objectives:

Students will define wind chill.

Students will make a graph of the data they collect.

Standards Assessed: Benchmarks

Earth Science:

- Grades 3-5: D. Analyze weather and changes that occur over a period of time.
- Grades 6-8: C. Describe interactions of matter and energy throughout the lithosphere, hydrosphere and atmosphere (e.g. weather).

Procedure:

1. Discuss the concept of wind chill. Do students feel colder when the wind is blowing? Is there a way they can find out what the wind chill is on a given day? (News shows and Web sites listed below)
2. Have the students find whether movement of the air or wind affects the temperature that we feel.
3. Prepare a pan of water with about .5 inch of room temperature water. Lay a thermometer in the water with the ball of the thermometer submerged. Take the temperature at the time you put the water in and then again five minutes later.
4. Have the students make a hypothesis of what they think will happen.
5. Put a fan by the water so that the air from the fan blows over the water. Wait about 20 minutes and again check the temperature. (Be careful! Don't get the fan or the cord of the fan wet!)
6. Plot the points on a graph on the board.
7. Students will write a summary of the graph and then answer the questions, "How does moving air or wind affect the temperature of the water? What do you think you could do to stay warm?"
8. Have students go to <http://www.nws.noaa.gov/om/windchill> to see the chart of wind chill factor (or the teacher could print the chart and distribute to students).

Materials:

- Shallow pan
- Water
- Thermometer
- Fan
- Board or chart paper for graph.



Evaluation:

Points

0, 5, 10

0, 5, 10

0, 10, 20

0, 10, 30, 50

0, 5, 10

Criteria

Heading, Title, Problem and Hypothesis are listed.

Materials and procedure are explained.

Data points were included and defined.

A clear conclusion that explains the results of the procedure is given.

Mechanics (grammar, spelling, punctuation, etc.)

Enrichment:

Older students might want to calculate the wind chill factor using the information below.

Formula to calculate a Fahrenheit wind chill.

$$T(wc) = .0817\sqrt{3.71V^{0.5} + 5.81 - 0.25V}(T - 91.4) + 91.4$$

T(wc) Wind Chill

V Wind Speed in statute miles per hour

T Temperature in degrees Fahrenheit

Note: When wind speeds are below four miles per hour, the above formulas will give you a wind chill that is higher than the actual temperature. When wind velocities are near zero and you are standing still, your body heat warms the air near your body. This warm air near your body provides some insulation from the colder environment. As a result, it may feel warmer than the actual temperature.

Source for both formulas: The National Weather Service http://www.5cities.com/weather/wind_chill_formula.htm

Extra-credit:

Students can determine from a wind chill graph when it would be dangerous to be outdoors.

Source for the formula: The National Weather Service



Ozone Hole Expert Groups

Objective:

Students will do research on the topics associated with the hole in the ozone layer over Antarctica.

Students will write five facts about their topics and one question for each of those facts.

Students will present what they learned to the rest of the class.

Standards Addressed: Benchmarks

Earth Science

- Grades 3-5: D. Analyze weather and changes that occur over a period of time.
- Grades 6-8: D. Explain that the universe is composed of vast amounts of matter, most of which is at incomprehensible distances and held together by gravitational force. Describe how the universe is studied by the use of equipment such as telescopes, probes, satellites and spacecraft.

Scientific Inquiry

- Grades 3-5: C. Develop, design and safely conduct scientific investigations and communicate the results.

Procedure:

1. Break the students into groups of three. Each group will become an expert on the topic they select. The teacher can write the topics on 3 x 5 cards and groups can select their topic.
2. Students will do research on the topic. They will find five facts about their topic and then write a question for each fact.
3. The group will then make a presentation about their topic, teaching the five facts they thought were important.
4. A test could be given using the questions the students made.

Topics:

- What are the layers of the earth's atmosphere?
- What is ozone?
- What are chlorofluorocarbons (CFC's) and from where do they come?
- What is global warming?
- What is the ozone hole and where is it located?
- What is the greenhouse effect?



Teacher Information:

What are the layers of the earth's atmosphere?

<http://www.atm.ch.cam.ac.uk/tour/index.html>

- We live in the **troposphere**.
- Most weather occurs here such as rain clouds.
- It is 10 km (6.2 miles) deep.
- The other layers are the **stratosphere**, the **mesosphere**, the **thermosphere** and the **exosphere**.
- The **stratosphere** is the important region where the ozone hole and global warming originate.

What is Ozone?

<http://www.atm.ch.cam.ac.uk/tour/index.html>

- Ozone forms a layer in the **stratosphere**.
- It is thinnest in the tropics (around the equator) and denser at the poles.
- Ozone is measured in **Dobson Units** (DU).
- There is typically around 260 DU near the tropics and higher elsewhere.
- Ozone is created when ultraviolet radiation (sunlight) strikes the stratosphere, splitting oxygen molecules (O₂) to atomic oxygen (O). The atomic oxygen quickly combines with other oxygen molecules to form ozone.

What are chlorofluorocarbons (CFC's) and where do they come from?

<http://www.atm.ch.cam.ac.uk/tour/index.html>

- Chlorofluorocarbons are a common industrial product used in refrigeration systems, air conditioners, aerosols, solvents, etc.
- They are inert in the lower atmosphere (troposphere) but are broken down into the components by the UV (ultraviolet) rays at higher altitudes.
- The chlorine formed in this process damages the ozone.
- The Montreal Protocol severely curtailed the manufacture of CFC's.
- Factories and homes produce CFC's.

What is global warming?

<http://www.arm.gov/docs/education/globwarm/causglobwarm.html>

- Global warming is an increase in the temperature outside. The current average global temperature is 57° Fahrenheit.
- In the last 100 years, the average global temperature has risen 1° Fahrenheit.
- In order for the earth to stay the same temperature from year to year, the energy arriving on Earth from the sun must be the same as the energy leaving the earth. If more energy leaves, the earth will cool down. If more stays, we will have global warming.
- Scientists believe that the earth's temperature will go up 2° F to 6° F over the next century.
- Carbon dioxide is the most common greenhouse gas. Because CO₂ absorbs energy emitted from the earth and prevents it from going back out into space, it is called a greenhouse gas.



What are the ozone holes and where are they located?

<http://www.atm.ch.cam.ac.uk/tour/index.html>

- The ozone hole should not be confused with global warming. There is a connection, but each is a separate issue.
- The ozone hole occurs in the stratosphere, in the cold polar regions above the south pole.
- The ozone has been depleted greatly in the last 15 years due to manmade chemicals.
- The size of the ozone hole varies with the time of the year.
- The Montreal Protocol in 1987 was aimed at reducing CFC's by half by the year 2000. Agreement has been reached on the control of industrial production of halocarbons until 2030.

What is the greenhouse effect?

<http://liftoff.msfc.nasa.gov/academy/space/greenhouse.html>

- The gases in the atmosphere let in light that warms the earth's surface, yet tends to prevent much of this heat from escaping. This natural warming of the planet is called the greenhouse effect.
- The greenhouse gases are carbon dioxide, methane, nitrous oxide and a few others.
- The greenhouse gases and clouds prevent some of the infrared radiation from escaping the earth's atmosphere. They trap the heat near Earth's surface where it warms the lower atmosphere.
- Without the greenhouse gases, Earth would be much too cold for us to survive.
- Greenhouse gases in the atmosphere can be seen from satellites in space.

Materials:

- Expert Group worksheet
- Internet connection
- Text references



Evaluation:

Worksheet:

CATEGORY	Excellent	Good	Satisfactory	Needs Improvement
Quality of Information	Information clearly relates to the group's topic. It includes several supporting details and/or examples.	Information clearly relates to the group's topic. It provides 1 to 2 supporting details and/or examples.	Information clearly relates to the group's topic. No details and/or examples are given.	Information has little or nothing to do with the group's topic.
Organization	Information is very organized with well-constructed paragraphs and subheadings.	Information is organized with well-constructed sentences.	Information is organized, but sentences are not well-constructed.	The information appears to be disorganized.
Amount of Information	Five facts are given and five questions asked about the topic.	Four facts are given and four questions asked about the topic.	Three facts are given and three questions asked about the topic.	Two facts are given and two questions asked about the topic.

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Presentation:

CATEGORY	Excellent	Good	Satisfactory	Needs Improvement
Content	Shows a full understanding of the topic.	Shows a good understanding of the topic.	Shows a good understanding of parts of the topic.	Does not seem to understand the topic very well.
Preparedness	Student is completely prepared and has obviously rehearsed.	Student seems pretty well prepared but might have needed a couple more rehearsals.	The student is somewhat prepared, but it is clear that rehearsal was lacking.	Student does not seem at all prepared to present.
Stays on Topic	Stays on topic all (100%) of the time.	Stays on topic most (99%-90%) of the time.	Stays on topic some (89%-75%) of the time.	It was hard to tell what the topic was.
Enthusiasm	Facial expressions and body language generate a strong interest and enthusiasm about the topic in others.	Facial expressions and body language sometimes generate a strong interest and enthusiasm about the topic in others.	Facial expressions and body language are used to try to generate enthusiasm, but seem somewhat faked.	Very little use of facial expressions or body language. Did not generate much interest in topic being presented.

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Expert Groups

1. Narrow your topic to a reasonable amount of material to teach in a 15-minute lesson.

Your large topic Ozone Hole Your Subtopic _____

2. Do research on your topic and find important facts.

3. Brainstorm the facts and/or concepts you plan to include in your lesson and select the five facts you feel are most important.

FACTS: List them below!

1. _____

2. _____

3. _____

4. _____

5. _____

4. Now write five test questions you plan to submit. Make at least two short essay-type questions. The other three can be true/false, multiple choice, matching or fill in the blanks. Write the questions in blue and the answers in red.

1. _____

2. _____

3. _____

4. _____

5. _____

**ANTARCTICA:
90 degrees South**

Plate Tectonics

Objective:

Students will identify the three layers of the earth: core, mantle and crust.

Students will demonstrate knowledge of the concepts of convergent and divergent motions of the earth.

Students will define plate tectonics.

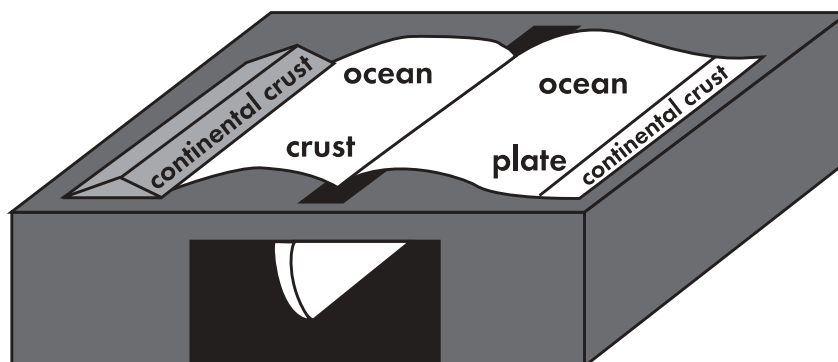
Standards Assessed: Benchmarks

Earth Science

- Grades 3-5: B. Summarize the processes that shape Earth's surface and describe evidence of those processes.
- Grades 6-8: A. Describe how the positions and motions of the objects in the universe cause predictable and cyclic events.
- Grades 6-8: E. Describe the processes that contribute to the continuous changing of Earth's surface (e.g., earthquakes, volcanic eruptions, erosion, mountain building and lithospheric plate movements).
- Grades 9-10: E. Explain the processes that move and shape Earth's surface.

Procedure:

1. The teacher will show a soft boiled egg (cut in half with the shell still on) and make a comparison between the soft boiled egg and the layers of the earth. The yolk, which is a little "runny," is the core of the earth. The white of the egg is like the mantle and the shell represents the crust of the earth.
2. Divide the students into groups of two or three.
3. Given Plate Tectonic worksheet, students will name the layers of the earth.
4. The students will make a box that will be used to replicate the movement of plates on the earth. They will use the box to demonstrate the convergence and divergence of the plates of the earth. To build the box, students will cut a long very thin strip in the top and will cut holes in both of the sides. (See worksheet for illustration.)



Step 1. Take two sheets of blue paper to represent the oceanic plate. On both sheets place a triangular tube to represent the plate with an oceanic and continental crust. (Brown cardboard works well.)

Put the unattached sides of the papers through the slit so that only about half of the paper is showing. When one paper is pulled down, this represents the convergence of the plates. When the paper is pushed up, this represents the divergence of the plates.



Step 2. Move only the sheet with the cardboard attached so that the cardboard comes to the edge of the slit. This represents the oceanic plate disappearing beneath the edge of the continent. This is called **subduction**. This sinking of the oceanic plate into the mantle below the edge of the continental crust results in “plate-pull” and may be one of the major forces driving plate tectonics. Subduction also results in volcanic eruptions and very deep ocean trenches.

Step 3. On the plain sheet of blue paper, attach another triangle so that this also has a continental and an oceanic crust. Now pull both sheets of blue paper from the bottom. If you do this carefully, one of the triangles will go on top of the other showing the development of mountains when convergence occurs.

Step 4. If the layers are moved toward the sides of the box, the students can see the action of fault lines moving in an earthquake. This is called a **transform fault**.

5. Have the students go to <http://www.ucmp.berkeley.edu/geology/tectonics.html> to see an animation of plate tectonics.
6. Have the students write a paragraph to explain what they have just done. They need to include a diagram showing at least one of the four steps above.

Vocabulary:

- **Continental crust** — The land crust of the earth.
- **Core of the earth** — There are really two cores, an **inner core** which is solid and is about 4300° C, and a **core** which is liquid around the inner core. They are composed of mostly iron with about 10% sulfur. (There is some “new” information that uranium may be in the core in quantity and may be responsible for much of the earth’s inner heat.)
- **Convergence** — The act of moving toward each other and colliding.
- **Crust** — The crust is much thinner. It is rocky and brittle, so it can fracture during plate movements, resulting in earthquakes.
- **Divergence** — The act of moving away from each other. Where plates diverge, hot molten rock rises and cools, adding new material to the edges of the mid-oceanic plates. This process is known as sea-floor spreading.
- **Mantle** — The mantle goes around the core and is solid. It comprises most of the earth’s mass. The temperature is about 1000° C.
- **Oceanic crust** — The crust underlying the ocean basin. This layer is much thinner than the earth’s continental crust and is young.
- **Plates** — The earth’s surface is broken into seven large and many small moving plates, each about 50 miles thick. They move relative to one another an average of a few inches a year or about as fast as fingernails grow.
- **Plate Tectonics** — This is a geological theory which says that the surface of Earth is broken into large plates. The size and position of the plates change over time. It was developed by Alfred Wegener. Unfortunately, he died before his theory was accepted as a **major paradigm** in modern geomorphology.
- **Transform fault** — Plates moving horizontally against each other.



Materials:

- Box
- Cutting instrument
- Blue paper
- Cardboard strips
- Tape or glue
- Writing material

Assessment:

Summary of procedure	10	15	25
Clear conclusions are drawn about plate tectonics	10	15	25
Mechanics — spelling and grammar	10	15	25
Diagram of one of the steps listed	10	15	25

Enrichment:

Lightweight tissue paper could be attached to the triangular tube and laid over the blue “ocean” paper. If the blue paper is then pulled, the tissue paper will wrinkle and ball up at the subduction zone becoming a mountain range.



Plate Tectonics

Label the layers of the earth below:

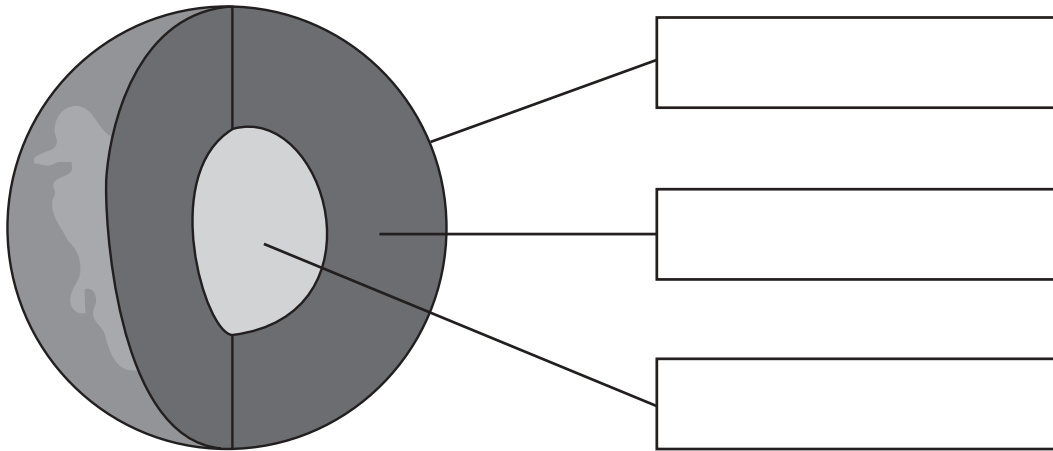
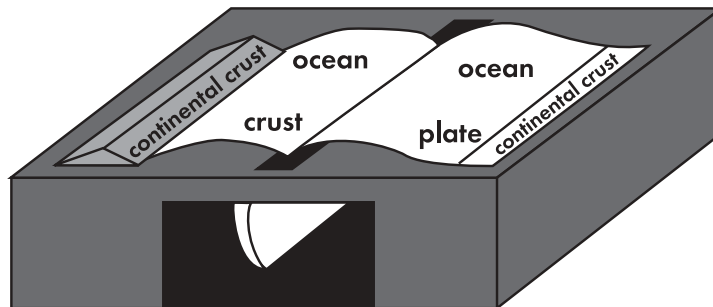


Plate tectonics is a geological theory that says the surface of Earth is broken into large plates. The size and position of the plates changes over time. The plates move in three ways:

1. **Convergence** occurs when the plates move together and collide. This causes mountains to develop.
2. **Divergence** occurs when the plates move away from each other. At that time, molten rock rises and cools and adds new material to the edge of the ocean crusts (ocean floor).
3. **Transform faults** occur in the horizontal movement of plates against each other. This causes earthquakes.

Now you are to make a simulation of plate tectonics. Follow the directions below to make a box that looks like the one below. Cut a long very thin strip in the top and cut holes in both sides of the box.



Step 1.

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Step 2.

Move only the sheet with the cardboard attached so that the cardboard comes to the edge of the slit. This represents the ocean plate disappearing beneath the edge of the continent. This is called **subduction**.

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Step 3.

On the plain sheet of blue paper, attach another triangle so that this also has a continental and an oceanic crust. Now pull both sheets of blue paper from the bottom. If you do this carefully, one of the triangles will go on top of the other showing the development of mountains when convergence occurs.

Step 4.

If the layers are moved toward the sides of the box, the students can see the action of fault lines moving in an earthquake. This is called a **transform fault**.

Go to RLINK <http://www.ucmp.berkeley.edu/geology/tectonics.html> and see an animation of the plates moving into the position they currently hold.

Write a paragraph to explain what you discovered when you followed the steps listed above. Be sure to use the correct terminology. Also make a diagram showing one of the steps and what happened when you did what you were asked to do.

Draw diagram:



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Video Worksheets

<http://www.pbs4549.org/antarcti>

Antarctica: 90 Degrees South
Video 101 (Overview)

Welcome to Antarctica: Video Worksheet

1. The coldest temperature ever recorded is _____.
2. The average temperature in Antarctica is _____ in the summer and _____ in the winter.
3. No rain has fallen in the part of Antarctica called the Dry Valleys for more than _____ years.
4. Antarctica has the world's longest glacier. It is _____ miles long and _____ miles wide.
5. Only _____ of an iceberg is visible above the water.
6. The place where the cold water of the south and the warm water of the north meet around Antarctica is called the _____.
7. Only about _____ % of Antarctica's land shows through the ice.
8. The average thickness of the ice is about _____ miles.
9. The massive ice sheet of Antarctica holds about _____ % of the earth's fresh water.
10. There are actually _____ South Poles.
11. Man-made chlorine and bromine containing pollutants have caused a problem above Antarctica called the _____.
12. You don't have to worry about flying insects in Antarctica because _____
_____.

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Antarctica Under Construction: Video Worksheet

1. Give two reasons why there is no mining of ores at Antarctica:
 1. _____
 2. _____
2. The theory that the continents moved or drifted into their current locations is called _____.
3. Alfred Wegener's theory called the one original continent _____.
4. The majority of Antarctica is within the Antarctic Circle, which is at _____ degrees South latitude.
5. Antarctica is the _____ largest continent.
6. The United States is _____ as big as Antarctica.
7. Antarctica has two major types of ice, _____ ice and _____ ice.
8. _____ % of the world's fresh water is contained in Antarctic ice.
9. Only _____ % of Antarctic land is not covered by ice.
10. The highest point in Antarctica is _____.

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Winter? Summer? How Can You Tell?: Video Worksheet

1. The coldest temperature on record anywhere was taken at Vostok Station in Antarctica and it was _____ degrees.
2. The very turbulent water between Antarctica and South America is called the _____.
3. The very fast winds that affect Antarctica are called _____ winds.
4. These winds have been known to blow as fast as _____ miles per hour.
5. The only place where the wind doesn't blow very hard in Antarctica is on the Antarctic Plateau, which is the home of the _____.
6. The ozone hole is estimated to be about _____ million square miles.

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I Thought Penguins Could Fly: Video Worksheet

1. Penguins have feathers all over their bodies to _____.
2. Penguins live in colonies called _____.
3. The very large birds that have wingspans of up to 10 feet and fly over Antarctica are called _____.
4. Baby seals are called _____.
5. Seals contain an enormous amount of blood which allows them to hold more dissolved oxygen and carbon dioxide so that they can _____.
6. Whales, dolphins and porpoises are not fish. Rather, they are _____.
7. In the past, whales were hunted for the thick layer of blubber they possessed, which was used for _____.
8. Krill are important pieces of the Antarctic ecosystem because _____.
9. An adult blue whale can eat up to _____ tons of krill a day.
10. Plants rarely grow taller than _____ inch in Antarctica.

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Antarctica: 90 Degrees South
Video 105 (Habitation)

Do I Need a Passport?: Video Worksheet

1. Antarctica is governed by the _____.
2. List two things that this treaty states:
 1. _____
 2. _____
3. _____ different nations have territorial claims to portions of Antarctica.
4. A corrugated steel and frame building is called a _____.
5. One building material that is often used in Antarctica is _____.
6. There are _____ airports serving Antarctica.

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Video Worksheets Answer Key

Video 101 – Welcome to Antarctica

1. -126° F
2. -22 F; -76° F
3. 2 million
4. 320; 25
5. $\frac{1}{8}$
6. Antarctic Convergence Zone
7. 2%
8. $1\frac{1}{3}$ miles.
9. 70%
10. 3
11. ozone hole
12. it's so windy, the wind blows them away

Video 102 – Antarctica Under Construction

1. 1) too expensive to mine; 2) too deep; 3) too hard to transport, 4) treaty forbids it.
2. plate tectonics or continental drift
3. Pangea
4. 66.5
5. fifth
6. $\frac{2}{3}$
7. sea and glacial
8. 70%
9. 2%
10. Vinson Massif

Video 103 – Winter? Summer? How Can You Tell?

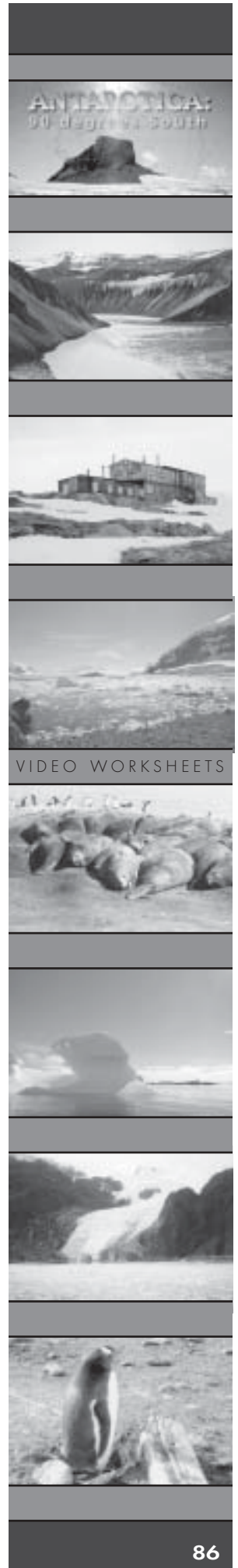
1. -132° F
2. Drake Pass
3. katabatic
4. 345
5. South Pole
6. 10

Video 104 – I Thought Penguins Could Fly

1. keep them warm
2. rookeries
3. albatross
4. pups
5. survive long periods of time without breathing
6. mammals
7. fuel
8. larger animals feed on them
9. 5
10. 1

Video 105 – Do I Need a Passport?

1. Antarctic Treaty
2. 1) no military activity; 2) no weapons testing; 3) no mining; 4) used only for scientific research
3. Seven
4. Quonset hut
5. ice
6. 30





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