Illuminating the Northern Lights

Watch it online http://www.kqed.org/quest/television/view/466
TV story length 8:34 minutes

QUEST SUBJECTS

Life Science Biology, Health, Environment

Earth Science Geology, Weather, **Astronomy**

Physical Science Physics, Chemistry, Engineering

CA SCIENCE STANDARDS

Grade 6

Energy in the Earth System
4. Many phenomena on Earth's surface are affected by the transfer of energy thorugh radiation and convection currents. (b)

Grades 9-12

Earth's Place in the Universe
1. Astronomy and planetary exploration reveal the solar system's structure, scale and change over time. (e)

Structure and Composition of the Atmosphere
8. Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life. (a)

Electric and Magnetic Phenomena
5. Electric and magnetic phenomena are related and have many practical applications. (f)

PROGRAM NOTES

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.

TOPIC BACKGROUND

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!

Media Enhance Education

Video and audio can be powerful tools for meaningful learning. It all depends on you, the educator. The key to using media effectively is preparation. Make the most of learning opportunities by encouraging students to become active viewers and listeners. Pick and choose from the suggested questions and activities to offer an engaging media experience.

Questioning

Oftentimes, teachers and students become frustrated during a media segment when students can't find the answers to a long list of questions. Provide a limited number of questions or topics for students. This focuses their attention during a media segment, helps to keep them engaged and generally results in higher quality answers. QUEST Ed. has provided a number of options for focus questions ranging from fact based to opinions, as well as "big picture" ideas.

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).

The name "aurora borealis" is credited to Galileo Galilei (1616) and means "northen dawn."

LESSON PLANS / ACTIVITIES

You Light Up My Life New York Times
http://www.nytimes.com/learning/teachers/lessons/20000328tuesday.html?searchpv=learning_lessons
- 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

Look for the  **indicating resources from QUEST partner organizations**

QUEST QUAD

FIELD NOTES

Go outside and ...

- 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.

FIELD TRIP

Visit ...

- 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

FIELD RESEARCH

Find out more about...

- The folklore and mythology of the northern lights
  - How did the ancients explained this unique natural phenomenon.

- The southern lights
  - In what ways are the northern and southern lights similar and different?

FIELD TEST

Experiment with...

- Building your own spectroscope
  - What colors make up white light?

www.cs.cmu.edu/~zhuxj/astro/html/spectrometer.html

- Building a Soda Bottle Magnetometer
  - Monitor the changes in the magnetic field in your home

http://image.gsfc.nasa.gov/poetry/workbook/page9.html

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California Academy of Sciences
www.calacademy.org

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www.chabotspace.org

East Bay Regional Park District
www.ebparks.org

Exploratorium
www.exploratorium.edu

Girl Scouts of San Francisco Bay Area
www.girlscoutsbayarea.org

Golden Gate National Parks Conservancy
www.parksconservancy.org

Lawrence Berkeley National Laboratory
www.lbl.gov

Lawrence Hall of Science
www.lawrencehallofscience.org

Oakland Zoo
www.oaklandzoo.org

The Tech Museum of Innovation
www.techmuseum.org

UC Berkeley Natural History Museums
http://bnhm.berkeley.edu/

OTHER WAYS TO PARTICIPATE IN QUEST

LOG ON

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LISTEN

KQED 88.5 FM San Francisco &
89.3 FM Sacramento
Fridays at 6:30am and 8:30am

WATCH

KQED Channel 9
Tuesdays at 7:30pm

IMAGE CREDITS

Sheraz Sadiq; Dish in the trees

Major funding is provided by the National Science Foundation, the Gordon and Betty Moore Foundation, the Richard and Rhoda Goldman Foundation, and The Amgen Foundation. Additional support is provided by the William K. Bowes, Jr. Foundation, Ann S. Bowers -The Robert Noyce Trust, the Dirk and Charlene Kabcenell Foundation, and the Vadasz Family Foundation.