

Weather In Antarctica

Integration: Science; Mathematics, Language Arts

Grade Levels: 3-6

Time: 4-5 class periods

Materials:

- *Weather Comparison* handout
- *Collecting Solar Energy* handout
- *Collecting Solar Energy—Directions* handout
 - Shoebox
 - Glue or tape
 - Black construction paper
 - White paper
 - Plastic wrap
 - Ruler
 - Watch or clock
 - Thermometer
 - Sunlight or lamp with an exposed bulb to simulate the sun on a cloudy day.
- *Build Your Own Anemometer* handout
 - 3-oz paper cups (four for each)
 - Hole puncher (optional)
 - Straight plastic drinking straws (two for each)
 - Stapler
 - Pencil
 - Pin
- Research materials (books, encyclopedias, almanacs, internet, etc.)

Objectives:

Students will:

1. Describe the weather conditions in Antarctica including temperature, wind, and precipitation.
2. Recognize the influence of the air currents and solar radiation on Antarctica's climate.
3. Compare the weather conditions in Antarctica to the weather conditions where they live.
4. Assess the weather-related problems Ann Bancroft and Liv Arnesen face during their Expedition.

Lesson:

Temperature

Full group

1. Ask students for their general assessment of what the weather is like in Antarctica. List the students' responses and inform the students that they will refer back to the list to determine which responses were correct.
2. Inform students that the first aspect of the weather they will cover is the temperature.
3. Tell students that Antarctica is the coldest place on earth. The coldest temperature ever recorded on earth was in Antarctica at a place called Vostok on July 21, 1983. It was -129°F (-89°C). The usual average temperatures in the interior (inland) of Antarctica range from -40°F to -94°F (-40° to -70°C) during the coldest months and from -4°F to -31°F (-20° to -35°C) in the summer. The coast is slightly warmer.
4. Individually or in small groups, have students write down the temperature information from Antarctica on their Comparison Sheets. They will enter in the local information later.
5. Tell students that they will investigate why Antarctica is so cold.
6. Solar radiation or the sun's energy influences the temperature in Antarctica.
 - a. Ask students how it feels when they stand in the sun versus standing in the shade.
 - b. Ask students to describe the amount of sunlight that Antarctica receives during the year.
 - Because of its location, Antarctica only receives sunlight for 6 months during the year.
 - c. Explain to students that the ice that covers Antarctica allows the sunlight that does reach the continent to bounce back into space. This means that the sunlight does not have a chance to warm the air.
 - How well the Earth reflects solar radiation is called its *albedo*. The higher the albedo, the more energy is reflected and does not warm the Earth.
 - Ice reflects 80-95% of solar radiation.
 - d. Lack of sunlight and reflection of the energy that does reach the continent causes Antarctica to be so cold.

Small groups

7. Divide the students into small groups and have them investigate solar energy and albedo by performing "Collecting Solar Energy."
 - a. Give each group a set of directions and enough worksheets so that everyone has one.
 - b. Have them follow the directions and observe what happens.

- c. The temperature will not change as much when white paper is used because the heat is not retained as well as with the black paper. Have students relate this experiment to what they now know about Antarctica.
8. Tell students that Antarctica would be even colder if it were not for the air currents arriving from other parts of the world.
 - a. Warm air rises. When air is heated by the sun at the equator, it rises and moves toward the poles.
 9. Individually or in small groups, have students compare the average temperatures in Antarctica to those of their own country, state, and city/town.
 - a. Students should utilize the internet, almanacs, and other sources for this activity.
 - b. Students should record their findings on the Comparison worksheet and compare them with the findings of other students.

Wind

10. Tell students that Antarctica is also the windiest place on earth. Ask students what the temperature feels like when it is windy (it feels colder).
11. Ask students if they have ever heard of wind chill. Explain the following:
 - a. The wind chill is how cold it feels when the effect of the wind is added to the temperature.
 - b. Wind moves heat away from the body so that it feels colder.
 - c. For example: it feels cooler when you are standing in front of a fan.
12. Inform students that the winds in Antarctica can be dangerously strong and that they can last for days. The harsh winds are called *katabatic winds*. They are found in other places in the world but never as strong as they are in Antarctica.
 - a. Katabatic winds originate in the interior of the continent.
 - b. They are formed because of the domed shape of Antarctica.
 - c. As the wind moves toward the coast it picks up speed, like a ball rolling down a hill, and can reach 72 mph (120 km/hr). The winds are known to gust up to 185 mph (300 km/hr). This is as windy as a hurricane.
 - d. The winds are much calmer in the interior of the country.
13. Ask students for reasons that the winds are dangerous.
 - a. The force of the winds can injure humans or animals.
 - b. The wind blows snow and produces blizzard conditions where it is impossible to see.
14. Have students compare katabatic winds to the winds they experience by building and using an *anemometer*. This can be done in small groups or as a class demonstration.
 - a. An anemometer is a device that measures wind speed.
 - b. Directions:

- Take four 3-oz paper cups and label them 1 through 4. Punch one hole about inch below the rim of each. You can use a hole puncher.
 - On a fifth cup, labeled 5, punch 4 equally spaced holes inch below the rim. Punch a hole through the bottom of this cup. The hole must be slightly larger than the width of a pencil.
 - Push a plastic drinking straw through the hole in cup 1. Fold the end of the straw staple it to the inside of the cup across from the hole. Repeat this with cup 2.
 - Slide the straw of cup 1 through one hole in cup 5 and out the other side.
 - Slide the end of straw from cup 1 that went through cup 5 into the hole in cup 3 and staple the straw to the inside as was done before. Make sure cup 3 faces the opposite direction of cup 1.
 - Repeat step #4 with the straw of cup 2.
 - Repeat step #5 by sliding the end of the straw from cup 2 that went through cup 5 into cup 4 and stapling. Make sure cup 4 faces the opposite direction of cup 2.
 - Turn the cups so that all of the open ends face in the same direction.
 - Push a pencil, eraser side up, through the hole in the bottom of the center cup and secure it by pushing a pin down through the intersection of the straws and into the pencil eraser.
 - The anemometer is built!
- c. To measure wind speed:
- Place the anemometer outside where it can measure wind or use a fan on the lowest setting.
 - Count the number of times the anemometer revolves in one minute. (It may be helpful to mark one cup so that you can count how many times it moves around.)
 - Calculate the circumference of the circle made by the cups in feet. The circumference is the diameter of the circle multiplied by π (3.1416) (you may want to do this for your class).
 - Multiply the circumference of the circle by the revolutions per minute to get velocity of the wind in feet per minute. (You can have your students convert the speed to miles per hour).

15. Have the students compare the wind speed they have calculated to the winds in Antarctica.

OPTIONAL: Have students write about what they have observed and what it would be like if the area they live in experienced these winds.

Precipitation

16. Ask students to brainstorm what they think of when they hear the word “desert”. Write the responses on the board or on a large piece of paper.
- a. Students may respond with descriptions of what they have experienced such as hot, sandy, lonely, dry, etc.

17. Explain to students that a desert is any place that is dry with little or no precipitation and low humidity.
18. Tell students that this means that Antarctica is considered a desert. In fact, it is the driest continent.
 - a. Antarctica receives less than 50 mm of precipitation (in the form of snow) each year.
 - b. The humidity is also very low (0.03%)
19. Inform students that cold air does not hold moisture as well as warmer air does. Antarctica is too cold for there to be much precipitation.
20. Have students, individually or in small groups, compare Antarctica to their country, state, and city/town (if possible) by comparing data on annual precipitation and average humidity. The results can be recorded on the Comparison worksheet.

Bancroft Arnesen Expedition

Small Group

21. Divide students into groups and have them think of each of the Antarctic weather elements they have learned about and to discuss how these elements will affect Ann Bancroft and Liv Arnesen on their expedition across the continent.
 - a. Temperature
 - Extremely low temperatures mean that Ann and Liv will have to wear layers of clothing.
 - Extremely low temperatures mean that Ann and Liv will have to be careful to avoid frostbite and hypothermia.
 - b. Wind
 - The katabatic winds will make it difficult to move around close to the coast.
 - The katabatic winds could produce blizzard conditions.
 - The wind causes it to feel even colder than it actually is.
 - However, the wind will also help Ann and Liv to ski. They will use sails to capture the wind and allow them to move farther.
 - c. Precipitation
 - The lack of precipitation does not necessarily hurt or help Ann and Liv during their Expedition.
 - However, they must be very careful not to become dehydrated. This is dangerous to their health. Among other things, it increases the risk of frostbite and hypothermia.
 - They have to stop to drink. Each must consume at least six liters of liquid every day.
22. Have students draw or write about how one or all of these conditions will affect the Expedition.

Assessment:

Teachers will assess:

1. Student's comparison of the weather conditions to the conditions where they live.
2. Student's comprehension of the temperatures, precipitation and wind conditions in Antarctica.
3. Student's ability to assess the effects the weather conditions in Antarctica have on expeditions.
4. Student's ability to follow directions and work cooperatively.