Lesson Created by Carrie Monday

NVACSS Lesson Plan Template

Grade Level: 5th	Topic: The Sun & Stars

General Lesson Description: (Include Estimated Time to Complete the Lesson)

This lesson is intended to be completed in (2)-40 minute sessions. Lessons may be split to accommodate time constraints.
The focus of the lesson is for the students to understand relative distances, and additional features of the Sun and the stars in our atmosphere. Students will be able to support a viable argument based on evidence/ discussion groups and be able to complete a project using scientific language.

Performance Expectation:

5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.

Clarification Statement:	Assessment Boundary:
None	Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).

Big Question:	Specific Learning Targeted Outcomes:
How can you provide evidence that supports the claim that stars differ in brightness based on relative distances from Earth, not additional factors?	• Stars are at different distances from Earth. Stars are different sizes and have different brightnesses. • A great deal of light travels through space to Earth from the Sun and from distant stars. • Groups of stars (constellations) appear to move together across the night sky because of Earth's rotation. • Different constellations are observed in the night sky during different seasons because Earth revolves around the Sun.

NGSS Anchor Phenomena:

https://www.ngssphenomena.com/new-gallery-1/55dvsqc5vzssd6a5zclpckma0i9cma
What objects do we observe in our solar system and how do they move in relation to each other? (FOSS Phenomena)
What do we see outside of our system? (FOSS Phenomena)

Background Information

Prior Student knowledge to teach this lesson:

This lesson is designed as an extension of FOSS, and is to be implemented after completing Investigation 2 Part 5 in the Earth and Sun kit.
If you are not using FOSS, students will need to understand that stars are at different distances from Earth, and have different sizes and brightnesses. Students will also need to understand that a star's' apparent brightness has to do with the relative distance from Earth, not it's size. Students will also need to know that the stars that seen at night are different based on the different seasons based on Earth's rotation around the Sun.

Teacher background information around big ideas: Information provided is from the Background for Teacher found in Investigation 2-Planetary Systems in the Earth and Sun Kit from FOSS.

A constellation is a group of stars that presents itself to humans on Earth in a striking or obvious pattern. The stars in a constellation are not the same distance from Earth. The patterns result from the apparent group, in which some may be much closer to Earth and others much farther from Earth. Stars are distributed three-dimensionally in space. Humans have groups stars together in constellations based on their relative positions on the sky's imaginary two-dimensional plane. If you went to another planetary system many light years away and visited a planet orbiting a different star, your perspective on the other stars would change, and you would see entirely new patterns.

The identifiable groups have universally accepted names, established in 1930 by the International Astronomical Union (IAU). The IAU divided the sky into 88 constellations. Each constellation is defined by an imaginary boundary on the sky and named after a star pattern within those boundaries. Asterism is another term used to describe a group of stars that forms a recognizable pattern. Asterisms are not the official constellations, but include many familiar star groups. Technically, the Big Dipper is not a constellation. It is only part of a constellation that includes several other stars. The Big Dipper is part of the constellation Ursa Major, the Great Bear.

If we limit the number of stars to the ones we can see from Earth without a telescope, it comes to about 7000 stars. Of that 7000, only about 2000 stars can be seen at one time from one place on Earth.

Stars in motion. The Milky Way is a huge spinning group of stars called a galaxy. The Sun is one of the billions of stars in the Milky Way galaxy. Sol is about two-thirds of the way out from the center of the galaxy.

The Sun is the closest star to Earth. Light from the Sun takes 8 minutes to travel the 150 kilometers or 0.00001582 light years to reach Earth. (Light travels at a speed of 1,080 million kilometers per hour.) Our nearest star neighbor in the Milky Way Galaxy is Proxima Centauri, 4.22 light years away from the Sun and Earth. Because it is a faint red dwarf star, it is too dim to be seen with the naked eye. It takes light more than four years to travel from the Sun's nearest star neighbor to Earth. To an observer on Earth, the apparent brightness of the Sun compared to other stars is due to the fact that they are so far away from Earth.

Have you ever seen the smear of light running like a backbone from north to south in the summer sky? That smear is actually the view toward the center of our Milky Way galaxy. The concentration of stars is greater toward the center, so we see the billions of stars in that direction as an undifferentiated glow. But there are stars in all the other directions.

If you watch the night sky from sundown to sunrise, you will notice that the stars appear to move across the sky. Constellations rise in the east, travel across the sky, and set in the west, just like the Sun and the Moon. The spatial and angular relationships between the stars, however, do not change. That's why the constellations are predictable year after year, century after century (for at least 50,000 years). The stars maintain their positions in the galaxy with respect to one another. But as Earth rotates on its axis, the perception of a viewer riding on Earth's surface is that the constellations are travelling across the sky at a stately, predictable rate.

Possible Student Misconceptions:

1. Students think that the constellations and stars are moving and not caused by the rotation of the Earth.
2. The size of a star determines the brightness of the star.
3. Stars disappear during the day and reappear at night.

Evidence Statements: How do students show mastery?

- Students identify a given claim to be supported about a given phenomenon. The claim includes the idea that the apparent brightness of the sun and stars is due to their relative distances from Earth.
- Students describe the evidence, data, and/or models that support the claim including: The sun and other stars are natural bodies in the sky that give off their own light. The apparent brightness of a variety of stars, including the sun. A luminous object close to a person appears much brighter and larger than a similar object that is very far away from a person (e.g., nearby streetlights appear bigger and brighter than distant streetlights). The relative distance of the sun and stars from Earth (e.g., although the sun and other stars are all far from the Earth, the stars are very much farther away; the sun is much closer to Earth than other stars).
- Students evaluate the evidence to determine whether it is relevant to supporting the claim, and sufficient to describe the relationship between apparent size and apparent brightness of the sun and other stars and their relative distances from Earth.
- Students determine whether additional evidence is needed to support the claim.
- Students use reasoning to connect the relevant and appropriate evidence to the claim with argumentation. Students describe a chain of reasoning that includes: Because stars are defined as natural bodies that give off their own light, the sun is a star. The sun is many times larger than Earth but appears small because it is very far away. Even though the sun is very far from Earth, it is much closer than other stars. Because the sun is closer to Earth than any other star, it appears much larger and brighter than any other star in the sky. Because objects appear smaller and dimmer the farther they are from the viewer, other stars, although immensely large compared to the Earth, seem much smaller and dimmer because they are so far away. Although stars are immensely large compared to Earth, they appear small and dim because they are so far away. Similar stars vary in apparent brightness, indicating that they vary in distance from Earth.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
7. Engaging in Argument from Evidence Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Support an argument with evidence, data, or a model.	ESS1.A: The Universe and its Stars The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.	3. Scale, Proportion, and Quantity Natural objects exist from the very small to the immensely large.

Lesson Plan: 5E Model

ENGAGE:

Teacher will introduce the lesson by letting the students know that today they will continue to learn more information about the stars within our solar system. Ask them to take a few moments to recall what they have learned about or remember about stars in our sky. Have them share within their groups what they know about stars. After they have had some time to share, compile a class list on the board or on chart paper listing what they know about stars. The idea about the brightness or coloring of stars should have come up, if not add it to the list and let them know that a stars coloring and brightness has always been something that people have misconceptions about and that we are to take a closer look at that today. Introduce them to the video from SciShow Kids: What Are Stars? (3:38)

https://www.youtube.com/watch?v=ZrS3Ye8p61Y

Assessment

Formative: Discussion/Groups Lists
Summative: N/A

Engage Materials Needed and Website/Other Resources:

https://www.youtube.com/watch?v=ZrS3Ye8p61Y

EXPLORE:

After the video, ask the students to take a few moments to discuss within their small groups what they learned about the brightness of stars. Have them close their eyes and imagine themselves gazing up at the night sky filled with stars. Ask them to think about what they are envisioning, focusing on the stars themselves. After giving them about one-two minutes to create the images, have them open their eyes, and share with their groups what they pictured. As you are circulating the room listening to their descriptions, you may need to ask a few questions about brightness and listen to their responses. After a few minutes (gauge the time on allowing every student to share), call the class back together. Let them know that they are going to continue the discussion about the brightness of stars, by viewing some images about light. The next portion of the activity can be done a few different ways depending on your class, available time and preference.

- Option 1: You can give each group an image to look at, discuss and use to answer the question sheet.
- Option 2: You can project one of the images to review whole group and then have them use one of the other images to answer the question sheet.
- Option 3: You can split the class into two sections and give each section one image to focus on and then have each section complete a question sheet for their image.

After the activity, you will then want to review their question sheets and add any additional notes that they have into their notebooks.

Assessment

Formative: Small group discussions
Summative: Light Brightness Question Sheet

Explore Materials Needed and Website/Other Resources:

Light Images Folder (contains images used for brightness comparisons) -OR- you can use your own images
Light Brightness Question Sheet
Glues stick or tape (to add question sheet into their notebook)
Science notebooks
Pencil

EXPLAIN:

Students will review their evidence from the question sheets, discussing results and the evidence behind them. Students will also review and provide evidence for their choices on which images are emitting the brightest rays of light and why.

After the students have a few minutes to review their responses, have them move into a sense making circle. To begin the discussion, ask the students to share what they observed with the images of different light sources. This should lead to a discussion about observations on stars, particularly about brightness and possibly sizes, and of course and other additonal findings and 'a-ha' moments. If the discussion stalls, pause then prompt with questions that would further continue the discussion. You are wanting them to share results and things that they noticed which will lead them up to the understanding that the size and location of a light source is an important factor when it comes to their brightness.
After the sense making circle, have students view the following video on the brightness of stars.

Introduce them to the following video from Crash Course Kids; Glow On: Crash Course Kids #20.2 (5:09)
https://www.youtube.com/watch?v=Zo-sKzMWYFA

Explain Materials Needed and Website/Other Resources:

https://www.youtube.com/watch?v=Zo-sKzMWYFA Website Link from Crash Course Kids
Notebooks for sense making discussion circle

ELABORATE:

Review with the students what they have previously learned about the brightness of stars, allowing them time to revisit the concepts about brightness. Let them know that today they will once again focus on the brightness of stars but this time they will be looking at a constellation in which to help them understand the differences in brightness. You will need to share with them the image of Orion (or provide an image that would be similar) and point out a few of the stars that make up Orion (Betelgeuse & Rigel). In the image the students can also view Sirius (part of Canis Minor). Have them compare the images of these stars alongside an image of the Sun. Have the students research the different stars, focusing primarily on their brightness and location from Earth. *Tell them to use the information to construct an explanation as to how they all appear to have the same amount of brightness, despite being different light years away from Earth. *Teacher will include this information after the students have discovered this information through their research.

Vocabulary: Apparent Brightness, true brightness, luminosity

Assessment

Formative: N/A
Summative: Constructed Explanations with evidence (Can be taken as a written or speaking and listening grade)

Elaborate Materials Needed and Website/Other Resources:

Orion Image
Sun Image
ipads, computers, chrome books or other devices to use for research

EVALUATE:

Let the students know that they will be able to apply and extend upon what they have learned about the brightness of stars in correlation with their distance from Earth. Pass out the Constellation Creation page and let them know that they will be creating their own constellations, but in addition to creating and writing about their new constellation, they will also need to discuss/share information about the star sizes that are included within their new constellations. This can either be done to expand their knowledge about what

they have been focusing on or to also include new information pertaining to the stars relations in the sky as well. Students will need to be sure to include proper vocabulary and cite evidence in the knowledge portion of the writing.
Assessment **Formative:** **N/A** **Summative:** **Constellation Creation Paper**
Evaluate Materials Needed and Website/Other Resources: **Constellation Creation Paper** **Pencil**
Comments/Teacher Tips: