

Travel Guide to the Northern Lights

Objectives

The primary objective is for students to understand that an observer's latitude, season, and timing of the solar cycle can all affect their ability to witness the aurora. After the activity, the students will be able to:

1. Explain that the closer an observer is to the poles of the Earth (greater than 45° N. or S. latitude) greatly increases the opportunities to see the aurora.
2. Explain that the changing length of daylight and nighttime through the seasons will affect visibility of the aurora.
3. Describe some advantages to viewing the aurora from various locations throughout the world.
4. Explain how the timing of the solar cycle can affect seeing the aurora.

Preparation

1. Gather all materials. Make photocopies and/or overhead transparency of Sunspot Cycle Graph (photocopy master on page 4), Hours of Daylight Chart / Aurora Tours Destination Worksheet (photocopy master on page 3), and World Map (master on page 2).
2. For Part C, geographic resources for students are needed. This can be in the form of geography books from the library, travel books, or this can be an opportunity to use the Internet as a research tool. If the Internet will be used, computers need to be available.
3. For the final product (travel brochure or poster), the format needs to be considered. If students can use computers, many commonly available computer applications support the production of the standard tri-fold brochure. If students make posters, poster board and sufficient drawing materials should be on hand.
4. (Optional) Have Styrofoam ball "Earth models" available and a single bright light source to simulate the sun. The optional "Earth-Sun Model" activity is best done a darkened room.

This activity is designed to have students explore where on Earth and what time of the year would be optimal to go see the northern lights. The concepts attained from the planetarium show activities relating to seasons and the midnight Sun are essential for students to apply in this activity.

Materials

For each student

- Aurora Tours Destination Worksheet

For each group of 2-4 students

- World Map with latitudes and longitudes*
- "Hours of Daylight" Chart*
- "Sunspot Cycle" Graph*
- A computer or a large sheet of paper (at least 11"x17") with drawing materials

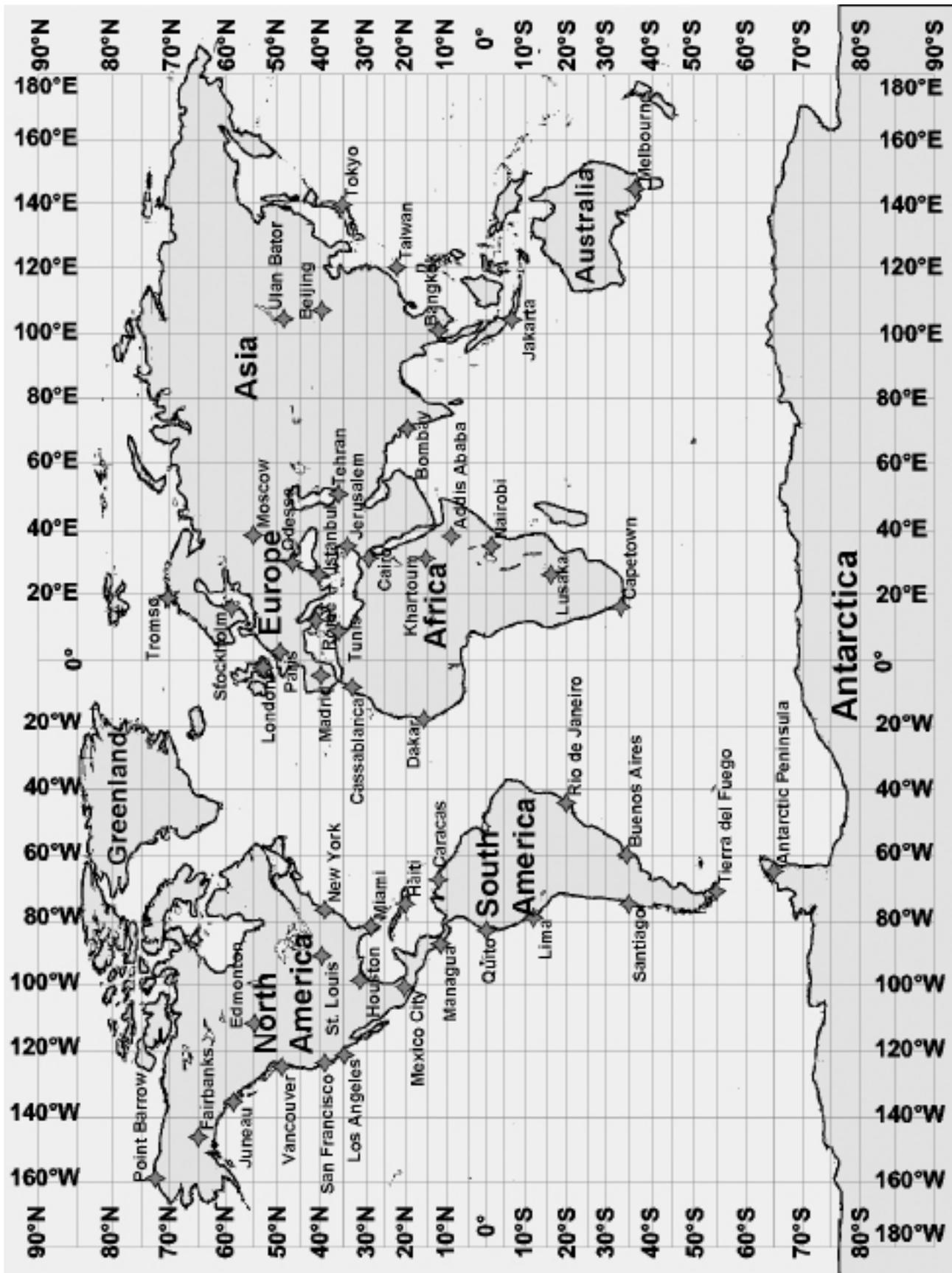
Optional

- Styrofoam ball "Earth model" (as described in Materials for the planetarium show)
- Bright light source to simulate the Sun (as described in Materials for the planetarium show)
- Video clips of auroral ring(s).

For the Class

- Large world map or globe
- Overhead transparency of the "Hours of Daylight" Chart*
- Overhead transparency of the "Sunspot Cycle" Graph*
- Overhead projector
- A small library (8-30) of geography books and/or travel books and/or
- computers with Internet connection (a computer for every group of 2-4 students)

* Masters for photocopy on pages 2 - 4.



Hours of Daylight

Entries in the chart show number of hours of daylight in hours and minutes as HH:MM where “HH” is number of hours and “MM” is number of minutes.

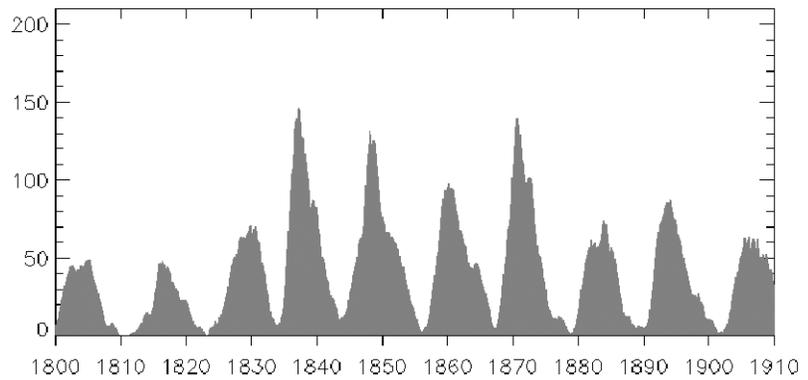
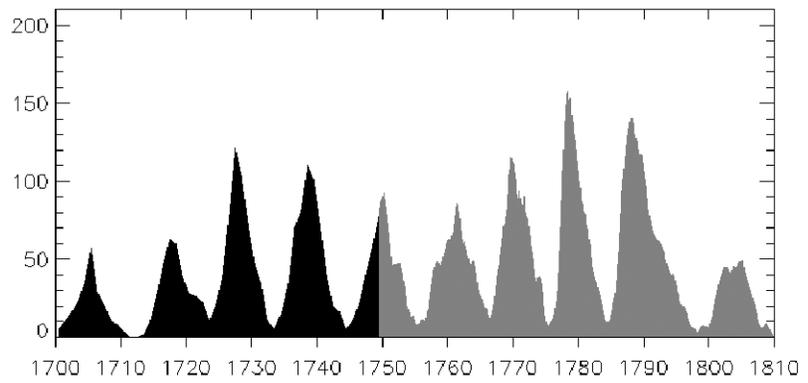
All data is for the 21st day of each month. The program *Voyager* by Carina software was used to generate this data.

Month*	Latitude							
	70°N	57°N	38°N	26°N	0°	26°S	38°S	70°S
Jan	0	7:47	9:59	10:46	12:07	13:30	14:20	24:00
Feb	8:20	10:02	11:03	11:25	12:07	12:49	13:14	16:26
Mar	12:28	12:17	12:11	12:10	12:06	12:06	12:06	12:11
Apr	17:11	14:35	13:25	12:55	12:07	11:20	10:52	7:38
May	24:00	16:43	14:23	13:31	12:07	10:45	9:55	0
Jun	24:00	17:53	14:49	13:46	12:07	10:31	9:21	0
Jul	24:00	16:55	14:24	13:32	12:07	10:44	9:54	0
Aug	17:10	14:46	13:25	12:55	12:07	11:20	10:52	7:39
Sep	12:31	12:19	12:11	12:09	12:06	12:05	12:04	12:07
Oct	8:09	9:56	11:00	11:25	12:07	12:51	13:17	16:38
Nov	0	7:43	9:57	10:47	12:07	13:30	14:22	24:00
Dec	0	6:42	9:32	10:30	12:08	13:46	14:48	24:00

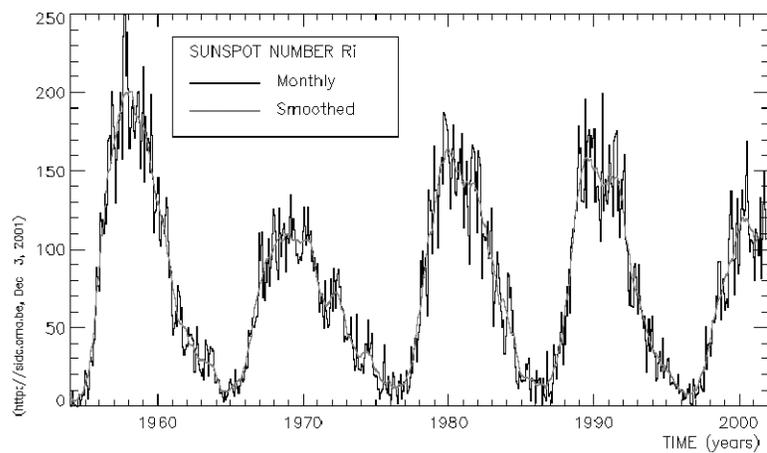
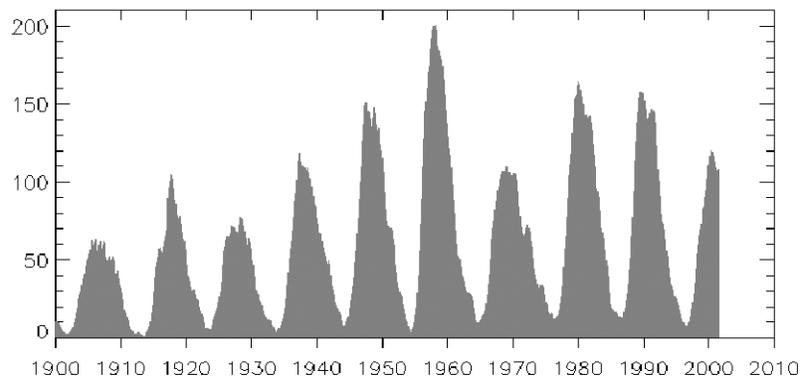
Aurora Tours Destination Worksheet				
City	Country	Longitude	Latitude	Favorable Months for Aurora
Edmonton	Canada	113.5°W	53.5°N	
Stockholm	Sweden			
Melbourne		145°E	38°S	
		120°E	22°N	
	S. Africa	18°E		
		122°E	24°N	
Lusaka	Zambia			
Point Barrow				
	Mongolia	48°N	107°E	
	Indonesia	6°S	107°E	
Lima	Peru			
		64°W	68°S	

Sunspot Cycle

source:
<http://sidc.oma.be/index.php3>



(<http://sidc.oma.be>, Dec 3, 2001)



In Class

1. Determine requirements for seeing aurora.

Tell the class:

If you worked for a travel company that offered aurora tours, or if you were a traveler planning a trip to see aurora, how could you figure out where to go and when to maximize the chances of actually seeing aurora? What are the requirements necessary for seeing an aurora?

Possible responses will include reference to latitude (how far north or south to travel), season (length of day), solar activity cycle, and weather. Accept all responses and have students explain them. Don't forget the Southern Hemisphere! If needed, ask further focusing questions, such as:

Can aurora be seen in the daytime? [Not with the naked eye.]

Where on Earth are aurora most often seen? [Chances of seeing aurora are best if you are at a latitude greater than 45°-50° North or South.]

Is one time of year better than another? Why? [Times of year when there are longer nights are better.]

Show the overhead transparency of the Hours of Daylight Chart and ask students to interpret and explain it in relation to the question, "Why would one time of year be better than another?"

Are some years better than other years for seeing aurora? [Yes. Peak years in the sunspot cycle are the best times for aurora viewing.]

Show the overhead transparency of the Sunspot Cycle Graph and ask students to interpret and explain it.

When did the latest peak occur? [About 2000-2001.]

When did the latest minimum occur? [About 1995-1996.]

How many years are there in each sunspot cycle? [About 11 years.]

When will the next peak occur? [About 2011 or 2012.]

When will the next minimum occur? [About 2006 or 2007.]

Optional

Conduct the "Light On the World" activity from the *Northern Lights* planetarium show, using a light in the middle of the room and Styrofoam balls to model the Sun, Earth, seasons & midnight Sun. This activity can illustrate very well some key factors that must be accounted for in planning an aurora tour. You may also elect to show video clips showing auroral ring(s) around poles of Earth.

At times of high sunspot activity, there is more chance for bursts in the solar wind (particles and magnetic disturbances streaming outward from the Sun), which results in increased aurora activity when the bursts in solar wind arrive at Earth.

2. Summarize requirements.

Have students write a list summarizing aurora viewing requirements. Make sure the following get on the list:

- Altitude greater than 45° North or South.
- Time of year when nights are longer (September through March in the Northern Hemisphere and March through September in the Southern Hemisphere).
- Preferably a year that is nearer the maximum of the solar sunspot cycle.

3. Choose aurora tour destinations.

Using a large globe or world map for all to see, point out various locations throughout the world and take an informal “straw poll” to see if students think an area/city/country is a good place to see the aurora. Have them give a thumbs up if definite yes, thumbs down if definite no, and no signal if the location is possible but with reservations. Call on various students to explain their choices. As you consider each location, have students fill in blanks on their Aurora Tours Destination Worksheets. Note that some locations have country and city listed, some have longitude & latitude, and others have all four columns of data. Have students find these locations on maps or globes, fill in missing data and then accept or reject as good places to see the aurora. The “Favorable Months” column can be found by using the “Hours of Daylight” data (separate sheet).

4. Aurora Tour Travel Agency.

Make up a few proposed tours/ads and have the class vote on whether or not this would be worth travelers paying \$1000-\$2000. Give some tours that would be likely to have good aurora-watching possibilities and others that would be terrible or impossible for aurora-watching. Examples:

- A train ride up the coast of Norway to the city of Tromsø in August, 2005, culminating in spectacular aurora viewing.
- Nighttime balloon rides outside of Mexico City, November, 2002.
- A cruise up the coast of Alaska all the way to the Bering Strait in January, 2011.
- A cruise around the tip of South America in July, 2012.
- Scientific expedition to Antarctica in November, 2006.
- combination safari and aurora-watching trip to South Africa in August, 2011.

Have the students work in teams and give each team a Sunspot Cycle Graph as well as the Hours of Daylight Chart.

Have students make up example tours, and encourage them to

deliberately make them either good or bad for aurora observation. Then see if their fellow students can select the ones that are good for aurora observation.

5. Create Aurora Tour advertising literature.

This is an interdisciplinary exercise that relates the science of where to view the aurora with learning a bit about the unique cultures and geography of the locales where it is possible to regularly witness aurora. Each Aurora Travel Agency Team should consist of 2-4 students. If possible allow the teams to choose a format of presentation: brochure, poster, Website, etc. depending on computer and resource availability. Prizes may be awarded to the “winning” teams. This can be determined by the teacher or by a vote of fellow students.

You are part of a team that puts together science-oriented travel packages for astronomy enthusiasts. You have been charged with the task of putting together a vacation package for those people interested in seeing the aurora. You will need to research a location, determine its suitability for viewing the aurora, and find other activities that will make the location a draw for tourists. Using this information, you will create a travel brochure (alternatively poster, magazine advertisement) with the idea of **selling** the prospective tourist on your vacation package. Each team can give a brief presentation to the tour agency to support their location. The team with the best sales job will be awarded the contract for the vacation package.

If students are to prepare a magazine advertisement, they should be assigned a space requirement such as quarter page, single column, etc.

Going Further

1. As good employees of the Aurora Tour Travel Agency, students can prepare a packing list of items the well-outfitted aurora tourist will need. This includes clothing needs for the weather and time of year, technology to record their experiences, basic personal needs, etc.
2. Students can write a letter home telling of their adventures in the land of the aurora. They should include discussion of the activities and sights that they used in their Travel Agency Tour Brochure.
3. Check out <http://www.sec.noaa.gov/Aurora/> for more on how to pick good aurora viewing locations and times.

Reference

The travel agency brochure part of this activity is inspired by an activity designed by Faye Gottlieb Cascio, which may be referenced at <http://www.accessexcellence.org/AE/ATG/data/released/0285-FayeCascio/index.html>