Cities of the Aurora

Overview:

Students discover the aurora is visible at latitudes under the aurora oval and recognize that the aurora oval can expand after a storm on the sun.

Objectives:

The student will:

- locate and identify cities from which the aurora is visible;

- convert the percentage of nights the aurora is visible from a certain location into the number of nights the aurora is visible each year from that location;

- recognize the frequency in which people can see the aurora depends on the latitude at which they live;

- explain that Elias Loomis watched the night sky and recorded where he saw the aurora, then pinpointed those places on a map to discover that auroral displays circle Earth's North Pole; and

- discover that the aurora oval expands.

Materials:

- Calculators
- Colored highlighters (blue, pink, green, and orange, 1 set per 4 students)
- VISUAL AID: "Elias Loomis"
- VISUAL AID: "Charting Experiment**"**
- VISUAL AID: "North Pole"
- VISUAL AID: "Aurora Oval"
- VISUAL AID: "Aurora Sightings"
- STUDENT WORKSHEET: "Calculation"
- STUDENT WORKSHEET: "Location"

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Activity Procedure:

1. Show VISUAL AID: "Elias Loomis." Explain that Elias Loomis was the first scientist to notice that auroral displays circle Earth's North Pole. For many years, Elias Loomis watched the night sky and recorded the date of every aurora he saw.

2. Show VISUAL AID: "Charting Experiment." In 1860, Loomis pinpointed on a map every place on Earth he had seen the aurora overhead. His observations formed three circles on his map. Each circle surrounds the North Pole. Explain that this activity is similar to Loomis' experiment more than 100 years ago.

3. Show VISUAL AID: "Aurora Oval" and explain that the aurora hangs in an oval or "crown of light" over both of Earth's geomagnetic poles.

4. Hand out the STUDENT WORKSHEET: "Calculation." Show students how to convert the percentage of nights the aurora is visible over a city into the number of nights each year the aurora is visible over that city. Use the following formula and the city of Chicago as an example. (Data is from the STUDENT WORKSHEET: "Calculation.")

   A. Divide % of nights by 100   4/100=0.04
   B. Multiply by 365   0.04 x 365 = 14.6 nights
   C. Round up the result   14.6 rounded up = 15 nights

6. Hand out calculators and ask students to calculate the remaining percentages on their worksheets.

7. Distribute the STUDENT WORKSHEET: "Location" and highlighters. Ask students to use the key at the bottom of the map to determine colors for each location.

8. Lay VISUAL AID: "Aurora Sightings" over VISUAL AID: "North Pole." Explain people who see the aurora live at high latitudes. Ask students to draw colored bands on their maps. Explain the aurora oval exists over the area colored in green. People far from the oval can sometimes see the aurora after it expands following a storm on the sun. Even after a storm, the oval never gets larger than the area colored in orange. People living in areas colored blue and pink can never see the aurora overhead, only at an angle.

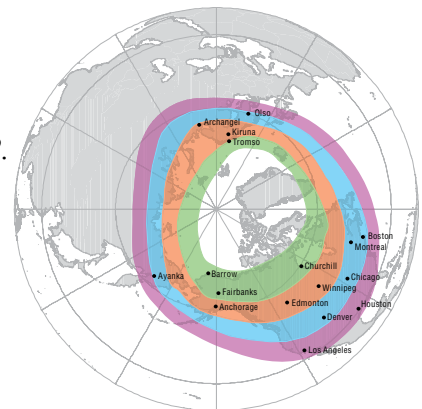9. Ask students to complete all questions on their worksheets.

Answers to Student Worksheets:

Calculation:

1. B. latitude	2A. 4;15	2B. 93;339
2C. 100;365	2D. 85;310	2E. 40;146
2F. 10;37	2G. 40;146	2H. 20;73
2I. 15;55	2J. 10;37	2K. 5;18
2L. 3;11	2M. 0.5;2	2N. 0.5;2
2O. 90;329	2P. 65;237	2Q. 10;37

Location:

1.B. He watched the night sky, recorded where he saw the aurora and pinpointed those places and on a map.

2.

Calculation

1. Fill in the blank:

    The number of nights people can see the aurora depends on the _____ at which they live.

    A) elevation   B) latitude   C) longitude

2. For each city listed below, translate the percentage of nights on which the aurora can be visible from a certain location into the number of nights the aurora is visible each year. Remember, the aurora can be visible only when the sky is dark and there are no clouds.

City	Percentage of Nights	Number of Nights
A. Chicago, Illinois	4	15
B. Barrow, Alaska	93	_____
C. Churchill, Canada	100	_____
D. Fairbanks, Alaska	85	_____
E. Anchorage, Alaska	40	_____
F. Montreal, Canada	10	_____
G. Edmonton, Canada	40	_____
H. Winnipeg, Canada	20	_____
I. Arkhangel'sk (Archangel), Russia	15	_____
J. Ayanka, Russia	10	_____
K. Boston, Massachusetts	5	_____
L. Denver, Colorado	3	_____
M. Houston, Texas	0.5	_____
N. Los Angeles, California	0.5	_____
O. Tromso, Norway	90	_____
P. Kiruna, Sweden	65	_____
Q. Oslo, Norway	10	_____

Location

1. Circle the correct answer:

    How did Elias Loomis figure out that auroral displays circle Earth's north pole?

    A) He reviewed satellite images.

    B) He watched the night sky, recorded where he saw the aurora and pinpointed those places on a map.

    C) He flew around the aurora oval in a plane.

2. Use the color key and STUDENT WORKSHEET: "Calculation" to create four rings around the North Pole. Each ring should connect cities from which the aurora can be seen the same number of nights each year.

Number of nights	Color
over 250	green
50-250	orange
5-49	blue
below 5	pink