Solar Eclipse Experiences

K-6

By Teaching Science Students

at

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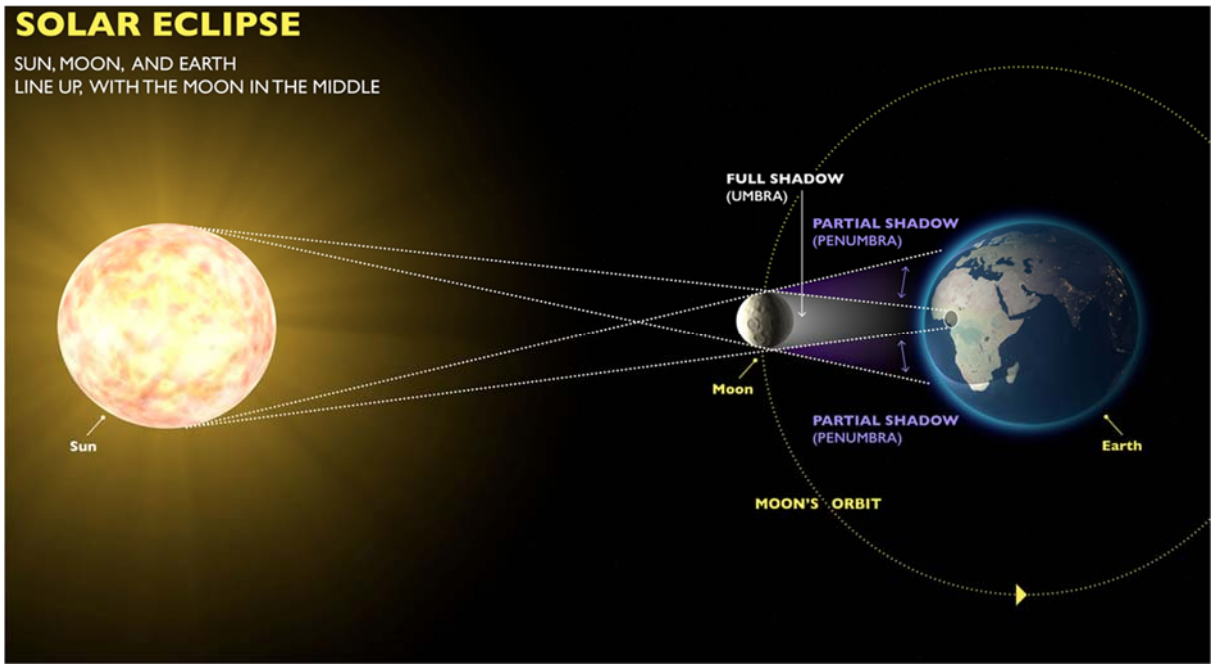

The total solar eclipse on August 21, 2017 will be the first that middle Tennessee has seen in over 500 years.

The earth, moon, and sun:
The moon orbits the earth roughly once every 28 days and rotates on its own axis at the same rate (meaning it's the same side of the moon that is always facing the earth). The earth spins on its own axis once every 24hrs which gives us night and day. The earth orbits counterclockwise around the sun. The earth and its moon orbit around the sun once approximately every 365 days.

The eclipse:
Half of the moon is always lit up by the sun, which is visible through the lunar phases. A Solar eclipse can only happen during a "new moon" phase when the moon is between the earth and the sun. The distance between the moon and the sun is just enough for the moon to block out the sun's light, which puts part of the earth in the moon's shadow. This shadow causes it to become dark during the day, but total darkness only lasts for a couple of minutes. It will take approximately 3 hours for the moon's shadow to move across the earth.

GRADE/ CLASS: Kindergarten

UNIT: Solar Eclipse

LESSON TITLE: Sun, Moon, Earth orbits

DURATION: 45 minutes

LESSON OVERVIEW:

Through this lesson, we will explore the movement of the Sun, Earth, and Moon.

STANDARDS:

1. SL.K.1 Participate in collaborative conversations with diverse partners about *kindergarten topics and texts* with peers and adults in small and larger groups
2. GLE 0007.Inq.1 Observe the world of familiar objects using the senses and tools.
3. GLE 0007.Inq.2 Ask questions, make logical predictions, plan investigations, and represent data.
4. GLE 0007.Inq.3 Explain the data from an investigation.
5. GLE 0007.T/E.2 Apply engineering design and creative thinking to solve practical problems.
6. GLE 0007.6.1 Know the different objects that are visible in the day and night sky.
7. GLE 0007.8.2 Collect daily weather data at different times of the year.
8. GLE 0007.10.1 Identify the sun as the source of heat and light.
9. GLE 0007.10.2 Investigate the effect of the sun on a variety of materials.
10. GLE 0007.11.1 Explore different ways that objects move.

LEARNING TARGETS/ OBJECTIVES:

1. TSW know how the Moon rotates or spins on its axis.
2. TSW understand how the Moon revolves or orbits around the Earth.
3. TSW know the Moon and Earth revolve around the Sun.
4. TSW demonstrate the motion of the Sun, Earth and Moon are cyclical.

ACTIVATING STRATEGY:

How does a clock spin? Clockwise or counterclockwise? Do you think the Earth spins (rotates) in the same direction as a clock? Do you think the Earth spins (rotates) around the moon or the sun?

https://jr.brainpop.com/science/space/solarsystem/
The Brain Pop video will have the students thinking and creating visuals of the objects.

Checking Understanding –
Now let's talk about the sun, earth, and moon. Does the sun orbit the earth? Would anyone like to show us how the moon orbits the earth, and how the earth orbits the sun? Is there a difference?

We will work in our “colored” groups today. (My class has daily five groups already established, and work well together. The children know which colored team they represent, which is easy to move them into place. Smooth transitions.)

INSTRUCTION:

Guided Practice –.

1. TTW choose a location in the classroom with ample room (approximately 10' x 10') to demonstrate the Sun-Earth-Moon model. Students may want to sit in a circle or semi-circle, with the model in the middle.
2. Material Managers from each team will collect materials for project.
3. TTW demonstrate the correct way to insert the bamboo skewer into the 6-inch Sun ball and the other end of the skewer into the Styrofoam disk to elevate and secure the Sun ball.
    - TSW insert one end of a skewer into the 6 inch Sun ball and the other end of the skewer into the Styrofoam disk to elevate and secure the Sun ball.
4. TTW model the 6-inch Sun ball or the lamp where all students can see it.
    - TSW will then repeat the modeled instructions.
5. TTW review what students know about the Sun and Earth. Write answers on the board in KWL format. (I suggest using anchor chart paper to save for later projects.)
    - ***(Kindergarten and First grade will not be able to write the points on the board, but second and third graders can write the answers to the KWL chart.)Possible points to elicit about the Sun and Earth.
6. Possible points to elicit about the Sun and Earth.
    1. The Sun:
        i. Is our closest star.
        ii. Is at the center of the solar system (like the hub of a bicycle wheel).
        iii. Spins slowly compared to the Earth.
        iv. Spins counterclockwise when seen from above.
        v. The Earth and other planets rotate on their axes and revolve or orbit around the Sun, but the Sun is in the center of the solar system and spins on its axis as well.
        vi. Is very hot and big—much bigger than Earth!
        vii. Is a light source and is always shining.
    2. The Earth:
        i. Is our home planet.
        ii. Is much smaller than the Sun.
        iii. Rotates or spins.
        iv. Takes a day and a night (24 hours) to complete one spin.
        v. Revolves or orbits around the Sun.
        vi. Takes one year to complete its orbit around the Sun.
7. TTW guide the students in placing a 3-inch ball on a 12-inch bamboo skewer to represent the Earth. Hold the skewer vertically so that the Earth can be held from above and rotated. (See photos) Remind students that the Earth spins counterclockwise, and that it is smaller than the Sun.

- Note: *Stress to students that Sun/Earth/Moon model is not to correct size or distance scale.* Explain that distances in space are vast and that this is a model to help us see the big picture.

8. TTW demonstrate the Earth orbiting around the Sun. Walk counterclockwise in a circle around the Sun and simultaneously turn the skewer counterclockwise to demonstrate the Earth's spin as it orbits the Sun.
9. TTW introduce the Moon.
    - Ask, "What revolves around the Earth? What do you see in the sky almost every night and also during the day?"
10. TTW ask what students know about the Moon and write answers on the board or use KWL chart.
11. Possible points to elicit about the Moon--
    - The Moon:
        - It is smaller than the Earth (4 Moons can fit across the Earth's diameter).
        - It revolves or orbits around the Earth.

12. TTW demonstrate placing a 1 1/4-inch Styrofoam ball on the 6-inch skewer. Insert the other end of the skewer in the 3" Earth ball at the approximate "equator" (i.e. perpendicular to the longer skewer). (See photos)
13. TTW rotate the long skewer counterclockwise to demonstrate the spin of the Earth and the Moon orbiting the Earth.
    - Note: *Remind your students that the model is not to correct scale or distance.*
14. TTW walk counterclockwise around the Sun to demonstrate that the Earth is rotating, that the Moon is revolving around the Earth, and that both are revolving around the Sun.
15. TTW Explain to students that the motions they see demonstrated happen as a cycle and that the rotating and revolving never stop! Explain again that it takes a day and a night for the Earth to make one entire rotation and that it takes a whole year for the Earth to complete its long orbit around the Sun.

Independent Practice -
This lesson in worked together as a class/ in groups. Each group will be able to present their interpretations to the teacher, but not to the class. I would like to know how each group interpreted the instructions. What type of spin can the groups add to the original instruction from the given knowledge presented?

MATERIALS/ RESOURCES/ TECHNOLOGY:

- Styrofoam balls:
    - 6-inch ball for the Sun
    - 3-inch ball for the Earth
    - 1 1/4-inch ball for the Moon
- Styrofoam disk:
    - 8-inch round x 2-inch thick for base to hold Sun ball *(Note: The relative sizes and distances of materials used in this model are not the scale of the Sun-Earth-Moon system.)*
- 3 bamboo skewers (about 12 inches)
- Lamp with 200 watt bulb and shade removed to serve as Sun

- Extension cord for lamp
- Chart Paper
- Magic Markers
- Ruler
- Pencils

ASSESSMENT/ EVALUATION/ CLOSURE:

TTW ask: Would any of the groups like to present to the class? What can you tell me about the sun, moon, and earth? Can anyone tell me why the earth rotates around the sun? Why does the moon rotate around the earth?

REFERENCES:

LESSON PLAN #1: Adapted from:

- Adding the Moon: Using a Classroom Model to Explore the Movement of the Sun, Earth, and Moon http://www.eyeonthesky.org/lessonplans/09sun_moonclass.html

EXTENSION #1 TO LESSON PLAN #1

- Phases of the Moon Lesson Plan: Position of the Planets https://educators.brainpop.com/lesson-plan/phases-of-the-moon-lesson-plan-position-of-the-planets/

Resources:
http://kids.msfc.nasa.gov
http://www.thursdaysclassroom.com
http://amazing-space.stsci.edu
http://www.kidsastronomy.com
http://spacelink.nasa.gov
http://sunearth.ssl.berkeley.edu
http://education.gsfc.nasa.gov
http://www.kideclipse.com

Bendick, J. (1991). *The Sun Our Very Own Star.* Brookfield : Millbrook Press
Branley, F. (1988). *Eclipse: Darkness in Daytime.* New York: Harper & Row
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Branley, F. (1997). *The Sun: Our Nearest Star.* New York: HarperCollins
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Fowler, A. (1992). *The Sun Is Always Shining Somewhere.* Danbury: Children's Press.
Gibbons, G. (1983). *Sun Up, Sun Down.* New York: Scholastic Inc.
Lindbergh, R. (1994). *What is the Sun?* Cambridge: Candlewick Press.
Vogt, G. (2000). *Sun.* Namkato: Capstone Press.

GRADE/ CLASS: First Grade

UNIT: Solar Eclipse

LESSON TITLE: What Makes Shadows? Day 2

DURATION: 45 minutes

LESSON OVERVIEW:

What makes shadows? Through this lesson, the class will explore which objects make shadows and which objects make light for shadows to appear.

STANDARDS:

1. SL.CC.1 Participate with varied peers and adults in collaborative conversations in small or large groups about appropriate 1st grade topics and texts.
2. 1.RI.CS.4 Determine the meaning of words and phrases in a text relevant to a grade 1 topic or subject area.
3. 1.MD.A.2 Measure the length of an object using non-standard units and express this length as a whole number of units.
4. 1.MD.A.1 Order three objects by length. Compare the lengths of two objects indirectly by using a third object.
5. GLE 0107.Inq.3 Explain the data from an investigation.
6. GLE 0107.6.1 Compare and describe features of the day and night sky.

LEARNING TARGETS/ OBJECTIVES:

1. TSW be able to make an accurate drawing of a classmate's shadow.
2. TSW be able to observe the position of the Sun.
3. TSW be able to make a connection between the location of the Sun and direction of the shadow.
4. TSW be able to notice the changes in shadows that take place over time.
5. TSW be able to develop and understanding of the Earth's motions on an elementary level.

ACTIVATING STRATEGY:

Have you ever got to trace your friend's whole body? Have you ever noticed how big your shadow can be? Today we are going to be able to do that and compare shadows.

https://jr.brainpop.com/science/energy/light/
This BrainPop activity will get students thinking about the correlation between shadows and the sunlight.

Checking Understanding – Can anyone tell me what a shadow really is? Is the sun and shadows related at all? Is everyone's shadow going to look the same? TTW ask these questions to see what the students have learned so far.

INSTRUCTION:

1. The lesson will start off by the teacher asking the students what they know about shadows. A KWL chart will be used for this lesson as the students will start off by putting these points on the “what we know” section.
2. TTW ask the students if they have any questions about shadows. They will list 3-4 of them on the "what we want to know" section of the KWL chart.
3. TTW explain to students that they will be going outside to observe shadows and make drawings of what they see.
4. TTW ask for a student volunteer to help demonstrate how to trace a shadow.
5. TTW turn on the lamp, turn off the overhead lights, and ask students to observe the student's shadow being cast in the classroom. Ask them where the light source is and where the shadow is cast.
6. TTW explain that the Sun is similar to the light and discuss the location of the shadow.
7. TTW demonstrate how to trace the shadow by following the outline of the student's shadow with your finger.
8. TTW explain that each student will use chalk to trace the outline of his or her partner’s shadow on the playground.
9. TTW tell the students that after the tracing is complete, they can use pencils to draw their partner, his or her shadow, and the location of the Sun on their paper.
10. TTW remind students NEVER to look directly at the Sun.
11. After students have drawn on their paper, they can add more detail in the classroom with crayons.

Independent Practice -
The lesson will be done in groups of two or three depending on the number of students in the class. The students will be able to show the drawings of the shadows to the class after completing the assignment.

MATERIALS/ RESOURCES/ TECHNOLOGY:

1. Pencils
2. Crayons
3. Chalk
4. Lamp with 200 watt bulb and shade removed
5. Chart Paper
6. Magic Markers

ASSESSMENT/ EVALUATION/ CLOSURE:

TTW ask the students what they have learned today. TTW will expect some of the students to verbally answer the question asked. TTW review the objectives covered.

REFERENCES:

LESSON PLAN #2: Adapted from:

- What Makes Shadows? *Observing and Drawing Shadows* - http://www.eyeonthesky.org/lessonplans/04sun_shadows.html

EXTENSION #1 TO LESSON PLAN #2:

- Making a sundial.

http://www.eyeonthesky.org/lessonplans/14sun_sundials.html

- http://pinterest.com/pin/411797959665185245/?source_app=android

Resources:

http://kids.msfc.nasa.gov
http://www.thursdaysclassroom.com
http://amazing-space.stsci.edu
http://www.kidsastronomy.com
http://spacelink.nasa.gov
http://sunearth.ssl.berkeley.edu
http://education.gsfc.nasa.gov
http://www.kideclipse.com

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Vogt, G. (2000). *Sun*. Namkato: Capstone Press.

GRADE/ CLASS: 2nd Grade – 3rd Grade

UNIT: Solar Eclipse

LESSON TITLE: Exploring the Moon's Shadow: Day 3

DURATION: 45 minutes

LESSON OVERVIEW:

By creating a model, we will explore the moon's shadow.

STANDARDS:

SCIENCE:

- GLE 0207.Inq.1 Observe the world of familiar objects using the senses and tools.
- GLE 0207.Inq.2 Ask questions, make logical predictions, plan investigations, and represent data.
- GLE 0207.Inq.3 Explain the data from an investigation.
- GLE 0207.T/E.1 Recognize that both natural materials and human-made tools have specific characteristics that determine their uses.
- GLE 0207.T/E.2 Apply engineering design and creative thinking to solve practical problems.
- GLE 0207.6.1 Realize that the sun is our nearest star and that its position in the sky appears to change.
- GLE 0207.6.2 Make observations of changes in the moon's appearance over time.

ELA:

- 2.RI.KID.3 Describe the connections between a series of historical events, scientific ideas, or steps in a process in a text.
- 2.RI.CS.4 Determine the meaning of words and phrases in a text relevant to a grade 2 topic or subject area.
- 2.RI.CS.5 Know and use various text features to locate key facts or information in a text efficiently.
- 2.SL.CC.1 Participate with varied peers and adults in collaborative conversations in small or large groups about appropriate 2nd grade topics and texts.

MATH:

- 2.MD.A.1 Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
- 2.MD.A.2 Measure the length of an object using two different units of measure and describe how the two measurements relate to the size of the unit chosen.
- 2.MD.A.3 Estimate lengths using units of inches, feet, yards, centimeters, and meters

LEARNING TARGETS/ OBJECTIVES:

1. TSW know the Moon is between the Earth and the Sun.
2. TSW know the Moon blocks the Sun's light from reaching the surface of the Earth.
3. TSW know the shadow cast by the Moon covers only part of the Earth's surface.
4. TSW know the Moon's shadow moves across the Earth.
5. TSW know it becomes dark during the day.

6. TSW know total darkness only lasts a few minutes.

ACTIVATING STRATEGY:

Have you ever thought about where the moon is in the sky? Or even if it moves? What about the shadow it casts on the Earth? Could it ever become dark during the day? Maybe because the moon's shadow?

Input Modeling/Modeled Practice –
Bill Nye the Science Guy- video of the sun, moon. Earth (eclipses)
https://www.netflix.com/watch/80046954?trkid=14277283&tctx=0%2C7%2C7804a1ab-b894-4157-b628-dc00ed449c8d-245738281

INSTRUCTION:

Guided Practice –.
Preparing the model

1. TTW Choose a location in the classroom with ample room (approximately 10' x 10') to demonstrate the eclipse model. Students may want to sit in a circle or semicircle with the model in the middle.
2. TTW Hang the Earth globe from the ceiling or framework, so that it hangs about 24" to 30" above the floor. A paperclip with one side bent into an "L" shape will support the globe. Tie string to the paper clip loop, and insert the "L" into the globe's small hole at top (North Pole point).
3. TTW To a chair or other sturdy object, tape a yardstick so it extends parallel to the floor.
4. TTW Cut a short length of thread or monofilament and attach the 3-inch Styrofoam "Moon" ball to one end of the thread. Tie the other end to the yardstick.
5. TTW Set the suspended Moon ball 12" - 15" away from the Earth globe.
6. TTW Place the lamp near the hanging "Moon" ball and globe so that the "Moon" casts a shadow on the Earth globe. (See photo)

Teaching with the model

1. TTW Turn on the lamp and turn off the classroom lights to make the shadow more visible.
2. TTW Slowly turn the Earth globe counterclockwise and begin your discussion of the model by asking students to identify the Sun, the Earth and the Moon.
3. TTW Ask students to use the model to explain how an eclipse takes place.
4. TTW Turn the globe so that the "Moon's" shadow is covering your city. Remind students never to look at the Sun, but ask them to describe how things might look in their city during a total solar eclipse.
5. TTW Point to the KWL chart used in the previous introductory lesson and review what students contributed. Ask if students have learned anything new to add the chart.
6. TTW Possible points to elicit in your discussion of what happens during an eclipse–
    - The Moon is between the Earth and the Sun.
    - The Moon blocks the Sun's light from reaching the Earth's surface.
    - The Sun's corona remains visible.
    - During the daytime it becomes dark on a small part of the Earth.

- The shadow cast by the Moon only covers part of the daytime side of the Earth's surface.
- The Moon's shadow moves across the Earth as it spins.
- The Moon continues to move in its orbit too.
- Total darkness of the eclipse only lasts a few minutes.
- Some animals respond as if it were night.

Independent Practice -

TTW Distribute the worksheets. The model can be left in the classroom to help students complete the worksheets. Have some students volunteer to share their drawings.

MATERIALS/ RESOURCES/ TECHNOLOGY:

1. Earth globe (approximately 14" to 16" in diameter)
2. String
3. Paperclip
4. Pencils
5. Frame or ceiling hook (from which to hang the globe)
6. Yardstick
7. Tape
8. Thread or monofilament line
9. 3-inch Styrofoam ball
10. Lamp with a 200 watt bulb, shade removed
11. Extension cord
12. Work sheets - http://www.eyeonthesky.org/activities_pdf/11sun_eclipseclass-ws.pdf
13. Chart Paper
14. Magic Markers

ASSESSMENT/ EVALUATION/ CLOSURE:

TTW ask the students to share what they have learned to finish the KWL chart. TTW review objectives covered.

REFERENCES:

EXTENSION #1 ON LESSON PLAN #3:

- How can the little Moon hide the giant Sun?

http://www.eyeonthesky.org/lessonplans/12sun_littlemoon.html

EXTENSION #2 ON LESSON PLAN #3:

- Making a Solar Eclipse Book: The Sun and Moon During a Solar Eclipse
  http://www.eyeonthesky.org/lessonplans/13sun_eclipsebook.html

Resources:

EXTRA LESSON PLANS:

- Eclipse Fact Sheet https://eclipse2017.nasa.gov/sites/default/files/publications/2017EclipseAcrossAmericaFlyer_508.pdf
- Eclipse: An Introduction http://www.eyeonthesky.org/lessonplans/10sun_eclipse.html

http://kids.msfc.nasa.gov
http://www.thursdaysclassroom.com
http://amazing-space.stsci.edu
http://www.kidsastronomy.com
http://spacelink.nasa.gov
http://sunearth.ssl.berkeley.edu
http://education.gsfc.nasa.gov
http://www.kideclipse.com

Bendick, J. (1991). *The Sun Our Very Own Star.* Brookfield : Millbrook Press
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Branley, F. (1997). *The Sun: Our Nearest Star*. New York: HarperCollins
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Lindbergh, R. (1994). *What is the Sun?* Cambridge: Candlewick Press.
Vogt, G. (2000). *Sun*. Namkato: Capstone Press.

Extra Resources:

BOOKS:

K-3 Books:

- Aldrin, B. (2005). Buzz Aldrin: reaching for the moon. New York: Harper Collins.
- Simon, S. (2003). The Moon. New York: Simon & Schuster.
- Aldrin, B. (2009). Look to the Stars. Penguin Young Readers Group
- Scott, E. Our Moon: New Discoveries about Earth's Closest Companion
- Aguilar, D. (2012). Little Kids FIRST BIG Book of Space. National Geographic Society
- Conner, J. (2004). Children's Night Sky Atlas. DK
- Dell, P. (2011). Mapping the Sky. Marshall Cavendish
- Bendick, J. (1991). *The Sun Our Very Own Star.* Brookfield : Millbrook Press
- Branley, F. (1988). *Eclipse: Darkness in Daytime.* New York: Harper & Row
- Branley, F. (1989). *Sunshine Makes the Season.* New York: HarperCollins
- Branley, F. (1997). *The Sun: Our Nearest Star*. New York: HarperCollins
- Branley, F. (1991). *What Makes Night and Day.* New York: HarperCollins
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- Lindbergh, R. (1994). *What is the Sun?* Cambridge: Candlewick Press.
- Vogt, G. (2000). *Sun*. Namkato: Capstone Press.
- Dorros, A. (1990). Me and My Shadow. Scholastic inc

WEBSITES:

- http://video.nationalgeographic.com/video/101-videos/moon-101-sci
- https://www.scholastic.com/teachers/articles/teaching-content/all-about-moon/
- https://www.nasa.gov/moon
- The Moon for Kids: https://www.youtube.com/watch?v=B-b4XvuQo1Y
- How Long Does It Take To Get To The Moon? https://www.youtube.com/watch?v=eOJAgQwfXNE
- space information for students: https://www.nasa.gov/kidsclub/index.html
- Moon facts for kids: http://www.coolkidfacts.com/moon-facts-for-kids/
- Moon 101: http://video.nationalgeographic.com/video/101-videos/moon-101-sci
- Moon Video- http://libraries.risd.org/bowlib/video_shortcuts/KOur_Moon.asx
- What is the Moon?- http://www.brainpopjr.com/science/space/themoon/zoom.weml
- Moon information- http://www.enchantedlearning.com/subjects/astronomy/moon
- YouTube Video- Apollo Moon Landing- Authentic Footage
- PBS Newshour- 8 thing you didn't know about the Moon
- Background knowledge of eclipses- http://www.mreclipse.com/Special/SEprimer.html
- Solar eclipse safety- https://eclipse2017.nasa.gov/safety

K-3 References

Adding the Moon: Using a Classroom Model to Explore the Movement of the Sun, Earth, and Moon http://www.eyeonthesky.org/lessonplans/09sun_moonclass.html

Eclipse: *Using a Classroom Model to Explore the Moon's Shadow*- http://www.eyeonthesky.org/lessonplans/11sun_eclipseclass.html

What Makes Shadows? *Observing and Drawing Shadows* - http://www.eyeonthesky.org/lessonplans/04sun_shadows.html

Bill Nye the Science Guy- video of the sun, moon. Earth (eclipses) https://www.netflix.com/watch/80046954?trkid=14277283&tctx=0%2C7%2C7804a1ab-b894-4157-b628-dc00ed449c8d-245738281

https://jr.brainpop.com/science/space/solarsystem/

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4-6 Solar Eclipse Exploration

4-6 Teacher Background knowledge

Q. Why do we see different phases of the moon?
A. The phases of the moon depends on **THE MOON'S** position in relation to the Sun and Earth. As the moon makes its way around the Earth, we see the bright parts of the Moon's surface at different angles.

Q. How long does it take the moon to orbit the Earth?
A. Approximately 28+ days.

Q. Do we see different sides of the moon as it orbits Earth?
A. From Earth we always see the SAME side of the moon.

Q. During what phase of the moon does a Solar Eclipse happen?
A. Solar Eclipses only happen during a New Moon phase.
The alignment equals- Sun Moon Earth/ Moon between Earth and Sun

Q. During what phase of the moon does a Lunar Eclipse happen?
A. Lunar Eclipses only happen during a Full Moon Phase.
The alignment equals- Sun Earth Moon / Earth between Moon and Sun

Q. How often do Total Solar Eclipse happen in the same region?
A. Total Solar Eclipses happen around every 500 years.

Q. When will the next Total Solar Eclipse happen in this same pattern?
A. Year 2566

Q. How can we protect our students' eyes?
A.MTSU is providing all Rutherford county and Murfreesboro City school with protective eyewear.

Q. How long will the Total Solar Eclipse last in our area?
A. Murfreesboro Tennessee will see the Total Solar Eclipse for 1:18 seconds starting at 1:28 pm on August 21, 2017.

Q. Is this even a ONCE in a LIFETIME event?
A.YES!

GRADE/ CLASS: 4th Grade – 6th Grade

UNIT: Solar Eclipse

LESSON TITLE: Moon Phases Day 1

DURATION: 45 minutes

LESSON OVERVIEW:

The first lesson will cover the phases of the moon. The length of the lesson is 45 minutes and the lesson will be covered over the course of five days. This lesson is constructed for students ranging from third to sixth grade. This lesson is available for students in the general education population but accommodations are listed for students who need additional support accessing the general curriculum.

STANDARDS:

1. GLE 0407.6.1- Analyze patterns, relative movements, and relationships among the sun, moon, and earth.
2. 0407.6.1- Chart the movements of the sun, moon and earth to develop and explanation for the phases of the moon and solar and lunar eclipses.
3. 0407.6.2- Sequence the major phases of the moon during the lunar cycle.

LEARNING TARGETS/ OBJECTIVES:

1. Students will demonstrate knowledge of the phases of the moon and the time it takes for the moon to complete its phases (one revolution of the earth), about 28 days.
2. The students will be able to identify why the moon's shape appears to change throughout each month. Students will be able to successfully explain that the moon's shape does not change but how it appears to us on earth does change because of the moon's rotation and revolution.

ACTIVATING STRATEGY:

1. The teacher will activate prior knowledge by asking a series of questions to the class.
    a. The teacher will review cardinal directions (North, South, East and West)
    b. The teacher will review degrees of angles and that a 90 degrees angle is a right angle
    c. The teacher will demonstrate a rotation of objects by making a mark on the top of an object and turning the marked point to face another direction
    d. The teacher will demonstrate a counterclockwise rotation by moving the marked piece of paper in the opposite direction of the clock's hands, from west to east
    e. The teacher will provide the students with the definition of a shadow (the darkened shape behind an object that is blocked by the object when light hits the object from the front)

f. The teacher will review the definitions for rotate (to spin around on an axis) and revolve (to move around another object)
g. The students must know that the moon revolves around the earth and the earth revolves around the sun
h. The teacher will review the shape of an ellipse (an oblong circle or oval)

INSTRUCTION:

1. The teacher will introduce the following vocabulary words:
    a. Phases of the moon - the changes in the observable shape of the moon over about 28 days
    b. Waxing - to get bigger
    c. Waning - to get smaller
    d. Crescent - less than half of the moon in an arc shape
    e. Gibbous - more than half of the moon in a bulging shape
2. The teacher will deliver the following content:
    a. If the light is on the right side of the moon, is it waxing or waning? waxing
    b. If the shadow is on the right side of the moon, is it waxing or waning? waning
    c. Where is the sun when the moon is waxing? on the right
    d. Where is the sun when the moon is waning? on the left
3. The teacher will distribute one, 3 ounce Dixie cup, a pencil and a piece of white construction paper to each student.
4. The students will take a piece of white construction paper, put the Dixie cup upside down on the paper and trace (using a pencil) around the edge of the cup to form a circle.
5. The students will draw a line through the circle to divide it into two equal halves.
6. The students will color the left half of their circle black and then cut out the circle.
7. In groups of four or five students, the students will be asked to practice rotating their circle 90 degrees counterclockwise. The students are to repeat this step four times in order to make a full rotation.
8. Each group will be given a tennis ball to represent the sun, two Styrofoam balls to represent the earth, and two poster boards.

MODIFICATIONS:

1. Students who have difficulties in the area of reading may be paired with stronger students in order to reinforce vocabulary
2. Students who are struggling will have help from their peers as well as visual aids around the room.
3. Students who have trouble writing will be allowed to explain their observations verbally to the teacher

MATERIALS/ RESOURCES/ TECHNOLOGY:

1. Smartboard
2. White Construction Paper
3. Pencils/Markers

4. 3 ounce Dixie Cups

ASSESSMENT/ EVALUATION/ CLOSURE:

1. The teacher will give a formative assessment over the lesson.
    - **a.** The teacher will first have the students demonstrate their knowledge of rotations by asking them to rotate their circles 90 degrees counterclockwise.
    - **b.** The teacher will then ask students to demonstrate their knowledge of definitions related to the content by defining waxing, waning, crescent, gibbous, and full moon.
    - c. The teacher will also go around the room asking the students the definitions of the new vocabulary words to reinforce the knowledge of the phases of the moon.In addition, the teacher should ask if there is light on the right side of the moon, is it waxing or waning. (waxing) If there is a shadow on the right side of the moon, is it waxing or waning? (waning)

REFERENCES:

"What Causes the Phases of the Moon?" Web. 31 May 2017.
http://www.cpalms.org/Public/PreviewResourceLesson/Preview/46446

GRADE/ CLASS: 4th Grade – 6th Grade

UNIT: Solar Eclipse

LESSON TITLE: Moon Phases Day 2

DURATION: 45 minutes for four (4) days

LESSON OVERVIEW:

Students will demonstrate and identify the position of the earth, moon, and sun for each phase of the moon. They will explain why there are phases of the moon.

STANDARDS:

1. GLE 0407.6.1- Analyze patterns, relative movements, and relationships among the sun, moon, and earth.
2. 0407.6.1- Chart the movements of the sun, moon and earth to develop an explanation for the phases of the moon, and solar and lunar eclipses.
3. 0407.6.2- Sequence the major phases of the moon during the lunar cycle.
4. SPI 0407.6.1- Organize the phases of the moon in correct sequence.
5. SPI 0407.6.2- Infer that the moon's phases are caused by the revolution of the moon, earth and the sun.

LEARNING TARGETS/ OBJECTIVES:

1. Students will be able to recount the phases of the moon during a month's lunar cycle.

2. Students will be able to observe and diagram each of the moon's phases in the correct pattern.

3. Students should understand that one side of the moon is ALWAYS lit up entirely by the sun even though the Earth rotates on its axis and revolves around the Sun.

ACTIVATING STRATEGY:

1. BrainPOP - Moon Phases
   https://www.brainpop.com/science/space/moonphases/
2. Take BrainPOP quiz as a class.

INSTRUCTION:

1. The teacher will draw what the current moon phase looks like on the board, and asks students:

2. Does the moon always look like this?

3. Why does the moon look like this right now and not at other times during the month?

Moon Phase Activity-

1. The teacher introduces, explains and models the Moon Phase activity.
2. The teacher should also encourage the student to stop regularly to engage with each of the moon's phases.
3. Students work in groups of 3or 4 allowing each other to take turns as either the Sun or the Earth.
4. Students who are the Earth hold the styrene ball (attached to skewer/stick) as the moon.
5. Students who are the sun stand on a chair directing the light, a large flashlight, toward the Earth.
6. Earth students rotate slowly on their axis while observing, talking and describing about how they care creating different phases of the moon as they move around the Sun.

   *The Sun student also talks about what they see from their vantage point (that the moon is/should ALWAYS be illuminated).
7. Students are instructed to diagram what they see at each position on a long piece of construction paper.
8. Students should make notes to coincide with observations and drawings.
9. When the students are finished walking through each 8 phases, they should put the phases in order (if they are not already) by numbering and naming each phase of their drawings.
   - *The students should have four (4) drawings and include at least the new moon, first quarter moon, full moon, and last quarter moon.
   - Note: a common mistake students make is to hold the moon too low that will allow their body to cast a shadow on the moon, when it should be full. Have students hold the moon up high, so that it is always illuminated by the sun.

MODIFICATIONS:

Mixed ability grouping.

MATERIALS/ RESOURCES/ TECHNOLOGY:

1. Polystyrene balls. These are the smooth balls, not the looser Styrofoam. 4 inch baseball sized balls work best.
2. Wooden skewers or sticks.
3. Shop lights with handles or clips. Students need to be warned not to touch the hot metal shield portion.
4. Blank construction paper and pencils.

5. Inflatable globes the size of a basketball

ASSESSMENT/ EVALUATION/ CLOSURE:

The teacher will have each small group share with the class their drawings and talk about what they saw as they were the Earth and Sun.

The teacher will give a closing review to make sure all activating questions are answered.

Formative Assessment:
The teacher will observe and assess for understanding while students are completing their activity.
The teacher will also ask questions and assess their feedback.

Summative Assessment -
At the end of the lesson, students will be asked to present what they learned and show their drawings to the class. The students will also be asked to go back into their composition notebooks and answer the question "Why does the moon have phases"?

REFERENCES:

Moon Phases (2017, May 31) Retrieved from
https://www.brainpop.com/science/space/moonphases/.htm

Lesson Plan adapted from-
Moon Phases (2017, May 30) Retrieved from
25960

GRADE/ CLASS: 4th Grade – 6th Grade

UNIT: Solar Eclipse

LESSON TITLE: Lunar and Solar Eclipse Day 3

DURATION: 45 minutes for four (4) days

LESSON OVERVIEW:

Students will understand that a lunar eclipse occurs when the Moon passes perfectly in line behind Earth, and Earth's shadow covers the Moon either partially or totally. Students will also gain an understanding of different types of lunar eclipses. Students will learn about eclipse and sun- viewing safety, and the differences and similarities between lunar and solar eclipses. Students within the 4th grade will be learning about the components of the full Solar Eclipse of August 21, 2017.

STANDARDS:

Science

1. GLE 0407.6.1 Analyze patterns, relative movements, and relationships among the sun, moon, and earth.

2. 90407.6.1 Chart the movements of the sun, moon, and earth to develop an explanation for the phases of the moon and solar and lunar eclipses.

3. 90407.6.2 Sequence the major phases of the moon during a lunar cycle.

Math

1. 4.MD.A.1 Measure and estimate to determine relative sizes of measurement units within a single system of measurement involving length, liquid volume, and mass/weight of objects using customary and metric units.

LEARNING TARGETS/ OBJECTIVES:

Students will be able to identify the differences and similarities between solar and lunar eclipses, the alignment of the sun, moon, and earth determine which type of eclipse is occurring, Students will also learn about viewing a solar eclipse safely and how not following proper safety procedures could cause injury.

Student I Can Statements:

1. I can identify what a lunar eclipse is.
2. I can identify what a solar eclipse is
3. I can identify the differences and similarities between solar and lunar eclipses.
4. I can identify how to view a solar eclipse safely.

ACTIVATING STRATEGY:

The teacher will briefly review information from the previous days' lessons such as lunar phases by beginning with a graffiti wall to gauge student understanding and to review.

1. Lunar eclipses are introduced

- How did Lunar gets its name - comes from a Latin word for moon "Luna"
- Explanation that a lunar eclipse happens when the Earth is blocking out the light that a full moon would otherwise be receiving from the Sun. Last up to 3 and ½ hours
- Show students a visual of the Earth passing in front of the sun and the three shadows that are created by the sun's immense light: umbra, penumbra, and antumbra.

(Q)What object is blocking out the Moon's light during a lunar eclipse?

2. Solar eclipses are introduced

- Explanation should include the orientation of the sun, moon, and earth. The following video can be used:

Solar eclipse: Space Trek [Video file]. (2006). Retrieved May 31, 2017, from https://learn360.infobase.com/PortalPlaylists.aspx?wID=147627&xtid=83192

The following photo could be used to provide some humor to the concept for the students:

unearthedcomics.com/comics/lunar-eclipse

INSTRUCTION:

1. Explain Blood Moon
   - (Q)During a lunar eclipse what will you see?
   - A reddish glow, called the, blood moon which is refracted, or bended light off of the Earth's atmosphere projected onto the moon.
   - When the sun's light hits the atmosphere, the longer wavelengths (red and orange) continue on in the umbral shadow, while the shorter wavelengths (yellow, green, blue, etc.) are absorbed.

2. Students will learn about solar eclipse safety.
   - Students should be told that they should not look directly at the sun without the appropriate eyewear (the provided eclipse glasses), or it could cause blindness.
   - more infromation can be found at the following link: www.space.com/15614-sun-observing-safety-tips-infographic.html
   - Students should also be told that photographing an eclipse or the sun may cause their camera to break.
   - more information can be found at the following link: www.sciencenotes.org/how-to-photograph-a-solar-eclipse-safely/

3. Students will work on the following activity to note the differences between solar and lunar eclipses and how the orientation of the Earth, Moon, and Sun affects the shadow cast on the object farthest from the sun (the moon in a lunar eclipse, and the Earth in a solar eclipse). (it would likely be useful to attach the toothpicks to the one inch and quarter inch balls prior to the activity in case any need to have holes made or be glued).
    - Students should discuss their observations- how big were the shadows cast in comparison to each other? How would the shadow look from Earth? Which type of eclipse will be seen by more people? Why?
    - Link to activity: www.astrosociety.org/ASPYardstickEclipseinstructions.pdf

MODIFICATIONS:

Students can be grouped based on ability levels and/ or levels of understanding from previous day's instruction. Additional information can be explored for students who grasp the information quickly. This information can be found in the internet resources page. Research into eclipses and it's causes can be investigated for upper level grades.

MATERIALS/ RESOURCES/ TECHNOLOGY:

- Computer/ Smart Board with internet connection to display videos
- White board, or post-its and anchor chart
- Yardsticks (folding or non- folding)- enough for each student or groups
- Binder clips - two per yardstick
- 1 inch ball- one per yardstick
- ¼ inch ball- one per yardstick
- Long wooden toothpicks- two per yardstick
- Access to a light source (outside sun being optimal)

ASSESSMENT/ EVALUATION/ CLOSURE:

Formative Assessment:
Students will complete a graffiti wall on the board noting something they now know about lunar phases. This can be done directly on a whiteboard, or can be done on post it notes that are brought up to a central area like a board or anchor chart. this should be reviewed with the class to remind them of information learned on previous days.
www.stma.k12.mn.us/documents/DW/Q_Comp/FormativeAssessStrategies.pdf

Summative Assessment -
Venn Diagram to compare the differences between lunar and solar eclipse with posted notes

REFERENCES:

Gibbons, G. (1998). *The Moon Book.* New York: Scholastic Inc.

GRADE/ CLASS: 4th Grade – 6th Grade

UNIT: Solar Eclipse

LESSON TITLE: 2017 Solar Eclipse Day 4

DURATION: 45 minutes for four (4) days

LESSON OVERVIEW:

This lesson is the last in a sequence covering lunar phases, lunar eclipses, and solar eclipses. Students will learn about the history of total solar eclipses in Tennessee and the path of the August 21, 2017 American Solar Eclipse, where they are within the path, and the concept of totality.

STANDARDS:

Science
GLE 0407.6.1 Analyze patterns, relative movements, and relationships among the sun, moon, and earth.

0407.6.1 Chart the movements of the sun, moon, and earth to develop an explanation for the phases of the moon and solar and lunar eclipses.

LEARNING TARGETS/ OBJECTIVES:

Students will be able to identify where they are in the path of the eclipse, when the last eclipse occurred in Tennessee, when the next will occur, and be able to let others know about the significance of the 2017 Solar Eclipse.

Student I Can Statements:

1. I can identify the significance of the Great American Solar Eclipse of 2017.
2. I can identify where I will be within the path of totality when the eclipse occurs.
3. I can identify how to view a solar eclipse safely.

ACTIVATING STRATEGY:

1. Begin by asking students what they think life will be like in Tennessee in the year 2566. Students should be given a chance to think about how many years between now and then. Students can draw a quick picture of what they think Tennessee or the world will be like, or write a short description and share with the class if they choose.

2. Students should then be told that this is the next chance they will have to see a total solar eclipse in Tennessee if they miss the one coming on August 21, 2017.

3. Students should then review information from previous days by working in groups to create a list of three truths or facts about eclipses and/ or moon phases, and one lie, or untruth. The list should be random in order as the groups will then read off their lists and the other groups of students will guess which of the "facts" is the fake one.

INSTRUCTION:

1. Students will learn about the solar eclipse that will be coming on August 21, 2017.
    - Students will be introduced to the concept of "totality" and should be reminded of their previous activity of seeing the dot from the ¼ inch ball (the Moon) move across the 1 inch ball (the Earth) the previous day.
    - They should be asked if everyone will see the eclipse, or will just a certain number of people?
        i. Students should be told that the path that the Moon casts its shadow on is called the "path of totality" meaning that anyone that is within that section of the path with see the "total" or all of the eclipse.
        ii. It should be noted that people outside of this path will still see an eclipse, but it will not be a total eclipse, and the amount of the sun that is covered is determined by how far away they are from this line of totality.
    - Students will then look at a map of the path of totality and determine where they are located within the map and if they are in the path of totality. They will then consider what other states and locations will also be within the path. This would work best with an interactive map, if possible, but individual maps can also be printed and displayed.
    - Students should note the times that the eclipse will begin and end in their area as noted on the maps (*approx start- 11:29 am, totality at approx 1:29 pm for roughly 2 minutes, approximate end 2:55 pm- it should be noted that the approximate start and end times include when the first part of the moon crosses over the sun. The most effective viewing will be at roughly 1:25pm to 1:33pm*)
        i. The maps can be located at the following website: https://eclipse2017.nasa.gov/eclipse-maps
        ii. An interactive application can be found here:
        iii. http://eyes.jpl.nasa.gov/eyes-on-eclipse-web-detail.html

    - Students will then learn about what can be expected to happen around them during the total eclipse.
        i. It may be best to ask students to predict what will occur to the rest of the sky, the temperature, animas, etc. Ample time should be given for students to consider possibilities. Responses can be written down as a group on an anchor chart, or just be discussed verbally.
        ii. Students should be told that the sky will become dark or look like twilight, the temperature will remain the same,as there hasn't been enough time for the earth to cool since the sun was blocked, but it will feel cooler to us since the sun won't be shining on our skin; animals and birds will become confused and think it is night time and begin their night time behaviors.

- Students will be introduced to the history of when the last total eclipse occurred in Tennessee (1478). They should be reminded of when the next will occur here (in 2566).
    i. In 1478, Columbus hadn't yet come to America.Native american indians were the only people here to see the eclipse.
    ii. Leonardo DaVinci hadn't painted the Mona Lisa yet. The Sistine chapel also hadn't been painted, and King Henry the VIII hadn't taken the English throne.
    iii. The Pilgrims won't land in now plymouth Massachusetts for another 142 years.
    iv. The Declaration of Independence wouldn't be written for 298 more years.

2. Students will work alone or in groups to create eclipse posters to let others know about the eclipse in our area or posters for where it can be viewed throughout the country in a tourism type format to try to entice others to view the eclipse. The posters should include some important facts about Solar eclipses and the 2017 eclipse in particular, as well as basic safety information. Some examples of tourism posters being used around the country are included below for examples, but are by no means a template for how students can complete their posters.
    - https://www.wku.edu/hardinplanetarium/images/shining_sea2017web.jpg
    - https://s-media-cache-ak0.pinimg.com/
    - https://ichef-1.bbci.co.uk/news/624/cpsprodpb/E4FE/production/_94722685_nord.jpg
    - https://i1.wp.com/metropolistourism.com
    - https://www.wku.edu/hardinplanetarium/images/2017_eclipse_poster_bg.jpg
    - https://www.google.com/imgres?imgurl

MODIFICATIONS:

Students can be grouped based on ability levels and/ or levels of understanding from previous day's instruction. Additional information can be explored for students who grasp the information quickly. This information can be found in the internet resources page. Research into eclipses and it's causes can be investigated for upper level grades.

MATERIALS/ RESOURCES/ TECHNOLOGY:

- Computer/ Smart Board with internet connection to display videos
- White board, or post-its and anchor chart
- Paper to make posters (varies depending on desired size and number of students)
- Crayons, markers, colored pencils, and other art materials.

ASSESSMENT/ EVALUATION/ CLOSURE:

Formative Assessment:
Students break into small groups and create a list of three "truths" or facts about solar eclipses, and one "lie" or made up fact. Groups then present their truths and lies to the other students,

making sure to include the lie in different places amongst the truths to try and trick the other students. The other students will then guess which of the "facts" is the lie.

Summative Assessment -
Students complete advertising 2017 eclipse posters individually, or in groups, to share facts about solar eclipses, the 2017 eclipse, where it can be viewed locally, or where it can be viewed nationally. Students should be sure to include information on viewing safety on the posters, especially if they will be displayed before the eclipse event.

REFERENCES:

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MTSU Department of Physics and Astronomy. *The Great Tennessee Eclipse* [PDF document]. Retrieved from MTSU eclipse website: http://mtsu.edu/eclipse/Presentation-to-K-12-Educators.pdf

Reigier, Natalie (n.d.). *Book Two: 60 Formative Assessment Strategies*. Retrieved from http://www.stma.k12.mn.us/documents/DW/Q_Comp/FormativeAssessStrategies.pdf

National Aeronautics and Space Administration. (n.d.). *Eclipse Maps*. Retrieved from https://eclipse2017.nasa.gov/eclipse-maps

National Aeronautics and Space Administration. (n.d.). *Eyes Eclipse 2017 Web Application*. Retrieved from http://eyes.jpl.nasa.gov/eyes-on-eclipse-web-detail.html

Shining Sea 2017 [Digital image]. (n.d.). Retrieved June 1, 2017, from https://www.wku.edu/hardinplanetarium/images/shining_sea2017web.jpg

[Digital image]. (n.d.). Retrieved June 1, 2017, from https://s-media-cache-ak0.pinimg.com/

[Digital image]. (n.d.). Retrieved June 1, 2017, from https://ichef-1.bbci.co.uk/news/624/cpsprodpb/E4FE/production/_94722685_nord.jpg

Retro Eclipse Poster [Digital image]. (n.d.). Retrieved June 1, 2017, from https://i1.wp.com/metropolistourism.com

2017 Eclipse Poster bg [Digital image]. (n.d.). Retrieved June 1, 2017, from https://www.wku.edu/hardinplanetarium/images/2017_eclipse_poster_bg.jpg

[Digital image]. (n.d.). Retrieved June 1, 2017, from https://www.google.com/imgres?imgurl

Infoplease. (2017). *1400-1700 World History*. Retrieved from https://www.infoplease.com/history-and-government/1000-1899-ad-world-history/

EXTRA RESOURCES:

3-6 Books:

- Krupp, E.C. (1993) *The Moon and You*. New York: McMillian.
- Gibbons, G. (1997) *The Moon Book*. New York: Scholastic Inc.
- Maloof, T. (2015) *Earth and Moon*. Teacher Created Materials.
- Fowler, A. (1991) *So That's How the Moon Changes Shape*!. Childrens Press.
- Hine, P. (2016). *Total Eclipse of the Sun Coast to Coast USA.* Virginia: Mascot Books
- Schneider, Howard. (2016) *Night Sky*. Washington D.C.: National Geographic.
- Prinja, Raman. (2011) *Awesome Astronomy*.Irvine: QEB Publishing.
- Stille, Darlene. (2004) *Earth*. Chanhassen: The Child's World.
- Burnie, David. (1999) Eyewitness: *Light*. New York: DK Publishing.
- Mitton, Jacqueline. (2009) *Eyewitness: Moon*. New York: DK Publishing.
- Kalman, Bobbie; Fast, April. (1999) *Cosmic Light Shows*. New York: Crabtree Publishing Company.