V...How Your Location Changes What You See

Introduction:

How does your location change what you see? Students will use hands on experiences to develop an understanding of how the distance and location of the observer changes the appearance of a star and other objects in the sky. Although no two stars are exactly as powerful, it is still true that the farther away stars are, the fainter they will be. This follows a precise law called the Inverse Square Law, which the students will be exploring. The students will also explore how the observer's location changes the perception of what is seen by looking at auroras from two different perspectives; from space and from the ground.

Materials:

Seven Mini-Maglite flashlights (these flashlights were chosen specifically because the reflector mechanism may be removed easily by unscrewing the top of the flashlight off, making the flashlight work more like a candle without the dangers of flames) - or Glow-in-the-Dark stars of the same color (available at many stores)

Dark room or area - the darker the better!

Cartoon copied onto colored paper

One Mini- Maglite flashlight (extension activity)

Index cards

Scissors

Graph paper with 1/2 inch squares (a stiff pad or clipboard is helpful)

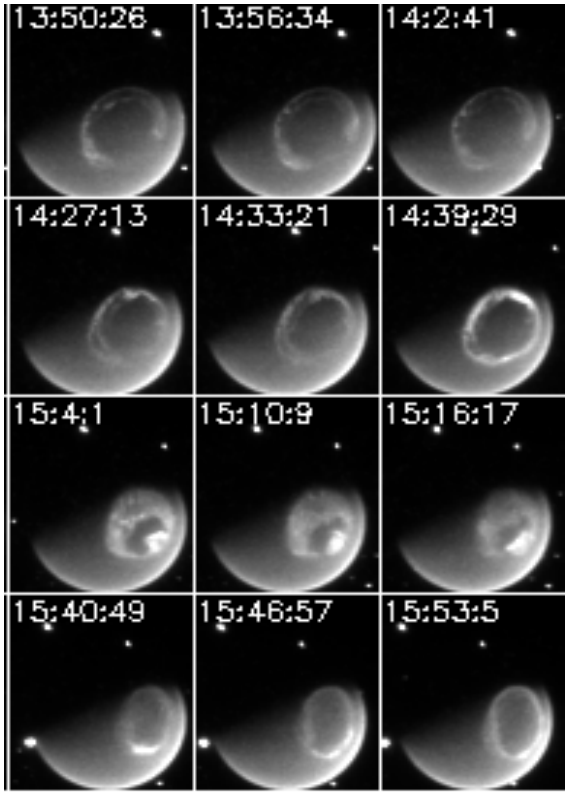
Pencil

Objectives:

- Students will make predictions about the influence distance has on appearance of an object.
- Students will explore the Inverse Square Law.
- Students will investigate the distance-perception relationship.
- Students will communicate observations to classmates.

Key Terms:

Inverse Square Law – states that for two identical lamps, the one that is twice as far from the observer will appear 1/4 as bright.



Aurora seen with IMAGE satellite

Procedure:

- Have three students stand approximately 10, 20 and 30 feet from the rest of the class, each holding a flashlight (with the reflector mechanism removed) or a Glow-in-the-Dark star. Darken the room and have the students turn on the flashlights or hold up the stars. Then have the rest of the class observe which light appears to be brighter. The class should discuss how this demonstration is related to the varying levels of brightness of the stars that we see. The darker the room/area, the more the students will have to look at the magnitude of the lights instead of where the flashlights are located.

- Have a student stand at the end of the hallway holding the cartoon with caption. The rest of the students should try to guess what that student is holding and if it has color. Have the student come toward the class slowly until the class can determine what is being held. The class can discuss how this demonstration is related to how distance changes the appearance of objects. Students should record their observations in their learning logs.

- Have seven students stand in a line with the Mini-Maglite flashlights (with the reflector mechanism removed) or the Glow-in-the-Dark stars. When the room is darkened, the students should turn on the flashlights or hold up the stars. Then the students should arrange themselves to look like a constellation such as the Big Dipper. Once they are arranged, assign them each a star number. (Some students could be sitting or kneeling on the floor). The rest of the class should walk around and observe the arrangement of student stars. Then ask the students who are star #1 and #6 to take four steps straight back. Student stars #3 and #7 should take 2 steps forward. Student star #2 should take one step back. Have the rest of the class walk around the newly arranged stars, and observe the changes. Discuss their observations. Does it still look like the Big Dipper from all sides? Compare this to observing the stars from different locations in space. The students should write about their observations in their learning logs.

- The students will need to have access to the internet to review sites that show images of auroras from the ground and from a satellite. Both images can be viewed at the same time if you go to: http://www.windows.umich.edu/spaceweather/sun_earth8.html A second site of interest can be found at http://www-istp.gsfc.nasa.gov/istp/outreach/coolpics.html This site has various images of auroras from the ground and from space as well as other information.

- Have the students discuss the differences in the appearance of the aurora. The students should record their observations in their learning logs. They should be able to conclude that although an aurora is actually a big circle (called an oval) small parts of it from the ground will look very different.

Grades 2-6

In this activity the students are going to explore the Inverse Square Law.

Procedure:

- The reflector mechanism needs to be removed from the flashlight. The students should cut a 1/2 inch by 1/2 inch square in the index card and attach it to the work surface one inch away from the modified Mini-Maglite. The students should place the graph paper against the index card, which means it is one inch away from the light source. Then the students should mark the number of squares that are illuminated on the graph paper and record the distance the graph paper was from the light source. The students should also note the intensity of the light on the graph paper.
- Now the students should move the graph paper to 2 inches away from the light source, illuminating a different area on the paper. Mark the squares that are illuminated, record the distance from light source and note the intensity of the light on the graph paper. Continue to move the graph paper away from the light source in inch increments, continue recording the distance from light source, the number of squares illuminated and the intensity of the light.
- The students should see a pattern of squares in the number of squares illuminated and the intensity of the light on the graph paper. When the graph paper was two inches away, there should have been four squares illuminated. When the graph paper was three inches away, there should have been nine squares illuminated.
- Discuss the students' observations and have the students record their observations in their science learning logs.

Conclusions:

The students will explore how the observer's location will change the appearance of stars and other objects in the sky. The students will learn that the distance between an observer and the object will change the object's appearance in size and brightness.

Extensions:

Grades 2- 3

- Students can predict whether all three children with flashlights would have to be exactly the same distance from the observers to have the lights appear to have the same brightness level. The students should design experiments to explore this further. Initiate a discussion about how stars in space are different distances from our view on earth.

Summary: The Inverse Square Law says that for two identical lamps, the one that is twice as far from the observer will appear 1/4 as bright.

Grades 4-6

- Students can predict the distance that the student holding the cartoon would have to move so that the observers could determine what was being held. The students should design a method for recording the distance the observer needs to be from the object being observed. Initiate a discussion about how stars in space are different distances from our view on earth. As the students saw from the demonstration with the cartoon, distance changes our perception of the stars.

Summary: The farther away an object is, the less detail the observer can see.

- To have students explore how the power of a star changes the distance – brightness relationship, students could use 25-watt & a 100-watt bulbs in lamps. As in the first activity listed here, the students should stand in different places in the hallway with the lamps. The students are exploring how a star that appears faint could actually be closer than a higher-powered star that is farther away.