

# Aurora Visibility

**Overview:**

The aurora is seen most frequently in cities beneath the aurora oval. Students use a globe and make a graph to demonstrate their ability to visualize the location of the aurora oval in relation to Earth.

**Objectives:**

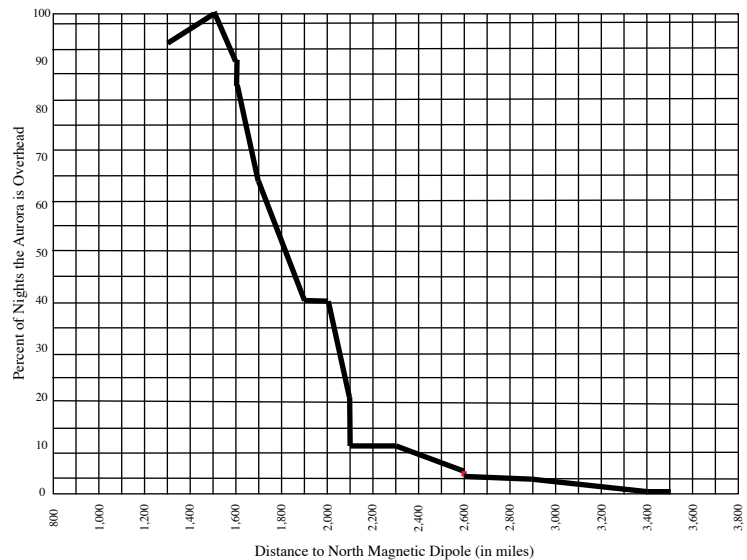
- The student will:
- use a scale to find distances on a globe;
  - make a line graph; and
  - draw conclusions from a graph.

**Materials:**

- Globe
- Strips of paper (each strip should be long enough to measure 3,500 scale miles for the globe)
- Markers
- Sticky dots
- STUDENT WORKSHEETS: “Aurora Visibility: Part One” and “Aurora Visibility: Part Two”

**Answers to Student Worksheet:**

City	Distance to Northern Magnetic Dipole (approximate)
Chicago, Illinois	2600 miles
Barrow, Alaska	1300 miles
Churchill, Canada	1500 miles
Fairbanks, Alaska	1600 miles
Anchorage, Alaska	1900 miles
Montreal, Canada	2300 miles
Edmonton, Canada	2000 miles
Winnipeg, Canada	2100 miles
Archangel, Russia	2100 miles
Ayanka, Russia	2300 miles
Boston, Massachusetts	2600 miles
Denver, Colorado	2900 miles
Houston, Texas	3500 miles
Los Angeles, California	3400 miles
Tromso, Norway	1600 miles
Kiruna, Sweden	1700 miles
Oslo, Norway	2100 miles



1. Approximately 1,500 miles. Answers between 1,300 and 1,700 are acceptable.
2. Possible Answers: Fairbanks, Circle, Fort Yukon, Bettles, Wainwright, Wiseman, Livengood
3. Approximately 60° N. Answers between 55° N and 65° N are acceptable.

## Aurora Visibility

### *Activity Procedure:*

1. Explain to students that they will use a globe to calculate the distances from various cities to the magnetic North Pole. Students will use this information to help them understand the relationship between aurora visibility and distance from the magnetic dipole.
2. Explain that the magnetic North Pole marked on the surface of the globe (magnetic surface pole) is different than the magnetic North Pole that affects the aurora (magnetic dipole). This is because the magnetic surface pole is affected by magnetic fields within Earth's crust, while the magnetic dipole represents only the powerful magnetic field generated in Earth's core. Because the aurora occurs 60 to 600 miles above Earth's surface, it is not affected by the relatively weak magnetic fields within the crust. Because of this, students must begin the activity by marking the location of the north magnetic dipole on the globe. The dipole is located at  $81.75^{\circ}$  N latitude and  $82.68^{\circ}$  W longitude. Ask a student to place a sticky dot on the north magnetic dipole.
3. Review how to use the scale on the globe to determine distances. Distribute a strip of paper and a marker to each student. Ask students to make a scale out of the strips of paper to accurately measure distances on the surface of the globe. Their paper scale should represent 3,500 miles and should be marked in 500 mile increments.
4. Distribute the STUDENT WORKSHEET: "Aurora Visibility: Part One" and ask students to complete the chart on the worksheet by measuring the distance between the magnetic dipole and each city in the chart. Students should round their measurements to the nearest 100 miles.
5. Once students have completed the chart, distribute the STUDENT WORKSHEET: "Aurora Visibility Part Two." Explain how to make a line graph that displays the relationship between distance from the pole and aurora visibility by plotting each city on the grid then connecting the dots. Ask students to complete the graph using their data.
6. Compare and discuss student graphs. Do all graphs show approximately the same slope? What might account for differences? Ask students to refer to their graph and chart to complete the questions at the bottom of the worksheet.

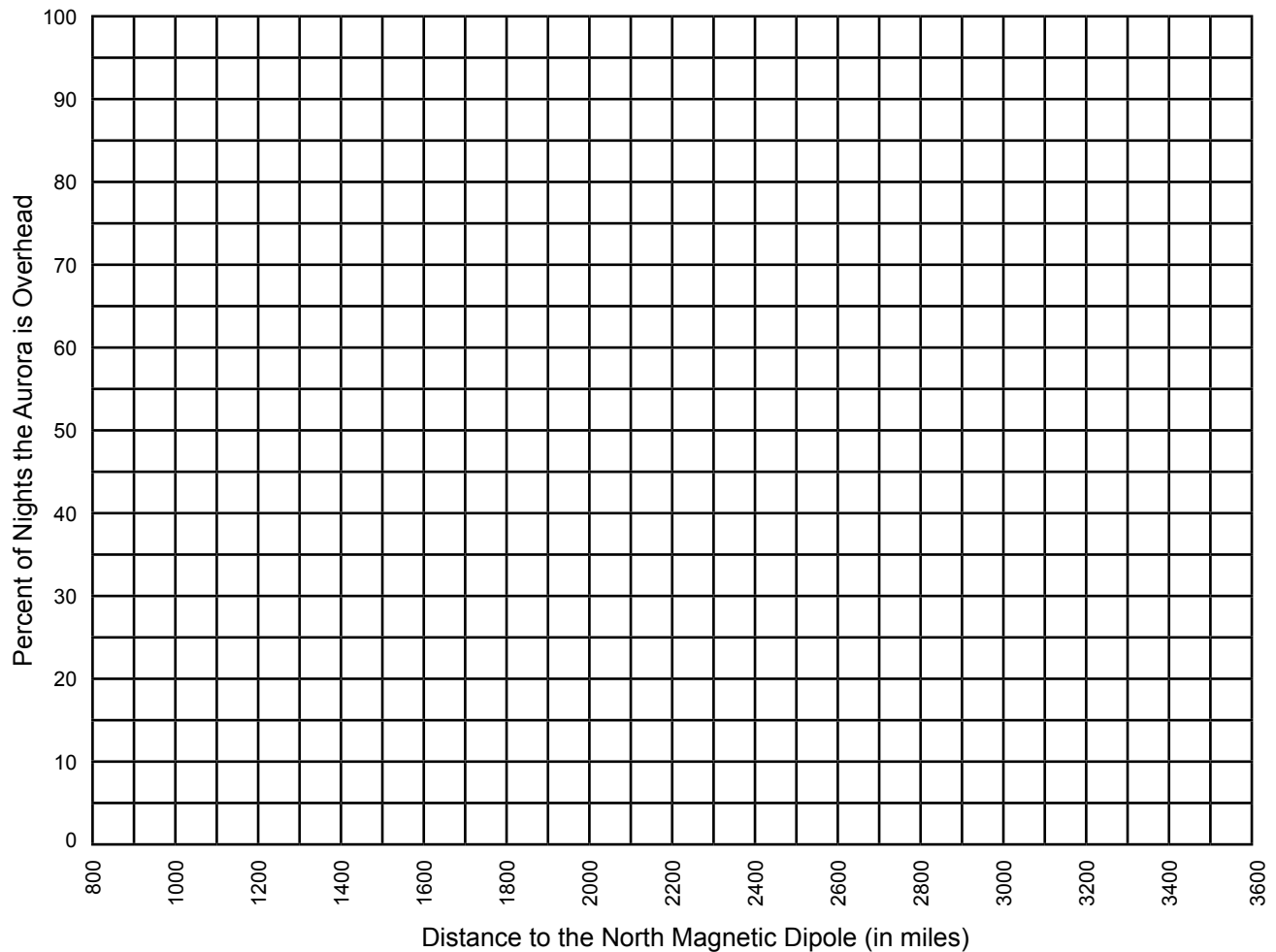
## Aurora Visibility: Part One

**Directions:** Using the scale on a globe, find the distances from the following cities to the north magnetic dipole. You will need to make a scale on a strip of paper to use for your measurements. Your scale should represent at least 3,500 miles and be marked in 500 mile increments. Record each distance in the chart below. Round your distances to the nearest 100 miles.

City	Percent of Nights Aurora is Overhead	Distance from North Magnetic Dipole
Chicago, Illinois	4	
Barrow, Alaska	93	
Churchill, Canada	100	
Fairbanks, Alaska	85	
Anchorage, Alaska	40	
Montreal, Canada	10	
Edmonton, Canada	40	
Winnipeg, Canada	20	
Arkhangel'sk, Russia	15	
Ayanka, Russia	10	
Boston, Massachusetts	5	
Denver, Colorado	3	
Houston, Texas	0.5	
Los Angeles, California	0.5	
Tromso, Norway	90	
Kiruna, Sweden	65	
Oslo, Norway	10	

## Aurora Visibility: Part Two

**Directions:** Using the chart on the STUDENT WORKSHEET: “Aurora Visibility: Part one,” plot each city on the graph below. (NOTE: The distance to the north magnetic dipole is on the x-axis and the percent of nights the aurora is overhead is on the y-axis.)



1. According to the graph above, how far from the north magnetic dipole should a person go to have the very best chance of seeing the aurora? \_\_\_\_\_
  
2. What towns would be closest to that distance if someone wanted to view the aurora in Alaska?  
 \_\_\_\_\_
  
3. Using a globe, to what latitude in Canada should a person go to have a really good chance to see the aurora? \_\_\_\_\_