Weather at the North and South Poles

Ms. Williams, a scientist, is planning to visit the North Pole and South Pole to compare the weather at each. First, she will travel to the North Pole, on a sheet of ice covering the Arctic Ocean. She will record the temperature, measure the precipitation, and measure the wind speed and direction.
Later in the year, she will travel to the South Pole, on the continent of Antarctica. She will record the temperature, measure the precipitation, and measure the wind speed and direction. She will also compare her records with the studies of other scientists to see if the weather is different from what is normal for those places.

Should Ms. Williams expect a big difference in temperature between the North Pole and South Pole?

_____ Yes! One place will be much colder than the other.

_____ No! Both places will be about the same.

Explain the thinking you used to make your choices. If you chose yes, which place would be colder? Why?

_____
_____
_____

What kinds of winter weather should Ms. Williams expect at the South Pole?

Temperature
_____ Warm temperatures
_____ Cold temperatures

Precipitation
_____ Rain
_____ Lots of snow
_____ Little snow

Wind
_____ High winds
_____ No wind

Explain the thinking you used to make your choices.

_____
_____
_____
_____

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Teacher Notes

Purpose

The purpose of this probe is to elicit students' ideas about weather at the poles. The probe is designed to find out if students recognize that the North Pole and South Pole are different in terms of average weather and climate.

Related Concepts

Earth's axis, seasonal change, weather, climate, humidity, precipitation, temperature, wind, currents, elevation

Explanation

Ms. Williams would expect to see a difference in temperature, as the South Pole tends to be much colder than the North Pole. The South Pole (Antarctica) is colder than the North Pole (Arctic Ocean) for several reasons, including Antarctica's high elevation, ocean and air currents, and high albedo (reflectivity) of the ice cover. In contrast, the North Pole (Arctic Ocean) has greater areas of open water and land to absorb heat, is closer to land and warmer air masses, and is at a much lower elevation.

At the South Pole, Ms. Williams would expect very cold temperatures, little snow, and high winds. Antarctica receives very little snow and is actually a very cold desert.

Curricular and Instructional Considerations

In the primary grades, students develop an understanding of local weather through firsthand observation. Their understanding of weather is basic and includes observable phenomenon (clouds, sun, rain, and snow) and temperature. They can begin to learn about other places which have different weather and to consider the ways in which weather affects human activity.

In the upper-elementary grades, students learn more sophisticated ways of describing and measuring weather including humidity, air pressure, and cloud types. Students are also ready to differentiate between day-to-day weather and long-term climate, to compare weather and climate of various locations, and to explore factors such as latitude and elevation that influence weather and climate.

Administering the Probe

Students should locate the North Pole and South Pole on the map before completing the probe. If necessary, remind students that seasons occur at different times in the Northern and Southern hemispheres. By planning her trips at different times during the year, Ms. Williams will be able to observe and measure summer weather in both locations.

Some students may inquire about the logistics of travel to these remote locations. At your discretion, discuss possible means of transportation to the North Pole (an ice-breaker ship, travel

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on the sea-ice via foot or dogsled) and the South Pole (fly to Antarctica's South Pole research station). This type of travel may also make an excellent inquiry topic after the probe has been completed.

The concepts in the probe will be most meaningful to students if they have had hands-on experience in observing, measuring, and recording weather conditions. It is recommended that this probe (and a study of polar weather and climate) follow hands-on investigations into local weather patterns and phenomena.

Related Ideas in *National Science Education Standards* (NRC 1996)

K-4 Changes in the Sky

Weather changes from day to day and over the seasons. Weather can be described by measurable quantities, such as temperature, wind direction and speed, and precipitation.

K-4 Understanding About Science and Technology

Tools help scientists make better observations, measurements, and equipment for investigations. They help scientists see, measure, and do things that they could not otherwise see, measure, and do.

K-4 Changes in Environments

Environments are the space, conditions, and factors that affect an individual's and a population's ability to survive and their quality of life.

5-8 Structure of the Earth System

Clouds, formed by the condensation of water vapor, affect weather and climate.

Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate, because water in the oceans holds a large amount of heat.

5-8 Understandings About Science and Technology

Technology is essential to science, because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size, and speed. Technology also provides tools for investigations, inquiry, and analysis.

Related Ideas in *Benchmarks for Science Literacy* (AAAS 1993)

K-2 The Earth

Some events in nature have a repeating pattern. The weather changes some from day to day, but things such as temperature and rain (or snow) tend to be high, low, or medium in the same months every year.

3-5 The Earth

Clouds and fog are made of tiny droplets of water.

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Air is a substance that surrounds us, takes up space, and whose movement we feel as wind.

K-2 Scientific Inquiry
Tools such as thermometers, magnifiers, rulers, or balances often give more information about things than can be obtained by just observing things without their help.

3-5 Scientific Inquiry
Scientific investigations take many different forms, including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments. Investigations can focus on physical, biological, and social questions.

Suggestions for Instruction and Assessment

Since firsthand experiences at the poles are not feasible, students can learn about polar weather and climate through data collection and reading. Students could track and compare temperature, wind, and precipitation data for the Arctic and Antarctica using web sites or newspapers. Children's literature and student-friendly web sites (such as Windows to the Universe) provide an opportunity to extend the lesson through content area reading.

Related NSTA Science Store Publications and NSTA Journal Articles

Bryson, L. 2004. S'COOL science. *Science and Children* 41 (8): 24-27.

Crane, P. 2004. On observing the weather. *Science and Children* 41 (8): 32-36.

Danaher, E. 2003. Science 101: Why do snowflakes form? *Science and Children* 40 (4): 53.

Keeley, P., F. Eberle, and L. Farrin. 2005. *Uncovering student ideas in science, vol. 1: 25 formative assessment probes*. NSTA Press.

Keeley, P., F. Eberle, and J. Tugel. 2007: *Uncovering student ideas in science, vol. 2: 25 more formative assessment probes*. NTSA Press.

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Koballa Jr., T. 2008. The point of it all. *Science and Children* 45 (5): 32-35.

Royce, C. 2003. Teaching through trade books: Snowflake science. *Science and Children* 40 (4): 18-20.

Royce, C. 2003. Teaching through trade books: Weather watchers. *Science and Children* 40 (8): 18-20.

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Related Publications

American Association for the Advancement of Science (AAAS) and National Science Teachers Association (NSTA). 2001. *Atlas of science literacy*. Washington, DC: AAAS and NSTA.

American Association for the Advancement of Science (AAAS). 1993. *Benchmarks for science literacy*. New York: Oxford University Press.

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academies Press.

Related Web Sites

British Antarctic Survey
http://www.antarctica.ac.uk/
The home page of this web site lists current temperatures (in Celsius) at various locations in Antarctica.

Arctic Map with Weather Data
http://www.athropolis.com/map2.htm
This map shows various communities, villages, and research stations throughout the Arctic. Click on a yellow dot to display current weather information for that location.

Why Is It Cold at the Poles?
http://www.educapoles.org/index.php?/fun_zone/multimedia_animations/why_it_cold_the_poles/&s=7&rs=13&uid=119&lg=en&pg=1&category=34
This animation from the EducaPoles site explains why the poles are colder than other places on earth.

Windows to the Universe: Polar Atmosphere
http://www.windows.ucar.edu/tour/link=/earth/polar/polar_atmosphere.html
This web site, written in English and Spanish at three levels (Beginner, Intermediate, and Advanced), provides content area reading on a variety of climate, weather, and astronomy topics. Of particular interest is the Polar Atmosphere section which includes links to articles on Arctic and Antarctic weather.

Children's Literature

North Pole, South Pole. Nancy Smiler Levinson. 2002. Nonfiction book. Recommended ages: Grades 2-4.
An easy reader explains basic weather at the poles—no rain, dry and windy—and how people and animals adapt to survive.

Survivor's Science at the Polar Regions. Peter D. Riley. 2005. Nonfiction book. Recommended ages: Grades 3-5.

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This book compares and contrasts the polar regions in terms of weather; clothes you would need to wear; plants and animals; ice, water, and snow; traveling in these regions; and seasons. Each topic includes a hands-on activity suitable for use in a classroom or as at-home enrichment. The book includes a glossary and an index.

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American Association for the Advancement of Science (AAAS). 1993. *Benchmarks for science literacy*. New York: Oxford University Press.

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