

Aurora Misconceptions: Rainbows & Aurora

Overview:

Students learn scientists once believed rainbows and the aurora were created in the same way. In 1868, Anders Jonas Angstrom used a prism to prove the theory wrong. He discovered that rainbows are created by bent or refracted sunlight and the aurora is created by different gases in Earth's atmosphere.

Objectives:

The student will:

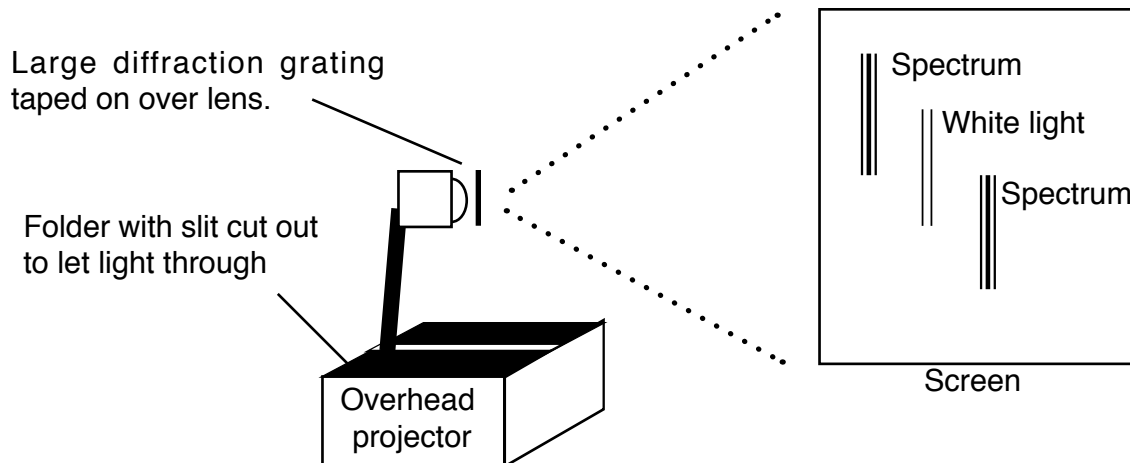
- discover rainbows and auroras are not created in the same way;
- differentiate between spectrums of aurora light and sunlight;
- confirm a certain, constant order of color is created whenever sunlight or white light is bent, or refracted;
- explain rainbows in the sky are created when sunlight is bent, or refracted, through water droplets in the air;
- conclude auroras are created by different gases in Earth's atmosphere;
- explain scientific theories can change, or be proven wrong, when new information is presented; and
- demonstrate how to use a prism.

Materials:

- Prisms
- Colored pencils
- Diffraction grating
- Black construction paper or manila folder
- VISUAL AID: "Aurora/Sunlight Spectrums"
- VISUAL AID: "Aurora/Sunlight Venn Diagram"
- VISUAL AID: "Venn Diagram with Answers"
- STUDENT WORKSHEET: "Spectrums of Light"



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Activity Preparation:

1. Cut a slit about 1/2 inch wide in a manila folder or black construction paper. Place the paper with a slit on an overhead projector. Cover the surface completely so that light shines only through the slit.
2. Tape a large (3 inches X 3 inches) diffraction grating over the lens of the projector. The diffraction grating is a thin piece of transparent material that looks like the “rainbow glasses” popular with students. A small cardboard frame may help hold the diffraction grating flat on the lens. Point the lens toward the screen in the front of the room.
3. Darken the room and turn on the projector light. A band of white light will appear on the screen. A spectrum will appear several feet away on one side. If the spectrum does not appear, try turning the diffraction grating 90 degrees.

For additional information NASA's website: (http://heasarc.gsfc.nasa.gov/docs/xte/learning_center/universe/prism.html).



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Activity Procedure:

1. Provide students with the STUDENT WORKSHEET: “Spectrums of Light” and colored pencils. Explain a prism can be used to show a spectrum of colors. Use the diffraction grating on the projector to show those colors. Explain the diffraction grating works like a prism. Ask students to record these colors in order under Question #1 on their worksheets.
2. Explain this color sequence always will result when sunlight or white light is bent, or refracted, through a prism. Explain raindrops or water droplets act like tiny prisms in the sky and that rainbows are created when sunlight passes through them.
3. Explain that 250 years ago, scientists had a theory. They thought rainbows and the aurora were created in the same way, by refracted or bent sunlight. It wasn’t until 1868, that Anders Jonas Angstrom used a prism to prove that theory wrong.
4. Show VISUAL AID: “Aurora/Sunlight Spectrums.” Explain Angstrom compared the spectrum of colors produced by aurora light and the spectrum of colors produced by sunlight to prove rainbows and auroras are not created in the same way.
5. Show VISUAL AID: “Aurora/Sunlight Venn Diagram.” Ask students to compare and contrast the spectrum of aurora light and the spectrum of sunlight. Fill in the Venn diagram as students make suggestions. If desired, show VISUAL AID: “Venn Diagram with Answers.” Students should notice the spectrum of aurora light:
 - contains some, but not all of the colors of the rainbow present in the spectrum of sunlight;
 - does not form a continuous band of colors that blend one into the other like those present in the spectrum of sunlight;
 - contains bold lines of color separated by large dark spaces.
6. Ask students to use colored pencils to create a spectrum of the aurora under Question #2 on their worksheets. Explain gases in Earth’s atmosphere create the aurora spectrum. Explain oxygen produces the familiar green glow of the aurora, nitrogen creates the purple fringe often seen at the bottom of the aurora and oxygen very high in the atmosphere produces a red aurora.
7. Review how a rainbow and an aurora are created, then ask students to answer Questions #3 and #4 on their worksheets.
8. After students turn in their worksheets, pass out prisms and let students experiment with different light sources.

Answers to Student Worksheet:

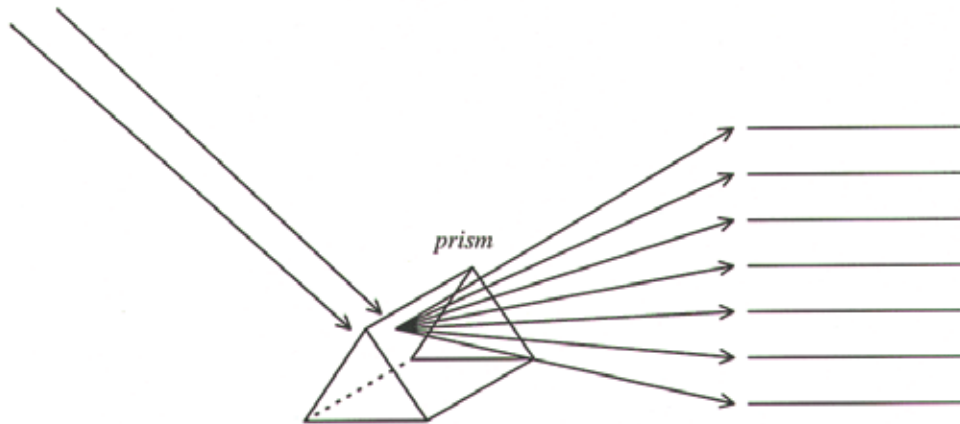
1. *red, orange, yellow, green, blue, indigo, violet*
2. *violet, blue, yellow (or greenish) and red*
3. *A. A rainbow is created by refracted sunlight or white light.*
4. *C. The aurora is created by different gases in Earth’s upper atmosphere.*

Spectrums of Light

Student Questions:

1. Use the prism to separate the white light or sunlight into a spectrum of colors. Record the colors on the right side of this sheet using your colored pencils. Pay close attention to the order of the colors and make sure you record them in the exact order they appear.

Rays of sunlight or white light



2. List or use colored pencils to draw a spectrum of the aurora.
(Use the *Angstrom's Theory* video to find a spectrum of the aurora.)

3. How is a rainbow created? (Circle the correct answer.)
 - A) A rainbow is created by refracted sunlight or white light.
 - B) A rainbow is created by different gases in Earth's upper atmosphere.
 - C) A rainbow is created when lightning strikes.
4. How is the aurora created? (Circle the correct answer.)
 - A) The aurora is created by refracted sunlight or white light.
 - B) The aurora is created by the reflection of sunlight off of Earth's poles.
 - C) The aurora is created by different gases in Earth's upper atmosphere.