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Solar Eclipse Implementation Sequence		
Phenomenon: Solar Eclipse **Grade Level:** 6-8	**Guiding Question:** Why are Solar Eclipses significant?	**Contact:** Reach out to the My NASA Data Team if you have questions.
Further Investigation: My NASA Data Solar Eclipse main website and the My NASA Data main website		
Revision Date: 2-16-2024		
Note to Teachers: The Solar Eclipse Implementation Sequence provides a series of lesson plans for students to learn about solar eclipses.		

Standards - These standards are supported by the activities in this guide but not completely covered.

Performance Expectations:

- MS-ESS1-1 Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
- MS-ESS1-2 Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
- MS-ESS1-3 Analyze and interpret data to determine scale properties of objects in the solar system.

Science and Engineering Practices:	Crosscutting Concepts:	Disciplinary Core Ideas:
• Developing and Using Models • Analyzing and Interpreting Data • Engaging in Argument from Evidence	• Patterns • Scale, Proportion, and Quantity • Systems and System Models	• *Note: DCIs are aligned to each activity below.*

My NASA Data Instructional Sequence: Solar Eclipse

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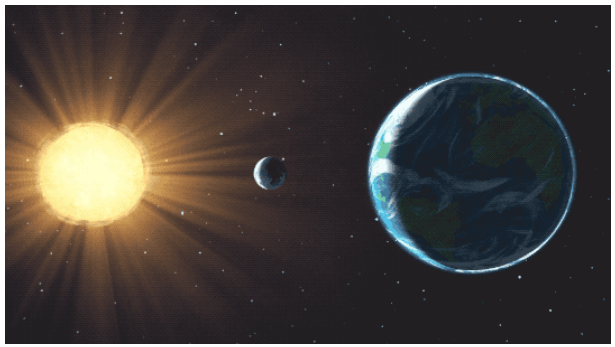
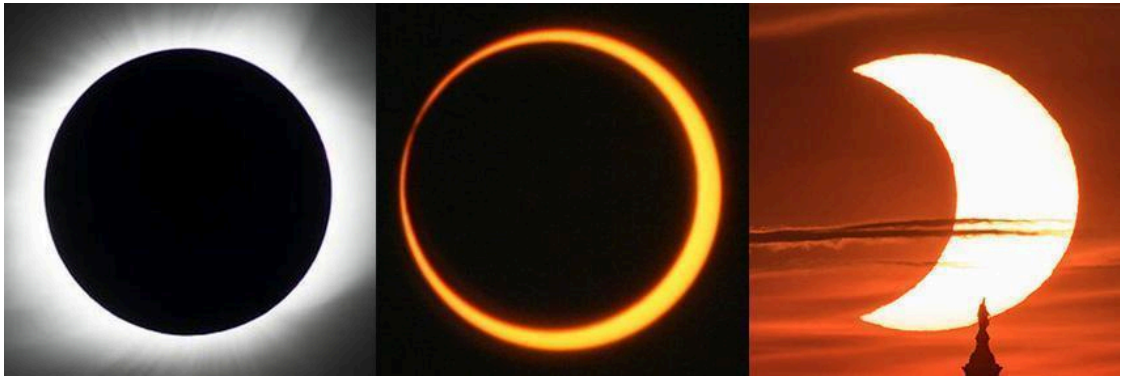
Background Information and NASA Connection



A solar eclipse occurs in the New Moon phase when the moon blocks part or all of the Sun.
Animation: Solar System Exploration:Eclipses

Solar eclipses occur during a New Moon when the Moon is in between the Sun and the Earth, casting its shadow on the Earth. The plane of the Moon's orbit is slightly different from Earth's orbit around the Sun which is why solar eclipses do not happen every time there is a New Moon. The Moon's orbit is also elliptical. When the Moon is near its farthest distance from Earth, it appears small and does not completely cover the Sun. These eclipses are called **annular eclipses** in reference to the mathematics term annulus which is the space between two concentric circles. **Total eclipses** occur when the Moon is at or near its closest point to Earth. You must wear solar eclipse glasses while observing the eclipse; however, when you can no longer see the sun, it is safe to briefly take off your solar eclipse glasses to see totality. This is when the Moon fully blocks the Sun and the **corona** can safely be observed with the naked eye. The corona, the outermost layer of the Sun's atmosphere, is of particular interest to NASA because a constant stream of particles called **solar wind** flow from the Sun, through the corona and into our solar system where they can interfere with technology in space and on Earth.



Total Eclipse Annular Eclipse Partial Eclipse

While the topic of solar eclipses ties together all of the resources in this implementation sequence, there is a wide range of content addressed in these lessons ranging from the life cycle of stars to solar weather. Below you will find a suggested pacing guide; however, there are many possibilities for the order of these lessons. Choose one or several resources to incorporate into your curriculum!

My NASA Data Instructional Sequence: Solar Eclipse

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Day 1			
Time	**NGSS Disciplinary Core Ideas**	**Learning Objective**	**Activity / Assessment**
30 min	**ESS1.A: The Universe and Its Stars** Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1) **ESS1.B: Earth and the Solar System** This model of the solar system can explain eclipses of the sun and the moon. (MS-ESS1-1) *Note: This DCI continues but does not include content relevant to this mini lesson.*	I can construct an explanation of what a solar eclipse is supported by evidence. 	**Mini Lesson:** **What is a Solar Eclipse?** Students will make observations about the objects, size, distance, and motion of the Sun, Earth, and Moon during a solar eclipse.
Day 2			
Time	**NGSS Disciplinary Core Idea**	**Learning Objective**	**Activity / Assessment**

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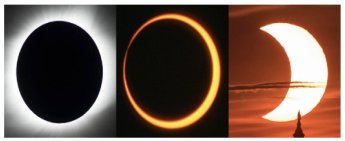
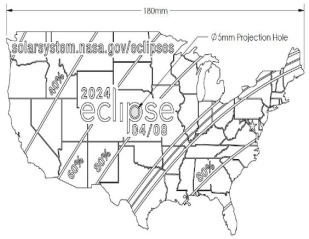
50 min	**ESS1.A: The Universe and Its Stars** Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)	I can calculate the size to distance ratio of the Sun and the Moon from Earth to determine how a solar eclipse can occur. 	**Lesson Plan: What are the Different Types of Solar Eclipses?** In this lesson students will calculate the size to distance ratio of the Sun and the Moon from Earth to determine how a solar eclipse can occur.
Day 3			
Time	**NGSS Disciplinary Core Idea**	**Learning Objective**	**Activity / Assessment**
50 min	**ESS1.A: The Universe and Its Stars** Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)	I can build and use a pinhole projector to make observations of the Sun. 	**Interactive Model**: Safely Observing the Sun Students will explore safe methods for viewing the Sun at home or in the classroom, including using solar eclipse glasses and a pinhole projector.

My NASA Data Instructional Sequence: Solar Eclipse

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Days 4 and 5			
Time	**NGSS Disciplinary Core Idea**	**Learning Target**	**Activity / Assessment**
90 min	**ESS1.B: Earth and the Solar System** This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1)	I can analyze space weather data. I can use data to recognize different features of the Sun. 	**Lesson Plan (Day 4 and 5): What Do Scientists Learn About the Universe from Observing Solar Eclipses?** In this activity, students will compare the methods scientists use to study the Sun, including drawings made during a total solar eclipse in the 1860's, modern coronagraphs, and advanced imagery gathered by NASA's Solar Dynamics Observatory.

Additional Resources (Page 1 of 7)			
Time	**NGSS Disciplinary Core Idea**	**Learning Target**	**Activity / Assessment**
30 min	**ESS1.A: The Universe and Its Stars** Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)	I can analyze a visualization that shows how the Moon's shadow during the 2017 solar eclipse affected temperature.	**Mini Lesson: How Does a Solar Eclipse Affect Air Temperature?** Students will examine air temperature data collected through The GLOBE Program during the 2017 US solar eclipse.
30 min	**ESS1.A: The Universe and Its Stars** Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)	I can create a model of a solar eclipse and a lunar eclipse.	**Mini Lesson: What is the Difference between a Solar Eclipse and a Lunar Eclipse?** In this activity students will examine NASA data to determine the differences between a solar and lunar eclipse.

My NASA Data Instructional Sequence: Solar Eclipse

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Additional Resources (Page 2 of 7)			
Time	**NGSS Disciplinary Core Idea**	**Learning Target**	**Activity / Assessment**
30 min	**ESS1.B: Earth and the Solar System** This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1)	I can analyze a projected map of the April 8, 2024 total solar eclipse across the US and a data table of the locations where people will experience it.	**Mini Lesson:** **How Will Different Locations in the US Experience the 2024 Solar Eclipse?** Students will analyze a projected map of the April 8, 2024 total solar eclipse across the US, with an accompanying data table of the locations and times, to explain how people in different locations experience a solar eclipse.
30 min	**ESS1.B: Earth and the Solar System** This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1)	I can predict what I may see during the April 8, 2024 total solar eclipse.	**Mini Lesson:** **What is the Sun's Corona?** In this activity students will compare different methods for observing the Sun's corona and make predictions about what they will observe during the April 8, 2024 total solar eclipse.

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Additional Resources (Page 3 of 7)			
Time	**NGSS Disciplinary Core Idea**	**Learning Target**	**Activity / Assessment**
30 min	**ESS1.B**: **Earth and the Solar System.** This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1)	I can model the relationship between the Sun, moon and Earth during a solar eclipse.	**Interactive: Explore Solar Eclipses** In this activity students will make observations about the objects, size, distance, and motion of the Sun, Earth, and Moon during a solar eclipse and manipulate slides to show the relationships.
>90 min	**ESS1.A: The Universe and Its Stars** Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2)	I can compare our solar system with another system in the Milky Way Galaxy.	**Story Map: Learning from Stars and Solar Eclipses Story Map** In this story map lesson students will learn how living with a star can teach us about our universe. Through a series of learning activities, students will examine the benefits and hazards of living with a star, describe and/or demonstrate how we use eclipses to study the Sun and its features, and investigate how our Sun may be used to learn about other stars and our universe.

My NASA Data Instructional Sequence: Solar Eclipse

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Additional Resources (Page 4 of 7)			
Time	**NGSS Disciplinary Core Idea**	**Learning Target**	**Activity / Assessment**
50 min	**ESS1.B**: **Earth and the Solar System.** This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1)	I can identify what scientists learn about the Sun from viewing a total solar eclipse.	**Interactive:** **Observing the Sun During a Total Solar Eclipse** This interactive takes students through the basic mechanics of a solar eclipse, using a NASA Space Place Handout, including an optional eclipse art activity.
30 min	**ESS1.B**: **Earth and the Solar System.** This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1)	I can model the relationship between the Sun, moon and Earth during a solar eclipse.	**Interactive:** **Calculating Ratios of an Eclipse** In this activity students will calculate the ratio of the size of the sun to the moon and the distance of the sun and moon from Earth to determine the type of solar eclipse possible.
>90 min	**PS2.B: Types of Interactions** Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5)	I can identify the causes and hazards of space weather.	**Interactive:** **What is Space Weather?** In this interactive, students will learn the basics of space weather by engaging in a short interactive which introduces key terms: space weather, sunspot, solar flare, coronal mass ejection, and solar wind. Students will be able to identify the causes and hazards of space weather.

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Additional Resources (Page 5 of 7)			
Time	**NGSS Disciplinary Core Idea**	**Learning Target**	**Activity / Assessment**
50 min	**ESS2.A: Earth's Materials and Systems** All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1)	I can identify the key elements in my body that are also created in stars.	**Interactive:** **What Elements are in Your Body?** This interactive guides students through exploring how stars create the elements that make up the universe and life itself. Students will be able to identify the key elements in their bodies that were created from exploding stars.
50 min	**ESS1.B: Earth and the Solar System** This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1)	I can interpret a model to determine why we see different types of solar eclipses.	**Lesson Plan:** **Modeling Solar Eclipse Geometry** In this activity, students will model the geometry of solar eclipses by plotting a few points on a piece of graph paper, and using quarters and a nickel to represent the Sun and Moon (not to scale). The goal for this activity is to visually show how the Sun and Moon move near the eclipse season and how the timing of their arrival determines whether you have a total eclipse, a partial solar eclipse, or no eclipse at all. Learners will create a graph for all three.
50 min	**ESS1.A: The Universe and Its Stars** Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.(MS-ESS1-1)	I can identify and practice safe methods for viewing the Sun	**Lesson Plan:** **Solar Eclipse Safety Activity** This hands-on activity is the construction of an extended coverage area of eclipse glasses to provide extra protection for safely viewing a solar eclipse. This makes it harder to look outside the lenses on the eclipse glasses.

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Additional Resources (Page 6 of 7)			
Time	**NGSS Disciplinary Core Idea**	**Learning Target**	**Activity / Assessment**
50 min	**ESS1.B: Earth and the Solar System** The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)	I can model the tilt of the Earth-Moon orbital plane	**Lesson Plan:** Modeling Sun-Moon Positions for Solar Eclipses In this activity, students will model the geometry of solar eclipses using quarters to represent the Sun and Moon (not to scale). The goal for this activity is to visually show how the Sun and Moon move near the eclipse season and how the timing of their arrival determines whether you have a total eclipse, a partial solar eclipse, or no eclipse at all.
90 min	**ESS1.B: Earth and the Solar System** This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1)	I can safely observe a solar eclipse.	**Lesson Plan:** How to Safely Observe a Solar Eclipse In this activity students will learn several ways to safely observe a solar eclipse.

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Additional Resources (Page 7 of 7)			
Time	**NGSS Disciplinary Core Idea**	**Learning Target**	**Activity / Assessment**
90 min	**ESS1.B: Earth and the Solar System** The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS-ESS1-3)	I can analyze solar eclipse data in order to prove why we don't have solar eclipses every month.	**Lesson Plan: Why Don't We Have Solar Eclipses Every Month?** In this activity, students will analyze past and future eclipse data and orbital models to determine why we don't experience eclipses every month.***Note:*** *Step VI of this lesson plan is the same as the Modeling Solar Eclipse Geometry lesson below.*

Image Credit from *NASA* Types of Solar Eclipses