The Kp Index and the Aurora

Overview:

Students read magnetometer Kp index graphs and compare a current Kp index calculation to a current prediction of aurora. Through this process, students learn that there are many factors in predicting the aurora. See "Infusing Native Language in the Science Curriculum" to incorporate Native language into this lesson.

Objectives:

The student will:
- interpret charts and graphs related to magnetometer readings;
- average Kp indices over a three-day period;
- compare a current Kp index calculation to a current aurora prediction; and
- discover that the Kp index is just one of many factors examined in forecasting the aurora.

Materials:

STUDENT WORKSHEETS: "The Kp Index and the Aurora"

Activity Procedure:

Teacher Suggestion: If necessary, on the day of the lesson, print out the information from the Internet websites listed in the lesson and make copies for the students.

1. Inform students that aurora forecasters examine many factors when predicting the aurora. To examine the extent of the aurora oval, forecasters use data from magnetometers. Today, students will see how aurora scientists read information from the magnetometers to see what part it may play in the forecast.
2. Distribute STUDENT WORKSHEETS: "The Kp Index and the Aurora." Scaffold learning by guiding them through the process in Part A of averaging the Kp index and determining the corresponding city. Continue with Part B, repeating the process in pairs or individually.
3. If students are struggling with responding to the question about why their calculations might be different from the prediction, ask them to think about what information aurora forecasters use in making predictions. Refer students to the first paragraph of the worksheet.
4. When students are finished, review their responses as a class.

Answers to Student Worksheets:
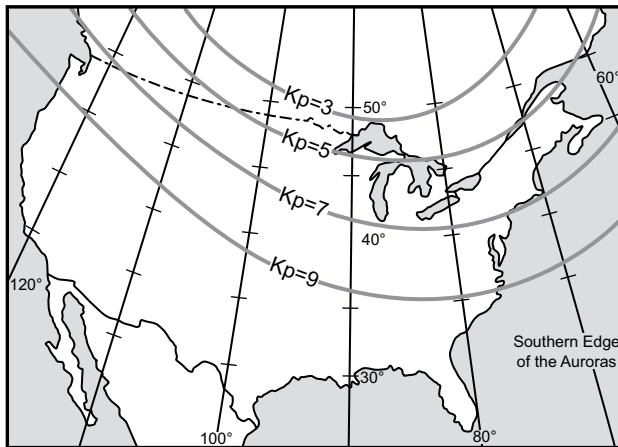
Part A:
1. *1*
2. *Fort Yukon*
3. *quiet*

Part B: 1-4. Answers will vary. Check student responses against information found at the Internet sites listed on the student worksheet.
5. *The actual aurora forecast factors in sunspots and other sources of solar activity that may not cause disturbances on Earth's magnetometers. Also, the data from the magnetometer is based on disturbances as they have occurred and not as a projection.*

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Predicting the aurora is very complex. Aurora scientists use a variety of charts, graphs, solar sun spot images, and magnetometer readings when they determine the aurora forecast. Scientists use magnetometers to measure disturbances in Earth's magnetosphere. These disturbances help aurora watchers and scientists determine how far south the aurora may be seen.

Magnetometers are located all over the world. The important long-term observatories in Alaska are: Sitka, College, and Barrow. Magnetometers record geomagnetic disturbances on Earth caused by solar wind. These disturbances are measured as a planetary magnetic disturbance index, or Kp index. The Kp index is derived in several ways, resulting in a number between one and nine. The larger the Kp index number, the wider the aurora oval, and the more activity. For example, a Kp of 1 means quiet aurora activity reaching as far south as Fort Yukon. A Kp of 2 refers to a slightly more active aurora reaching as far south as Fairbanks (a distance of about 135 miles). A Kp reading of 3 can result in an active aurora as far south as Anchorage (another 260 miles away). The highest and most rare Kp reading is 9. When a Kp reading is 9 the aurora can be seen very far south, and has been seen as far south as Texas!

Scientists at Cornell University created the map at the left to show the southern edge of aurora oval at different Kp values. The chart below lists several communities and their corresponding Kp index.

To see the extent of ovals around the world, including the ovals of the southern hemisphere, click on the map at http://son.nasa.gov/tass/magnetosphere/ob_kp.htm.


Southern Edge of the Auroras

City:	Kp Index:
Fort Yukon, Alaska	1
Fairbanks, Alaska	2
Anchorage, Alaska	3
Ketchikan, Alaska	4
Quebec City, Quebec	5
Great Falls, Montana	6
Seattle, Washington	7
New York, New York	8
Denver, Colorado	9

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Part A: Calculating the Kp Index:

    Look at the Kp index chart. This is the Kp index for April 4-7, 2007. The numbers on the left side (Y-axis) of the graph are the estimated Kp index for each of the dates listed along the bottom (X-axis) of the graph. The Kp index is updated every three hours.

    It is important to note that an average of the day's readings gives a more accurate measure of the aurora oval than any one reading. For instance, one Kp reading of 4 during the day does not necessarily mean that the aurora was seen as far south as Ketchikan; however, an average Kp reading of 4 over a 24- or 48-hour period would indicate active auroras around Ketchikan.
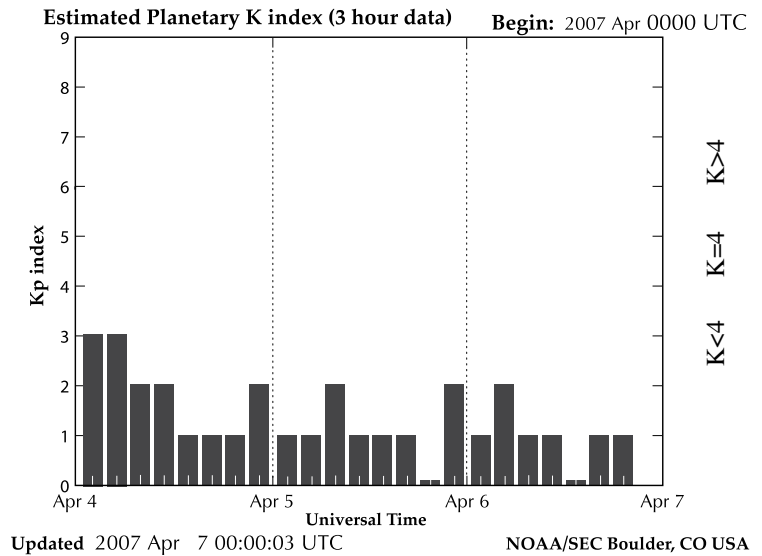
Compare the Kp index chart to the table of cities and corresponding Kp indices. Answer the following questions:

Estimated Planetary K index (3 hour data)   **Begin:** 2007 Apr 0000 UTC

Updated 2007 Apr 7 00:00:03 UTC   **NOAA/SEC Boulder, CO USA**

1.   What was the average Kp index over the three days? (NOTE: To calculate the average, add up all the Kp indexes and divide by the number of readings, then round to the nearest whole number.)

   (Show work here.)

2.   To which city does this correspond? (Use the chart on the previous page.)_____

3.   Was this a period of quiet, moderate, or active auroras?_____

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Part B: Comparing Current Kp Data to a Current Aurora Prediction:

Directions: Briefly look at the Kp index for the last three days at http://www.sec.noaa.gov/rt_plots/ kp_3d.html.

1. Calculate the average Kp index for the last three days shown as shown on the Kp index graph online. (Show work here.)

2. Use the chart of cities and corresponding Kp indices (found on the first page of this worksheet). Which city corresponds to the average Kp index? _____

3. Go to http://www.gedds.alaska.edu/AuroraForecast/. What is today's prediction for Alaska? _____

4. How does the calculation using the Kp index graph from the last three days compare to today's prediction? _____

5. Why might your calculation be different from the prediction found on the website?

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