### Desired Results

<table>
<thead>
<tr>
<th>BVSD Standard(s)/Grade Level Expectations</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Fourth Grade Science</td>
<td></td>
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<tr>
<td><strong>GLE3.1.</strong> Earth is part of the Solar System, which includes the Sun, Moon, and other bodies that orbit the Sun in predictable patterns that lead to observable paths of objects in the sky as seen from Earth.</td>
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<tr>
<td>Fourth Grade Language Arts</td>
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<tr>
<td><strong>GLE2.2.</strong> Use a range of strategies efficiently to construct meaning while reading informational texts.</td>
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<tr>
<td><strong>GLE3.2.</strong> Use the recursive writing process to create informative/explanatory and opinion pieces for a variety of audiences and purposes.</td>
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### Unit Essential Questions

1. What are the patterns of movement for the Sun and Moon across the sky as observed from Earth?
2. How does Earth compare to other objects orbiting the Sun?
3. How do we study the Solar System? (i.e. models, photographs, space observation from earth, etc.)

### Students will know...

| a) The Sun rises in the east and sets in the west |  |
| b) Shadows form when sunshine is blocked by a solid object |  |
| c) Day and night on Earth result from Earth’s rotation on its axis |  |
| d) The tilt of the Earth on its axis causes the seasons |  |
| e) Gravity is the force that holds the parts of the Solar System together |  |

### Students will be able to...

| a) Gather, analyze, and interpret data about components of the Solar System. |  |
| b) Utilize direct and indirect evidence to investigate the components of the Solar System. |  |
| c) Gather, analyze, and interpret data about Sunrise and Sunset, and Moon movements and phases. |  |
| d) Develop and write a scientific explanation regarding relationships of the components of the solar system. |  |
| e) Select appropriate tools to conduct an experiment, use them correctly, and report the data in proper units. |  |
| f) Share results of experiments with others and respectfully discuss results that are not expected. |  |
| g) Express questions, predictions, data, claims and evidence using complete sentences in a science notebook. |  |
| h) Conduct investigations safely in the classroom. |  |
| i) Understand that models are developed to explain and predict natural phenomena that cannot be directly observed because they happen over long periods of time. |  |
# Academic Vocabulary

## Investigation 1

<table>
<thead>
<tr>
<th>Area</th>
<th>Axis</th>
<th>Cardinal Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compass</td>
<td>Day</td>
<td>Globe</td>
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<tr>
<td>Horizon</td>
<td>Model</td>
<td>Night</td>
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<tr>
<td>Orbit</td>
<td>Rises</td>
<td>Rotate</td>
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<tr>
<td>Season</td>
<td>Sets</td>
<td>Shadow</td>
</tr>
<tr>
<td>Sun</td>
<td>Sunrise</td>
<td>Sunset</td>
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</tbody>
</table>

## Investigation 2

<table>
<thead>
<tr>
<th>Crescent Moon</th>
<th>First quarter Moon</th>
<th>Gibbous Moon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lunar cycle</td>
<td>Moon</td>
<td>New Moon</td>
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<tr>
<td>Orbit</td>
<td>Phase</td>
<td>Sliver</td>
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<tr>
<td>Star</td>
<td>Third quarter Moon</td>
<td>Waning</td>
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<tr>
<td>Waxing</td>
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</tbody>
</table>

## Investigation 2

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Gravity</th>
<th>Solar System</th>
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<tbody>
<tr>
<td>Assessment Evidence</td>
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<tr>
<td>Pre/post assessment</td>
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<tr>
<td>Science notebook entries</td>
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<tr>
<td>Informal observation and discussion</td>
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<thead>
<tr>
<th>Materials and Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Materials</strong></td>
</tr>
<tr>
<td>• Science notebooks for students</td>
</tr>
<tr>
<td>• Document Camera (optional)</td>
</tr>
<tr>
<td>• <em>FOSS Sun, Moon and Planets</em> kit</td>
</tr>
<tr>
<td>• Additional informational texts related to the Solar System</td>
</tr>
<tr>
<td><strong>FOSS Sun: Investigation 1 - 2 WEEKS</strong></td>
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<tr>
<td>----------------------------------------</td>
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<tr>
<td><strong>Session</strong></td>
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</tbody>
</table>
| 5 | Use Compass Outdoors  
• Find cardinal directions and mark on the pavement  
• Students identify direction of Sunrise and Sunset  
• Complete “Where’s the Sun” sheets  
• Complete part of Evidence Graphic Organizer | Students will gather and record data about the position of the Sun over the course of a day  
• Students will predict the position of the Sun based on their understanding of the Sun’s movement  
• Students will utilize direct and indirect evidence to investigate the components of the Solar System | Record data using a drawing and by writing the time of the observation  
• Point to cardinal directions when asked  
• Use a graphic organizer to record evidence |
|---|---|---|
| 6 | Discussion and Reflection  
• Class discussion about data  
• Students write in their notebooks  
• Add words to glossary | Students will analyze data about the position of the Sun over the course of a day  
• Students will describe the pattern of movement for the Sun across the sky as observed from Earth | Participate in a class discussion about observations  
• Write a description of how the Sun appears to move across the sky, using a sentence frame if needed |
| 7 | Sunrise, Sunset  
• Read “Sunrise and Sunset”  
• Add words to glossary | Students will describe the pattern of movement of the Sun across the sky as observed from Earth | Read informational text with a partner  
• Identify useful information in the text  
• Participate in a modeled writing lesson |
| 8 | Shadow Tracking - outdoors  
• Introduce shadows  
• Practice making shadows  
• Collect data on shadows outside  
• Make predictions about how shadows will change  
• Collect data on shadows again  
• Complete shadow reflection | Students will predict the patterns of movement of shadows based on their understanding of the Sun’s path across the sky as seen from Earth | Collect data using pictures and by writing the time  
• Complete a brief written reflection |
<table>
<thead>
<tr>
<th>Page</th>
<th>Activity</th>
<th>Student Outcomes</th>
<th>Teacher Activities</th>
</tr>
</thead>
</table>
| 9 | Writing a Scientific Explanation  
- Develop a claim about the movement of the Sun  
- Identify evidence from previous sessions that supports the claim  
- Complete a graphic organizer with evidence  
- Teacher models writing a paragraph based on the graphic organizer |  
- Students will describe the pattern of movement for the Sun across the sky as observed from Earth  
- Students will develop a scientific explanation regarding relationships of the components of the Solar System (Earth and Sun) |  
- Use a graphic organizer to write a claim and supporting evidence.  
- Listen and watch a writing demonstration of how to write a paragraph |
| 10 | Shadow Tracking With a Model  
- Discuss how the globe is a model  
- Demonstrate the movement of a shadow using the globe  
- Discuss that the reason shadows move and the Sun appears to move across the sky is because of the Earth's rotation on its axis.  
- Complete Outdoor Shadows reflection |  
- Students will explain that day and night on Earth results from Earth’s rotation on its axis |  
- Participate in discussion with a partner about using a globe as a model  
- Complete a written science notebook entry about shadows, with appropriate scaffolding as necessary |
| 11 | Reading and Writing About Shadows  
- Read *My Shadow Poem*  
- Share connections  
- Read *Changing Shadows* |  
- Students will explain that day and night on Earth results from Earth’s rotation on its axis  
- Students will describe the pattern of movement for the Sun across the sky as observed from Earth  
- Students will develop a scientific explanation regarding relationships of the components of the Solar System (Earth and Sun) |  
- Students make text-to-self connections  
- Complete a written explanation of what causes shadows to move throughout the day |
| 12 | Orbit and Rotate  
• Students act-out orbiting and rotating  
• Add rotate and orbit to glossary  
• Complete rotate and orbit student sheet  | Students will explain that day and night on Earth results from Earth’s rotation on its axis  | Recognize the words rotate and orbit and demonstrate their meaning with movement  
• Complete a reflection with drawings and by completing a sentence frame |
|---|---|---|
| 13 | What causes the seasons?  
• Watch video of the seasons  
• Model tilt of the Earth’s axis  
• Watch second part of video  
• Compare and contrast seasons  | Students will understand that the tilt of the Earth’s axis causes the seasons  
• Students will use a model to understand a scientific concept  
• Students will compare and contrast the tilt of the Earth’s axis during the winter and summer months  | Develop a focus question using sentence frames  
• Discuss observations with a partner  
• Follow directions for a procedure |
| 14 | Revisit KWL | | |
FOSS Sun, Moon, and Planets
Investigation 1: The Sun

Session 1: Set-up Pre Assessment and Introduction [30 minutes]

• Students will complete a pre-assessment.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and staple</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Unit Pre/Post Assessment Moon Calendar</td>
<td>Pencil</td>
</tr>
</tbody>
</table>

1. Pre-assessment of entire unit
   While students are seated at their desks, tell them that they will be beginning a new unit. Let them know that the same assessment will be given at the end of the unit in order to see how much they learned. Pass out the pre-assessment and make sure that student names are on the papers. Place the assessment under document camera. Read out loud all instructions and questions to the students. Tell students, **Remember, it's okay if you don't know what some of the words mean or the answers. I just want to see what you know already about the Sun, Moon and planets. As you fill out the assessment, please raise your hand for clarification of words or instructions. I can read the text to you, but I cannot give you any answers.**

2. Homework: Observe sky and record observations
   Most fourth graders have a planner or calendar that they use to record their assignments. In this planner students should record what they observe about the Moon by drawing a picture and noting the time and location. This can be done on the daily assignment pages or use the provided Moon Calendar or you can print the blank Moon calendar from the website. [http://sciencenetlinks.com/interactives/moon/moon_worksheet/moon_worksheet.htm](http://sciencenetlinks.com/interactives/moon/moon_worksheet/moon_worksheet.htm). Demonstrate how to draw the moon by drawing a circle, shading the area of the circle that you do not see. Demonstrate how to record the time and location.

Example:

8 pm in my front yard.
Pre/Post Assessment

Sun Moon Planets

Name: __________________________

1. What star is closest to Earth? ________________________________

2. What is the name of the satellite that orbits the Earth? 
   
   Circle the one best answer
   
   a. Mercury
   
   b. Mars
   
   c. Moon

3. Which of the following objects can be seen in the night sky? 
   
   Mark all the correct answers
   
   _____ a new Moon
   
   _____ stars
   
   _____ a crescent Moon
   
   _____ Venus
   
   _____ Saturn
   
   _____ the Sun
4. Which items are not in our Solar System
   *Mark all the correct answers*

   ____ Sun    ____ Stars    ____ Mars    ____ Moon    ____ Meteor
   ____ Black hole    ____ Galaxy

5. Mark the names of Planets
   *Mark all the correct answers*

   ____ Chicago    ____ Jupiter    ____ Mars    ____ Sun
   ____ Saturn    ____ Venus    ____ Earth

6. What instrument makes faraway objects seem closer?
   *Circle the one best answer*

   a. Microscope
   b. Telescope
   c. Periscope

7. What is a model?
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
8. What are some ways our Solar System is studied?
   a. Satellites gather data
   b. Observation and recording of information over time
   c. Photographs from outer space
   d. Missions into outer space
   e. Models
   f. All of the above
   g. No one of the above

9. An example of **indirect** evidence is
   _____ Reading a book
   _____ Watching a video
   _____ Observing the moon
   _____ Drawing your shadow
   _____ Reading the internet
   _____ Going on a space expedition

10. In what direction did the Sun rise this morning? ______________________

11. In what direction will the Sun set this evening? ______________________

12. Does the Sun rise and set in the same direction each day? ______________
13. Where is the Sun at noon?
   a. At the horizon
   b. At the equator
   c. At its highest point in the sky

14. How does the Sun appear to travel across the sky during the day?

   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

15. Why does the Sun appear to travel across the sky during the day?

   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

16. What information can a shadow give you?
   Mark all the correct answers
   
   _____ the position of the sun
   _____ the time of day
   _____ how tall you are
   _____ where east and west are
17. Look at the picture below.
   Draw an outline of the student’s shadow.

   Why did you draw the shadow where you did?

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

18. What is a shadow?

   ____________________________________________________________
   ____________________________________________________________
What do you need to have a shadow?

____________________________________________________________________

____________________________________________________________________

19. How could you tell the approximate time if you didn’t have a watch, but had a compass and you were outside on a sunny day?

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

20. Where will your shadow be if the Sun is behind you?

Circle the one best answer

a. in front of you
b. behind you
c. beside you

21. Why do the shape and direction of your shadow change during the day?

Circle the one best answer

a. The Sun’s position changes during the day.
b. The shadows can show the time of day.
c. The Sun rises at different times each day.
22. What direction do shadows always point?
   *Circle the one best answer*
   
   a. Toward the Sun  
   b. Away from the Sun  
   c. To the left

23. Which of the following Moon drawings is a crescent moon?

   ![Moon Drawings](image)

   a.  
   b.  
   c.  

24. What times might you be able to see the Moon in the sky?
   *Mark all the correct answers*
   
   ____ at night  
   ____ during a new moon  
   ____ early in the morning  
   ____ just before sunset  
   ____ just after sunrise

25. How many weeks are between full moons?
   *Circle the one best answer*
   
   a. one week  
   b. two weeks  
   c. four weeks
26. How long does it take for the Moon to orbit Earth?
   Circle the one best answer
   a. one week
   b. one month
   c. one year

27. Why does the shape of the Moon appear to change each night?
   Circle the one best answer
   a. The Moon revolves around Earth.
   b. The Earth revolves around the Moon.
   c. The Earth rotates on its axis.

28. Why does the Moon appear to move across the sky each night?
   Circle the one best answer
   a. The Moon revolves around Earth.
   b. The Earth revolves around the Moon
   c. The Earth rotates on its axis

29. Why does the Moon look a little bit different every night?

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
30. Why does the Moon look like it shines?

_____________________________________________________________

_____________________________________________________________

_____________________________________________________________

31. What causes the seasons on Earth?

_____________________________________________________________

_____________________________________________________________

_____________________________________________________________

32. When will your shadow be the longest?
   Circle the one best answer
   a. noon in winter
   b. sunrise in winter
   c. noon in summer

33. When will your shadow be the shortest?
   Circle the one best answer
   a. noon in winter
   b. sunrise in winter
   c. noon in summer
34. How does flagpole’s shadow change over a year?

_____________________________________________________________

_____________________________________________________________

_____________________________________________________________

35. Why do shadows change over a year?

_____________________________________________________________

_____________________________________________________________

_____________________________________________________________

36. What affects the length of a flagpole’s shadow?
   Mark all the correct answers
   
   _____ the time of day
   _____ the temperature
   _____ the season
   _____ the height of the flagpole
   _____ the distance from the Sun
37. In the morning, you are facing west. Where will your shadow be?

*Circle the one best answer*

a. pointing east  
b. behind you  
c. in front of you

38. What causes day and night on Earth?

a. Earth rotates on its axis.  
b. Earth revolves around the Sun.  
c. The Moon revolves around Earth.

39. What is gravity?

_____________________________________________________________

_____________________________________________________________

_____________________________________________________________

40. What is an everyday word for orbit? ____________

41. What causes day and night?

_____________________________________________________________

_____________________________________________________________
42. What is an everyday word for rotate? ____________________

43. Draw a diagram showing how a moon moves in relationship to a planet.

44. What is this movement called? _________________________

45. Draw a diagram showing how planets move in our Solar System.
1. What star is closest to Earth? The Sun

2. What is the name of the satellite that orbits the Earth?
   Circle the one best answer
   a. Mercury
   b. Mars
   c. Moon

3. Which of the following objects can be seen in the night sky?
   Mark all the correct answers
   ____ a new Moon
   ____ stars
   ____ a crescent Moon
   ____ Venus
   ____ Saturn
   ____ the Sun

4. Which items are not in our Solar System
   Mark all the correct answers
   ____ Sun
   ____ Stars
   ____ Mars
   ____ Moon
   ____ Meteor
   ____ Black hole
   ____ Galaxy
5. Mark the names of Planets  
*Mark all the correct answers*

- Chicago
- x Jupiter
- x Mars
- Sun
- x Saturn
- x Venus
- x Earth

6. What instrument makes faraway objects seem closer?  
*Circle the one best answer*

a. Microscope
b. Telescope
c. Periscope

7. What is a model?  

* A representation of something that is too big. A way to represent a concept.*

8. What are some ways our solar system is studied?  

a. Satellites gather data
b. Observation and recording of information over time
c. Photographs from outer space
d. Missions into outer space
e. Models
f. All of the above
g. None of the above
9. An example of **indirect** evidence is

- Reading a book
- Watching a video
- Observing the moon
- Drawing your shadow
- Reading the internet
- Going on a space expedition

10. In what direction did the Sun rise this morning? **East**

11. In what direction will the Sun set this evening? **West**

12. Does the Sun rise and set in the same direction each day? **Yes**

13. Where is the Sun at noon?
   a. At the horizon
   b. At the equator
   c. At its highest point in the sky

14. How does the Sun appear to travel across the sky during the day?
    
    The Sun moves from east to west each day.

15. Why does the Sun appear to travel across the sky during the day?
    
    The Sun is in one place, and the Earth is rotating to the east on its axis.
16. What information can a shadow give you?
   *Mark all the correct answers*
   - [x] the position of the sun
   - [x] the time of day
   - [____] how tall you are
   - [____] where east and west are

17. Look at the picture below.
   Draw an outline of the student’s shadow.

   Why did you draw the shadow where you did?
   *Shadows are always on the opposite side from the Sun.*

18. What is a shadow?
   *A shadow is a dark area where an object has blocked the light.*

19. What do you need to have a shadow?
   *A light source and an object to block the light.*
20. How could you tell the approximate time if you didn’t have a watch, but had a compass and you were outside on a sunny day?

Use the compass to find out east and west. In the morning your shadow will point west and in the afternoon it will point east. If your shadow is long, it is near sunrise or sunset and if it is short it is noon.

21. Where will your shadow be if the Sun is behind you?
Circle the one best answer

a. in front of you
b. behind you
c. beside you

22. Why do the shape and direction of your shadow change during the day?
Circle the one best answer

a. The Sun’s position changes during the day.
b. The shadows can show the time of day.
c. The Sun rises at different times each day.

23. What direction do shadows always point?
Circle the one best answer

a. Toward the Sun
b. Away from the Sun
c. To the left
24. Which of the following Moon drawings is a crescent moon?

\[ \text{Diagram: a, b, c} \]

25. What times might you be able to see the Moon in the sky?  
Mark all the correct answers

\[ x \text{ at night} \]
\[ \_ \_ \text{ during a new moon} \]
\[ x \text{ early in the morning} \]
\[ x \text{ just before sunset} \]
\[ x \text{ just after sunrise} \]

26. How many weeks are between full moons?  
Circle the one best answer

a. one week
b. two weeks
c. four weeks

27. How long does it take for the Moon to orbit Earth?  
Circle the one best answer

a. one week
b. one month
c. one year
28. Why does the shape of the Moon appear to change each night?
   *Circle the one best answer*
   
a. The Moon revolves around Earth.
b. The Earth revolves around the Moon.
c. The Earth rotates on its axis.

29. Why does the Moon appear to move across the sky each night?
   *Circle the one best answer*
   
a. The Moon revolves around Earth.
b. The Earth revolves around the Moon
   c. The Earth rotates on its axis

30. Why does the Moon look a little bit different every night?
   
   As the Moon revolves around Earth, we see a different part of the lighted side.

31. Why does the Moon look like it shines?
   
   The light from the Sun shines on the Moon, and the sunlight reflects back to us.

32. What causes the seasons on Earth?
   
   The tilt of the Earth causes the seasons.

33. When will your shadow be the longest?
   *Circle the one best answer*
   
a. noon in winter
b. sunrise in winter
c. noon in summer
34. When will your shadow be the shortest?
   
   *Circle the one best answer*

   a. noon in winter  
   b. sunrise in winter  
   c. noon in summer

35. How does a flagpole’s shadow change over a year?

   *In the summer the shadows are shorter, and in the winter the shadows are longer.*

36. Why do shadows change over a year?

   *In the summer the Sun is higher in the sky, and in the winter the Sun is lower in the sky.*

37. What affects the length of a flagpole’s shadow?

   *Mark all the correct answers*

   ___ the time of day  
   ___ the temperature  
   ___ the season  
   ___ the height of the flagpole  
   ___ the distance from the Sun

38. In the morning, you are facing west. Where will your shadow be?

   *Circle the one best answer*

   a. pointing east  
   b. behind you  
   c. in front of you
39. What causes day and night on Earth?
   a. Earth rotates on its axis.
   b. Earth revolves around the Sun.
   c. The Moon revolves around Earth.

40. What is gravity?
   The force that holds the parts of the Solar System together.

41. What is an everyday word for orbit? — go around something

42. What causes day and night? The rotation of the Earth?

43. What is an everyday word for rotate? — spin

44. Draw a diagram showing how a moon moves in relationship to a planet.
   ![Diagram](image)

45. What is this movement called? orbit
46. Draw a diagram showing how planets move in our Solar System.
Session 2: Pre Assessment and Day Observations [20 minutes]

- Students will be able to identify observable objects in the sky – Sun, Moon, stars.
- Students will be able to conduct investigations safely in the classroom and outside.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Sun Pre/Post</td>
<td>Pencil</td>
</tr>
<tr>
<td>Internet</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Pre-assessment **OPTIONAL**
   While students are seated at their desks, tell them that they will be beginning a new investigation about the Sun. Let students know they will be taking another assessment that specifically focuses on the Sun. This assessment will be identical to the assessment at the end of the investigation in order to see how much they learned. Pass out the pre-assessment and make sure that student names are on the papers. Place the assessment under the document camera and read out loud all the instructions and questions to the students.

   *Remember, it’s okay if you don’t know what some of the words mean or the answers. I just want to see what you know already about the Sun. As you fill out the assessment, please raise your hand for clarification of words or instructions. I can read the text to you, but I cannot give you any answers.*

2. Introduction to vocabulary
   After students are finished with the pre-assessment, ask students to identify new vocabulary or academic vocabulary (words scientists use) found in the assessment. Add the words to the word wall that is posted in the classroom but do not provide the definitions yet.

3. Review “Safety in the Classroom”
   Students should never look directly at the Sun, as it will damage their eyes. View [http://www.astrocappella.com/](http://www.astrocappella.com/), a song from NASA about the Sun that provides a good overview of information about the Sun and warnings about looking at the Sun. See the FOSS Teacher Guide Page 24 for more information.

4. Day sky observations
   Take your students outside and investigate what is visible in the sky. Make some initial observations that you see, and then ask your students what they see around them. Students will often suggest the Sun, birds, clouds, airplanes, etc. Some will suggest things like trees. Ask the class what kinds of things could qualify as being “in the sky.” For example, if it is touching the ground, it should not qualify.
Session 3: Set-up Science Notebook [30-35 minutes]

- Students will be able to recognize and understand academic vocabulary by developing a glossary in their notebook.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pen/Marker</td>
<td>Glossary*</td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Document camera/LCD projector</td>
<td></td>
<td>Glue</td>
</tr>
<tr>
<td>Chart paper</td>
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<td>Pencil</td>
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</tbody>
</table>

*Frayer Model Glossary sheets are provided for students that need extra literacy support.

1. Set up science notebooks
   Tell students, *All scientists record their thinking, observations and data in order to share with other people.* Use an example teacher science notebook to model putting your name on the outside of the notebook. Model for students how to create a title page. Tell students, *The first page in our science notebook is going to be the title page.* *I’m going to title my notebook “Sun, Moon and Planets”. You can give your notebook a different title if you’d like. Under the title, I’m going to write my name to show that I’m the author. Under my name, I’m going to draw a picture that represents my title.*

   ![Sun, Moon and Planets](image)

Number the pages at the bottom and explain the use of a table of contents. Model for students how to write “Table of Contents” at the top of the first or second page of the science notebook. Show students how to make an entry in the table of contents with the corresponding page number. The first entry will be the Glossary, which will start on the last page of the notebook.

<table>
<thead>
<tr>
<th>Table of Contents</th>
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</thead>
<tbody>
<tr>
<td>Glossary</td>
</tr>
<tr>
<td>Title Page</td>
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<tr>
<td>Table of Contents</td>
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<tr>
<td>Investigation 1 – The Sun</td>
</tr>
<tr>
<td>What I Already Know About the Sun</td>
</tr>
<tr>
<td>Questions I have about the Sun</td>
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<tr>
<td>Compass</td>
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</table>
Turn your notebook upside down so that you can still read it from left to right. Write in the page numbers starting from this back page towards the “front,” and after every page number, put the letter G for Glossary. This allows students to continue to add new vocabulary as the investigation proceeds, but does not interfere with their other work (and helps distinguish glossary pages from work pages). If the pages are all numbered, they would end up with numbers at the top going backwards (with G) and numbers at the bottom going forwards. Ask students why it would be important to have a glossary. Explain that we want to keep track of new words just like on the word wall in case we forget. Each time that students update their science notebooks, you should update the teacher science notebook as a model for them to follow. You may also have your students use the provided Glossary* student sheets. This link http://www.nasa.gov/audience/forstudents/k-4/dictionary/Gravity.html shows NASA glossary using the same format as your glossary in your notebook.

2. KWL: The Sun

Use your example science notebook under the document camera or use chart paper to create a KWL chart. Let's make a class KWL chart about the Sun in our science notebooks. Please put the title Sun KWL Chart at the top of the page. Remember to add this to your table of contents with the corresponding page number. Model writing “Sun KWL Chart” at the top of the next available page and also write it in the table of contents in your example science notebook and add the corresponding page number.

Model writing and have the students write “K: What I Already Know About the Sun” at the top of their page and list what they already know. Have students share out what they know and write their ideas on the class chart below “K: What I Already Know About the Sun”. Students may or may not add all of the ideas to their list after hearing other students’ ideas. (The goal is to have students feel safe sharing their ideas freely, so adding comments like “We’ll be learning about that, that is discovered during this unit, we’ll find out more about that, etc. are encouraged if the teacher feels s/he needs to comment.) See example below.

Investigation Two: Sun

K: What I Already Know About the Sun

Next, have students write “W: What I Want to Know About the Sun” and leave space for answers as they are discovered. (This may be more than one page for some students.) Have students share out their questions while you write them on the class KWL chart below “W: What I Want to Know about the Sun”. Students may add questions to their own notebooks.

W: What I Want to Know About the Sun
Once students have finished writing down what they know, have them write “L: What I Learned about the Sun” and leave at least a half page to be completed at the end of the investigation.

**L: What I Learned about the Sun**

3. Review “Safety in the Classroom”
Remind students to never look directly at the Sun, as it will damage their eyes. Encourage students to continue observing the sky during the day and night. (Students may choose to write their observations daily in their notebook as homework or in class.) These observations are good opening discussions for each day and the information will be referred to later in the unit.
Space

Academic Vocabulary

Glossary

Words for all three chapters of this science journal will be collected in this glossary. Glossaries are organized in alphabetical order. Complete the entry as you learn the words.

1. Rewrite the word in your best handwriting. Spelling it correctly.
2. Draw a picture representing the word.
3. Write what the word means, use everyday words.
4. Write a sentence using the word. Be sure the meaning of the word is clear in how you use it. Be sure your sentence is written with proper punctuation and spelling.
5. Add any other words you learn during this unit of study (These extra words do not need to be in alphabetical order.)

Example:

<table>
<thead>
<tr>
<th>Word: space</th>
<th>Picture:</th>
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<tbody>
<tr>
<td>Definition: sky.</td>
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<tr>
<td>Sentence using word: Astronauts enter space to discover what is out there in our sky.</td>
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<td>Word</td>
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<td>sunset</td>
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<tr>
<td>Definition:</td>
<td></td>
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<tr>
<td>Sentence using word:</td>
<td></td>
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</tbody>
</table>
**Word:** telescope  
**Definition:**

**Sentence using word:**

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**Word:** tilt  
**Definition:**

**Sentence using word:**

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**Other New Academic Vocabulary:**

**Word:**

**Definition:**

**Sentence using word:**

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This link [http://www.nasa.gov/audience/forstudents/k-4/dictionary/Gravity.html](http://www.nasa.gov/audience/forstudents/k-4/dictionary/Gravity.html) shows NASA glossary using the same format as your glossary in your notebook!
Session 4: Introduce Compass [15-20 minutes]

• Students will be able to classify objects in the sky as natural or man-made.
• Students will be able to use a compass to find the cardinal directions: north, south, east, west.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document Camera/LCD Projector</td>
<td>Compass Reflection</td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Chart paper</td>
<td></td>
<td>Pencil</td>
</tr>
<tr>
<td>Compass (1 per pair)</td>
<td></td>
<td>Compass</td>
</tr>
<tr>
<td>N – E – S – W signs</td>
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</table>

1. Discuss daytime sky observations
Tell students that in this investigation they will be learning about objects in the sky. Have students share objects that they’ve seen in the sky, reminding them of what they observed in session 2. Write out students responses on chart paper, on the board or under the document camera in the example science notebook. Students may suggest the Sun, birds, clouds, airplanes, etc. Ask the class to remind you what kinds of things they decided qualify as being “in the sky.” (Not touching the ground.) Draw a T-chart on the board with one side labeled “Natural” and the other side labeled “Made by humans”. Have your students help categorize the objects that they observed in the sky while you write them out in the T chart.

2. Discussion about the Sun
Ask students,
- Is the Sun always in the sky? (Yes; but anticipate that many students will say no because at night they can’t see it.)
- How can you tell where the Sun is in the sky when it’s cloudy? (It is a really bright light.)
- When can you see the Sun? (During the day.)
- What is day? (When sunlight shines on you, from morning when the Sun comes up, until night when the Sun goes down.)
- What is night? (After the Sun sets, when it gets dark outside.)
To start students thinking about the Sun’s movement ask,
- Where did the Sun come up this morning?
- Does the Sun appear to move after it comes up?
- Where will the Sun go down tonight?
- Where does the Sun go after it sets?
- How would you describe how the Sun appears to travel across the sky?
- Does the Sun follow the same path every day?

3. Introduce the compass
Tell students that you have a tool that you want to share with them. Hold up the compass and ask your students if they have seen the tool before and how they think it could be used. You told me where you think the Sun rises and sets. I have a tool here that can help us describe the location of the Sun.
• **What do we call this tool?** (Compass)

• **What does a compass do?** (It points north. It also shows the directions south, east, and west, which are all called the cardinal directions.)

Ask students to point to the direction where they think north is in the classroom. Ask, **Are you all pointing in the same direction?** You will probably see fingers pointing in several directions.

4. Students use compass
   Distribute one compass to each pair of students. Ask them to place the compass flat on the table, away from any metal. Give them a minute to observe the needle inside the compass. Draw their attention to the colored end of the needle. Explain, **One end of the needle always points toward the north. In this compass the end that is colored red points north.** Ask students to slowly turn the compass while leaving it flat on the table. Ask, **What happens to the red end of the needle?** The red end of the needle continues to point north while the compass body turns under it. Ask them to turn the compass until the letter N is right under the red end of the needle. Once all student compasses are pointing north, have students point north with their fingers. Ask, **Are you all pointing in the same direction? What did the compass help us do?**

5. Introduce cardinal directions
   Using the document camera/projector, demonstrate locating the four directions and how the compass works. **Can anyone tell me the four main directions used on a compass? We call the four main directions – north, south, east, and west – the cardinal directions. You can use a compass to determine these directions anywhere you are, inside or outside.** Have students work with their compasses to determine west. Once the entire class has found west, post the W sign in that spot. Have students find the other 3 cardinal directions and post the corresponding signs in the correct locations.

6. Discuss compasses
   **Turn to your partner and talk about when you might use a compass.** (2 minutes)
   **What were some of your ideas?** Allow students to share their ideas with the whole class.

7. Compass Reflection
   Tell students, **We are going to write about what we learned about a compass in our notebooks.** Give each student a copy of the sheet Compass Reflection. Have students glue this on the next available page in their science notebooks and update their table of contents with the corresponding page number. Have students complete the reflection individually or with a partner.

8. Update word wall and glossary
   Add the following words to the word wall: “compass” and “cardinal directions” and any other words that came up during the session. Have students also add these words with their definitions to the glossary in their science notebooks.
9. Homework reminder
   Remind students to record their observations of the night sky from home.
A compass is a tool that ______________________

______________________________________________

______________________________________________

The red end of the needle always points

______________________________________________

Here is a picture of a compass rose:

The red end of the needle always points

______________________________________________

Here is a picture of a compass rose:
Session 5: Use Compass Outdoors [40-45 minutes]

- Students will gather and record data about the position of the Sun over the course of a day.
- Students will predict the position of the Sun based on their understanding of the Sun’s movement.
- Students will utilize direct and indirect evidence to investigate the components of the Solar System.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Where’s the Sun</td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Chart paper</td>
<td>Evidence Graphic Organizer</td>
<td>Glue</td>
</tr>
<tr>
<td>Sidewalk chalk</td>
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<td>Pencil</td>
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<tr>
<td>Compass (1 per pair)</td>
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<td>Compass</td>
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Plan this for a clear or slightly overcast day. (Session 5 and 6 may be one session) Do the first observation as early in the day as possible, again during or around lunch time, and again before students leave in the afternoon. In advance, draw a chalk line outside that determines East/West.

1. Focus question

   Scientists learn about (or study) objects in the sky through observations. Today we will observe and record our observations about how the Sun appears to move across the sky using cardinal directions. I’d like for us to be able to track the movement of the Sun today, but there are so many things we can focus on, it may be best to choose one before we go outside. Let’s come up with a focus question about the Sun. We have observed objects in the day sky already and now we know our cardinal directions and how to use a compass. Our focus question for the next couple of days is: How does the Sun appear to move throughout the day? Model writing the focus question in the example science notebook on the next available page using the document camera. Have students write the focus question in their science notebooks and update their table of contents with the corresponding page number.

2. Set expectations

   Review behavioral expectations of going outside as well as the safety concerns of looking directly at the Sun. Hand students Where’s the Sun student sheets and make sure they glue them into their science notebooks either below the focus question or on the next available page. Have students update the table of contents with the corresponding page number. Make sure that each pair of students has a compass, and each student has a pencil and their science notebook before going outside. Remind students to handle the compass with care and to share them.

3. Morning observations

   Go outside to a concrete or asphalt paved area that receives direct sunlight and that will be safe for students to work in. Establish the cardinal directions on the pavement. (Using their compasses, students can gather at each location on the paved area and determine the direction.) Use chalk to write the letters that represent the directions on the pavement.
Draw a line between east and west. Along the designated east-west line, have all students face south.

Ask students,
- *Where is the Sun?* (Remind students not to look directly at the Sun.)
- *Where did the Sun rise this morning?*
- *Where will the Sun set?*
- *When does the Sun rise in the south or the north?* (This question can be a useful formative assessment to determine which students already understand the apparent movement of the Sun during the day as described by cardinal directions.) Discuss the fact that the Sun does not rise in the south or the north, it only rises in the east and sets in the west.

4. Data collection
   Explain how to use the *Where's the Sun* page for data collection by modeling with the example science notebook. Have a student be your partner to help model.
   - *Everyone stand with their partners on the east-west line facing south.* (Model this with your student partner.)
   - *One person is the pointer and the other person is the observer.*
   - *The pointer will point at the Sun with their index finger. Remember not to look directly at the Sun.*
   - *The observer draws the pointer’s arm on the armless figure on the sheet in your science notebook. Be sure to get the angle on the pointer’s arm just right.*
   - *Write the time of day next to the arm. (e.g. 10:20 a.m.)*
   - *After you draw the arm and record the time, switch places. The person who was recording now points at the Sun. The new observer draws the arm and writes the time next to it.*

Make sure that all the students have had a chance to point and draw before coming inside.

5. Prediction
   Once inside, tell students, *When scientists make a prediction, they state what they think is going to happen and why. They make their prediction based on the knowledge that they have at that time. We will make the same observations around*
noon. Where do you think the Sun will be at that time? Record your prediction by drawing an arrow on the Where’s the Sun sheet in the direction that you think the Sun will move between now and noon. Label the arrow “noon prediction.”

6. Noon observations
Before going outside, remind students of the behavioral expectations and make sure students have their science notebooks, a pencil and a compass for their group. Tell students, Make sure that you are standing on the East/West line and facing South. Repeat the arm drawing activity with your partner and remember to take turns. Remember to label the time. Check that students are drawing accurately and labeling with the correct time.

What to look for in the “Where’s the Sun?” page:
• Students can draw the correct position of the arm pointing to the Sun and record the time.
• Students record their predictions.
• Students can represent the movement of the Sun in drawings.
• If asked to explain, students can describe the recording method and what the data tell them about the movement of the Sun.

Make sure that all students have had a chance to point and draw before coming inside.

7. Prediction
Once inside, have students predict where the Sun will be in the sky in the afternoon when they go outside just before the end of the school day. Have them draw an arrow on the Where’s the Sun sheet in the direction that they think the Sun will move between now and the late afternoon. Remind students to label the arrow “Afternoon Prediction.”

8. Afternoon observations
Before going outside, remind students of the behavioral expectations and make sure students have their science notebooks, a pencil and a compass for their group. Tell students, Make sure that you are standing on the East/West line and facing South. Repeat the arm drawing activity with your partner and remember to take turns.
**Remember to label the time.** Check that students are drawing accurately and labeling with the correct time.

What to look for in the “Where’s the Sun?” page:

- Students can draw the correct position of the arm pointing to the Sun and record the time.
- Students record their predictions.
- Students can represent the movement of the Sun in drawings.
- If asked to explain, students can describe the recording method and what the data tell them about the movement of the Sun.

Make sure that all students have had a chance to point and draw before coming inside.

9. Evidence graphic organizer

Once students are back inside the classroom, ask students to raise their hand if they accurately predicted the movement of the Sun from the morning until noon, and then again from noon until the late afternoon. For students that did not correctly predict the movement from morning to noon, ask them if they changed their prediction for the noon to late afternoon observation. Encourage students to make predictions based on observations.

Hand students the Evidence Graphic Organizer and have them glue it into their science notebooks on the next available page. Students may need to fold it in half in order for the page to fit in their science notebooks. Remind students to update their table of contents with the corresponding page number. Tell students, **This is a graphic organizer that is going to help keep our observations and evidence organized.** Place the graphic organizer under the document camera, or draw it out on chart paper for students to see. **The first thing I need to do is write the focus question. Who can tell me the focus question? How does the Sun appear to move throughout the day?** Write the focus question on the lines provided and have your students do the same. **The second thing I want to determine is the type of evidence that I gathered from my observations. Can anyone tell me the difference between direct and indirect evidence? Direct evidence comes from observations that you personally have made, while indirect evidence comes from observations of others, who then pass on that information to you. In the activity we just did, Where’s the Sun, did we get direct evidence or indirect evidence? We collected direct evidence since we personally went outside and observed where the Sun was located at certain times throughout the day. I’m going to circle Direct Evidence on my graphic organizer, and I’d like you all to do the same.**

**Let’s write the title of the activity that we just completed in the box below labeled Source.** The source indicates where we got our evidence from. Write in “Where’s the Sun” in the second box in the first column. Have students do the same on their sheet. **The point of this graphic organizer is to help keep track of the evidence that I’ve collected. What evidence can I use to help answer my focus question? I’d need to write down where the Sun was located at different times during the day in order to help answer my focus question. In this first box under the Evidence 1 column, I’m going to write down some notes from the morning observation. Can anyone tell me the time**
when we first went outside? And if I recall correctly, I think the Sun was in the East, right? I'll write that in too. And lastly, can anyone tell me if the Sun was really high in the sky or low in the sky? Great, I'll write that in the box. (You should have an early morning time and the cardinal direction east of the Sun’s location as well as the Sun being low in the sky.) Please fill in your Evidence 1 box just like mine. Who can tell me what evidence we can put in the Evidence 2 box? Students should provide the time, cardinal direction and height of the Sun at noon. Write the evidence in the corresponding box together as a class. For the third box, have students work in pairs to come up with the evidence and then share out as a class while you fill in the last row. We will be using this Evidence Graphic Organizer throughout the unit, so please make sure it is glued into your science notebook and you have updated your table of contents with the corresponding page number.

10. Homework reminder
Remind students to record their observations of the night sky from home.
Where's the Sun?
# Evidence Graphic Organizer

**Focus Question:**

- __________________________________________________________
- ____________________________________________________________________

<table>
<thead>
<tr>
<th>Source</th>
<th>Evidence 1</th>
<th>Evidence 2</th>
<th>Evidence 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Evidence or Indirect Evidence</td>
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<tr>
<td>Direct Evidence or Indirect Evidence</td>
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</tbody>
</table>

1.5.b

60
Session 6: Discussion and Reflection [15-30 minutes]

- Students will analyze data about the position of the Sun over the course of a day.
- Students will describe the pattern of movement for the Sun across the sky as observed from Earth.

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<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>What Do Data Tell Us Where’s the Sun Reflection*</td>
<td>Science notebooks Glue Pencil</td>
</tr>
<tr>
<td>Chart paper</td>
<td></td>
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</tbody>
</table>

*A scaffolded Where’s the Sun Reflection sheet is provided for students that need extra support with sentence stems and a word bank.

1. Discuss results from Where’s the Sun observations
   - **Who can tell me our focus question?** (How does the Sun appear to move throughout the day?)
   - **What evidence do you have that the Sun appears to move?** (The pointing arm pointed to a different place each time we went outside.)
   - **Which direction did the Sun move in the sky?** (From east to west)
   - **How do you know that the Sun moved east to west?** (The finger pointing at the Sun moved from east to west, facing south we observed the sun moving from east to west.)
   - **In which direction did the Sun rise this morning?** (In the east)
   - **In which direction will the Sun set tonight?** (In the west)
   - **Why do you think that?** (The Sun moves west during the day, so it will keep going west until it sets.)
   - **If we recorded the Sun’s movement every day for a year, do you think its movement will always be the same? Why?** (Results will be similar, day after day. The Sun will always move east to west, but the exact location at which it rises and its height above the horizon will both change with the seasons.)

2. Data reflection
   After the discussion, give students time to explain their discovery in their notebook. Pass out What Do These Data Tell Us student sheets and have students update their table of contents with the corresponding page number. Have students complete the questions independently.

3. Shared reflection
   Either have students write out the following two questions or hand them either of the two scaffolded versions depending on the students’ level of needed structural support. Write the question either on chart paper, the white board, or place a copy of the student sheet under the document camera.
Where’s the Sun Reflection

Why is a compass a useful tool?

How does the Sun travel across the sky as seen from Earth?

Complete the Where’s the Sun Reflection as a class and make sure students have the questions and answers written in their science notebooks.

Example answers:

Where’s the Sun Reflection

Why is a compass a useful tool? You can use it to find directions: north, south, east, and west.

How does the Sun travel across the sky as seen from Earth? It rises in the east, travels from east to west across the sky and sets in the west.

OR complete sentences

Where’s the Sun Reflection

A compass is a useful tool because you can use it to find directions: north, south, east, and west.

The Sun rises in the east, travels from east to west across the sky and sets in the west.

4. Update word wall and glossary

Update the class word wall by adding the following words and definitions. Give students time to update their glossaries.

• Sun is the star that appears to rise in the morning, in the east, crosses the sky, and set at night in the west (Later it can be revised to include the center of our Solar System).
• Compass is a tool used to determine directions.
• Cardinal directions are the four main points on a compass: north, south, east, west.
• Day is the time when the Sun appears in the sky, and it is light outside. (Later it can be revised to include the time it takes a planet to make one rotation.)
• Night is the time when the Sun is below the horizon and it’s dark outside.

5. Homework reminder

Remind students to record their observations of the night sky from home.
What do these data tell you about the movement of the Sun?

Draw how the Sun appears to move across the sky.

The sun appears to move from ________________ to ________________ in the sky.

The sun is not in the same place all day long.

The sun appears to move from ________________ to ________________ in the sky.

The sun is not in the same place all day long.
Where’s the Sun Reflection

1. Why is a compass a useful tool?

2. How does the Sun appear to travel across the sky as seen from Earth?
Where’s the Sun Reflection

A compass is a useful tool because you can use it to find the four ________________ directions:
___________________, _________________,
___________________, and ________________.

The sun appears to rise in the ________________,
travel from ________________, to
______________________ across the sky and set in
the _________________.

Where’s the Sun Reflection

A compass is a useful tool because you can use it to find the four ________________ directions:
___________________, _________________,
___________________, and ________________.

The sun appears to rise in the ________________,
travel from ________________, to
______________________ across the sky and set in
the _________________.
Session 7: Sunrise, Sunset (30-35 minutes)

• Students will describe the pattern of movement of the Sun across the sky as observed from Earth.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chart paper</td>
<td></td>
<td>Sunlight, Sunset*</td>
</tr>
<tr>
<td>Document camera</td>
<td></td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Sticky notes</td>
<td></td>
<td>Glue</td>
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<td></td>
<td></td>
<td>Pencil</td>
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<tr>
<td></td>
<td></td>
<td>FOSS Science Resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sun, Moon and Stars book</td>
</tr>
</tbody>
</table>

* A scaffolded version of Sunrise, Sunset student sheet is provided for students that need extra support with sentence stems and word banks.

1. Paired reading
   Have students sit in pairs to read *Sunrise and Sunset* (page 1-3 in book, FOSS Science Resources Sun, Moon, and Stars), an expository text that provides information about the movement of the Sun across the sky. Before reading, discuss the author’s purpose for writing an expository text. Discuss the reader’s purpose for reading (finding information about sunrises and sunsets). Students will be asked to answer questions at the end of the article. Write the questions on the board or under the document camera and read them out loud to the students prior to reading the text.
   • *Where does the Sun rise and where does it set?*
   • *How does the Sun move from sunrise to sunset?*

   Provide sticky notes for students to mark the location of the answers. Students can write the number of the question that is answered on the sticky note if that helps them. Allow students to read the text to each other out loud and take turns with each paragraph. After students have finished reading, have students discuss the questions in pairs and then share out with the class.

2. Sunrise, Sunset
   Have students get out their science notebooks and write in the table of contents “Sunrise, Sunset.” For students that need minimal additional writing support, have them write the title “Sunrise, Sunset” at the top of the next available page and write the questions in their science notebook, leaving plenty of room for their answers in complete sentences. For students that need extra writing support, hand them the appropriately scaffolded version of Sunrise, Sunset* to be glued into their science notebook on the next available page. Remind students to update the corresponding page number in their table of contents.

3. Update word wall and glossary
   Add “sunrise”, “sunset” and “horizon” to the word wall and have students update the glossary in their science notebooks.
   **Sunrise** - the event or time of the daily first appearance of the Sun above the eastern horizon.
   **Sunset** - the apparent descent of the Sun below the horizon.
Horizon - (or skyline) is the apparent line that separates earth from sky.

4. Evidence graphic organizer
   Let’s go back to our Evidence Graphic Organizer so we can write down the evidence we’ve just read. Display your Evidence Graphic Organizer under the document camera or use the chart paper previously used. We just learned some important information from the FOSS reader, and I think we can use some of it to help answer our focus question. Is information from a book direct evidence or indirect evidence? Why? Students should explain that it is indirect evidence because someone else observed the sunrises and sunsets and wrote about that information in a book, which we then read. Let’s circle indirect Evidence and write in the title of the section of the book that we read, Sunrise and Sunset, and let’s put the word Text after it, to indicate it was from a book. Model writing this in your example science notebook and have students do the same. I’d like my first piece of evidence from the text to be about when the Sun rises. Can anyone tell me where the Sun rises? (In the east.) And does anyone know on which page that can be found in the text? It’s important to cite the exact page where we found that information. (Page 1) Who can tell me what another piece of evidence is from the text that can help answer our focus question. Students should provide that the Sun always sets in the west, found on page 2. Your students may want to add additional evidence, for example that the Sun always rises and sets in the same place regardless of where you are located in the world, page 2.

5. Homework reminder
   Remind students to record their observations of the night sky from home.
Sunrise, Sunset

Where does the Sun rise and where does it set?

___________________________________________

___________________________________________

___________________________________________

___________________________________________

___________________________________________

How does the Sun move from sunrise to sunset?

___________________________________________

___________________________________________

___________________________________________

___________________________________________

___________________________________________

Sunrise, Sunset

Where does the Sun rise and where does it set?

___________________________________________

___________________________________________

___________________________________________

___________________________________________

___________________________________________

How does the Sun move from sunrise to sunset?

___________________________________________

___________________________________________

___________________________________________

___________________________________________

___________________________________________
Sunrise, Sunset

Where does the Sun rise and where does it set?
The Sun appears to rise in the east. The Sun appears to set in the west.

How does the Sun move from sunrise to sunset?
The Sun rises in the east and moves westward. It is highest in the sky at noon. In the evening it sets in the west.
Sunrise, Sunset

The Sun rises in the __________________________

and sets in the____________________________.

The Sun moves in a __________________________
direction. The Sun is highest in the sky at

______________________________.

In the evening the sun sets in the

__________________________.

Word list: (not all words are used and some may be used twice.)
West        East
Westward    Eastward
Morning     Evening

Sunrise, Sunset

The Sun rises in the __________________________

and sets in the____________________________.

The Sun moves in a __________________________
direction. The Sun is highest in the sky at

______________________________.

In the evening the sun sets in the

__________________________.

Word list: (not all words are used and some may be used twice.)
West        East
Westward    Eastward
Morning     Evening
Session 8: Shadow Tracking [40-45 minutes]

- Students will predict the patterns of movement of shadows based on their understanding of the Sun’s path across the sky as seen from Earth.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Shadow Prediction 1</td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Sidewalk chalk</td>
<td>Shadow Prediction 2</td>
<td>Glue</td>
</tr>
<tr>
<td>Compasses (1 per pair)</td>
<td>Shadow Reflection</td>
<td>Pencil</td>
</tr>
<tr>
<td>Lamp/light</td>
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This activity needs to be done outdoors three times (preferably the same day) in the early morning, noon and in the afternoon. The location should have minimal building shadows, and have a flat surface with minimal traffic. Try to be near a flagpole or tetherball pole.

1. Introduce Shadows
   - **What is a shadow?** (A shadow is a dark area where an object has blocked the light.)
   - **Do you have a shadow all of the time?**
   - **What do you need in order to have a shadow?**

2. Practice making shadows
   
   *A shadow is a dark area where an object has blocked the light.* Please write this word in the glossary while I add it to the word wall. Have students add “shadow” to their glossaries. Select a student to help make a shadow. Turn off the lights and use the document camera/LCD projector or light from the FOSS kit to create a shadow. Have the student stand in the projected light with his/her back to the light.
   - **Where is the shadow?** (On the board or wall that the volunteer is facing.)
   - **How did we make a shadow?** (The student stood in front of the light source and blocked the light from reaching the board.)
   - **If I turn off the light source, will (student name) still have a shadow?** (Not in the same location since the light source creating this shadow has been turned off.)

   Have students notice that the back of the volunteer is lit, but the front (the side facing away from the projector) is dark. Practice making other shadows with objects and hands. Have students notice that each time one side of the object is lit and the other side is dark, a shadow appears on the wall.

   Ask students,
   - **How could shadows help us locate the Sun?**
   - **Do you always have a shadow when you are outdoors?** (No)
   - **What do you need to make a shadow outside during the daytime?** (The Sun needs to be shining to make a shadow and you need a solid object to block the light.)

3. Morning shadow observation
   We are going to go outside to continue to gather more evidence to help answer our focus question. Who can remind me what our focus question is? (How does the Sun
appear to move throughout the day?) How could finding shadows help us locate the Sun? Do you remember the activity where we drew the arm of the person on the Where’s the Sun student sheet? We are going to do something similar, but with more detail. I want you to use your compasses to help determine the direction while we trace shadows of your partners to help track the movement of the Sun. Review cardinal directions by asking where items in the room are located, resulting in responses of east, west, south, or north. Prompt students, if necessary, to use the E, N, S, W signs around the room. Review how to use a compass if necessary.

Before going outside, review the expectations for outside behavior and the safety concerns about looking directly at the Sun. Make sure each pair of students has a piece of chalk and a compass. Tell students, We will be tracing your shadows, including your shoes. Please make sure that you are tracing accurately and completely or your shadows may be altered.

Once outside, have students spread out so that their shadows do not overlap. Watch for trees and buildings that could later create shadows. Have students find the cardinal directions and make sure they are all facing south. Have one student trace the outline of their partner’s shadow and feet (both shoes). Label the shadow with the owner’s name and the time of day on the inside of the shadow drawing. Ask, Which direction are your shadows pointing? (Shadows should be pointing toward the west in the morning.) Where is the Sun right now? (In the east.) Is the sun rising or setting? (Rising) Return to the classroom for discussion.

4. Discuss observations and make predictions
Once back in the classroom, ask students,
   • Why did you have a shadow?
   • What direction did your shadows point?
   • After lunch, will your shadow fall right into the outline you traced?
   • What do you predict your shadow will be like around noon?
Have students open their science notebooks to the next available page. Give each student a copy of the Shadow Prediction 1 student sheet. Have students glue this into their science notebook and add it to their table of contents with the corresponding page number. Have students complete their predictions independently or with a partner.

Draw how your shadow looks now and how you predict it will look at noon.

<table>
<thead>
<tr>
<th>Now</th>
<th>Noon</th>
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5. Noon shadow observation (3-4 hours later)
Before going outside again, review the expectations for outside behavior and the safety concerns about looking directly at the Sun. Make sure each pair of students has a piece of chalk and a compass. Tell students, *We will be tracing your shadows again, including your shoes. Please make sure that you are tracing accurately and completely or your shadows may be altered.*

Once outside, have students stand in their own footprints and find the cardinal directions and make sure they are all facing south. Have the students stand where their feet have been drawn before and have their partner trace the new outline of their partner’s shadow and feet (both shoes). Label the shadow with the owner’s name and the time of day on the inside of the shadow drawing. While walking around to your students, ask the following questions:

- **What do you observe about the direction your shadows are pointing?** (The morning shadow points west and the noon shadow points north/northeast.)
- **Why do you think your shadows changed?** (The Sun’s position in the sky changed.)
- **What do you observe about the length of your shadow?** (The shadow is longer in the morning and shorter around noon.)
- **Where is the Sun now?** (The Sun should be directly overhead.)

Help students make the connection between the Sun’s position in the sky and the location and length of their shadows. When the Sun is in the east in the morning, their shadows point west and are longer. When the Sun is directly overhead around noon, their shadows point north/northeast and are short.)

Once back in the classroom, ask students,

- **What direction did your shadows point?**
- **Before we leave school, where will your shadows be?**
- **What do you predict your shadows will be like in the late afternoon?**

Have students open their science notebooks to the next available page. Give each student a copy of the Shadow Prediction 2 student sheet. Have students glue this into their science notebook and add it to their table of contents with the corresponding page number. Have students complete their predictions independently or with a partner.

6. Afternoon shadow observation (3-4 hours later)
Before going outside again, review the expectations for outside behavior and the safety concerns about looking directly at the Sun. Make sure each pair of students has a piece of chalk and a compass. Tell students, *We will be tracing your shadows again, including your shoes. Please make sure that you are tracing accurately and completely or your shadows may be altered.*

Once outside, have students stand in their own footprints and find the cardinal directions and make sure they are all facing south. Have the student stand where their feet have been drawn before and have their partner trace the new outline of their
partner’s shadow and feet (both shoes). Label the shadow with the owner’s name and the time of day on the inside of the shadow drawing. While walking around to your students, ask the following questions:

- **What do you observe about the direction your shadows are pointing?** (The morning shadow points west, the noon shadow points north/northeast and the afternoon shadow points east.)
- **Why do you think your shadows changed?** (The Sun’s position in the sky changed.)
- **What do you observe about the length of your shadow?** (The shadow is longer in the morning and in the afternoon, and shorter around noon.)
- **Where is the Sun now?** (In the west.)
- **Is the Sun rising or setting?** (Setting)

Help students make the connection between the Sun’s position in the sky and the location and length of their shadows. When the Sun is in the east in the morning, their shadows point west and are long. When the Sun is directly overhead, the shadows point north and are short. When the Sun is in the west in the afternoon, their shadows point east and are also long.

7. Shadow reflection

Once students are inside go over the same questions as a class.

- **What did you observe about your shadow?** (They changed shape and direction. They now point east.)
- **Why do you think your shadows changed?** (The Sun’s position in the sky changed.)
- **When do you think you will have the longest shadow? The shortest shadow?** (The shadow is longest when the Sun is lowest in the sky, early morning/late afternoon. The shadow is shortest then the Sun is highest around noon.)
- **How does drawing our shadows during the day help answer the focus question of How does the Sun appear to move throughout the day?** (By drawing the shadows, students observe that the Sun rises in the east and travels west throughout the day- creating either long or short shadows that face different directions depending on where the Sun is in the sky.)

Give students a copy of the Shadow Reflection student sheet and have them glue this into their science notebook on the next available page and update their table of contents with the corresponding page number. Have students write a reflection about their discoveries about shadows and the Sun. Remind students to use scientific vocabulary, cardinal directions and the time of day in their explanation.

8. Evidence graphic organizer

*Let’s go back one last time to our Evidence Graphic Organizer and fill in the evidence from this activity.* Have students turn to their Evidence Graphic Organizer. *First, let’s decide if our evidence is direct or indirect. Who can tell me which type it is and why?* (Direct, because students observed with their own eyes.) *Let’s fill in the title of the*
activity under the Source column. Model writing in Shadow Predictions 1 & 2 in the last row under the first column and have students do the same in their science notebooks. We gathered a lot of evidence during our shadow activity. Who can tell me all the things we can say about the Sun in the morning? Students should tell you

- The sun rose in the east
- A specific time
- The Sun was low in the sky
- Their shadow pointed west and was long

Write down their ideas in the class Evidence Graphic Organizer and have students write in their science notebooks. For the next piece of direct evidence, have your students work in pairs and fill out the next box. Have them share out with the class when they are finished and write in the evidence provided on the class evidence graphic organizer. If they gathered all the evidence for that column, have them work independently to fill in the last column. If not, work together as a class or in small groups to come up with the evidence for the last column.

9. Homework reminder
Remind students to record their observations of the night sky from home.
Shadow Prediction 1

I think my noon shadow will point __________________________

____________________________________________________direction,

because ____________________________________________

____________________________________________________

____________________________________________________

____________________________________________________.

Draw how your shadow looks now and how you predict it will look at noon.

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<tr>
<th>Now</th>
<th>Noon</th>
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</tbody>
</table>

Shadow Prediction 1

I think my noon shadow will point __________________________

____________________________________________________direction,

because ____________________________________________

____________________________________________________

____________________________________________________

____________________________________________________.

Draw how your shadow looks now and how you predict it will look at noon.

<table>
<thead>
<tr>
<th>Now</th>
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</thead>
<tbody>
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</tbody>
</table>
Shadow Prediction 2

I think my afternoon shadow will point ________________

______________________________________________ direction,
because _____________________________________________________________________

______________________________________________.

Draw how your shadow looks now and how you predict it will look in the afternoon.

Noon | Afternoon
--- | ---
| |

Shadow Prediction 2

I think my afternoon noon shadow will point ________________

______________________________________________ direction,
because _____________________________________________________________________

______________________________________________.

Draw how your shadow looks now and how you predict it will look in the afternoon.

Noon | Afternoon
--- | ---
| |

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Shadow Reflection

Draw a picture of what your shadow looked like in the afternoon.

Did you shadow change from the morning? YES NO
I think my shadow changed because the Sun ______________________

_____________________________________________________

_____________________________________________________

I think the longest shadow is when the Sun is
__________________________ in the sky.
I think the shortest shadow is when the Sun is
__________________________ in the sky.

Shadow Reflection

Draw a picture of what your shadow looked like in the afternoon.

Did you shadow change from the morning? YES NO
I think my shadow changed because the Sun ______________________

_____________________________________________________

_____________________________________________________

I think the longest shadow is when the Sun is
__________________________ in the sky.
I think the shortest shadow is when the Sun is
__________________________ in the sky.
Session 9: Writing a scientific explanation [30-40 minutes]

- Students will describe the pattern of movement for the Sun across the sky as observed from Earth.
- Students will develop a scientific explanation regarding relationships of the components of the Solar System (Earth and Sun).

### Materials needed

<table>
<thead>
<tr>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Chart paper</td>
<td>Glue</td>
</tr>
<tr>
<td>Scientific Explanation Graphic Organizer</td>
<td>Pencil</td>
</tr>
</tbody>
</table>

1. **Scientific explanation (modeled writing)**

   Scientists often express their thinking as an explanation. A scientific explanation includes a claim. Can anyone tell me what a claim is? [A claim is a statement or a conclusion based on the evidence]. Usually a claim answers our focus question. What was our focus question? (How does the Sun appear to move throughout the day?)

   Write the focus question on the white board, chart paper or using document camera. What is a claim that I could make about how the Sun appears to move across the sky? Write student responses. We want our claim to be as specific as possible, so if it’s okay with you, I’m going to write our class claim as “The Sun appears to move from the east to west across the sky as seen from Earth.” Write “The Sun appears to move from the east to west across the sky as seen from Earth” and circle it.

2. **Scientific explanation graphic organizer**

   Give each student a copy of the Scientific Explanation Graphic Organizer. Have them glue it into their science notebooks and update their table of contents with the corresponding page number. Please write the circled claim on the board on your graphic organizer. Model for students where to write their claim.

3. **Finding evidence to support claim**

   Whenever we write a claim, what do we need to state in order to support it? (Evidence) Scientists must provide evidence to support their claims. We have collected several pieces of evidence throughout this investigation about how the Sun appears to move across the sky. Where might we find the evidence we have collected so far? (In our Evidence Graphic Organizer in our science notebooks.) Let’s look at our table of contents and find the page for our Evidence Graphic Organizer. Please find your evidence graphic organizer in your science notebook. The first activity in which we gathered evidence about the Sun was “Where’s the Sun”. Find the row of evidence for “Where’s the Sun” in your Evidence Graphic Organizer. Point to the row in your example science notebook under the document camera if you have one.

   What is one piece of evidence I have from this activity that I could use to support my claim? Allow students to offer examples. Choose one piece of evidence and write it in the first row of the Scientific Explanation graphic organizer.
With our evidence, we also want to record the source of that evidence. It is important to record sources of evidence. What was the source of this evidence? Was this something that we observed directly or indirectly? It was something we observed directly, so I’m going to write the name of the activity where the observation was recorded in my Evidence Graphic Organizer. Write “Where’s the Sun” in the graphic organizer.

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Sun was in the east at 9:00 AM.</td>
<td></td>
</tr>
</tbody>
</table>

Let’s look at our Evidence Graphic Organizer again. The second activity in which we gathered evidence about the Sun was when we read “Sunrise and Sunset”. Find the row of evidence for “Sunrise, Sunset” in your Evidence Graphic Organizer. Point to the row in your example science notebook under the document camera if you have one.

*What is one piece of evidence I have from this activity that I could use to support my claim?* Allow students to offer examples. Choose one piece of evidence and write it in the next row of the Scientific Explanation Graphic Organizer. **Because this is from a book, I’m going to put it in quotes and write the page number.**

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>“The Sun always sets in the west.” P. 2</td>
<td></td>
</tr>
</tbody>
</table>

Can anyone tell me the source of that evidence? Was this something that we observed directly or that we read about? It was something we read about, so I’m going to write the name of the article from our book “Sunrise and Sunset”. Write “Sunrise and Sunset” in the graphic organizer.

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>“The Sun always sets in the west.” P. 2</td>
<td>“Sunrise and Sunset”</td>
</tr>
</tbody>
</table>

Let’s look at our evidence graphic organizer one more time. The third activity in which we gathered evidence about the Sun was when we gather data about shadows. Find the row of evidence for “Shadow Observations” in your Evidence Graphic Organizer.
Point to the row in your example science notebook under the document camera if you have one.

What is one piece of evidence I have from this activity that I could use to support my claim? Allow students to offer examples. Choose one piece of evidence and write it in the first row of the Scientific Explanation Graphic Organizer.

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>At noon, my shadow was very short and pointed north.</td>
<td>Shadow Observations</td>
</tr>
</tbody>
</table>

With our evidence, we also want to record the source of that evidence. It is important to record sources of evidence. What was the source of this evidence? Was this something that we observed directly or that we read about? It was something we observed directly, so I'm going to write the name of the activity where the observation was recorded. Write “Shadow Observations in the graphic organizer.”

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>At noon, my shadow was very short and pointed north.</td>
<td>Shadow Observations</td>
</tr>
</tbody>
</table>

Because I’m going to use the information from this graphic organizer to create a paragraph, I will want to restate my claim in a concluding sentence. One way we could do that is to say “These pieces of evidence support the claim that the Sun appears to move from the east to the west as seen from Earth.” Model writing “These pieces of evidence support the claim that the Sun appears to move from the east to the west as seen from Earth” in the blank at the bottom of the Scientific Explanation Graphic Organizer. Please write this sentence in your graphic organizer.

Note: You may want to break at this point and finish writing the paragraph in the next lesson.

4. Writing a scientific explanation in paragraph form

I will introduce how to write a scientific explanation as a paragraph by thinking out loud and modeling my writing process. Teachers are encouraged to model their own thinking and writing. Below is just an example of a model and think out loud.

I'm going to start by giving my paragraph a title “The Movement of the Sun across the Sky as it Appears from Earth.” Next, I'm going to write my claim as the topic sentence.

The Sun appears to move from the east to the west across the sky as seen from Earth.

Next I’m going to look on my Scientific Explanation Graphic Organizer to support the claim. I’m going to start with the early morning evidence that I gathered during the
Where’s the Sun activity because I gathered direct evidence from it and it was fun. So I’m going to write, ‘When we did the “Where’s the Sun?” activity, I observed that the Sun was in the east at 9:00 in the morning.’

Next I want to use my evidence from the observing shadows activity because it’s also direct evidence that I gathered. And since I already talked about the Sun in the early morning, I’m going to talk about evidence from noon. So I’m going to write, ‘When we did the activity on observing shadows, I observed that, at noon, my shadow was very short and pointed north. This tells me that at noon on that day, the Sun was high in the sky and just slightly to the south.’

And lastly I’m going to support my claim with evidence from the text “Sunrise and Sunset” where I gathered indirect evidence. So I’m going to write, ‘Further evidence to support my claim comes from the article “Sunrise and Sunset”, which states that the Sun always sets in the west.’

Do these sentences state the evidence that I collected? Do they support my claim? Do they make it clear to the reader what I observed? Just like all paragraphs, I have to end with a concluding sentence. Restating the claim is a strong way to end a scientific explanation. So I’m going to write These pieces of evidence support the claim that the Sun appears to move from the east to the west as seen from Earth.

PUNCTUATION NOTE: Sun is capitalized because it is naming a specific astronomical body. Solar System objects will be capitalized when it is their name.

ORGANIZATION NOTE: The structure of a paragraph was used to write a scientific explanation.

OPTIONAL: Some students may choose to copy your paragraph into their notebook. You may glue a copy of your modeled scientific explanation into their notebook. Other students may try to write their own scientific explanation to the question. Have students add this to the science notebook and update their table of contents with the corresponding page number.

Today, I wrote the scientific explanation to model what fourth graders are expected to write to answer a science question. You will do this writing more independently as we go along.

5. Homework
Check calendar to ensure that students are recording daily Moon observations. Ask students to review all data to this point. Ask, What do you notice? There’s no need for a discussion, just ask the question. The purpose of collecting data is to look for patterns.
Scientific Explanation Evidence Graphic Organizer

Write the claim in a complete sentence:

________________________________________________________________________

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
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</tbody>
</table>

Restate claim in different words as concluding sentence:

________________________________________________________________________
Session 10: Shadow Tracking with a Model  [30-40 minutes]

* Students will explain that day and night on Earth results from Earth’s rotation on its axis.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Outdoor Shadows*</td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Chart paper</td>
<td></td>
<td>Glue</td>
</tr>
<tr>
<td>Overhead projector</td>
<td></td>
<td>Pencil</td>
</tr>
<tr>
<td>Globe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lamp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masking tape</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scissors</td>
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<td></td>
</tr>
</tbody>
</table>

*A scaffolded version of Outdoor Shadows is provided for students that need extra support with sentence stems and word banks. Before class, make a small tape triangle tent by taking a piece of masking tape and folding it in half in the middle, leaving the two sides open to stick onto a surface. It should stick up 1-2 cm. Cut the edges to make a triangle point in the middle.

1. Globe model

Since we don’t have time to travel into outer space today and watch the Earth move and see how the Sun shines on Earth, we will instead use a globe as a model. I’d like for us to compare and contrast a model globe with the Earth. How is this globe like the Earth? Turn to your partner and share 3 ways that you think the globe is like the Earth. Allow a minute for students to discuss.

Have your partner tell you 3 other ways he/she thinks the globe is like the Earth.

Allow a minute for students to discuss. Have students share their ideas about ways that the globe is similar to Earth, using the graphic organizer below, while you write them on chart paper or under the document camera.

| Similar (How the globe is like Earth) |

Now let’s discuss how the globe is different from the Earth. The person who went first last time will go last this time when sharing ideas. Turn to your partner and share 3 ways in which you think that the globe is different from the Earth. Allow a minute for students to discuss.

Have your partner tell you 3 other ways he/she thinks the globe is different from the Earth. Allow a minute for students to discuss. Have students share their ideas about ways that the globe is different from the Earth with the class while you write them on chart paper or under the document camera. Use the graphic organizer below.
2. Light model
Discuss with your students how the light is a model of the Sun. The Sun is a hot, gaseous star that emits a large amount of light and heat. Therefore, we cannot go near it. Instead, we will use the document camera or light bulb as a model of the Sun.

How is the light like the Sun? Turn to your partner and share 3 ways that you think the light is like the Sun.
Allow a minute for students to discuss.

Have your partner tell you 3 other ways he/she thinks the light is like the Sun.
Allow a minute for students to discuss. Have students share their ideas about ways that the light is similar to the Sun with the class while you write them on chart paper or under the document camera using the same graphic organizer as before.

Now let’s discuss how the light is different from the Sun. Turn to your partner and share 3 ways you think the light is different from the Sun. The person who went first last time will go last this time when sharing ideas. Allow a minute for students to discuss.

Have your partner tell you 3 other ways he/she thinks the light is different from the Sun.
Allow a minute for students to discuss. Have students share their ideas about ways that the light is different from the Sun with the class while you write them on the chart paper or under the document camera using the same graphic organizer as before.

I will use my hand to move the Earth, modeling how gravity moves Earth in space. This is really not a good model of gravity because my hand is on the surface of the globe and gravity is throughout our Solar System. My hand does make the globe move like Earth. We will only be observing one way Earth moves, which is called rotating. Later we will explore another type of movement called orbiting.

3. Demonstrate with the globe
Place the globe in front of the light source. Ask students if they notice that the Earth is tilted. Tell students that the Earth rotates on its axis, which is an imaginary line that goes through the center of the Earth from the north pole to the south pole. The Earth spins or rotates on this axis at a tilt (23.5°). Orient the globe with the supporting arm on the shadow side of the globe. Have students notice that the side of the globe toward the light is brightly lit and the side away from the light is dark. The dark side of the globe is in the shadow of the globe. There should also be a circular shadow on the wall behind the globe. Have a student find Colorado on the globe and tape the masking tape triangle to it. Explain, The Earth rotates on its axis once every day. It takes 24 hours for it to rotate. Watch what happens to the triangle’s shadow on our state as I rotate the globe. Notice when the shadow is in the lighted area and when it is in the dark area.
Rotate the globe slowly counterclockwise (when viewed from above the north pole). Have students watch the shadow of the tape triangle carefully. Rotate the globe again, hesitating as the triangle just comes into the light and casts a shadow. **This is morning, some time shortly after sunrise.** Ask students to describe the direction the shadow is pointing and the length. (Northwest, long shadow) Continue rotating to the noon position and observe the shorter shadow. Finally, hesitate at the afternoon position before rotating Colorado into darkness.

4. Discuss objects and shadows
If you have time, you can write the following questions and student answers on chart paper or under the document camera.

- **Where is west on this globe?** (West is on the left side of the globe.)
- **Where is east on the globe?** (East is on the right side of the globe.)
- **Where is north on this globe?** (North is located towards the top of the globe.)
- **What direction is the shadow pointing in our state early in the morning?** (In our state early in the morning, the shadow points northwest; halfway between north and west is where the shadow is pointing.)
- **What direction is the shadow pointing in our state around noon?** (North is the direction the shadow points around noon in our state.)
- **What direction is the shadow pointing in our state late in the afternoon?** (Northeast, halfway between north and east is where the shadow points in our state late in the afternoon.)
- **What makes the shadow change direction during the day?** (As the Earth rotates, the Sun appears to move across the sky as the day progresses. As the Earth rotates toward the east, the Sun appears to move toward the west in the sky. That changes the direction from which the sunlight is coming.)
- **How long is the shadow in the morning, noon, and afternoon?** (The shadow changes length – long in the morning, short at noon and long again in the afternoon.)
- **Why does the shadow change length?** (Shadows change length because of the angle from which the sunlight comes.)
• Why does the shadow change direction and length between morning and afternoon? (Shadows change direction and length between morning and afternoon because the position of the Sun in the sky changes during the day due to the Earth rotating around the Sun.)

Invite students to come up and rotate the globe and discuss their observations of direction and time. This concept can also be demonstrated by using a light (found in FOSS kit) with students holding a globe or a blow-up ball of the Earth (teams of 4 work well). You can place stickers to represent different locations on Earth. Make sure that the light stays stationary in the center of the room while students stand around the light in a circle. Have students rotate the globe. When the globe stops, have the students decide if it is sunrise, sunset, noon, or night in his/her location.

5. Update word wall and glossary
   Add “rotate” and “axis” to the word wall and have students add them to the glossary in their science notebooks.

6. Outdoor shadows
   Give each student a copy of the student sheet Outdoor Shadows*. There are three different scaffolded versions of this student sheet for you to choose from. Have the students glue the student sheet into their science notebook and add it to their table of contents with the corresponding page number. Have students complete the sheet independently or with a partner as you circulate and check answers.

7. Homework reminder
   Remind students to record their observations of the night sky from home.
Outdoor Shadows

How do shadows happen outdoors?

_________________________________________

_________________________________________

_________________________________________

Why do shadows change over a day?

_________________________________________

_________________________________________

_________________________________________
Outdoor Shadows

Shadows happen outdoors because...

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Shadows change shape and direction over a day because...

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Outdoor Shadows

Shadows happen outdoors because...

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Shadows change shape and direction over a day because...

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Outdoor Shadows

Shadows happen outdoors because ____________
from the__________ is blocked by an object to
create a ________________________.

Shadows change ________________________ and
________________________ over a day because the
Sun’s position in the sky changes during
the__________________________.

Word Bank (chose from these words to complete the sentences)
light Sun shadow
shape day direction
Session 11: Reading and Writing About Shadows [30 minutes] *OPTIONAL*

- Students will explain that day and night on Earth result from Earth’s rotation on its axis.
- Students will describe the pattern of movement for the Sun across the sky as observed from Earth.
- Students will develop a scientific explanation regarding relationships of the components of the Solar System (Earth and Sun).

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>My Shadow</td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Chart paper</td>
<td>What Causes Shadows</td>
<td>Glue</td>
</tr>
<tr>
<td>Sticky notes</td>
<td></td>
<td>Pencil</td>
</tr>
</tbody>
</table>

1. My Shadow
   Pass out My Shadow poem to students and have them glue it on the next available page in their science notebooks. Remind students to update their table of contents with the corresponding page number. Read the poem out loud together as a class, chorally.

   **My Shadow** By Robert Louis Stevenson 1850–1894
   *I have a little shadow that goes in and out with me,*
   *And what can be the use of him is more than I can see.*
   *He is very, very like me from the heels up to the head.*
   *And I see him jump before me, when I jump into my bed.*

   *The funniest thing about him is the way he likes to grow –*
   *Not at all like proper children which is always very slow;*
   *For he sometimes shoots up taller than an India-rubber ball,*
   *And he sometimes gets so little that there’s none of him at all.*

   *He hasn’t got a notion of how children ought to play,*
   *And can only make a fool of me in every sort of way.*
   *He stays so close beside me, he’s a coward you can see;*
   *I’d think shame to stick to nursie as that shadow sticks to me!*

   *One morning, very early, before the sun was up,*
   *I rose and found the shining dew on every buttercup;*
   *But my lazy little shadow, like and errant sleepy-head,*
   *Had stayed at home behind me and was fast asleep in bed.*

2. Share connections
   Have students sit in pairs, knee to knee, looking at each other in the face. Tell students, **Summarize the poem to each other and discuss what happened in the poem and why you think that happened. Use as many scientific words that we have learned in this unit as you can.**
   - One person speaks for one minute in response to the prompt, 2nd person listens carefully.
• Stop when one minute has passed.
• 2nd person tells what they heard their partner say in one minute.
• Stop when one minute has passed.
• 1st person clarifies if the ideas that their partner stated were misunderstood or left out.
• Stop in less than one minute or when talking stops.
• Trade the speaker and follow the same procedure again with the same prompt.

3. Changing Shadows
Have students switch partners to do a paired reading called Changing Shadows (page 4 - 8) in FOSS Science Resources Sun, Moon, and Stars book, which is an expository text that discusses what shadows are and what they tell about the apparent motions of the Sun over a day and over a year. Before students begin reading, discuss the author’s purpose for writing an expository article. Discuss the reader’s purpose for reading (What causes shadows to change? The Sun’s movement and shadows are evidence that the Sun moves). Students will be asked to answer questions at the end of the article, so model reading the questions out loud so students know what they should be looking for. You may write up the questions on chart paper or put them under the document camera for students to read along with you. While students are reading, provide sticky notes if they want to use them to identify where important information is located. Also hand out What Causes Shadows student sheet for students to glue into their science notebooks on the next available page. Remind students to update their table of contents with the corresponding page number. Have students discuss the answers to the questions with their partners and write their responses in their science notebook. Students may join with another pair to compare and refine their answers with more detail.

4. Homework reminder
Remind students to record their observations of the night sky from home.
My Shadow
BY ROBERT LOUIS STEVENSON 1850–1894

I have a little shadow that goes in and out with me,
And what can be the use of him is more than I can see.
He is very, very like me from the heels up to the head.
And I see him jump before me, when I jump into my bed.

The funniest thing about him is the way he likes to grow –
Not at all like proper children which is always very slow;
For he sometimes shoots up taller than an India-rubber ball,
And he sometimes gets so little that there’s none of him at all.

He hasn’t got a notion of how children ought to play,
And can only make a fool of me in every sort of way.
He stays so close beside me, he’s a coward you can see;
I’d think shame to stick to nursie as that shadow sticks to me!

One morning, very early, before the sun was up,
I rose and found the shining dew on every buttercup;
But my lazy little shadow, like and errant sleepy-head,
Had stayed at home behind me and was fast asleep in bed.

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The funniest thing about him is the way he likes to grow –
Not at all like proper children which is always very slow;
For he sometimes shoots up taller than an India-rubber ball,
And he sometimes gets so little that there’s none of him at all.

He hasn’t got a notion of how children ought to play,
And can only make a fool of me in every sort of way.
He stays so close beside me, he’s a coward you can see;
I’d think shame to stick to nursie as that shadow sticks to me!

One morning, very early, before the sun was up,
I rose and found the shining dew on every buttercup;
But my lazy little shadow, like and errant sleepy-head,
Had stayed at home behind me and was fast asleep in bed.
What Causes Shadows

1. How does the sun’s position in the sky change over a day?

___________________________________________________

___________________________________________________

___________________________________________________

___________________________________________________

2. In what ways do shadows change during a day?

___________________________________________________

___________________________________________________

___________________________________________________

___________________________________________________

What Causes Shadows Continued

3. What causes shadows to change during a day?

___________________________________________________

___________________________________________________

___________________________________________________

___________________________________________________
Session 12: Orbit and Rotate [15-25 minutes]

- Students will explain that day and night on Earth results from Earth’s rotation on its axis.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Rotate and Orbit</td>
<td>Pencil</td>
</tr>
<tr>
<td>Chart paper</td>
<td></td>
<td>Science notebook</td>
</tr>
</tbody>
</table>

1. Rotate and Orbit

Who can tell and show me what it means to rotate? Can anyone tell and show me what it means to orbit? Write the words on chart paper or under the document camera and write student definitions and drawings if needed. Students may have the misconception that they are the same thing. Write down their ideas even if they are incorrect, and then go back and correct any mistakes together as a class.

Have the students stand up and explain to them that their body will be a model of the Earth for this activity. Review how a model is the same and different from the real thing. Have students demonstrate the movement of orbit by walking in a circle around an object (a chair, science notebook, piece of paper, etc.) Have students either confirm the original definition of orbit or change their original definition to make more sense (to orbit is when one object goes around another in a circular pattern).

Have students demonstrate the movement of rotating by standing in one place and spinning (making sure they don’t hurt themselves or others). Have students either confirm the original definition of rotate or change their original definition to make more sense [to spin]. Clarify any misconceptions to make sure they understand the movement of each.

2. Call out activity

To reinforce the movement of the words, have students stand ready for you to call out either rotate or orbit, and for them to move accordingly. Do this several times until you are confident that the movements are understood by all students. (If a lamp is available, have students pretend they are Earth and the lamp is a model of the Sun or have one student or teacher be the designated model of the Sun.)
3. Earth’s rotation and orbit
Ask students if the Earth rotates or orbits. This is a trick question because the Earth does both. It rotates (a full rotation is 24 hours) while it orbits the Sun (a full orbit is 364.25 days). Demonstrate how the Earth rotates and orbits (around the Sun) at the same time. Have a student model the Earth while incorporating both rotation and orbit. Have a light, an object or a student to model the Sun in the middle. Make sure that students understand this concept well by having numerous students demonstrate rotating while orbiting around an object.

4. Rotate and orbit
Hand out the student sheet Rotate and Orbit and have students glue it into their science notebook on the next available page. Remind students to update the table of contents with the corresponding page number. Model drawing “rotate” under the document camera by showing movement with curved arrows. Have students work in pairs. When students have finished drawing both, have students show their drawings under the document camera to see if there are any misconceptions lingering. Have students complete the sentence frame on the worksheet with their partners.

Possible drawings for rotate

Possible drawing for orbit

5. Revise definitions of day and year
*How long does it take the Earth to rotate once?* (About 24 hours or a full day). *Now that we know a full day actually means one full rotation of the Earth (on it’s axis), let’s make up a new definition for day that is more scientific. Who can give me a good definition of day?* Have your students come up with a definition similar to the time it takes the Earth to make one full rotation. Your students may connect that a day may be different on Earth compared to other planets due to each planet’s speed while rotating.

*How long does it take the Earth to orbit the Sun?* (364.25 days- the 0.25 is added up over 4 years and a day is added to the western calendar for Leap Year.) *Now that we know a full year actually means one full orbit around the Sun, let’s make a new definition for year that is more scientific. Who can give me a good definition of year?* Have your students come up with a definition similar to the time it takes the Earth to make one full orbit around the Sun. Your students may connect that a year may be
different on Earth compared to other planets due to the other planet’s speed of orbit and distance from the Sun. Add these new definitions to the word wall and have students write them in the glossary in their science notebooks. Make sure the words “rotate” and “orbit” are also on the word wall and in student glossaries.

6. Online resources
   Below are online resources that contain short videos to help support the science concepts covered in this lesson.


   **ROTATE** [http://www.youtube.com/watch?v=q0WW-a6fU5M&feature=related](http://www.youtube.com/watch?v=q0WW-a6fU5M&feature=related) - note the light shining on the Earth, talk about how the Sun only shines on part of the Earth at a time, much like the shadow experience students had.


   [http://www.youtube.com/watch?v=k-oLJxjCzBg](http://www.youtube.com/watch?v=k-oLJxjCzBg) shows day and night

   **ROTATING** and **ORBITING** [http://www.youtube.com/watch?v=R2IP146KA5A](http://www.youtube.com/watch?v=R2IP146KA5A)


   **SEASONS** [http://www.youtube.com/watch?v=_KouS3mzlwM&feature=related](http://www.youtube.com/watch?v=_KouS3mzlwM&feature=related)
Rotate and Orbit

Draw a picture representing how the Earth rotates and orbits.

<table>
<thead>
<tr>
<th>Rotate</th>
<th>Orbit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Complete the following sentence:

The Earth ____________________________

and ____________________________ around the ____________________________.

Rotate and Orbit

Draw a picture representing how the Earth rotates and orbits.

<table>
<thead>
<tr>
<th>Rotate</th>
<th>Orbit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

Complete the following sentence:

The Earth ____________________________

and ____________________________ around the ____________________________.

___________________________________ and ____________________________ around the ____________________________.
Session 13: What Causes the Seasons? [45 minutes]

- Students will understand that the tilt of the Earth’s axis causes the seasons.
- Students will use a model to understand a scientific concept
- Students will compare and contrast the tilt of the Earth’s axis during the winter and summer months.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Comparing and Contrasting Summer and Winter Seasons</td>
<td>Pencil Glue Science notebooks</td>
</tr>
<tr>
<td>Internet (Billy Nye video)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chart paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polystyrene ball with a pencil or dowel pushed through it (optional)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Discuss the summer and winter seasons on Earth
Tell students, *Today we will learn about what causes the seasons on Earth.*
*First, let’s think about how the summer and winter seasons are different.*
Guiding questions for discussion are listed below. Record student answers on a t-chart on the white board or chart paper.

- *How is winter different from summer?*
- *How are the temperatures in winter different from the temperatures in summer?*
- *How are the clothes you wear in summer different from the clothes you wear in winter?*

2. Show Bill Nye “Seasons” video clip (available on Mediacast)
Find “Seasons” online at [http://www.gamequarium.org/cgi-bin/search/linfo.cgi?id=3751](http://www.gamequarium.org/cgi-bin/search/linfo.cgi?id=3751) and show the section of the video from time 1:15-2:42. After the video, use the following questions to guide a discussion.

- *Why do we have seasons on Earth?* (The tilt of the Earth’s axis as it orbits the Sun causes the seasons)
- *What is it called when the Earth travels around the Sun?* (Orbit)
- *What is the word that describes how the Earth “spins” on its axis?* (Rotate)
- *Describe the tilt of the Earth.*

Use student responses to create a picture on the board similar to the one below. The vertical line illustrates how the axis would be if the axis were not tilted. The line connecting the north and south poles shows the tilted axis of the Earth. The tilt is shown by using a polystyrene ball and pencil model to demonstrate for students by putting the model vertical, then tilting it to the side. Students can also act this out by standing straight up, then tilting their bodies to the side (trying to keep a straight line in their bodies) when instructed to tilt.
What happens to the tilt when the Earth orbits around the Sun? (It stays the same.)

3. Update word wall and glossaries
   Review the word wall to make sure the words “axis” and “tilt” are present. If they are not, add them to the word wall and have students add them to their glossaries. Make sure that students have incorporated “rotate” in their definition of “axis” (The Earth rotates on its axis.) Tilt is how the Earth’s axis leans to the side. The tilt of the Earth’s axis is always the same.

4. Reinforce ideas with Bill Nye clip
   Show the remaining portion of the Bill Nye Season video that begins at 2:42 - until the end of the “experiment” (about 3 minutes). Ask students:
   • What happens when the Earth is tilted towards the Sun? (The light and heat energy from the Sun is focused on a smaller area and it feels hotter. It’s summer.)
   • What happens when the Earth is tilted away from the Sun? (The light and heat energy from the Sun is spread out over a larger area and it feels colder. It’s winter.)
   • In the experiment, how did the temperature of the juice can lid change when the tilt of the lid changed? (Tilted lids were cooler than lids that were directly under the light.)
   • How did the experiment help you understand how the energy from the Sun hits the surface of the Earth? (The energy from the Sun hits the Earth at different angles depending on if the tilt of the Earth’s axis is away or towards, which causes our seasons.)

5. Compare and contrast the summer and winter seasons
Distribute the Comparing and Contrasting Summer and Winter Seasons student sheet. Have students glue it into their science notebooks and update their table of contents with the corresponding page number. **I’d like for you to turn and talk with your partner for two minutes about the following question:** How are the summer and winter seasons the same? After 2 minutes, have partners share out their ideas. Record ideas on a class student sheet in the example science notebook or on chart paper and have students record ideas in their science notebook. Sample responses are below. Students may also use pictures to display their understanding.

<table>
<thead>
<tr>
<th>How are the summer and winter seasons the same?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• They are both caused by the tilt of the Earth’s axis.</td>
</tr>
<tr>
<td>• The heat and light energy from the Sun is the same during both seasons.</td>
</tr>
<tr>
<td>• They both have a change in air temperature and types of weather associated with them.</td>
</tr>
</tbody>
</table>

**Now let’s focus our attention on the way that summer and winter are different. Let’s first focus on how the tilt of the Earth’s axis is different in summer and winter.** It may be helpful to draw pictures with the class before having them discuss their ideas. Have students label one side of their t-chart with Summer and the other side with Winter.

**Ask students,**

What is the tilt of the Earth’s axis when it’s summer season in the northern hemisphere? (The Earth’s northern hemisphere is tilted towards the Sun.) Draw a picture of the Earth tilted towards the Sun in the class t-chart.

**What is the tilt of the Earth’s axis when it’s winter season in the northern hemisphere?** (The Earth’s northern hemisphere is tilted away from the Sun.) Draw a picture of the Earth tilted away the Sun in the class t-chart.

**Ask students, I’d like for you to turn and talk with your partner for two minutes about the following question:** How are the summer and winter seasons different? Have partners share out and add their ideas to their worksheet. Possible student responses are below. Use the responses from this part of the session to assess student understanding.
<table>
<thead>
<tr>
<th>Summer in northern hemisphere</th>
<th>Winter in northern hemisphere</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Summer Diagram" /></td>
<td><img src="image2" alt="Winter Diagram" /></td>
</tr>
<tr>
<td>• The Earth’s axis is tilted towards the sun.</td>
<td>• The Earth’s axis is tilted away from the Sun.</td>
</tr>
<tr>
<td>• Energy from the Sun is focused on a smaller area.</td>
<td>• Energy from the Sun is spread out over a larger area.</td>
</tr>
<tr>
<td>• It’s warm.</td>
<td>• It’s cold.</td>
</tr>
</tbody>
</table>
Comparing and Contrasting Summer and Winter

How are the summer and winter seasons the same?

How are the summer and winter seasons different?
Session 14: Post Assessment [30 minutes]

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Sun Post Assessment</td>
<td>Pencil</td>
</tr>
<tr>
<td>Stapler</td>
<td></td>
<td>Colored pencil</td>
</tr>
<tr>
<td>Students’ Pre-Assessments</td>
<td></td>
<td>Science notebook</td>
</tr>
</tbody>
</table>

1. KWL

*Now that we have completed Investigation 1 on the Sun, let’s go back to our KWL that we started at the beginning and see if we can answer any of our questions that we wrote about.* Use either the example science notebook or chart paper where you wrote the class KWL chart at the beginning of the investigation and read the questions out loud with the students. Have students answer the questions out loud while you write them on the chart under the column “L: What I Learned About the Sun.” Have students also write the answers to the questions on their own KWL in their science notebooks under “L: What I Learned About the Sun.” If there are remaining questions, encourages students to search answers on their own or add in an additional session to investigate a concept further.

2. Post-assessment *OPTIONAL*

While students are seated at their desks, hand them the post assessment for Investigation 1: The Sun. Make sure students put their names at the top of the paper. Remind students that this is the same assessment that was given at the beginning of the unit. Place the assessment under the document camera and read out loud all the instructions and questions to students. *As you fill out the assessment, please raise your hand for clarification of words or instructions. I can read the text to you, but I cannot give you any answers. This is to show me what you have learned about the Sun and shadows.*

*When you have completed the post-assessment, please wait silently until the rest of the class has finished. Once everyone is finished, we are going to go over your pre and post assessments together and compare your answers.*

When the class has finished taking the post assessment, pass out their pre-assessments and make sure each student has a colored pencil to use while going over the assessments. Place the assessments under the document camera and read the questions out loud. You may put a students’ assessment under the document camera as an example for students to see how to revise an answer with a colored pencil. Have students volunteer their answers while others check to see if their responses are correct. If there are disagreements about answers, encourage students to look them up in their science notebooks. When the class has finished going over the assessments, have students staple them together and hand them in to you (if you score them).
### FOSS Moon: Investigation 2

<table>
<thead>
<tr>
<th>Session</th>
<th>Content Objectives</th>
<th>Language Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Introduction</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• KWL</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>The Night Sky</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Create class Moon calendar</td>
<td>• Collaboratively develop a focus question about the Moon</td>
</tr>
<tr>
<td></td>
<td>• Develop a focus question</td>
<td>• Participate in a class discussion about the Moon and objects in the night sky</td>
</tr>
<tr>
<td></td>
<td>• Discuss observations of the Moon and other objects in the sky</td>
<td>• Complete a written observation about the Moon</td>
</tr>
<tr>
<td></td>
<td>• Write night sky observations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Students will be able to identify observable objects in the sky – Sun, Moon, and stars</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Students will know that the Moon can appear in the sky during both night and day</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>Read “The Night Sky”</strong></td>
<td>• Make text to self connections with pictures in the text</td>
</tr>
<tr>
<td></td>
<td>• Discuss purpose for reading and types of connections</td>
<td>• Read informational text for content.</td>
</tr>
<tr>
<td></td>
<td>• Pre-read questions about the reading</td>
<td>• Respond to questions about the text orally and in writing</td>
</tr>
<tr>
<td></td>
<td>• Read and answer questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Structured small-group discussion about answers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Students will use indirect evidence to investigate components of the Solar System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Students will know that a variety of objects can be observed in the night sky</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><strong>Phases of the Moon</strong></td>
<td>• Listen for information in a video about the Moon</td>
</tr>
<tr>
<td></td>
<td>• Update Moon calendar and discuss patterns</td>
<td>• Participate in a class discussion about the Moon</td>
</tr>
<tr>
<td></td>
<td>• Make predictions about the Moon</td>
<td>• Represent phases of the Moon with drawings</td>
</tr>
<tr>
<td></td>
<td>• Review questions to think about while watching video</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Watch video</td>
<td></td>
</tr>
</tbody>
</table>
| 5 | Read “Changing Moon”  
• Discuss questions  
• Complete “Phases of the Moon” sheet  
• Complete Evidence from Moon Video  
| Students will know that the Moon changes its appearance, or phase, in a regular pattern over 4 weeks  
• Students will develop a scientific explanation regarding relationships of the components of the Solar System (Earth, Moon, Sun)  
• Students will know that the Moon appears to change shape because it orbits around the Earth, and as it orbits, we see different amounts of it lit by the Sun from Earth  
| Use pictures and captions while reading informational text with a partner  
• Answer questions about the phases of the Moon, using an appropriate level of scaffolding |
| 6 | Moon phase modeling  
• Discuss the use of a model to represent the Moon  
• Demonstrate Moon phases and discuss  
• Students model Moon phases  
• Rephrase focus question  
• Complete “Phases of the Moon 2” sheet and compare with class Moon calendar  
| Students will know that the Moon changes its appearance, or phase, in a regular pattern over 4 weeks  
• Students will develop a scientific explanation regarding relationships of the components of the Solar System (Earth, Moon, Sun)  
• Students will know that the Moon appears to change shape because it orbits around the Earth, and as it orbits, we see different amounts of it lit by the Sun from Earth  
| Use models to physically demonstrate phases of the Moon  
• Revise a written focus question |
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>• Write answer to focus question.</td>
<td>orbits, we see different amounts of it lit by the Sun from Earth</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Read “Summary: The Moon”</td>
<td>Students will know that the Moon changes its appearance, or phase, in a regular pattern over 4 weeks</td>
</tr>
<tr>
<td></td>
<td>• Review author’s purpose</td>
<td>• Students will develop a scientific explanation regarding relationships of the components of the Solar System (Earth, Moon, Sun)</td>
</tr>
<tr>
<td></td>
<td>• Paired reading of “Summary: The Moon”</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Scientific Explanation</td>
<td>Students will develop a scientific explanation regarding relationships of the components of the Solar System (Earth, Moon, Sun)</td>
</tr>
<tr>
<td></td>
<td>• Write a scientific explanation about Moon phases</td>
<td>• Identify direct and indirect evidence</td>
</tr>
<tr>
<td></td>
<td>• Use writing process to publish scientific explanation</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Revisit KWL</td>
<td></td>
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<tr>
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</tbody>
</table>
INV.2.1. FOSS Sun, Moon, and Planets
Investigation 2 – Moon

Session 1: Pre Assessment MOON and KWL [30 minutes]

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and staple</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td></td>
<td>Pencil</td>
</tr>
<tr>
<td>Chart paper</td>
<td></td>
<td>Science notebook</td>
</tr>
</tbody>
</table>

Have students continue to observe and record night sky observations for the next few weeks.

1. Model new section
   Use your example science notebook to model setting up Investigation 2 under the document camera or use chart paper. Since we are starting a new investigation (the Moon), let’s set up a new section in our table of contents labeled Investigation 2: The Moon. This will help keep us organized. Write “Investigation 2: The Moon” on the next available line in your table of contents for students to see and have them write the same in the table of contents in their science notebooks.

2. KWL chart
   Use your example science notebook under the document camera, or use chart paper to create a KWL chart. Let’s make a class KWL chart about the Moon in our science notebooks. Please put the title Moon KWL Chart at the top of the page. Remember to add this to your table of contents with the corresponding page number. Model writing “Moon KWL Chart” at the top of the next available page and also write it in the table of contents in your example science notebook and add the corresponding page number. Model writing and have students write “K: What I Already Know About the Moon” at the top of their page and list what they already know. Have students share out what they know and write their ideas on the class chart under where you have written “K: What I Already Know About the Moon”. Students may or may not add all of the ideas to their list after hearing other students’ ideas. (The goal is to have students feel safe sharing their ideas freely, so adding comments like “We’ll be learning about that, that is discovered during this unit, we’ll find out more about that, etc. are encouraged if the teacher feels s/he needs to comment.)

Investigation Two: Moon

K: What I Already Know About the Moon

Next, have students write “W: What I Want to Know About the Moon” and leave space for answers as they are discovered. (This may be more than one page for some students.) Have students share out their questions while you write them on the class KWL chart under where you have written “W: What I Want to Know about the Moon”. Students may add questions to their own notebooks.
Once students have finished writing down what they know, have them write “L: What I Learned about the Moon” and leave at least a half page to be completed at the end of the investigation.

3. Update word wall
   Add in any new vocabulary that may apply to what students have shared during the KWL activity, but do not define the words yet.
<table>
<thead>
<tr>
<th>Sunday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
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</tbody>
</table>
Session 2: The Night Sky [30-35 minutes]

• Students will be able to identify observable objects in the sky – Sun, Moon, and stars.
• Students will know that the Moon can appear in the sky during both night and day.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pen/Marker</td>
<td>Moon Calendar</td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Document camera/LCD projector</td>
<td>Night Sky Observations*</td>
<td>Glue</td>
</tr>
<tr>
<td>Chart paper</td>
<td></td>
<td>Pencil</td>
</tr>
<tr>
<td>Class calendar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class Moon calendar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Have students continue observing and recording night sky observations for the next few weeks. Night Sky Observation* sheet has a scaffolded version for students that need extra support with sentence stems and a word bank.

1. Fill in class Moon calendar

   *For the past few weeks you have been recording what you see in the sky at night at home. We are going to share what you have observed and recorded and create a Moon Calendar for the class.* Have an enlarged class Moon Calendar either under the document camera or on chart paper. Students should already have their own Moon Calendar in which they have been drawing and writing down their observations (if not, give them a copy of the Moon Calendar student sheet). Remind students to update their table of contents by adding in the title Moon Calendar and the corresponding page number if they haven’t done so already.

   Record the data for the past two weeks on the class Moon Calendar with the help of students’ observations. You might want to model entering the first day’s data, then invite students to come up and add their data. Students may copy data from the class Moon Calendar onto their own Moon Calendar sheet if they have missed any observations. Students’ drawings of the Moon should have about the same shape. Consult a Moon calendar online [http://stardate.org/nightsky/moon](http://stardate.org/nightsky/moon) if students were unable to see the moon due to weather. For a different blank moon calendar, go to [http://sciencenetlinks.com/media/filer/2011/10/14/moon_worksheet.html](http://sciencenetlinks.com/media/filer/2011/10/14/moon_worksheet.html).

   **Moon Calendar**

<table>
<thead>
<tr>
<th>Sunday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
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</tbody>
</table>

   (Number boxes according to the current calendar or use website.)

2. Discuss objects in the sky

   Ask students the following questions and write down their answers on chart paper or under the document camera for future reference.

   • *What did the Moon look like on the first day that we collected data?*
• **What natural objects did you observe in the night sky?** (Some possibilities are the Moon, stars, clouds, rain, fog.)
• **Did you observe the same objects in the night sky and the day sky?** (The Moon, satellites, airplanes, clouds, rain, fog.)
• **Are there some objects you don’t see at night or in the morning? How are they different?** (It’s difficult to see stars during the day—students may see a planet during the day, the full Moon is usually seen only at night and not during the day.)
• **When can you see the Sun? The Moon?** (You can see the Sun only during the day, the stars only at night. Sometimes you can see the Moon during the day; sometimes you can see the Moon at night.)
• **Did the sky look different each night?** (Answers will vary depending on weather, but the Moon shape will always look different every 2 nights.)
• **What have you learned about the shape of the Moon?** (It appears to change a little bit each day.)
• **What do you think the Moon will look like tomorrow? Why?** (Students should be able to predict the shape using the pattern of either the shape getting bigger or smaller.)
• **Is there a pattern to the changes in the shape of the Moon?**
• **How would you describe that pattern?** (The Moon either gets a little smaller or a little bigger each night.)

3. **Focus question**
Tell students, *All scientists begin investigating with a question. Let’s look at our Moon calendars and think of a question you may have.* Encourage students to look at the changes in the shape of the Moon. Have students share with a partner about ideas for a focus question. Have students share their ideas with the entire class. Guide them to the focus question: “How does the shape of the Moon appear to change over time?” On the next available page in your example science notebook, write “Focus Question: How does the shape of the Moon appear to change over time?” at the top of the page. Have students do the same in their science notebooks and remind them to update the table of contents with the corresponding page number.
*We are going to look at our Moon data closer and then make a claim that answers our question. Let’s share some of our observations.*

4. **Night sky observation writing**
Pass out Night Sky Observations sheet to the students. Have them glue it on the next available page in their science notebooks and remind them to update their table of contents with the corresponding page number. Have students complete the observation sheet and share out with the class to compare. Students may work together and use the class list of answers to help support their individual answers.
**Night Sky Observations**  
Please answer the question in complete sentences.

Focus Question: ____________________________


Direct / Indirect evidence? (circle one)

<table>
<thead>
<tr>
<th>Data</th>
<th>Evidence 1</th>
<th>Evidence 2</th>
<th>Evidence 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moon Calendar Observation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Session 3: The Night Sky Literacy Connection [20-25 minutes]

- Students will use indirect evidence to investigate components of the Solar System.
- Students will know that a variety of objects can be observed the night sky.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pen/Marker</td>
<td>The Night Sky Review</td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Document camera/LCD projector</td>
<td></td>
<td>Pencil</td>
</tr>
<tr>
<td>Sticky notes</td>
<td></td>
<td>Glue</td>
</tr>
</tbody>
</table>

1. Read “The Night Sky”
   Have students sit in pairs to read “The Night Sky” (pages 14-18) in the FOSS Science Resources Sun, Moon, and Stars book containing informational text that describes the objects that can be observed in the sky at night. Tell students, **We are going to do some reading about the night sky, but before we read, I’d like to use some of our literacy strategies for science!**
   - **What is the purpose for reading about the night sky?** (To learn more information about objects in the night sky.)
   - **Let’s look at the pictures before we read and make our connections to the pictures. Who can tell me the different connections we can make?** (Text to self, text to text and text to world.)
   - **Let’s make some text to self connections with the pictures. Who can tell me some connections they’ve made to the pictures?**
   Hand out The Night Sky Review student sheet to the students. Have students read these questions once to their neighbor before they begin reading. Pass out sticky notes for students to use if they’d like (and if you use this strategy in your practice) to mark locations of answers to the questions. Remind students that while they are reading, they should also read the diagrams and look closely at the photographs to get more information. Give students time to read “The Night Sky” in pairs and locate answers to questions.

2. Discuss reading
   When students have completed reading, have them discuss the answers to the questions from The Night Sky Review and find the locations within the text with their partners. Have students write their answers on their student sheets. Remind students that their responses should be in complete sentences. Have students glue the sheet into their science notebook and update their table of contents with the corresponding page number. There may be several words in the reading that are new. Have them write down these words in the glossary in the back of their science notebooks and go over them as a class after students have finished discussing their answers.
Have students join with another pair of students to compare and refine their answers in more detail. There are four questions, one for each student to facilitate the discussion. For each group, choose the student that is sitting closest to North as Student 1 and number the rest in clockwise order.

- Student 1 will read question 1 out loud to the group.
- Ask their original partner to read his/her written response from their science notebook.
- Ask next student in clockwise order to read his/her written response from their science notebook.
- Ask the last student to read his/her written response from their science notebook.
- And finally have the first student read his/her written response from their science notebook.
- Students will clarify ideas by asking questions about each other’s responses.
- Students will show where their answer was in the text by sharing text location and reading aloud.
- Students will add details and revise written responses with a colored pencil.
- Student 1 will re-read the question to make sure all of the question was addressed.

Have students continue the process by rotating to Student 2 and Question 2, until all 4 questions are complete. It may be helpful for students to use a colored pencil when revising their responses with input from others.

3. Update word wall

During the reading, possible words that may be unknown are “sliver”, “orbit”, “planet”, “Venus”, “star”, “horizon”, “Mercury”, “Mars”, “Jupiter” and “Saturn.” Add any new words to the word wall and have students add them to the glossary in their science notebooks if they are not already there.
The Night Sky Review
Write your answers in complete sentences

1. What are some of the objects you can see in the night sky that you can’t see during the day?
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________

2. Which object is the brightest object in the night sky?
   __________________________________________________________________________
   __________________________________________________________________________

3. Which star is the closest to planet Earth?
   __________________________________________________________________________
   __________________________________________________________________________

4. Look at the picture of the crescent Moon on page 18 of the Science Resources book. What is the other bright object you can see in the night sky?
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
**Session 4: Phases of the Moon [20-30 minutes]**

- Students will observe and describe the pattern of the Moon’s phases.
- Students will know that the Moon changes its appearance, or phase, in a regular pattern over 4 weeks.
- Students will know that the Moon appears to change shape because it orbits around the Earth, and as it orbits, we see different amounts of it lit by the Sun from Earth.

**Materials needed**

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Moon Prediction</td>
<td>Pencil</td>
</tr>
<tr>
<td>Chart paper</td>
<td>Phases of the Moon 1</td>
<td>Science notebook</td>
</tr>
<tr>
<td>Class Moon Calendar</td>
<td>Evidence Graphic</td>
<td>Glue</td>
</tr>
<tr>
<td>Computer &amp; Internet</td>
<td>Organizer</td>
<td></td>
</tr>
</tbody>
</table>

You can either view the FOSS video/DVD (26 min) or several of the videos from NASA online or both if time permits. Review and decide what works for you and your class with the purpose of viewing to discover the vocabulary to describe moon shapes. To watch the NASA video about the Moon, go to the following website, click on K-5 Section and scroll down to Our World: The Moon.

http://www.nasa.gov/audience/foreducators/nasaeclish/search.html?terms=&category=1000

1. **Update class Moon calendar**
   Update the class Moon calendar and fill in any missing days. Ask students,
   - *What was our focus question about the Moon* (How does the shape of the Moon change over time?)
   - *How did the shape of the Moon change over time?*
   - *How would you describe the pattern of the Moon phases?*
   - *What shape do you predict the Moon will look like two days from now?*
   - *Why?*
   Allow students time to generate predictions orally.

2. **Predictions**
   Give each student a copy of the student sheet Moon Prediction. Have students glue this into their science notebook and update their table of contents with the corresponding page number. Have students complete this with a partner.

3. **Video**
   *We are going to watch a video about the Moon. After the video we will discuss the following questions. Look and listen for the answers while viewing the video.* Write the following questions on the board, chart paper or under the document camera and read them out loud to the class.
   - *What does “the dark side of the Moon” mean?*
   - *Why is the same side of the Moon always seen from Earth?*
   - *When we see the Moon lit up, where does the light come from?* (Sun)
   - *When the Earth is between the Sun and the Moon, what phase is it in?* (Full)
   View FOSS video/DVD (26 minutes) or several of the videos from NASA online. Feel free to stop the video of choice periodically to point out information and highlight new vocabulary.
After viewing this video, ask students the following questions.

- **What does “the dark side of the Moon” mean?** (The side of the Moon facing away from the Sun and therefore not reflecting any sunlight.)
- **Why is the same side of the Moon always seen from Earth?** (The Moon rotates and orbits at the same speed in relationship to Earth’s rotation and orbit so that only one side of the Moon can be viewed from Earth.)

4. **Update word wall**
The following words may need to be added to the word wall: “rotate”, “revolve”, “new moon”, “quarter moon” and “full moon”. You may not have full definitions for each of these words, but put them on the word wall to later be defined. Have students also add these words to the glossary in their science notebooks.

5. **Phases of the Moon 1**
Hand students the Phases of the Moon 1 sheet and have them glue them into their science notebooks. Remind them to update the table of contents with the corresponding page number.

*Let’s see if we can fill in the different phases of the Moon from our own Moon Calendars and from what we just learned in the Moon video.* Demonstrate on the example science notebook under the document camera or draw an enlarged version of Phases of the Moon 1 on chart paper. Begin with a full circle colored in, indicating a new moon (it’s dark because we can’t see it). If students already know the names of the phases of the Moon, include them. If not, leave them blank and add them later after students have learned them. Have students either share the next phase by drawing it on the example science notebook or have them show their own drawing from their science notebook (or use examples from the class Moon Calendar). Try to incorporate the new vocabulary learned from the videos as you go over the phases of the Moon with the students.

6. **Record evidence from Moon video**
Give each student a copy of the student sheet Evidence Graphic Organizer. Have students glue this into their science notebook and update their table of contents with the corresponding page number. Students should be able to fill out the focus questions independently, and may work with a partner to write the evidence in the first blank row. If students need extra support, you can fill in the organizer with the class.
Moon Prediction

Today’s date:

Draw what you think the Moon will look like in two days?

__________________________

__________________________

__________________________

Explain why you think the Moon will look like your drawing.

__________________________

__________________________

__________________________

Moon Prediction

Today’s date:

Draw what you think the Moon will look like in two days?

__________________________

__________________________

__________________________

Explain why you think the Moon will look like your drawing.

__________________________

__________________________

__________________________
# Evidence Graphic Organizer

Focus Question: __________________________________________________________

<table>
<thead>
<tr>
<th>Source</th>
<th>Evidence 1</th>
<th>Evidence 2</th>
<th>Evidence 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moon Video</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Evidence or Indirect Evidence</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Direct Evidence or Indirect Evidence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Evidence or Indirect Evidence</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Session 5: Changing Moon [30 minutes]

- The Moon changes is appearance, or phase, in a regular pattern over 4 weeks.
- Moon phase is the portion of the illuminated half of the Moon that is visible from Earth.
- Students will know that the Moon appears to change shape because it orbits around the Earth, and as it orbits, we see different amounts of it lit by the Sun from Earth.

### Materials needed

<table>
<thead>
<tr>
<th>Papers to copy and cut</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Pencil</td>
</tr>
<tr>
<td>Changing Moon*</td>
<td>Science notebook</td>
</tr>
<tr>
<td>Glue</td>
<td>FOSS Sun, Moon and Stars book</td>
</tr>
</tbody>
</table>

*Changing Moon sheet has a scaffolded version for students that need extra support with sentence stems and a word bank.

1. Paired Reading
   Students will be doing a shared reading of “Changing Moon” (pages 19-29) in the FOSS Science Resources Sun, Moon and Stars reader that describes the phases of the Moon, the names and more information about the lunar cycle. They can also listen using a mobile Apple device via iTunes (search FOSS Science).
   Before reading, review with the class the author’s purpose for writing an expository text. Then discuss the reader’s purpose for reading the article (To make connections to what you learned in the previous sessions and in Investigation 2). Model how to read a diagram and captions to photographs by doing a picture walk (identifying photographs) as a whole class and detailing captions, titles, and labels. Ask, **What do you notice in this non-fiction book?** (Photographs and charts). **What can you learn from looking at the text features?**

   Students will be asked to answer questions at the end of the article, so you may either read the questions out loud to the class or remind them to pre-read the questions to their partners prior to reading to know what is important to look for. Pass out the Changing Moon* student sheet and have students glue it into their science notebooks on the next available page. Remind students to update their table of contents and add the corresponding page number. There is a scaffolded version of Changing Moon* for students that need extra writing support. While students are reading, remind them to find the answers to the questions within the text and to remember to read the diagrams and photographs for more information.

2. Discussion
   When students have completed reading the expository text, have them discuss their answers and the locations within the text with their partners, and write their answers in their science notebooks. After attempting or completing the questions, students may join another pair of students to compare and refine their answers with more detail. Go over the answers with the class and if there are any discrepancies, refer back to the
FOSS reader to find the information within the text. While many of the words from the reading may be new, wait until the next class session to add the new words to the class word wall and student glossaries.

Questions (priority questions 1, 2 and 5)

<table>
<thead>
<tr>
<th>Changing Moon</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How long does it take Earth’s Moon to complete one lunar cycle? (28 days, or 4 weeks)</td>
</tr>
<tr>
<td>2. What is a new moon and what causes it? (It is the phase of the Moon that occurs when the Moon is between Earth and the Sun. The new moon is invisible because the Moon’s dark side is toward Earth.)</td>
</tr>
<tr>
<td>3. What is the difference between a waxing moon and a waning moon? (The waxing moon appears to get bigger each successive day. The waning moon appears to be smaller each day.)</td>
</tr>
<tr>
<td>4. What is the difference between a crescent moon and a gibbous moon? (A crescent moon shows less than half of the Moon illuminated. A gibbous moon shows more than half of the Moon illuminated.)</td>
</tr>
<tr>
<td>5. Describe the Moon’s appearance at 1 week, 2 weeks, 3 weeks, and 4 weeks after the new moon. (Drawings can be included in the explanation.) (Week 1 is first quarter; the right half of the Moon is bright. Week 2 is the full moon; the whole Moon is bright. Week 3 is the third quarter; the left side of the Moon is bright. Week 4 is the new moon.)</td>
</tr>
</tbody>
</table>

OR Answers in complete sentences (students own words)

Changing Moon
1. It takes Earth’s Moon 28 days, or 4 weeks, to complete one lunar cycle.
2. The new moon is the phase of the Moon that occurs when the Moon is between Earth and the Sun. The new moon is invisible because the Moon’s dark side is toward Earth.
3. The difference between a waxing moon and a waning moon is the size. The waxing moon appears to get bigger each successive day. The waning moon appears to be smaller each day.
4. The difference between a crescent moon and a gibbous moon is how much light is on the Moon. A crescent moon shows less than half of the Moon illuminated. A gibbous moon shows more than half of the Moon illuminated.
5. After the new moon, each week the Moon looks different.
   - Week 1 is first quarter; the right half of the Moon is bright.
   - Week 2 is the full moon; the whole Moon is bright.
   - Week 3 is the third quarter; the left side of the Moon is bright.
   - Week 4 is the new moon.

OR

*Scaffolded document Cloze Activity (questions 1, 2, and 5 are focus)

<table>
<thead>
<tr>
<th>Changing Moon</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It takes Earth’s Moon_______ days, or _______ weeks, to complete one lunar cycle.</td>
</tr>
</tbody>
</table>
2. The __________ Moon is the phase of the Moon that occurs when the Moon is between Earth and the Sun. The __________ moon is invisible because the Moon’s __________ side is toward Earth.

3. The difference between a waxing moon and a waning moon is the __________. The waxing moon appears to get __________ each successive day. The waning moon appears to be __________ each day.

4. The difference between a crescent moon and a gibbous moon is how much __________ is on the moon. A crescent moon shows __________ than half of the Moon illuminated. A gibbous moon shows __________ than half of the Moon illuminated.

5. After the new moon, each week the Moon looks different.
   a. Week 1 is __________; the right half of the Moon is bright.
   b. Week 2 is the __________; the whole Moon is bright.
   c. Week 3 is the __________; the __________ of the Moon is bright.
   d. Week 4 is the __________.

   **Word Bank**
   1. 28 4
   2. New New Dark
   3. Size Bigger Smaller
   4. Light Less More
   5. first quarter full moon third quarter new moon

3. **Evidence graphic organizer**
   Have students turn back to their Evidence Graphic Organizer in their science notebooks. Have students fill out the evidence in the next row. Remind them to circle whether or not the evidence is direct or indirect.
Changing Moon
Write answers in complete sentences.

1. How long does it take Earth’s Moon to complete one lunar cycle?

________________________________________________________________________

________________________________________________________________________

2. What is a new moon and what causes it?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

3. What is the difference between a waxing moon and a waning moon?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Changing Moon Continued

4. What is the difference between a crescent moon and a gibbous moon?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

5. Describe the Moon’s appearance 1 week, 2 weeks, 3 weeks, and 4 weeks after the new moon. (Drawings can be included in explanation.)

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Changing Moon
Fill in the blanks with the correct word or number.

1. It takes Earth’s Moon_______ days, or ______ weeks to complete one lunar cycle.

2. The____________________ moon is the phase of the Moon that occurs when the Moon is between Earth and the Sun. The _______________ moon is invisible because the Moon’s ________________ side is toward Earth.

3. The difference between a waxing moon and a waning moon is the__________________. The waxing moon appears to get ________________ each successive day. The waning moon appears to get ________________ each day.

4. The difference between a crescent moon and a gibbous moon is how much______________ is on the moon. A crescent moon shows __________ than half of the Moon illuminated. A gibbous moon shows ______________ than half of the Moon illuminated.

5. After the new moon, each week the moon looks different.
   a. Week 1 is___________; the right half of the Moon is bright.
   b. Week 2 is the______________________; the whole Moon is bright.
   c. Week 3 is the; the ________________ of the Moon is bright.

Week 4 is the ______________________________.

Word Bank (words may be used more than once)
New     Dark     Size     4     Bigger     Smaller     28

More     third quarter
Session 6 Moon Phase Modeling [30 minutes]

- Students will know that the Moon changes its appearance, or phase, in a regular pattern over 4 weeks.
- Students will develop a scientific explanation regarding relationships of the components of the Solar System (Earth, Moon, Sun).
- Students will know that the Moon appears to change shape because it orbits around the Earth, and as it orbits, we see different amounts of it lit by the Sun from Earth.

<table>
<thead>
<tr>
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<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Phases of the Moon 2</td>
<td>Pencil</td>
</tr>
<tr>
<td>Light</td>
<td>New Focus Question for the Moon*</td>
<td>Science notebook</td>
</tr>
<tr>
<td>Pictures of phases of the Moon with names</td>
<td></td>
<td>Glue</td>
</tr>
<tr>
<td>1 per pair: White polystyrene spheres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slim straws/pencils</td>
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</tr>
</tbody>
</table>

*New Focus Question for the Moon sheet is a scaffolded version for students that need extra support with sentence stems and a word bank.

1. Use of models
   Remind students that scientists use models to explain things that are very big and far away. Hold the ball with the straw in front of the class and ask students the following questions. Have students share their ideas with their partners before sharing out with the entire class.
   - **How is this a good model of the Moon?** (Sphere, rotates, can orbit)
   - **How is this not a good model of the Moon?** (Size)
   - **What does the light represent?** (Sun)
   - **Where does the light on the (real) Moon come from?** (Sun)
   - **How much of the ball can be lit by the light source?** (Half)
   - **Where is the part of the ball (Moon) that is in the dark?** (The side facing away from the light source.)

2. Demonstrate Moon phases
   Have the class gather around, being careful to keep clear of the light source. Make sure that you have pictures of the phases of the Moon with the corresponding name either under the document camera or on the board for students to see while you demonstrate. Stand in the light and hold the Moon model at arm’s length in front of your face. Rotate your whole body in a counterclockwise direction with your arm out. Have students observe the amount of light that can be seen on the Moon model from where you (Earth) are standing. Ask students, **What does the amount of light shown on the Moon model represent?** (The phases of the Moon.) Go through all the phases of the Moon by rotating a full circle in place, naming each stage for students to become familiar with the names. Start again, making sure you are in the new moon phase. Rotate slowly in the counterclockwise direction through one entire phase cycle. While you are demonstrating the Moon phases, have a student point to the corresponding Moon phase picture and say the name out loud: new moon, waxing crescent, first quarter,
waxing gibbous, full moon, waning gibbous, third quarter, waning crescent, to the new Moon again.

3. Update word wall and glossary
Have students write the following words in the glossary of their science notebooks:

- A **Moon phase** is the shape of the bright part of the Moon.
- A **new moon** occurs when the Moon is positioned between Earth and the Sun. The new moon is dark.
- A **full moon** occurs when Earth is positioned between the Sun and the Moon. The entire face of the Moon is lit.
- A **first-quarter moon** occurs when the Moon is halfway between full-moon position and new-moon position. The right side of the Moon’s face is lit.
- A **third-quarter moon** occurs when the Moon is halfway between full-moon position and new-moon position. The left half of the Moon’s face is lit.
- A **crescent moon** is any phase of the Moon that has less than half of its face illuminated.
- A **gibbous moon** is any phase of the Moon that has more than half of its face illuminated.
- When the face of the Moon looks larger each day, it is **waxing**.
- When the face of the Moon looks smaller each day, it is **waning**.

4. Students demonstrate Moon phases
Each pair of students will get a polystyrene ball and one straw to stick in the bottom of the ball. Make sure that the light source is in the center of the room. Each student should have at least one turn creating the Moon phases while saying the names of the Moon phases as they rotate.

5. Discuss Moon phase activity
Ask students the following questions:

- **Where did you stand, and how did you hold the Moon model to observe a full moon?** (The Sun was at their back, and the Moon was in front of them so they could see only the light side of the ball.)
• Where did you stand, and how did you hold the Moon model to observe a new moon? (The Sun and Moon were both in front of them. They could see only the dark side of the ball.)

• Where did you stand, and how did you hold the Moon model to observe a first-quarter moon? (The Sun was shining on their right cheek, and the Moon was out in front of their face.)

• Where did you stand, and how did you hold the Moon model to observe a third-quarter moon? (The Sun was shining on their left cheek and the Moon was in front of their face.)

6. Phases of the Moon 2
   Hand out Phases of the Moon 2 to the students and have them glue it into the next available page in their science notebooks. Remind students to update their table of contents with the corresponding page number. Model the first entry with student suggestions and pay close attention to the source of light- it is coming from the bottom of the page. Have students complete this sheet with a partner. If students are having trouble drawing and answering the questions, allow for them to use the Moon models and light to better support their understanding.

7. Comparison
   Let's compare our Moon Calendars to the Phases of the Moon 2 worksheet.
   • Can you find the pattern in both?
   • Can you predict what the Moon will look like in 5 nights? In 10 nights?
   • What questions do you have after observing the pattern of the Moon?

   Share your questions with your neighbor. Now that we have more information about the Moon, we can change our focus question to be more detailed. Scientists often clarify their questions to get more specific answers. Let's try and make our focus question more specific. Have students share their questions out loud and write a few examples on the board. Formulate the focus question on the board with students’ ideas. An example is “How does the Moon change its shape over 4 weeks?” (Note the detail of time for the cycle in the question.)

   Have students write the new focus question on the next available page in their science notebooks and title it “New Focus Question for the Moon” and add the corresponding page number. A scaffolded New Focus Question and Response sheet has been provided for students that need extra writing support. Students should update their table of contents with the corresponding page number.

   Use the new focus question and the vocabulary of the Moon phases to write a response to the questions. Remember to use your Moon Calendars and Phases of the Moon 1 and 2 to help support your answer. Share your responses with a partner, then with the people in your small group. Take a few minutes to revise your response with details.
8. Evidence graphic organizer
Have students turn back to their Evidence Graphic Organizer in their science notebooks and fill in the evidence from this activity in the next available row. Note that it could be argued that modeling the Moon phases is both direct and indirect evidence. The students are experiencing a phenomenon directly, but it is a model of the Earth, Sun, Moon system – not the actual system itself that is being observed.
PHASES OF THE MOON–2

The Moon orbits Earth during a 4-week lunar cycle. Place in each box the phase of the Moon we see from Earth during the cycle and name the phase. Note where the Sun is.

1. full Moon, waxing gibbous, third quarter, waning crescent, waxing crescent, new Moon, first quarter, waning gibbous

Earth

Sunlight
New Focus Questions for the Moon

How does the __________________ change its __________________ over ________________?

The Moon changes appearance in a predictable ____________________ from the invisible _________________.

__________________________, to the ______________________________, back to the ________________________________.

WORD BANK:
cycle    new moon    full moon    new moon

New Focus Questions for the Moon

How does the __________________ change its __________________ over ________________?

The Moon changes appearance in a predictable ____________________ from the invisible _________________.

__________________________, to the ______________________________, back to the ________________________________.

WORD BANK:
cycle    new moon    full moon    new moon
Session 7: Summary Reading [30 minutes]

- Students will know that the Moon changes its appearance, or phase in a regular pattern over 4 weeks
- Students will develop a scientific explanation regarding relationships of the components of the Solar System (Earth, Moon, Sun)

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pen/Marker</td>
<td>Summary: The Moon</td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Document camera/LCD projector</td>
<td></td>
<td>Pencil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Glue</td>
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<tr>
<td></td>
<td></td>
<td>Sun, Moon and Stars</td>
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<td></td>
<td></td>
<td>FOSS book</td>
</tr>
</tbody>
</table>

1. Reading

Have students in pairs to read “Summary: The Moon” (page 30-33) in the FOSS Science Resources Sun, Moon, and Stars book, a text that revisits the concepts developed in the investigation. Before students read, review the author’s purpose for writing an expository text. Discuss the reader’s purpose for reading. Tell students, *We will be reading to see if this article confirms what we learned from the other activities about the Moon.* Students will be asked to answer questions at the end of the article, so read the questions out loud prior to reading so they know what information to look for. Give each student a copy of the student sheet Moon Summary and have them glue this into their science notebooks and update their table of contents with the corresponding page number. Remind students to be sure to read the diagrams and photographs for more information.

2. Discussion

When students are finished reading, have them discuss their answers with their partner. Have students write their responses in their science notebooks. Tell students, *Think about how you can add detail and use specific academic vocabulary as you write the answers.* After attempting or completing the assignment, students may join another pair of students to compare and refine their answers with more detail.
**Summary: The Moon**

1. The ________ stands at the center of the Solar System. Earth orbits the ________________, and the Moon orbits ________________. That is how they move around the Solar System.

2. We can see only the sunlit half of the Moon. As the Moon orbits Earth, we see different amounts of the sunlit half, so that the Moon appears to change ________________.

3. Starting with the new moon, there are different phases. During the week following the new moon the Moon is a ________________. On day 7 the Moon is the ________________. The second week the Moon is a ________________ moon. On day 14 the Moon is full. The third week the Moon is a ________________ moon. Day 21 is the ________________. The fourth week the Moon is a ________________ moon. At the end of 4 weeks it is a ________________ again.

**Word Bank:**
Sun, Earth, shape, waxing crescent, first quarter waxing gibbous, waning gibbous, 3rd quarter, new moon
Session 8: Scientific Explanation [two sessions, 45 minutes each]

- Students will develop a scientific explanation regarding relationships of the components of the Solar System (Earth, Moon, Sun).
- Students will be able to identify direct and indirect evidence.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pen/Marker</td>
<td>Scientific Explanation</td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Document camera/LCD projector</td>
<td>Graphic Organizer</td>
<td>Pencil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Glue or tape</td>
</tr>
</tbody>
</table>

1. Scientific explanation

   *We began Investigation 2 with the focus question: How does the shape of the Moon change over time?* In your science notebook you have collected many pieces of evidence. Let’s take a minute to flip through your science notebook and see all the evidence we have gathered about our focus question. (You may want to allow a minute for students to cross check their table of content entries at this time.)

   - Your Moon Calendar (2.1.a)
   - Night Sky Observations (2.2.a)
   - The Night Sky Review (2.3.a)
   - Evidence Graphic Organizer (2.4.c)
   - Moon Prediction (2.4.a.1)
   - Changing Moon (2.5.a)
   - Phases of the Moon 2 (2.6.a)
   - New Focus Question for the Moon (2.6.b)
   - Summary: The Moon (2.7.a)

   That is a lot of evidence we’ve collected. What do scientists do after collecting evidence about their questions? They develop claims and scientific explanations based on their evidence and share it. Can anyone remind me what a claim is? [A claim is a statement of a conclusion based on the evidence]. *Usually a claim answers our focus question. What was our focus question for this investigation?* (How does the Moon change its shape over 4 weeks?) Write the focus question on the white board, chart paper or using the document camera. *What is a claim I could make about how the Moon changes its shape over 4 weeks?* Write student responses on chart paper or under the document camera in the example science notebook.

   We want our claim to be as specific as possible, so if it’s okay with you, I’m going to write our class claim as “The Moon appears to change shape over 4 weeks in a regular pattern of phases as the Moon orbits the Earth."

   Write “The Moon appears to change shape over 4 weeks in a regular pattern of phases as the Moon orbits the Earth.” on the board and circle it.

2. Scientific explanation graphic organizer

   Give each student a copy of the Scientific Explanation Graphic Organizer. Have them glue it into their science notebooks on the next available page and update their table of contents with the corresponding page number. *Just as we did with this graphic*
organizer in Investigation 1, please write the circled claim on the board on your graphic organizer.

3. Finding evidence to support claim

Whenever we write a claim, what do we need to state in order to support it? (Evidence) Scientists must provide evidence to support their claims. We have gathered several pieces of evidence throughout this investigation about how the Moon appears to change shape over 4 weeks. Where might we find the evidence we have collected so far? (In our science notebooks) Let’s look at our table of contents and find the page for our Night Sky Observation. Please find your Night Sky Observation in your notebook. What is one piece of evidence I have from this activity that I could use to support my claim? Allow students to offer examples. Choose one piece of evidence and write it in the first row of the Scientific Explanation graphic organizer.

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Moon changed from being fully lit (full moon) on our first day of observation to being mostly lit (waning gibbous) on the fourth day of our observations.</td>
<td></td>
</tr>
</tbody>
</table>

It is important to record sources of evidence. What was the source of this evidence? Was this something that we observed directly or that we read about? It was something we observed directly, so I’m going to write the name of the activity in which we made the observation. Write “Night Sky Observation” in the graphic organizer. Please notice that I am writing my evidence in complete sentences because it will help me later construct my paragraph.

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Moon changed from being fully lit (full moon) on our first day of observation to being mostly lit (waning gibbous) on the fourth day of our observations.</td>
<td>“Night Sky Observation”</td>
</tr>
</tbody>
</table>

Let’s look at our table of contents and find the page for Evidence Graphic Organizer. Please find the entry of the Moon Video from the graphic organizer. What is one piece of evidence I have from this activity that I could use to support my claim? Allow
students to offer examples. Choose one piece of evidence and write it in the second row of the Scientific Explanation graphic organizer.

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>It takes 27.3 days for the Moon to orbit the Earth.</td>
<td></td>
</tr>
</tbody>
</table>

*With our evidence, we also want to record the source of that evidence. It is important to record sources of evidence. What was the source of this evidence? I’m going to write Moon Video in our graphic organizer.*

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>It takes 27.3 days for the Moon to orbit the Earth.</td>
<td>Moon Video</td>
</tr>
</tbody>
</table>

*Please find the entry titled Evidence from Changing Moon in your Evidence Graphic Organizer. What is one piece of evidence I have from this activity that I could use to support my claim? Allow students to offer examples. Choose one piece of evidence and write it in the second row of the Scientific Explanation graphic organizer.*

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>The light we see coming from the Moon is reflected sunlight from the Sun.</td>
<td></td>
</tr>
</tbody>
</table>

*With our evidence, we also want to record the source of that evidence. It is important to record sources of evidence. What was the source of this evidence? Was this something that we observed directly or that we read about? It was something we read about, so I’m going to write the name of the article from our book – “Changing Moon”. Write “Changing Moon” in the graphic organizer.*
Please find Evidence from Phases of the Moon 2 in your Evidence Graphic Organizer. What is one piece of evidence I have from this activity that I could use to support my claim? Allow students to offer examples. Choose one piece of evidence and write it in the first row of the Scientific Explanation graphic organizer.

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>The light we see coming from the Moon is reflected sunlight from the Sun.</td>
<td>“Changing Moon” p. 19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>When the Sun is on one side of the Earth, and the Moon is on the opposite side, we see a full moon, because the side of the Moon we see is fully lit by light from the Sun.</td>
<td></td>
</tr>
</tbody>
</table>

Who can tell me what I am missing? The source. Was this something that we observed directly or that we read about? It was something we observed directly, so I’m going to write the name of the page where the observation was recorded in my notebook. Write “Phases of the Moon 2” in the graphic organizer.

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>When the Sun is on one side of the Earth, and the Moon is on the opposite side, we see a full moon, because the side of the Moon we see is fully lit by light from the Sun.</td>
<td>“Phases of the Moon 2”</td>
</tr>
</tbody>
</table>

4. Restate claim.

Because I’m going to use the information from this graphic organizer to create a paragraph, I will want to restate my claim in a concluding sentence. One way we could do that is to say, “These pieces of evidence support the claim that the Moon appears to change shape over 4 weeks in a regular pattern of phases as the Moon orbits the Earth”. Model writing “These pieces of evidence support the claim that the
Moon appears to change shape over 4 weeks in a regular pattern of phases as the Moon orbits the Earth” in the blank at the bottom of the Scientific Explanation Graphic Organizer. **Please write this sentence in your graphic organizer.**

Note: You may want to break at this point and finish writing the paragraph in the next lesson.

5. Draft a paragraph

Now we have our main ideas from four sources during our investigation in one place! Our next step is to begin our draft. To begin writing we must determine our audience (other scientists that are 4th graders and their families) and our purpose (to share our information about the focus question). **This determines our form of writing** (scientific explanation). Scientific explanations are written to share information, so they are as clear, concise and accurate as possible. Our Scientific Explanation Graphic Organizer is our plan for writing. We have a claim that we can use as a topic sentence, four sources, one or more main ideas from each source, and a concluding sentence. Looks a lot like a paragraph to me! As a writer, you now choose which ideas from your plan that you want to include in your paragraph. Read over your work and circle or star the three pieces of evidence you want to include in your scientific explanation. The teacher should model and think out loud about the three ideas she/he would select from the four in her Scientific Explanation Graphic Organizer and perhaps why she/he is selecting those three ideas. Circle the ideas on the graphic organizer as they are selected.

**What do we do next? We will make the sentences that we chose from our organizer more complete by adding the source into the sentence.** Encourage some students to begin drafting sentences about their selected ideas on their own in their science notebook, while the teacher continues thinking out loud and modeling how to revise the sentences with reference to the source. Students may work collaboratively on this. Teacher may provide significant support if needed.

Let’s read what I have written. We’ll begin with the topic sentence from my plan, then read my drafted sentences written in my science notebook, and then back to my plan for the concluding sentence. Tell students your thinking as you read out loud, revising and editing as you read. Focus on specific grammar or punctuation depending on your students needs. Examples: “I have a series here, did I put my commas in the right place.” That idea is not clear in this sentence; let me revise. **I want to read it one more time and check to see if I can add in more science vocabulary.** Have students revise their paragraphs.

6. Publish

Now our paragraphs are ready for publishing. Students could publish their own paragraph for class posting or publication in newsletter.
Scientific Explanation Evidence Graphic Organizer (Moon)
Focus Question: How does the shape of the Moon appear to change over 4 weeks?

Claim (topic sentence):

<table>
<thead>
<tr>
<th>Evidence (from science notebook)</th>
<th>Source or Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Restate claim in different words as concluding sentence:

______________________________
Session 9: Revisit KWL [15-20 minutes]

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td></td>
<td>Pencil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Colored pencil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Science notebook</td>
</tr>
</tbody>
</table>

1. KWL

*Now that we have completed Investigation 2: The Moon, let’s go back to our KWL that we started at the beginning and see if we can answer any of our questions that we wrote about.* Use either the example science notebook or chart paper where you wrote the class KWL chart at the beginning of the investigation and read the questions aloud with the students. Have students answer the questions out loud while you write them on the chart under the column “L: Things I learned about the Moon.” Have students also write the answers to the questions on their own KWL in their science notebooks under “L: Things I learned about the Moon.” If there are remaining questions, encourage students to search for answers on their own or add an additional session to investigate a concept further.

2. Glossary

*At the end of each investigation it is important to take time to read your glossary. Check for a clear understanding of the meaning of the new science words. Make sure the new words are ones you can use when you are talking about what you have learned. You may revise with colored pencils*

3. Table of Contents

*Check to see that your table of contents matches the pages in your science notebook for this session.*
<table>
<thead>
<tr>
<th>Session</th>
<th>Content Objectives</th>
<th>Language Objectives</th>
</tr>
</thead>
</table>
| 1       | Activate background knowledge of the Solar System and ask questions  
  • KWL  
  • Questions  
  • Define solar system | • Students will be able to define a solar system as a star and the planets and other objects that orbit the star. Our Solar System orbits the Sun  
 • Participate in a class discussion to complete a KWL chart  
 • Write statements expressing what students already know about the Solar System  
 • Write questions about the Solar System  
 • Write the definition of solar system |
| 2       | View videos about Solar System  
  • View Video: What is a solar system”  
  • Discussion about video  
  • View Video: Moons in the Solar System  
  • Discussion about video  
  • Complete student sheet on ways scientists learn about the Solar System | • Students will identify ways that scientists study the Solar System  
 • Students will be able to identify objects in the Solar System – planets, comets, etc  
 • Students will know that the planets orbit the Sun  
 • Students will know that some other planets have moons  
 • Listen for information about a variety of topics (i.e. objects, moons, ways to study the Solar System)  
 • Talk about main ideas viewed in videos  
 • Participate in a class discussion about the Solar System and objects in it.  
 • Participate in class discussion about the ways scientists investigate the Solar System |
| 3       | How is Earth different from other objects our Solar System?  
  • Introduce focus question  
  • Introduce planet cards  
  • Sort planet cards by different characteristics  
  • Reflection | • Students will analyze indirect evidence from a text  
 • Students will classify objects in the Solar System using indirect evidence.  
 • Students will justify their classifications with reasoning  
 • Sort cards with pictures and written information into different groups based on characteristics  
 • Complete a sentence frame to explain how cards were sorted into two groups |
| 4 | Gathering information from a text  
• Discuss direct and indirect evidence about the Solar System.  
• Investigate non-fiction text features  
• Introduce the strategies: skim and scan  
• Read *Our Solar System and Beyond*  
• Take notes about Earth | • Students will use indirect evidence to investigate components of the Solar System  
• Students will identify a variety of objects in our Solar System | • Discuss features of non-fiction text and their purposes.  
• Skim and scan informational text for content  
• Take notes about the Earth using graphic organizer to gather information |
| --- | --- | --- |
| 5 | Compare and contrast Solar System Objects  
• Review focus question  
• Compare and contrast using a graphic organizer  
• Reflection | • Students will analyze indirect evidence from a text  
• Students will compare and contrast Earth and other objects in our Solar System | • Use a graphic organizer to compare and contrast Earth with another object in the Solar System |
| 6 | Read “Other Objects in the Solar System”  
• Review focus question  
• Model how to skim and scan for information about the Earth  
• Skim and scan for information about chosen object in our Solar System  
• Compare and contrast using a graphic organizer  
• Reflection | • Students will analyze indirect evidence from a text  
• Students will compare and contrast Earth and other objects in our Solar System | • Use a graphic organizer to compare and contrast Earth with another object in the Solar System  
• Skim and scan informational text for content |
<table>
<thead>
<tr>
<th>7</th>
<th>Gravity</th>
<th>Students will know that gravity is the force that holds the parts of the Solar System together</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hands on activity observing gravity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Viewing video about gravity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skim and scan text for specific topic information (gravity).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discuss gravity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Complete student sheet.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Revisit KWL and questions</td>
<td>Listen for information in video</td>
</tr>
<tr>
<td></td>
<td>Write a reflection on personal learning</td>
<td>Share information orally</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skim and scan same text for different information</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identify location of specific information</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complete a CLOZE activity about gravity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Read own writing in science notebook</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reflect on new understanding of concepts</td>
</tr>
</tbody>
</table>
Investigation 3: The Solar System

Session 1: KWL of the Solar System [30 minutes]

- Students will be able to define a solar system as a star and the planets and other objects that orbit the star. Our Solar System orbits the Sun.

<table>
<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pen/Marker</td>
<td></td>
<td>Science notebooks</td>
</tr>
<tr>
<td>Document camera/LCD projector</td>
<td></td>
<td>Pencil</td>
</tr>
<tr>
<td>Chart paper</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. KWL

*We are starting the last investigation in which we will learn all about the Solar System.* Use the example science notebook to write Investigation 3: Solar System in your table of contents on the next available line. Have students do the same in their table of contents in their science notebooks. Next, write in KWL in the table of contents and have students do the same. Turn to the next available page in the example science notebook and title it “KWL: Solar System”. Have students do the same and update the table of contents with the corresponding page number.

Model writing and have students write “K: What I Already Know About the Solar System” at the top of their page and list what they already know. Have students share out what they know and write their ideas on the class chart under where you have written “K: What I Already Know About the Solar System”. Students may or may not add all of the ideas to their list after hearing other students’ ideas. (The goal is to have students feel safe sharing their ideas freely, so adding comments like “We’ll be learning about that, that is discovered during this unit, we’ll find out more about that, etc. are encouraged if the teacher feels s/he needs to comment.)

Investigation 3: Solar System

K: What I Already Know About the Solar System

Next, have students write “W: What I Want to Know About the Solar System” and leave space for answers as they are discovered. (This may be more than one page for some students). Have students share out their questions while you write them on the class KWL chart under where you have written “W: What I Want to Know about the Solar System”. Students may add questions to their own notebooks.

W: What I Want to Know About the Solar System

Once students have finished writing down what they know, have them write “L: What I Learned about the Solar System” and leave at least a half page to be completed at the end of the investigation.
L: What I Learned about the Solar System

2. Word work

*Has anyone heard the word “solar” before? Where have you heard it? What do you think it means?* Have students share out their ideas with the class and write them down on chart paper under the word “solar”. Students may have used solar ovens, have solar panels, and already associate solar with the Sun. Write down as many student ideas as possible, and guide students to the meaning, Sun.

*Has anyone heard the word “system” before? Where have you heard it? What do you think it means?* Have students share out their ideas with the class and write them down on chart paper under the word “system”. Students may have heard the word used before in science and may associate it with many different things. Write down as many student ideas as possible. [System: a group of objects that interact and work together.] Help guide students to the meaning of the word by giving examples: An ecosystem is where all the living organisms interact together to maintain life in that area.

*Has anyone heard the words “Solar System?” Where have you heard it? What do you think it means?* Have students share out their ideas with the class and write them down on chart paper under the words “Solar System”. Students may have heard the words before during the unit or outside of class. Help students connect their ideas about Solar (the Sun) to a system. Since they have studied the Sun, guide students to the system that surrounds the Sun. [Solar System: A star (the Sun) and the planets and other objects that orbit that star.] Keep these ideas and definitions either on the chart paper or in the example science notebook for future reference.
Session 2: Space Objects [35-40 minutes]

- Students will identify ways that scientists study the Solar System.
- Students will be able to identify objects in the Solar System – planets, comets, etc.
- Students will know that the planets orbit the Sun.
- Students will know that some other planets have moons.

### Materials needed

<table>
<thead>
<tr>
<th>Pen/Marker</th>
<th>Video Questions</th>
<th>Science notebooks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>How Do Scientists Study the Solar System?</td>
<td>Glue</td>
</tr>
<tr>
<td>Word Wall</td>
<td></td>
<td>Pencil</td>
</tr>
<tr>
<td>Internet</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Papers to copy and cut

1. NASA video on the Solar System

   *We will be watching a video about objects in outer space. Some of the objects you will have heard of before, and some will be new. There is a lot of content in this video, so we are going to watch it a few times. The first time we watch it, I’d like you to just watch and read the subtitles. Then we will watch the video again and look for new words. I’d like you to look and listen for answers to some questions I have.* The video is found online on the NASA website [http://www.nasa.gov/audience/foreducators/nasaeclips/search.html?terms=&category=1000](http://www.nasa.gov/audience/foreducators/nasaeclips/search.html?terms=&category=1000). Choose “Our World: What is the Solar System” If you don’t see the title, type “Solar System” in the search bar and it will appear. The video is about 6 minutes long. For subtitles, click the CC button on the bottom right-hand side of the screen. You can also download this video to your computer so that you are not dependent on an Internet connection when you show it.

Have students watch the video. When the video is finished, hand out Video Questions student sheet and have students glue it into their science notebooks on the next available page and update their table of contents with the corresponding page number. Read the questions out loud with your students before watching the video. Some may remember the information, so you may want to allow a few minutes for students to write down their responses. Watch the video again and if you need to, pause the video where information can be found.

- What is a solar system any way? (47 seconds)
- How do we sort all these space objects? (2:19)
- What 3 things are needed for an object to be considered a planet?
- What 2 things are needed for an object to be classified as a moon?
- What do scientists use to classify objects in our Solar System?

2. Discussion

   Go over the responses to the questions together as a class. Ask students if they heard any new vocabulary and write it on the word wall. Have students stand up in two lines facing each other. Tell students, *Tell the person in front of you one thing that you found interesting in the video, while the person across from you...*
*listens silently.* Model this process with one of the students. Make sure that students understand the instructions, and have them begin. Then have students switch and have the other partner share what they thought was interesting. After the partners have finished sharing, have students move one person to the right. The end person will come to the front of the line to be with the first person. *Tell the new person in front of you one thing that you found interesting in the video while your partner listens silently.* Have students switch again and have the other partner share what they thought was interesting. Continue this process 3 to 5 times depending on students’ engagement, time and attention.

3. NASA video on Moons

*We are going to watch another video today, and this one is about moons. We learned a lot about Earth’s Moon, and now we will learn about moons of other planets. The first time we watch the video, I’d like you to just watch and read the subtitles. The second time we watch it, I’d like you to look and listen for what tools scientists use to learn about space.* Go to the website http://www.nasa.gov/audience/foreducators/nasaclips/search.html?terms=&category=1000 and choose “Our World: Moons in Our Solar System.” If it does not appear, type “Solar System” into search bar. The video is about 4 minutes long. For subtitles, click the CC button on the bottom right-hand side of the screen. You can also download this video to your computer so that you are not dependent on an Internet connection when you show it.

Show the video to your students. When the video is done, pass out the student sheet How Do Scientists Study the Solar System and have students glue it into their science notebooks and update their table of contents with the corresponding page number. Watch the video again and stop it at any point that students need time to write their responses.

4. Discussion

Have students share their responses out loud with a partner. Use the example science notebook or chart paper to write out student responses. Through watching the video, students should have listed satellites, space probes, telescopes, photographs, exploration (astronauts), rovers and models. There are many other great videos on the NASA website to share with your students and get more answers to how scientists study the Solar System. You may refer back to this student sheet throughout this investigation.
Video Questions

1. What is a Solar System?

________________________________________

________________________________________

________________________________________

2. How do we sort space objects?

________________________________________

________________________________________

________________________________________

3. What 3 things are needed for an object to be considered a planet?

________________________________________

________________________________________

________________________________________

Video Questions Continued

4. What 2 things are needed for an object to be considered a moon?

________________________________________

________________________________________

________________________________________

5. What do scientists use to classify objects in our Solar System?

________________________________________

________________________________________

________________________________________
<table>
<thead>
<tr>
<th>Ways that scientists study the Solar System</th>
<th>What this can tell us about the Solar System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: telescope</td>
<td>What objects in the Solar System look like</td>
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</tbody>
</table>

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<thead>
<tr>
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<th>What this can tell us about the Solar System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: telescope</td>
<td>What objects in the Solar System look like</td>
</tr>
</tbody>
</table>
Session 3: How is the Earth different from other objects our Solar System? (45 minutes)

- Students will analyze indirect evidence from a text.
- Students will classify objects in the Solar System using indirect evidence.
- Students will justify their classifications with reasoning.

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<tr>
<td>Document camera/LCD projector</td>
<td>Sorting Planets by Diameter</td>
<td>Pencil</td>
</tr>
<tr>
<td>Chart Paper</td>
<td>Sorting Planets by Surface</td>
<td>Glue</td>
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<tr>
<td>16 sets of Planet Cards; 1 set per partner group</td>
<td>Sorting Planets by Surface Reflection Sorting Planets by ___________</td>
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1. Introduce focus question

*Our Earth is a very special place in our Solar System.* Ask students,

- *What makes our planet Earth unique?* (Life is found on Earth; we have an atmosphere that supports life; we have liquid water.)
- *What makes Earth different from other objects in our Solar System?* (Life like ours isn’t found on other planets, other planets look different.)

*I wonder, how is Earth different from other objects in our Solar System? Let’s write this down as our focus question for this part of the investigation.* Write the focus question on the white board or the example science notebook using the document camera. Update the table of contents with the corresponding page number.

2. Introduce planet cards

Tell students, *Today we will look at data regarding the 8 planets in our Solar System.* Scientists collected this data so we can have a better understanding of the characteristics of other planets that make up the Solar System.

- *Is this direct or indirect evidence that we will be looking at?* (Indirect)
- *What other objects, besides these planets, are found in our Solar System?* (Moons, asteroids, comets, dwarf planets.)

*All of the indirect evidence we will work with today is written on a card. Your job will be to look at the evidence on the card and use the evidence to sort the planets into different categories.*

3. Sort planets by diameter

*First, let’s look at the information presented on each card.* Distribute one set of cards to each partner group. Preview the different kinds of information that are found on each card. Ask students,

- *What is the first piece of evidence on the card?* (Diameter)
- *What is diameter measured in?* (Meters)
- *What does that tell us about what diameter is?* (A distance)
Diameter is the distance across and through the center of a circle. Add “diameter” to the word wall and have students add it to their student glossaries in their science notebooks. Draw a picture to support understanding of the word.

• Why do you think diameter is a piece of evidence on the card? (Because the diameter will tell us how wide the planet is across, which will tell us how big the planet is. Planets with a large diameter are bigger than planets with a small diameter).

For our first sorting activity, I would like you and your partner to put the planets in order of smallest diameter to largest diameter. Put the cards in order on your desk. Call me over to check your work when you are finished.

• What will this sort teach us about the 8 planets? (Which planets are smallest and which planets are biggest.)

After checking student work, distribute the Sorting Planets by Diameter student sheets and have it glue them on the next available page in their science notebook. Remind them to update the table of contents with the corresponding page number. Have students record their results on the student sheet. Record the results on a class data sheet on the white board or document camera. Ask students,

• What do you notice about the diameter of the planets in our Solar System? (They are all different, some are closer than others in value.)
• Which planet has the largest diameter? (Jupiter)
• Which planet has the smallest diameter? (Mercury)
• What is the diameter of our Earth? (12, 756 km)
• How does the diameter of Earth compare to Jupiter and Mercury? (Larger than Mercury, smaller than Jupiter.)

Please record your ideas about what you noticed about the 8 planets and their diameters on the bottom of the student sheet.

4. Sort planets by surface
Ask students,
• What is the second piece of evidence on the card? (Surface)
• What does this piece of evidence describe? (What the surface of the planet looks like.)

Tell students, Your job with this sort is to put the 8 planets into two groups according to their surfaces. Read through the cards, and then decide which planets should go together. When you’ve put your planets into 2 groups, call me over to check your work.
• What will this sort teach us about the 8 planets? (How the surfaces of planets are different, how some planets have similar surfaces.)

After checking student work, distribute the Sorting Planets by Surface student sheet. Have students record their results on the student sheet and explain why they put them into the two groups. Have students glue it into their science notebooks on the next available page and update the table of contents with the corresponding page number. When students complete the sort, discuss results and record them on a class data sheet on the white board or under the document camera. Ask students, What do you notice about the different groups of planets? (Their surfaces are gaseous or rocky, but not both.)

Distribute the Sorting Planets by Surface Reflection sheet or provide students with the following sentence frames:

“If I had to pick a name for the Group A planets, I would name the group __________________________ because __________________________”

and “If I had to pick a name for the Group B planets, I would name the group __________________________ because __________________________”

Have students glue the page into their science notebook and update their table of contents with the corresponding page number. Have students discuss their ideas for naming the group with a partner before they complete the sentence frame. Since one group will have surfaces described as “gases,” it may be beneficial to talk about appropriate naming strategies for this group before the students begin recording their ideas.

5. Sort planets by another piece of evidence
   Ask students:
   • What other information is presented on the cards that we haven’t used yet? (Moons, Length of Day, Length of Year.)

   In the last sort, you and your partner can pick one of the remaining 3 pieces of evidence to sort your cards by. Turn and talk with your partner about which piece of evidence you’d like to focus on.

   Distribute the Sorting Planets by ________________ student sheet. Have students glue it into their science notebooks and update their table of contents with the corresponding page number. Tell students to fill in the blank with the piece of evidence they’ve collected. Once they have done so, they may conduct their sort. The student sheet provides a strategy for summarizing what they learned after the sort is completed. Circulate while students complete the activity with a partner.

6. Reflection
   Ask students to find another partner group to form a group of 4. Have them share the results of their last sort by reading their reflections from the student
sheet to each other. Tell students, At the end of the reflection, you identified a planet that you want to learn more about. In our next session, you will be able to do research on this planet to help you answer the focus question: How is Earth different from other objects in our Solar System?
Sorting Planets by Diameter

Write the names of the 8 planets in order from smallest diameter to largest diameter.

______________________  smallest diameter
______________________
______________________
______________________
______________________
______________________
______________________

______________________  largest diameter
______________________
______________________
______________________
______________________
______________________
______________________
______________________

I noticed ___________________________________________
________________________
________________________
________________________
________________________
________________________

I noticed ___________________________________________
________________________
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## Sorting Planets by Surface

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<th>Group B</th>
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I put these planets in this group because __________________

<table>
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I put these planets in this group because __________________
Sorting Planets by Surface Reflection

If I had to pick a name for the Group A planets, I would name the group ______________________

because ____________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

If I had to pick a name for the Group B planets, I would name the group ______________________

because ____________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

Sorting Planets by Surface Reflection

If I had to pick a name for the Group A planets, I would name the group ______________________

because ____________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

If I had to pick a name for the Group B planets, I would name the group ______________________

because ____________________________________________

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________
Sorting the Planets by

3 facts I learned about the planets by sorting my cards using this piece of evidence were:

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

2 questions I have about the planets are:

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________

1 planet I would like to learn more about is:

_____________________________________________________________________________

_____________________________________________________________________________

_____________________________________________________________________________
Session 4: Gathering Information From a Text [40-45 minutes]

- Students will use indirect evidence to investigate components of the Solar System.
- Students will identify a variety of objects in our Solar System.

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<td></td>
<td>Pencil&lt;br&gt;Science notebook&lt;br&gt;Glue&lt;br&gt;Our Solar System and Beyond</td>
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1. Gathering information
   Ask students the following questions to guide them needing to gather indirect evidence from a text.
   - *How do we learn about the Solar System?*
   - *What tools can we use to learn about objects in the Solar System?*
   - *Is it easy to learn about the Solar System?*
   - *When we learn about the Solar System, are we gathering direct or indirect evidence?*
   - *How do you know?*
   - *What types of direct evidence have we gathered about the Solar System?* (Students did observations of the Sun and shadows and observations of the Moon.)
   - *Can we gather direct evidence about planets?*
   - *Can we gather direct evidence about other objects in the Solar System?*
   - *Can we directly see the Sun?*
   - *Can we gather indirect evidence about the Solar System?*
   - *What are ways that we can gather indirect evidence about the Solar System?*

*It is difficult to learn about objects in our Solar System without using the help of specific tools that can gather direct evidence for us. We are going to be reading from the text Our Solar System and Beyond to help gather what kind of evidence? (Indirect Evidence) Have students sit in pairs to preview the book. With your partner, I’d like you both to identify some features of a non-fiction text in this book and discuss how that feature helps you read and find information.*

*Have students share out their ideas as a class and write them on a list on chart paper or under the document camera. Possible responses are: headings, captions, pictures, bold writing for vocabulary, etc.*

*Before you read the text, I’d like you and your partner to choose one of the two reading strategies for non-fiction: skimming or scanning. Who can tell me what skimming is?* (Reading parts of text quickly, focusing on desired information,
2. Notes about the Earth
Explain to your students that you will be modeling note-taking about the Earth from the text. Write “Earth” on the board, chart paper or under the document camera using the example science notebook. Tell students, One thing I’d really like for us to focus on is how the objects in our Solar System compare to Earth. But before I can investigate other objects, I need to gather information about Earth. So my focus today will be finding information about Earth that I think will help me be able to compare it to other objects. Some things that I read I may already know about Earth, and other things may be new to me. So I am going to have to read carefully to find important facts that will help me later. If you’d like to take notes along with me, you may.

Let’s begin. Do I need to read the entire book if I just want to find information about Earth? (No) What can I use to help me find Earth in the book? (Table of contents.) I’m going to go to page 8 and start there. What clues do I see indicate that this is about Earth? (Earth is a planet, so it will be included under the heading Planets, and the photo of Earth.) Before I read the entire paragraph, I’m going to skim and scan to see if this is about Earth. Do this out loud, and stop when you read the second sentence. The second sentence had the word Earth in it, so I’m going to read the sentence more carefully out loud. ‘Earth is the third planet from the Sun.’ Is that important? Knowing the distance from the Sun may be important to know, so I am going to write this down. But I’m only taking notes, so I am not going to be writing complete sentences. I’m going to write “3rd from the Sun p.8” and that’s all. Model writing so students can see.

I’m going to skim and scan the rest of the paragraph to see if there’s more evidence that I can gather. Note that you do not see the word Earth in the text and move on to the second paragraph. The second sentence also has the word Earth, so I’m going to read it more carefully. ‘Earth has one Moon.’ I already know that. Is that important? It could be since we know from the NASA video that other planets also have moons, and I want to compare Earth to other objects in the Solar System. I’ll write that down. Write “1 Moon p. 8” on the next line in your notes. I’m going to keep reading to see if there’s more important information. I see Earth again in the text, so I will read more carefully. ‘It is Earth’s closest neighbor in space.’ Is this important? It’s talking about how the Moon is Earth’s closest neighbor. This is just talking about the distance between the Moon and Earth, and won’t help me compare the Earth to other objects. I’m going to keep reading. Continue with this process on the next page and then jump to page 11. Notes that teachers should write down are:
Earth
- 3rd planet from the Sun p.8
- 1 moon p.8
- Inner planet p.9
- Small and dense p.9
- Solid and rocky p.9
- “Blue planet” p. 11
- 3/4ths Liquid water p.11
- Oxygen atmosphere p.11
- Plains, mountains, valleys, craters and volcanoes p.11

I’d now like for you all to take notes on an object that you found interesting when you were skimming and scanning with your partners or from our card sorts during the last class. Select one planet and follow the same procedure that I did while looking for important information that could be used to help compare to Earth. Once you chose your planet, title your page with the name of the planet and remember to add it to your table of contents with the corresponding page number. Remember to use the book’s table of contents and to skim and scan the pages. Also remember to just write the important words, not complete sentences. Students may work in partners or individually if you have enough books.
Session 5: How is the Earth different from other objects our solar system? [45 minutes]

- Students will analyze indirect evidence from a text.
- Students will compare and contrast Earth and other objects in our Solar System.

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<td>Pencil Glue FOSS Our Solar System and Beyond reader</td>
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1. Review
Tell students, **Today we will be answering our focus question from our last session. Who can remind us of our focus question?** (How is the Earth different from other objects in our Solar System?) **In the last session, we took notes about the Earth and another object in space. Please turn to the page with your notes about the Earth and another planet from the last session in your notebook. If you can't remember what page your notes are on, what should you do?** (Look in your table of contents).
**Please turn and talk with your shoulder partner about the following question: How are the Earth and the other planet the same? One partner talks while the other partner listens. After one minute, the other partner will talk while the partner who was speaking listens. I will tell you when it is time to switch.**

After discussing the first question, ask a few partners to share their ideas with the class.

**Now I would like for you to turn and talk to discuss another question. One partner talks while the other partner listens. After one minute, the other partner will talk while the partner who was speaking listens. The question I would like for you to discuss is: How are the Earth and the other planet different?**

After discussing the second question, ask a few partners to share their ideas with the class.

2. Compare and contrast
Distribute the Comparing and Contrasting Earth and _________ student sheets. **Let's organize our ideas about how the Earth and the other planet in our Solar System you've chosen are the same and different. First, please write the name of your object in the blank lines. For example, if I were studying how the planet Mars is the same and different from Earth, I would put Mars in all the blank lines.** (Model using the document camera, if necessary).
With your partner, I’d like for you to talk for 2 minutes about more ways that the Earth and your other planet are similar. I will tell you when 2 minutes are up. After 2 minutes, record all of your ideas in the box on your paper.

When students are done writing their ideas about how their other planet is the same as Earth, have students share their ideas with the class. Record themes from the discussion (such as “some other planets are rocky like Earth” or “some objects are also inner planets”) on the white board or chart paper under the heading “How Earth and other objects in the Solar System are the same.”

Now we will focus on how your other planet in our Solar System is different from Earth. We will organize our ideas in a t-chart. Why is a t-chart a good strategy to organize ideas about how the objects are different? (It allows you to describe the characteristics of one thing on one side and the characteristics of another thing on the other side. It helps you see how their characteristics are different).

Write “Earth” on one heading of the t-chart. Write your other planet on the other heading. With your partner, I’d like for you to talk for 2 minutes about more ways the Earth and your planet are different. I will tell you when 2 minutes are up. After 2 minutes, record all of your ideas in the t-chart on your paper.

When students are done writing their ideas about how their planet is different from Earth, have students share their ideas with the class. Record themes from the discussion (such as “some other planets are further from the Sun than Earth” or “some objects are much bigger than Earth”) on the white board or chart paper under the heading “How Earth and other objects in the Solar System are different.”

3. Reflection
Tell students, We’ve explored a lot of ways in which your other planet is the same and different from our Earth. Please turn to a new page in your science notebook. Title the page “I think, I wonder, I understand”. Remember to update your table of contents with the page number. Once students are ready, to write, tell them: We are going to do a free-write with 3 sentence stems. You will have 2 minutes to write all of your ideas. Please keep writing all of your ideas for the whole two minutes until I call time. There are no wrong answers, this is just an opportunity for you to reflect on what you learned and what you are still wondering about.

The first sentence stem is “I think...” (Display on the white board or in the example science notebook under document camera). Please write the sentence stem and complete the sentence with everything you are thinking about the
**Earth and your other planet.** After 2 minutes, call for students to put their pencils down.

Tell students, *The second sentence stem is “I wonder...”* (Display on the white board or in the example science notebook under the document camera). *Please write the sentence stem under your first sentence stem and complete the sentence with everything you are wondering about the Earth and your other planet.* After 2 minutes, tell students to put their pencils down.

Tell students, *The third sentence stem is “I understand...”* (Display on the white board or in the example science notebook under the document camera). *Please write the sentence stem under your second sentence stem and complete the sentence with everything you understand about the Earth and your other planet.* After 2 minutes, have students put their pencils down.

Have students share their sentences with their partner, if time allows. Ask students who feel comfortable with sharing their ideas with the class to share out loud in a whole class discussion.
Comparing and Contrasting Earth and
_____________________

How are the Earth and _________________ the same?

How are the Earth and _________________ different?

Comparing and Contrasting Earth and
_____________________

How are the Earth and _________________ the same?

How are the Earth and _________________ different?
Session 6: How is the Earth different from other objects our solar system? [45 minutes]

- Students will analyze indirect evidence from a text.
- Students will compare and contrast Earth and other objects in our Solar System.

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1. Review

Tell students, **Today we will be answering our focus question from our last session.**

- **Who can remind us of our focus question?** (How is the Earth different from other objects in our Solar System?)

**In the last session, we compared the Earth with another in our Solar System, a planet.**

- **What other objects are found in our Solar System?** (Asteroids, dwarf planets, comets and meteors.)
- **How do you think these other objects compare to our Earth?** (They are different sizes, they don’t have the same characteristics of Earth.)

2. Read

Have students join in pairs to read “Other Objects in the Solar System” in the FOSS reader on pages 14-15. **Today we will learn about other objects in our Solar System by reading in our text.**

- **What is our purpose for reading?** (To determine how other objects in the Solar System are different from Earth.)
- **What type of evidence will we be reading about?** (Indirect evidence based on the direct evidence collected by scientists using a variety of tools.)
- **Based on the bold words, what are the four objects in the Solar System we will be studying in this text?** (Dwarf planets, asteroids, comets, and meteors.)

**Before you read the text, I would like for you to decide with your partner which object you would like to study.** Prepare a page in the notebook for students to record their notes about this new object, similar to the notes created in Session 4 when students used a note-taking strategy to record information from a non-fiction text. Have students update their table of contents with corresponding page number. **Before you read the text, I’d like you and your partner to choose one of the two reading strategies for non-fiction: skimming or scanning.**
• **What is skimming?** (Reading parts of text quickly, focusing on desired information, purposeful reading)
• **What scanning?** (Looking over the text and features quickly for something specific like key words)

I’d like you all to take notes on the object you’ve chosen while skimming and scanning the text with your partners. Look for important information that could be used to compare this object to Earth. Remember, just write the important words, not complete sentences.

3. Compare and contrast
Distribute the Comparing and Contrasting Earth and ____________ student sheets. Let’s organize our ideas about how the Earth and the object in our Solar System you’ve chosen are the same and different. First, please write the name of your object in the blank lines. For example, if I were studying how meteors are the same and different from Earth, I would put meteors in all the blank lines. (Model using the document camera, if necessary).

With your partner, I’d like for you to talk for 2 minutes about more ways the Earth and your object are similar. I will tell you when 2 minutes are up. After 2 minutes, record all of your ideas in the box on your paper.

When students are done writing their ideas about how their object is the same as Earth, have students share their ideas with the class. Record themes from the discussion, if any arise, on the white board or chart paper under the heading “How Earth and other objects in the Solar System are the same.”

Now we will focus on how your object in our Solar System is different from Earth. We will organize our ideas in a t-chart. Why is a t-chart a good strategy to organize ideas about how the objects are different? (It allows you to describe the characteristics of one thing on one side and the characteristics of another thing on the other side. It helps you see how their characteristics are different.) Write “Earth” on one heading of the t-chart. Write your other object on the other heading. With your partner, I’d like for you to talk for 2 minutes about more ways that the Earth and your object are different. I will tell you when 2 minutes are up. After 2 minutes, record all of your ideas in the t-chart on your paper.

When students are done writing their ideas about how their object is the different from Earth, have students share their ideas with the class. Record themes from the discussion, if any arise, on the white board or chart paper under the heading “How Earth and other objects in the Solar System are different.”

4. Reflection
Have partners find another set of partners (preferably a group that studied a different object than the other group) to join with and create a group of 4. **Now we will share what we learned by skimming and scanning the text. Each partner group will present the following information to the other partners. When they are finished, the partners who listened will get to share what they learned.**

Tell students and post under the document camera or on the white board that they are responsible for sharing:

- A definition of the object (For example, an asteroid is a space object made of rock, metal, or a mixture of the two.)
- One way their object is the same as Earth.
- One way their object is different from Earth.

After students share, have them prepare a sheet in their notebooks for reflection. Remind students to update their table of contents with corresponding page number. Read the following questions out loud and put them under the document camera or white board. Allow students to respond to the questions for 3-4 minutes. Use student responses as a check for understanding.

1. What are two other objects in the Solar System that are not planets?
2. How was your object different from Earth?
3. What did you learn from your classmates about how their object was different from Earth?
Comparing and Contrasting Earth and ______________________

How are the Earth and ______________________ the same?

How are the Earth and ______________________ different?

Comparing and Contrasting Earth and ______________________

How are the Earth and ______________________ the same?

How are the Earth and ______________________ different?
Session 7: Gravity [20-25 minutes]

- Students will know that Gravity is the force that holds the parts of the Solar System together.

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<td>Pencil</td>
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<td>Notebook</td>
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1. Introduce gravity
   Tell students, *We have been studying objects in our Solar System. What holds all of these objects in the Solar System together?* (Gravity) Tell students to hold their pencil between two fingers above the floor. *On the count of three let go of the pencil.* Ask,
   - What happened to the pencil?
   - Did everyone’s pencil do that?
   - Will that happen every time we let go of a pencil? Of another object?
   - Why does that happen?
   - What is gravity?

2. Video
   View NASA website video that gives an OVERVIEW of gravity. [http://www.nasa.gov/audience/foreducators/nasaclips/search.html?terms=&category=1000](http://www.nasa.gov/audience/foreducators/nasaclips/search.html?terms=&category=1000) choose “Our World: Gravity in Space”. While we are watching I’d like for you to keep track of the ways scientists study gravity.

3. Discussion
   Discuss what was learned from the video. Have class stand up in two lines, facing each other. *Tell the person in front of you one thing you found interesting about gravity in the video. Listen to him/her tell you one thing she/he found interesting about gravity in the video.* Model/review this process with one set of students. Make sure students understand the directions. *After sharing move one person to the right. The end person comes to the head of the line to be with the first person. Tell the person in front of you one thing you found interesting about gravity in the video. Listen to him/her tell you one thing she/he found interesting about gravity in the video. You may share your idea or one you heard from another student.* Continue the process 3 to 5 times depending on your class engagement and attention. After sharing line, ask the students to *Tell the class something interesting about gravity you heard.*

4. Read
   Pass out copies of the book *Our Solar System and Beyond* and have students sit in pairs. Ask students to skim and scan to see if there is any information about gravity
5. Discussion about gravity
   Ask students, **What is gravity?** Write student answers on the board. If students do not say it, make sure to add “Gravity is a force” and circle it. **What does gravity do?** Write out student answers on the board. If students do not say the following things, make sure to add these to the board and circle them. “Gravity pulls objects toward one another.” “Gravity holds the parts of the Solar System together.”

6. Gravity
   Give each student a copy of the Gravity student sheet. Have students glue this into their science notebook on the next available page. Remind them to update their table of contents and add the corresponding page. Provide students who need extra support with the following word bank: force, center, holds, Solar System, orbit.
Gravity

Gravity is the _________________ that draws all things to the _________________ of the Earth. Gravity is the _________________ that _________________ the parts of the Solar System together. Gravity causes objects in the _________________ to _________________ around the Sun.
Session 8: Revisit KWL / Post Assessment [20-25 minutes]

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<thead>
<tr>
<th>Materials needed</th>
<th>Papers to copy and cut</th>
<th>Students will need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document camera/LCD projector</td>
<td>Post Assessment</td>
<td>Pencil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Colored pencil</td>
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<tr>
<td></td>
<td></td>
<td>Science notebook</td>
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</tbody>
</table>

1. KWL

*Now that we have completed Investigation 3 on the Solar System, let’s go back to our KWL that we started at the beginning and see if we can answer any of our questions that we wrote about.* Use either the example science notebook or chart paper where you wrote the class KWL chart at the beginning of the investigation and read the questions aloud with the students. Have students answer the questions out loud while you write them on the chart under the column “L: Things I learned about the Solar System.” Have students also write the answers to the questions on their own KWL in their science notebooks under “L: Things I learned about the Solar System.” If there are remaining questions, encourages students to search answers on their own or add in an additional session to investigate a concept further.

2. Glossary

*At the end of each investigation it is important to take time to read your glossary. Check for clear understanding of the meaning of the new science words. Ask questions to make sure the new words are ones you can use when you are talking about what you have learned.*

3. Table of contents

*Check to see that your table of contents matches the pages in your science notebook for this session.*

4. Post assessment

*Now you are going to have an opportunity to show how much you have learned in this unit. This is the exact same test that we took at the beginning of the unit.* While students are seated at their desks, hand them the post assessment. Make sure students put their names at the top of the paper. Remind students that this is the same assessment that was given at the beginning of the unit. Place the assessment under the document camera and read out loud all the instructions and questions to students. *As you fill out the assessment, please raise your hand for clarification of words or instructions. I can read the text to you, but I cannot give you any answers. This is to show me what you have learned about the Sun, Moon and planets. When you have completed the post-assessment, please wait silently until the rest of the class has finished. Once everyone is finished, we are going to go over your pre and post assessments together and compare your answers.*
When the class has finished taking the post assessment, pass out their pre-assessments and make sure each student has a colored pencil to use while going over the assessments. Place the assessments under the document camera and read the questions out loud. You may put a students’ assessment under the document camera as an example for students to see how to revise an answer with a colored pencil. Have students volunteer their answers while others check to see if their responses are correct. If there are disagreements about answers, encourage students to look them up in their science notebooks. When the class has finished going over the assessments, have students staple them together and hand them in to you.