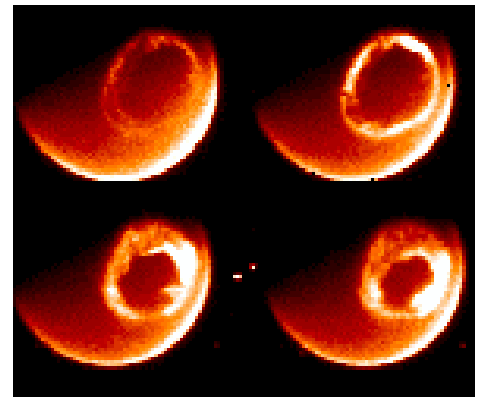
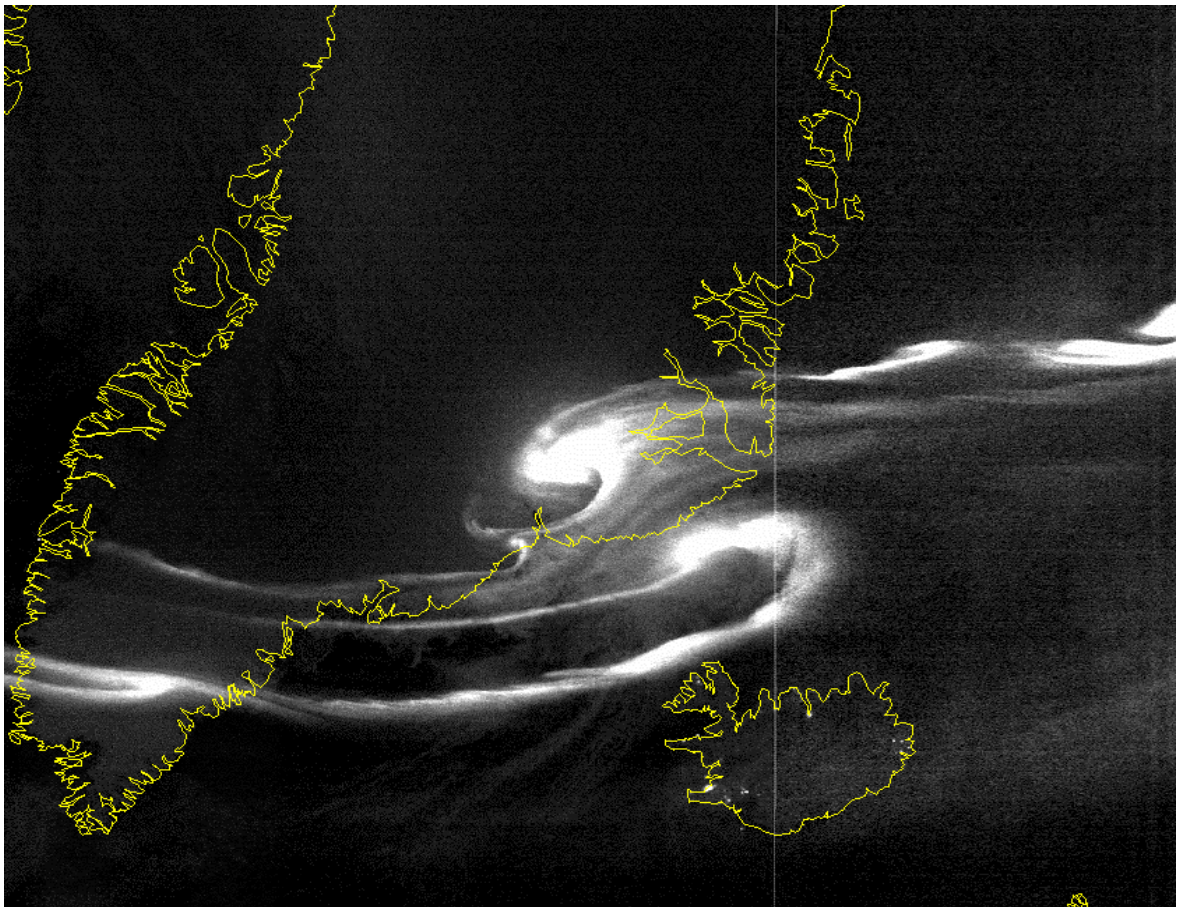


# THE NORTHERN LIGHTS



A Grade 7-8 guide to understanding the Aurora Borealis through math, geometry and reading activities.

This series of activities will help students understand how the Northern Lights work, what causes them, and how to observe them.

Through a series of math and reading activities, students will learn:

How aurora are described by scientists and by other students  
(Reading)

The geographic locations of aurora based on satellite data  
(Geography)

How aurora appear in the sky at different geographic latitudes (Geometry)

The height of aurora above the ground (Geometry - parallax)

How to predict when they will appear (Mathematics)

What Norse Mythology had to say about aurora (symbolic code translation)

This booklet was created by the NASA, IMAGE satellite program's Education and Public Outreach Project.

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For more classroom activities about aurora and space weather, visit the IMAGE website at:

**<http://image.gsfc.nasa.gov/poetry>**

The cover shows a view from the NPOESS satellite looking down at an aurora over Greenland. ([http://npoesslib.ipa.noaa.gov/S\\_sess.htm](http://npoesslib.ipa.noaa.gov/S_sess.htm)). Viking rune inscription (<http://www.commersen.se/vikingar/vardag/runor.html>). The three smaller images at the bottom of the page are: (Left) an aurora borealis viewed from the Space Shuttle; (middle) portion of the auroral oval over North America viewed by the DMSP satellite showing city lights; (right) the auroral oval viewed over the Arctic region on July 15, 2000 by the IMAGE satellite.



**Introduction:**

Aurora are the beautiful curtains of colored light that are commonly seen in the Arctic and Antarctic regions of Earth, and which have a long history of sightings by humans for over 3000 years. We now know that aurora are caused by high-speed electrons that collide with oxygen and nitrogen atoms in the upper atmosphere. One popular misunderstanding is that these streams of particles come directly from the Sun and flow down into the polar regions along Earth's magnetic field. In this activity, we will read about the scientific explanation for Aurora and also read student essays that describe how aurora make you feel when you see them from the ground!

**Objectives:**

Students will read essays to be informed about auroral activity and describe the information given.

**Materials:**

Essays  
Student Page

**Procedure:**

- 1) Discuss the student's prior knowledge about aurora.
- 2) Allow sufficient time for the students to read the three essays.
- 3) Students will answer questions 1 through 5. Encourage the students to refer to the article as needed.
- 4) Discuss the student responses.

**Conclusion:**

Students will learn about the aurora phenomenon and how scientists have studied it over the last few centuries. They will learn how older ideas have been replaced by newer explanations.



## Nature's Spectacular Light Show

The most spectacular example of the way that the Sun and Earth are invisibly connected is the phenomenon of the Aurora Borealis (Northern Lights) and the Aurora Australis (Southern Lights). For millennia, people have watched them and worried about what ill omens they represented: war, death or the wrath of God. It wasn't until the mid-1800s that scientists finally began to discover many of their mysteries. Like lightning and earthquakes, they were natural events, not supernatural ones. Thanks to intensive study by research satellites during the Space Age, aurora have been substantially de-mystified, even as their ethereal beauty has remained to dazzle us and inspire awe.

Scientists learned that aurora often accompanied magnetic 'storms' and an unsettled magnetosphere; they were produced by flows of charged particles entering the atmosphere; they came and went with the sunspot cycle; and their colors were the product of excited oxygen and nitrogen atoms hundreds of miles above the surface of the Earth.

By the turn of the 20th century, scientists actually created artificial aurora in their laboratories. Once television and the fluorescent lamp were invented, it was pretty clear just how aurora worked. What scientists still didn't understand was what was triggering them. Some thought it was from direct currents of particles from the Sun itself. This is still the explanation you will find in your textbooks today! Other scientists felt it was more complicated than that. Here is what the standard explanation looks like today:

When a major solar storm buffets Earth's magnetic field, it causes some parts of this field to rearrange itself, like rubber bands pulled to their breaking point. This releases energy that causes powerful currents of particles to flow from distant parts of the magnetic field, into the atmosphere. These particles did not originate from the Sun, but were already trapped in the magnetic field like flies in a bottle. Once they reach a charged layer of the atmosphere called the ionosphere, they pick up still more energy like a roller coaster shooting down the other side of a tall hill. The currents of fast-moving charged particles continue to flow along the magnetic field into the polar regions and collide with nitrogen and oxygen atoms in the atmosphere. These collisions produce deep red glows as high up as 1,000 kilometers above the ground, and beautiful curtains of green and blue light at altitudes as low as 90 kilometers. They never reach the ground, though they can sometimes seem as though they do!

*(Dr. Sten Odenwald. IMAGE Satellite Program)*



## Alaskan Student Essays about Aurora

### Heavenly Lights ..... *Denali Foldager (Seward Elementary School)*

Beautiful, heavenly lights in the sky, different colors for different dancers way up high. Waves like a colorful mid ocean, swimming around in the sky like a dance that never ends. Shimmering and shiny colors across the world, like a colorful raindrop surrounded by a black puddle. Heavenly lights that are peaceful like a flower, but big and colorful as the sun and lots of rainbows. Its colors glowing into the night like it's the diamond and the stars are the gems. Alaska is as beautiful as the northern lights. You could almost touch them because they seem so close to you when you look up at the sky. It makes me feel happy and proud to live in Alaska. The great, wonderful northern lights will always be there when you need them or when you don't. The colors will brighten up your day some way or another. Even though when you can't see them, you can always feel them around you. A swirl of colors all in one. It's either the colors on a cold night or just when you're seeing them for the first time. But just knowing that you have seen the blue, red, or even green the colors are great. Skies, I think, would never be the same without the colorful, calm dance of the heavenly lights. It would just be black with no rainbow to brighten your day and dancers would have no color to their dances. The colors are magnificent and nothing will change that. Color after color day after day a new color is made into the swirl to make it better. All of the auroras are magnificent and heavenly. It doesn't matter what you call it, heavenly lights, gates to heaven, rainbow in the sky, all of them are the same. Auroras will always be there colors and all.

### The Compelling Dance of Light .... *Sonta Hamilton (Mt. Edgecumbe High School)*

What can a person find by looking deep into the Alaskan Aurora Borealis? The Alaskan northern lights are usually a pale hue of green and purple. No matter what the color is at that time, people witnessing the event find something within themselves. Ancestral generations that have resided in Alaska's great outdoors over many years have felt that warmth of life that the northern lights have breathed into them. When the night air is crisp and calm, the onlookers are still comforted and feel enriched with a quiet hope. The beams and flashes of vibrant color in the creamy dark sky spreads like a blanket over the land and its inhabitants. There are many moments of quiet stillness and wonder that spreads throughout the vast snow-powdered land. Changes occur in a swift motion, and a person is strangely hypnotized by the northern light's effective grasp on the earth's skies. Its wispy enchanting hands grab a strong hold and guide a person on a journey that tells a comforting story. There is no need to drink hot coca on this night, for the spectacle warms you inside and out. Take off those worn-out gloves and dance with the sky, just as the soft gentle bounce of a person mask dancing can be kept in sync with the swaying colors as it glides through the night's sky. The momentum and beat speaks the northern lights story. A story told by the northern lights is one that a person's ancestors have heard and witnessed on many blustery nights. The story is whispered in and out of different souls, each with a different meaning. All of the colors and resonant light ignites a spark in the many soul seekers of this event. These are the moments in the wilderness of Alaska that a person can feel fortified with everlasting hope towards a secure future. Events such as these don't last one single night; a person remembers the northern lights throughout their life.

To read more essays by Alaskan students, visit the IMAGE 'Alaskan Schools' web page at:

**<http://image.gsfc.nasa.gov/poetry/alaska/alaska.html>**



Student Name \_\_\_\_\_ Date \_\_\_\_\_

Read the accompanying essays about aurora and answer the following questions based on what you have learned in each essay:

- 1) **Why do aurora make some people feel strong emotions?**
  
- 2) **What kinds of colors and shapes are seen in an aurora?** Be sure to cite specific examples from each essay.
  
- 3) **Compare the essay by Denali Foldager and Sonta Hamilton. Do you think age makes a difference in the way some people express themselves?**
  
- 4) **According to Dr. Odenwald, what kind of explanation has been given for why aurora occur?**
  
- 5) **Is there a natural phenomenon you have witnessed that made you feel like the Alaskan students did? Describe the circumstances.**

