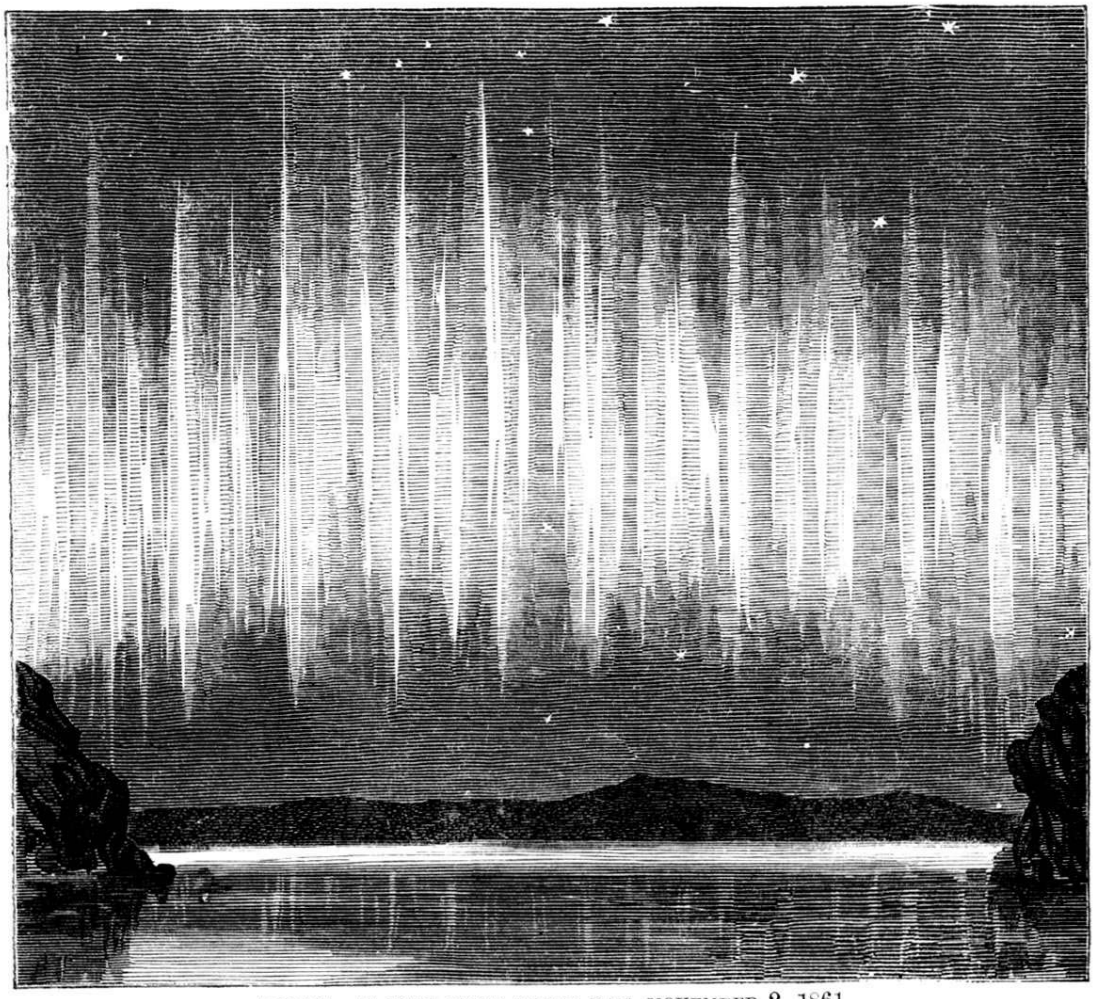
Aurora Borealis



AURORA AS SEEN FROM FIELD BAY, NOVEMBER 2, 1861.

the icy, dancing skies of the north

What are the aurora borealis?

People generally know the aurora borealis by their common name, the Northern Lights. The northern lights are natural phenomena that occur in nature. Often on a clear, dark night in the boreal forest, green, purple, pink, and white lights dance on the horizon changing their shape and color. It is perhaps one of nature's most fascinating displays of artistry.

Specifically, the aurora borealis is Latin for "northern dawn." The aurora australis is the same phemonena in the southern hemisphere, most visible from Antarctica, Australia, and New Zealand.

Today there are scientific explanations that tell us why the aurora borealis occur, but for many years, people were baffled by how they happened. Legends and myths surrounding the aurora borealis are common to all native cultures living in the northern boreal forest and Arctic regions. Often aurora borealis were a signal of change or a sign of impending doom. For example in Norse mythology, red aurora was a call to arms, and often signaled the beginning of a battle or a war. The aurora have also been a signal of changing weather. Ancient Norwegians believed the aurora would bring harsh, cold weather, while many Inuit cultures viewed the aurora as a sign of warming temperatures.

A common belief among the Inuit is that the aurora can be attracted by whistling to it, while a handclap will cause it to go away. Other Inuit beliefs suggest that the aurora is produced by spirits playing a game of soccer with the skull of a walrus.

The aurora borealis has been defined as fires of ancestors, angry gods, and dead enemies by cultures in the northern Arctic and near sub-Arctic for thousands of years. Whatever the aurora were or whatever caused them was certainly a force much greater than humans.

It has only been within the last hundred or so years that scientists have begun to answer the questions that have so often been asked. However, there are still many questions that have not been scientifically answered.

What do the Northern Lights look like?

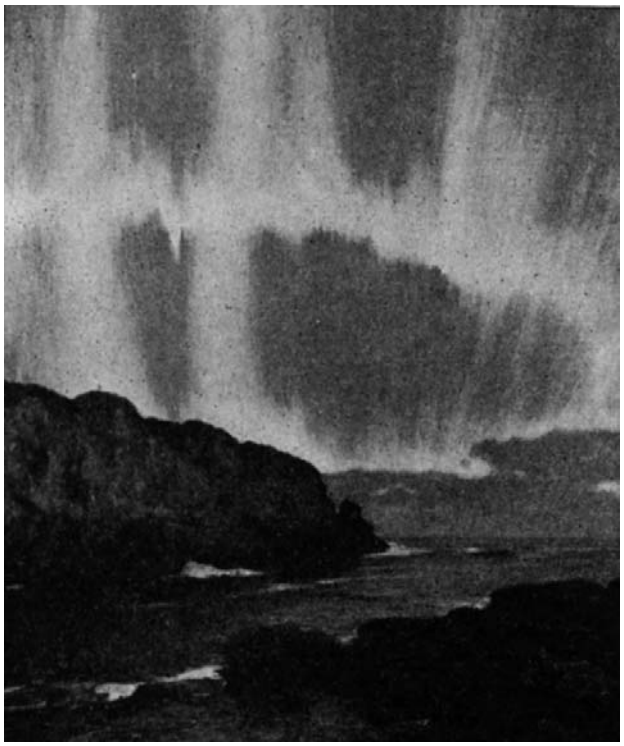
It's difficult to put into words the feeling one gets while seeing the northern lights. Describing the aurora borealis doesn't quite do them justice either.

During a young man's first canoe trip as a teenager, he decided to sleep outside of his tent for the night. It was a cool and clear night in late June. Despite the constant buzzing of blackflies and mosquitoes, he was determined to spend the night at the water's edge. Surrounded by the sounds of the wilderness and kept warm in his sleeping bag he drifted off to sleep. Sometime in the middle of the night, he was awakened by what he thought was a friend shining a flashlight over him. It wasn't frightening or even startling,

but more like being woken up very gently. Up in the sky he could see what looked like clouds, except they were changing from white to green and then even to a brilliant purplish pink.

What he did not know at the time was that he was seeing a spectacular display of the Northern Lights.

The aurora borealis occur in a few distinct patterns and can come in virtually every color of the rainbow. The aurora can be displayed as a veil, curtain, ray, or simply a bright glow in the horizon.



What type of Northern Light display do you think this is? Ray, veil, or curtain?

To see examples of the different patterns and colors that aurora borealis produce visit:
http://www.geo.mtu.edu/weather/aurora/images/aurora/jan.curtis/
http://www.geo.mtu.edu/weather/aurora/images/aurora/

What causes the Northern Lights?

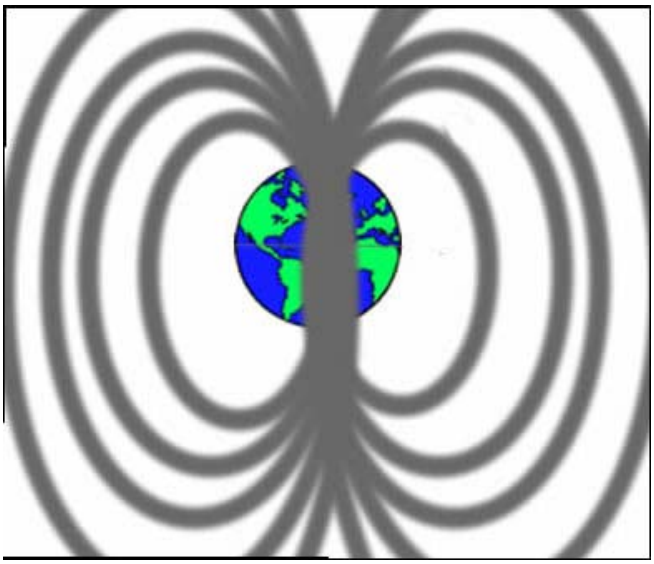
As scientists begin to study and learn more and more about what causes the northern lights, we gain a greater understanding of the earth and the solar system. There is a long-held belief that the aurora borealis is simply sunlight being reflected off of the polar icecaps.

While the sun and polar-regions have quite a bit to do with the formation of the aurora borealis, the northern lights are a bit more complicated than that.

The earth's atmosphere is made up several gasses and compounds. Nitrogen, oxygen, and hydrogen are the most common gasses found in the earth's atmosphere. Also surrounding the earth is a magnetic field that can't be seen.

The earth's core is a giant magnet that causes the earth to rotate. The magnetic field enters and exits from the earth's magnetic poles (north and south). Since we can't see the magnetic field, the lines to represent the way the field might look. The further away you get from a magnet, the weaker its magnetic pull. The lines furthest apart are the weakest. Where the lines are closest to each other is where the magnetic pull is the strongest.

Where is the earth's magnetic pull the strongest? Where is it the weakest?



The Earth's Magnetic Field

There are also lots and lots of energized particles surrounding the magnetic field. All of the particles move along the magnetic field's lines. These energized particles are what make up the aurora.

The northern lights are formed when particles from solar winds enter into the earth's magnetic field. The sun has a powerful magnetic field, just like earth, and is continuously emitting solar wind particles. The solar wind particles are electrically neutral charged particles that blast out from the sun at speeds between 1 million and 3 million kilometers per hour! Some of these particles get sucked up into the earth's magnetic field and race along the earth's magnetic lines down towards the northern and southern poles. When these electrically energized particles collide with gas atoms from the earth's atmosphere and ionosphere (oxygen, nitrogen, hydrogen, etc), the result is energy in the form of light.

Where do the Aurora Borealis occur?

The Aurora Borealis are best seen from northern latitudes, because those areas are closest to the magnetic poles (where the magnetic strength is strongest). The further north you are, the better chance you have of seeing the northern lights. Places like Alaska, Norway, Greenland, and northern Russia offer some of the best sightings of the aurora borealis. In the far north, people can see the aurora borealis on virtually every clear night.

The best places to view northern lights in North America

Remember that as you travel closer to the magnetic poles, your chances of seeing northern lights are greater. The aurora's projections will also be the more intense. However, northern lights have been seen virtually all over North America, even in southern California.

There is always a different amount of solar particles colliding with the earth's atmosphere to create aurora. When there are lots of solar particles entering the earth's atmosphere, more of the earth is covered by the aurora. The amount of earth covered by aurora activity is called the *auroral oval*. It's basically a ring around the magnetic poles that is like the earth's hat. When there are more solar particles entering the atmosphere, the auroral oval extends further south toward the equator.

When is the best time to see aurora borealis?

Generally, the best time to see the northern lights is between 10:00 PM and 3:00 AM, when the sky is dark and clear. This means that you have to be as far away from all artificial light sources (cities, towns, etc.) as possible. Artificial light and pollution can disrupt viewing almost more than a cloudy night deep in the wilderness.

Some scientists believe that early spring and fall are the best time to view the aurora borealis. During the summer months, the skies are not dark enough, and sometimes during the winter months, outside viewing can be uncomfortable due to the cold weather.

Activities for the Classroom

Objective: Students will gain a greater understanding of excited atoms by recognizing how static electricity is formed. Students will then transfer their gained knowledge of excited particles to the formation of aurora borealis.

Skills Used: Know and apply the concepts, principles, and processes of inquiry, data collection, sequential logic, application of concepts that describe force and motion, comparison of types of energy, basic understanding of the effects of electromagnetic forces. Students will demonstrate and explain ways that observable, natural forces which cause actions and reactions.

Materials Needed: Balloons and string for each student, carpeted surface, wool cloth

Procedure: Begin with a large group discussion to determine what students know about electromagnetic energy. Discuss how magnetism, energetic attraction and repulsion, and atomic composition of matter works. For more information refer to http://www.mos.org/sln/toe/staticintro.html

Explain to students that all matter is composed of both positively and negatively charged atoms. Introduce the concept of neutrally, negatively, and positively charged atoms. Ask students to think about ways in which information, energy, and material is transferred.

Give each student a balloon and have them blow it up and tie it off.

Suspend the balloon from a desk or doorway (so that the balloon is free from obstruction) with a piece of string or tape.

Ask the students if the balloon is negatively, positively, or neutrally charged in its present state. Have them hypothesize how atoms can be transferred.

Have the students rub the balloon with a piece of wool cloth or part of their clothing to create static electricity. Ask them to determine if the balloon's charge has been changed and to what state of charge.

Ask students to determine how the strength of the charge can be measured. What happens if the balloon is closer to an attractive object? What happens to the strength of the charge as the attractive object is moved further from the balloon?

Ask students why this exercise is similar to the earth's electromagnetic field. For more activities about static electricity, visit http://www.ilstu.edu/~cjclay/Static%20Electricity%20Activities.htm

Track the Northern Lights!

Objective: Students will gain a greater understanding of the auroral oval and how it grows and recedes dependent upon the amount of solar wind particles that enter the earth's atmosphere and ionosphere. Students will internet resources to predict and track aurora borealis activity for a particular region in the northern hemisphere.

Skills Used: Prediction, analysis of collected data, guided internet research, explanation of energy interactions with matter, comparison of geographic regions dependent on their latitude.

Procedure: Discuss why the aurora borealis occurs, and where it is most likely to occur. Ask students if they feel that the aurora borealis is predictable. Research your answers at http://www.fmi.fi/weather/faq_5.html

Break students up into groups of three students and assign them a longitude range from 0-180º East and West by increments of 15º. Have students locate their particular range on a world map or globe. Answer questions 1-3 on the Northern Lights Prediction worksheet.

Have groups of students visit
http://www.gi.alaska.edu/aurora_predict/worldmap1.html

Tell each group to find their particular longitude region on the interactive globe. Discuss the auroral oval and how it affects aurora activity.

Have students refer to
http://www.gi.alaska.edu/aurora_predict/worldmap1.html for five days to track the auroral activity for the week. Have them hypothesize the solar wind activity in correlation to the auroral activity. Fill in the corresponding charts on the Track the Northern Lights Worksheet.

Track the Northern Lights Worksheet

We need to figure out where to go to find the best northern lights. To be able to accurately predict them we need to look to a particular region and find out when, if, and how intense they will be. Make sure that all your answers are specific to the northern hemisphere.

Use http://www.gi.alaska.edu/aurora_predict/worldmap1.html to help you with your research.

1. What is your longitude range (remember to specify East or West)._____
2. Name the countries that your longitude region passes through._____
   _____
   _____
   _____
3. What are the major cities your longitude region passes through?_____
   _____

	Monday	Tuesday	Wednesday	Thursday	Friday
Prediction					
Accurate					

Graph your results on the back of the worksheet.

Questions for the Chat Room or Classroom Discussion

Topic: Aurora Borealis

Suggested Questions for students to ask:

What do the northern lights look like?

When do you see them best?

Have you ever seen the northern lights while you were off of a wilderness trip?

How come you can't see the northern lights near a city?

How does pollution affect the aurora borealis?

Where is the best place to see the northern lights?

How do scientists predict the aurora borealis?

What does aurora borealis mean?

What does the earth's electromagnetic field have to do with the formation of the aurora borealis?

What is a sunspot?

When does solar wind occur, and how does it affect the northern lights?

What are some of the things that people thought the northern lights meant, predicted, or implied?

Do the aurora borealis occur in the southern hemisphere? If so, what are they called?

What is the earth's atmosphere composed of? What gives the gases energy to become light?