In Finland they’re called revontulet, or “fox fires.” The name comes from an ancient fable about the arctic fox starting fires or spraying snow with its brush-like tail. The mysteries of the colorful bands known as the northern lights are beginning to unfold as scientists explore their causes.

In this segment you’ll find…

- what the northern lights are and what causes them.
- how work by the THEMIS scientists will help further understanding of the northern lights and their impact on space weather.

Imagine seeing brightly colored lights that seem to dance like beautiful ribbons in the sky. At first you might enjoy nature’s free show, but eventually you may ask what causes them. Centuries ago, people asked themselves this question when they first saw these nighttime lights. Their explanations, which ranged from the fiery breath of dragons in early Chinese myths to the breath of heavenly warriors fighting battles in the sky, have given way to more scientific explanations.

The northern lights, or aurora borealis, got their name from the Italian astronomer Galileo Galilei because he thought they looked like the pink-tinged light of dawn.

As modern-day scientists began to explore the northern lights, they discovered that the phenomenon not only appears as bands or rippling curtains but also as pulsating globs and a steady glow. Scientists realized that there was a connection between the appearance of the lights, the Sun and Earth’s magnetic field.

The Sun continually spews electrically charged particles, called ions, into our solar system. These particles, traveling a million miles per hour, make up the solar wind. As the wind encounters Earth’s magnetosphere, the space surrounding our planet that contains the magnetic field, it causes the colored bands of lights in the sky.

The colors, which range from red to green to purple and blue, depend on altitude, atmospheric gases and the energy of the particles that make up the solar wind. Oxygen is responsible for green and red, the two main colors. Nitrogen causes blue and deep red. Green lights start at altitudes of about 75 to 110 miles. Red northern lights occur at altitudes higher than 75 miles; blue and violet occur mostly at lower altitudes.

At these altitudes, the magnetic substorms caused by the northern lights can impact satellites and astronauts as they leave or return through Earth’s atmosphere, so scientists have very good reasons for learning all they can about them!
PRE-VIEWING

• What do you already know about the northern lights?
• What is the other term for the northern lights?
• How would you best describe this phenomenon?
• What do you think causes the northern lights?

VIEWING FOCUS

NOTE: You may choose to watch the television segment twice with your students: once to elicit emotional responses and get an overview of the topic and again to focus on facts and draw out opinions.

• Record the colors you see.
• Do researchers today understand what causes the northern lights and how they work?
• Describe the shape of Earth’s magnetic field.
• What is solar wind? In what ways does it impact Earth?
• What are magnetic substorms?
• What kind of problems can these magnetic substorms cause?
• Dr. Vassilis Angelopoulos is responsible for the NASA project Themis. What is Themis?
• What is the purpose of Themis?
• What is the difference between space weather and atmospheric weather?

POST-VIEWING – Links to activities mentioned here can be found on the following page.

• Review students’ answers to the Viewing Focus Questions.
• Imagine you were born in ancient times, create a myth to explain the northern lights, then disprove your myth using scientific facts.
• Read more about the northern lights (auroras) in the article “Earth, Wind, and Fireworks: Sun’s Storms Blow Northern Lights South” by William Broad in the New York Times (2000).
LESSON PLANS / ACTIVITIES

You Light Up My Life New York Times
• These lesson plans and activities examine the causes and effects of auroras

IMAGE Education and Public Outreach NASA
http://image.gsfc.nasa.gov/poetry
• This site provides classroom activities and lesson plans that focus on auroras and Earth’s magnetic field.

EDUCATOR WEB SITES

NORDLYS: Northern Lights
http://www.northern-lights.no/
• Experience the aurora borealis through video, sound pictures and text.

The Aurora Page Michigan Tech
http://www.geo.mtu.edu/weather/aurora/
• This site provides information about and images of the northern lights.

Space Weather Now NOAA
http://www.sec.noaa.gov/SWN/
• Find the latest information on current space weather (ex. geomagnetic storms, radio blackouts, solar radiation storms, and more).

ARTICLES / READING

Beyond the Northern Lights Lynn Blakie
Fitzhenry and Whiteside 2006

Auroras: Light Shows in the Night Sky Donna Walsh Shepherd
Franklin Watts 1995

Solar Storms: The Silent Menace Dr. Sten Odenwald
http://image.gsfc.nasa.gov/poetry/workbook/storms.html
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<tr>
<th>FIELD NOTES</th>
<th>FIELD TRIP</th>
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<td><strong>Go outside and ...</strong></td>
<td><strong>Visit ...</strong></td>
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| ☐ Observe the night’s sky on consecutive nights  
  • You probably won’t see the northern lights, but what do you see?  
  • Note any changes from one night to the next. | ☐ Take a virtual field trip to the Exploratorium’s Aurora Paintings in the Sky.  
  • take the Self-Guided Tour and learn everything you’ve always wanted to know about the northern lights. [www.exploratorium.edu/learning_studio/auroras](http://www.exploratorium.edu/learning_studio/auroras) |

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<th>FIELD RESEARCH</th>
<th>FIELD TEST</th>
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<td><strong>Find out more about...</strong></td>
<td><strong>Experiment with...</strong></td>
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| ☐ The folklore and mythology of the northern lights  
  • How did the ancients explained this unique natural phenomenon. | ☐ Building your own spectroscope  
| ☐ The southern lights  
  • In what ways are the northern and southern lights similar and different? | ☐ Building a Soda Bottle Magnetometer  