

Latitude and Distance

Overview:

Students use a circumpolar map to determine the latitude and longitude of cities in areas where aurora legends originated. Students use a scale to determine the distance between each area and the geographic North Pole.

Objectives:

The student will:

- locate cities in areas where aurora legends originated on a circumpolar map;
- identify the latitude and longitude of cities on a circumpolar map; and
- calculate the distance from a city to the geographic North Pole.

Materials:

- Calculators
- VISUAL AID: “The Northern Hemisphere”
- STUDENT INFORMATION SHEET: “The Northern Hemisphere”
- STUDENT WORKSHEET: “Latitude and Distance”

Answers to Student Worksheet:

City	Latitude	Longitude	Distance to North Pole
1. Barrow, Alaska	71° N	156° W	1311 miles
2. Anchorage, Alaska	61° N	150° W	2001 miles
3. Seattle, Washington	47° N	122° W	2967 miles
4. Oslo, Norway	60° N	10° E	2070 miles
5. Paris, France	49° N	2° E	2829 miles
6. Tokyo, Japan	35° N	139° E	3795 miles
7. Edmonton, Canada	53° N	113° W	2553 miles

8. *Barrow, Alaska*
9. *Tokyo, Japan*
10. *Barrow, Alaska*
11. *Tokyo, Japan*
12. *Barrow, Alaska*
13. *Paris, France*

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Activity Procedure:

1. Explain that Earth is divided into the Northern Hemisphere and the Southern Hemisphere by an imaginary line called the equator. Place VISUAL AID: “The Northern Hemisphere” on the overhead projector. Define lines of latitude, then explain that the North Pole is at 90° north latitude, while the South Pole is at 90° south latitude. The equator is at 0° latitude.
2. Explain that Earth also is divided into the Eastern Hemisphere and Western Hemisphere by an imaginary line running from the North Pole to the South Pole called the Prime Meridian. Define lines of longitude, then explain that the Prime Meridian, at 0° longitude, passes through Greenwich, England. Places east of Greenwich, England, have an east longitude; places to the west of Greenwich, England, have a west longitude. On the opposite side of Earth from 0° longitude is 180° longitude.
3. Explain that students will use latitude and longitude to describe the location of cities in or near areas where aurora legends originated. Distribute the STUDENT INFORMATION SHEET: “The Northern Hemisphere” and the STUDENT WORKSHEET: “Latitude and Distance.” Place the VISUAL AID: “The Northern Hemisphere” on the projector. Demonstrate how to describe locations using the longitude and latitude coordinate system. Before starting the activity, work with students on examples of cities not on the student worksheet chart. **Examples could include:** *Beijing, China (40° N 116° E); Berlin, Germany (52° N 13° E); Anchorage, Alaska (61° N 150° W).* Also ask what cities could be found at 42° N 88° W (*Chicago, Illinois*); and 55° N 83° E (*Novosibirsk, Russia*).
4. Ask students to complete the latitude and longitude columns in the chart on their worksheet.
5. After students identify the coordinates of each city, ask them to find the distance from each city to the geographic North Pole. Distribute calculators. Explain that students will calculate each distance using the latitude of the city. Because lines of latitude are parallel, the distance between them remains constant: one degree of latitude equals about 69 miles. (The distance between lines of longitude varies, because lines of longitude converge at the poles.) Since the geographic North Pole is located at 90° latitude, students can find the distance from a city to the geographic North Pole using the following equation:

$$\begin{aligned} &(\text{latitude of geographic North Pole} - \text{latitude of city}) \times 69 \text{ miles}/^\circ\text{latitude} \\ &= \text{distance from city to geographic North Pole} \end{aligned}$$

6. Demonstrate how to calculate this distance. Ask students to complete the chart on their Student Worksheet by performing the calculation. After chart completion, ask students to answer questions 8-13. Discuss the correlation between latitude and aurora visibility. Ask students to describe any correlation between longitude and aurora visibility.

Teacher’s Note: Distance between lines of *latitude*:

- 1 degree (1°) = 111 kilometers or 69 miles
- 1 minute (1’) = 1.85 kilometers or 1.15 miles
- 1 second (1”) = 30.83 meters or 101.2 feet

Teacher’s Note: As you move north or south of the equator, the distance between the lines of *longitude* gets shorter until the lines meet at the poles. Therefore, the distances between lines of longitude will vary depending on location.

The Northern Hemisphere

Earth's surface is crisscrossed by imaginary lines of latitude and longitude. These lines make up a coordinate system that permits pinpointing any location on Earth. The equator is located at 0° latitude and divides Earth into the Northern Hemisphere and the Southern Hemisphere. The North Pole is at 90° north latitude, and the South Pole is 90° south latitude.

An imaginary line called the Prime Meridian runs from the geographic North Pole to the geographic South Pole, dividing the world into the Eastern Hemisphere and Western Hemisphere. This line, which represents 0° longitude, passes through Greenwich, England. Places east of Greenwich have an east longitude; places west of Greenwich have a west longitude. On the opposite side of Earth from 0° longitude is 180° longitude.

Directions: Below is a circumpolar map of the Northern Hemisphere. Use this map to find the latitude and longitude coordinates of cities on STUDENT WORKSHEET: "Latitude and Distance."



Latitude and Distance

Directions: Many aurora legends have originated in areas at northern latitudes because the aurora is most frequently visible from high latitudes. The cities listed in the chart below are located in areas where aurora legends originated. Use the map on STUDENT INFORMATION SHEET: “The Northern Hemisphere” to determine the latitude and longitude coordinates of each city in the chart.

After finding the coordinates for each city, use the following equation to determine the distance from each city to the geographic North Pole.

Equation:

$$(\text{latitude of geographic North Pole} - \text{latitude of city}) \times 69 \text{ miles/}^\circ\text{latitude} = \text{distance from city to geographic North Pole}$$

Fill in the blanks in the equation below to find the coordinates for each city.

$$\left(\underset{\substack{\circ \\ \text{latitude of geographic North Pole}}}{90} - \underset{\substack{\circ \\ \text{latitude of city}}}{\quad} \right) \times 69 \text{ miles/}^\circ\text{latitude} = \underset{\substack{\text{distance from city to geographic North Pole}}}{\quad}$$

	City	Latitude	Longitude	Distance to North Pole
1.	Barrow, Alaska			
2.	Anchorage, Alaska			
3.	Seattle, Washington			
4.	Oslo, Norway			
5.	Paris, France			
6.	Tokyo, Japan			
7.	Edmonton, Canada			

8. Which city has the highest latitude? _____
9. Which city has the lowest latitude? _____
10. Which city is closest to the geographic North Pole? _____
11. Which city is farthest from the geographic North Pole? _____
12. Which city is farthest from 0 degrees longitude? _____
13. Which city is closest to 0 degrees longitude? _____