8th Grade Astronomy/Space Science Unit Plan — Karen Weir-Brown
Astronomy and Space Science (Endeavor Course) — Fall 2018

Big Ideas:
A relationship between the Earth, its moon, and the sun can be predicted and impacts life on Earth.
Earth and its solar system are part of the Milky Way galaxy which is a small part of the universe.
The universe consists of galaxies, stars, planets, and other objects.
Gravity is a driving force for motion in space.

Essential Questions:
How does Earth's place in the universe affect life on Earth?
What is the role of gravity in the motions of objects in our Solar System?
How would our lives be different if the Earth was not tilted on its axis?
Why are scale models important when studying space?

Course resources:
There are so many terrific resources from this course to include. The difficult part is limiting what I will use!
I have listed NASA resources to use for each lesson below the lesson description.

How will using these resources help your students better achieve your goals for the unit?
Using the NASA data and images will help my students meet the level of complexity that the NGSS standards demand. The NASA activities are written to facilitate student sense-making by using real data/images or creating meaningful models. This unit will now be much more engaging for my students because it is driven by actual NASA missions and not the textbook.

Standards

ESS1.A: The Universe and Its Stars
- **Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)**
- **Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2)**

ESS1.B: Earth and the Solar System
- **The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS-ESS1-3)**
- **This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1)**
- **The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2)**

Patterns
- **Patterns can be used to identify cause-and-effect relationships. (MS-ESS1-1)**

Scale, Proportion, and Quantity
- **Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-3),**

Systems and System Models
- **Models can be used to represent systems and their interactions. (MS-ESS1-2)**

Interdependence of Science, Engineering, and Technology
- **Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-ESS1-3)**

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- **Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-ESS1-1),(MS-ESS1-2)**

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- **Develop and use a model to describe phenomena. (MS-ESS1-1),(MS-ESS1-2)**

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- **Analyze and interpret data to determine similarities and differences in findings. (MS-ESS1-3)**

MS-ESS1-1. **Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.** [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]

MS-ESS1-2. **Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.** [Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).] [*Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.*]

MS-ESS1-3. **Analyze and interpret data to determine scale properties of objects in the solar system.** [Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [*Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.*]

Common Core State Standards Connections:

ELA/Literacy -

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-3)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS1-3)

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-ESS1-1),(MS-ESS1-2)*

Mathematics -

MP.2 Reason abstractly and quantitatively. (MS-ESS1-3)

MP.4 Model with mathematics. *(MS-ESS1-1),(MS-ESS1-2)*

6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *(MS-ESS1-1),(MS-ESS1-2)*,(MS-ESS1-3)

7.RP.A.2 Recognize and represent proportional relationships between quantities. *(MS-ESS1-1),(MS-ESS1-2)*,(MS-ESS1-3)

6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-ESS1-2)*

7.EE.B.6 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-ESS1-2)*

<u>7 week unit plan overview:</u>

Objectives:

Students will be able to accurately

- draw a model of the Earth-sun-moon system including Earth's tilt, relative size and distances, and describe the relationships between the Earth-moon and sun-Earth systems for each season. (ESS1-1)
- draw a model of the Earth-moon system to describe the phases of the moon (ESS1-1)
- depict the relationships between the sun-Earth-moon for a solar and a lunar eclipse (ESS1-1)
- draw a scale model of our solar system including the relationships between objects and include gravitational force vectors and factors influencing gravitational force (ESS1-2)

- use data to identify space objects (ESS1-3)

Differentiation:
This unit plan involves a lot of kinesthetic modeling which is typically helpful for EL and resource students. Be sure to include the use of vocabulary word walls and Frayer models. There is also opportunity to include use of programming the Sphero robots in this unit for students who are showing understanding early in the unit.

Lessons:
1. Pre-assessment:
- Students complete the packet of Page Keeley probes which will be collected and reviewed by the teacher. Students will receive the packet back at the end of the unit to make corrections/additions to demonstrate learning. (1 period)
    - How far away is the sun? (#11) pages 61-64
    - Why is it warmer in the summer? (#15) pages 79-83)
    - Earth or moon shadow? (#19) pages 103-107
    - Moon phase and solar eclipse (#20) pages 108-112
    - Chinese moon (#23) pages 123-126
    - Gravity in other planetary systems (#33) pages 177-180
    - Which is bigger? (#37) pages 199-202

2. Unit Engage (1 period)
- Students watch the YouTube video "View of the stars as the Earth rotates" by Gabriel Lopes and explain what they see as a notebook entry.
- Students share in table discussion and then a class discussion.
- Teacher creates class KWL chart to drive questions/motivation for the unit.

https://www.youtube.com/watch?time_continue=37&v=jasQpiR1mho

3. Identify Objects in Space
Overview: Students will describe the components of the universe in terms of galaxies, stars and solar systems.

Students learn about the classification of galaxies using Hubble Images. (2 periods)
Hubble Deep Field Images
http://hubblesite.org/images/galleryhttp://hubblesite.org/images/gallery

Students learn about the age and life cycle of stars. (2 periods)
Life Cycle of Stars (Goddard plan)
https://imagine.gsfc.nasa.gov/educators/lifecycles/stars.html

Students learn asteroids, comets, meteors, satellites. (1 period)
https://www.nasa.gov/audience/forstudents/k-4/more_to_explore/Asteroids-Comets-Meteorites.html

Assess - (1 period)

4. Scale of the Solar System
Overview: Students will explore several ways to look at the scale of the solar system before they draw a model in their notebooks.

Scale models of the Solar System unit (walking planet distances and relative planet sizes) (2 periods)

https://www.nasa.gov/offices/education/programs/national/summer/education_resources/earthspacescience_grades7-9/ESS_ss-scale-models.html

Solar system scroll (2 periods)
https://www.jpl.nasa.gov/edu/teach/activity/solar-system-scroll/

Sizing up Pluto (using new data to revise previous understandings) (2 periods)
https://www.jpl.nasa.gov/edu/teach/activity/measuring-pluto/

Assess and Gallery walk of models (2 periods)

5. Gravity
Overview: Students will explore the role of gravity in the formation of some solar system objects and then they explore the role gravity has on keeping objects in orbit around larger objects. Students will be able to add gravitational forces to their solar system model.

Students learn about accretion (clumping) by playing a game. (2 periods)
https://dawn.jpl.nasa.gov/DawnClassrooms/pdfs/ActiveAccretion.pdf
https://dawn.jpl.nasa.gov/news/pdf/iCceres/Active_Accretion.pdf

Gravitational well activity (2 periods)
https://www.lpi.usra.edu/education/explore/solar_system/activities/bigKid/planetPull/
http://www.ingridscience.ca/node/520
https://www.youtube.com/watch?v=iJq4cXY97_Y

Assess (1 period)

6. Earth-Moon-Sun System
Overview: Students will revisit their 6th grade understanding of unequal heating of Earth's surfaces to develop their understanding of seasons. Students will explore the relationships between the Earth, moon, and sun to explain the phases of the moon and the eclipses.

Students dive deep into explaining the reason for seasons. (3 periods)

Students use photoperiods to explain seasons
Use "Tackling misconceptions about seasons" by Susan German from NSTA Science Scope 3/2017.

Students sequence pictures of phases of the Moon and explain why the Moon appears to change shape. (2 periods)

review/remediation activity: https://www.jpl.nasa.gov/edu/teach/activity/moon-phases/
Modeling the Earth-moon system
https://www.jpl.nasa.gov/edu/teach/activity/modeling-the-earth-moon-system/

Students compare and contrast solar and lunar eclipses. (2 periods)

Modeling eclipses - use August 2017 solar eclipse data/lessons
https://eclipse2017.nasa.gov/educational-lessons-and-activities
Differentiation for advanced:
https://www.jpl.nasa.gov/edu/teach/activity/epic-eclipse-a-pi-in-the-sky-challenge/

Assess and gallery walk of models (2 periods)

7. Extend - Studying Space (4 periods)
Students research either a specific NASA mission or research tools used to study space (satellites, telescopes, imagery) and create an infographic, presentation, Thinglink, etc on their learning. Share student work on a Google classroom link.

8. Summative Assessment (2 periods)

Assessments:
Summative

- Create a children's book that describes how the Earth would be if it was not tilted on its axis. Be sure to address the seasons and eclipses.

- You are designing a new telescope to send into space. Describe what your telescope will be able to document and how you will interpret the images.

- Create a model of the solar system using your classmates. Describe how many peers you need, what they will be doing, where they will be placed, and the limitations of your model. Prepare to model moon phases and eclipses if asked.

Formative

- Draw a sketch that shows the position of the Sun, Earth, and Moon to explain the new and full moons.
- Draw a sketch that explains solar and lunar eclipses.
- Explain how gravity affects the movement of the Sun, Moon and Earth.
- Calculate the relative size of planets and relative distances between planets, given a scale to use.
- Revise the Keeley probes packets given at the beginning of the unit.

Resources:
German, Susan. (March 2017). *Tackling Misconceptions About Seasons*. NSTA Science Scope 40:7. Pages 92-95.

Keeley, Page and Cary Sneider. (2012). *Uncovering Student Ideas in Astronomy*. Arlington, Virginia. NSTA Press.

Lopes, Gabriel. *View of the stars as the Earth rotates. [VIDEO].mp4*. (March 31, 2010). *YouTube*. Retrieved 10 August 2016, from https://www.youtube.com/watch?time_continue=37&v=jasQpiR1mho

NASA Goddard Space Flight Center. *Imagine the Universe: Life Cycles of Stars*. (2018). *Imagine.gsfc.nasa.gov*. Retrieved 21 November 2018, from https://imagine.gsfc.nasa.gov/educators/lif

NASA Jet Propulsion Lab. *Sizing Up Pluto Activity | NASA/JPL Edu*. (2018). *NASA/JPL Edu*. Retrieved 21 November 2018, from https://www.jpl.nasa.gov/edu/teach/activity/measuring-pluto/