Endeavor
STEM Teaching Certificate Project

Earth vs. Moon Comparison

Grade(s): High School
Lesson Duration: 4 Class periods that are 58 minutes
Course Name(s): Earth Science (9th Grade)
Lesson Author: Stephanie Archuleta, Center, CO

BIG IDEAS

Students will use data from NASA missions to Earth's Moon to compare the Moon's composition and features to Earth's composition and features. The goal is to gain evidence to support or not support the leading theory that the Moon likely formed after a Mars-sized body collided with Earth. Students will need to support their stance with four points of data and mission evidence. Evidence from other planets moons can also be used to support or not support that our Moon came from part of Earth.

EDUCATION STANDARDS

Science Performance Expectations (or state Science standard):
HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. [Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.]

Science and Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. ♣ Apply scientific reasoning to link evidence to the claims to	ESS1.C: The History of Planet Earth ♣ Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide	Patterns ♣ Empirical evidence is needed to identify patterns. (HS-ESS1-5) Stability and Change ♣ Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS1-6)

assess the extent to which the reasoning and data support the explanation or conclusion. (HS-ESS1-6) Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. ♣ Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-ESS1-5) -- Connections to Nature of Science ---- Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena ♣ Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. (HS-ESS1-6) Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-ESS1-5)	information about Earth's formation and early history. (HS-ESS1-6) ESS2.A: Earth Materials and Systems ♣ Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1) (Note: This Disciplinary Core Idea is also addressed by HS-ESS2-2.) PS1.C: Nuclear Processes ♣ Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to HS-ESS1-5), (secondary to HS-ESS1-6)	

State Math or ELA Standards (Colorado):

MATHEMATICS High School, Standard 3. Data, Statistics, and Probability

- HS.S-IC.B. Making Inferences & Justifying Conclusions: Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
- HS.S-ID.B. Interpreting Categorical & Quantitative Data: Summarize, represent, and interpret data on two categorical and quantitative variables.

Reading, Writing and Communicating:

Ninth/Tenth Grade Band, Standard 1. Oral Expression and Listening

- 2. Organize and develop credible presentations tailored to purpose and audience.

Ninth/Tenth Grade Band, Standard 4. Research Inquiry and Design

- 1. Synthesize multiple, authoritative literary and/or informational sources, creating cohesive research projects that show an understanding of the subject.

MEASURABLE STUDENT LEARNING OBJECTIVES

- Day 1: Scientists will be able to research and identify the rock and mineral found on Earth and the Moon.
- Day 2: Scientists will be able to compare the Earth and Moon rocks and minerals data and assess if the Moon was part of the Earth as one point.
- Day 3: Scientists will be able to create a presentation that analyzes collected data points to present their findings.
- Day 4: Scientists will be able to present findings about Earth and Moon research and describe the potential Moon's origins.

MATERIALS NEEDED

- https://app.discoveryeducation.com/learn/techbook/units/2c10966f-d0e2-44b6-8617-5116e7a53f29/concepts/47acd64e-ef98-4969-92fc-c3046cc978ad/tabs/759da9a7-2edf-4cde-9515-7081ca990764/pages/3ae9908c-f666-4821-8dcd-144125c3578c
    - This is the textbook I use for class. Students will take notes on What Chemical and Physical Features Distinguish the Inner Planets and Their Moons.
- https://science.nasa.gov/moon/facts/
    - Students will use this NASA site to research Moon facts
- https://science.nasa.gov/moon/missions/
    - Students will use this NASA site to research Moon Missions for evidence of the Moons composition.
- https://science.nasa.gov/moon/composition/
    - Students will use this NASA site to research the Moon's Composition
- https://serc.carleton.edu/mel/teaching_resources/moon_mel.html
    - Students will this site that describe evidence and alternative explanations for the formation of the Moon.

ENGAGING CONTEXT/PHENOMENON

https://orbitaltoday.com/2023/06/16/the-legacy-of-the-universe-moon-myths-and-folklore/#:~:text=According%20to%20the%20Native%20American,to%20help%20humanity%20at%20night.

See Think Wonder: I wonder where did the moon really come from, what myth and folklore exist about the moon and how can we uncover the truth?

- Classes will spend 10-15 minutes discussing common folklore around the moon. Well known folklore: werewolves and cultural folklore: La Llorona. (my students are primarily Mexican)

DATA INTEGRATION

Students will be collecting and analyzing data from Earth samples and NASA Moon mission's samples. Students will be comparing the Moon and Earth data to assess if the compounds found on Earth and the Moon are similar or different. This data will prove or disprove the leading theory that the Moon is composed from debris from an impact with Earth and a Mars sized celestial body.

TEACHER BACKGROUND KNOWLEDGE

Teacher background knowledge needed includes knowledge of how to navigate the NASA data websites and the Earth and Moon's compositions and layers. Prior to assignment practice navigation of the NASA date sites. The Discovery Ed Textbook can help with the composition and layers information.

DIFFERENTIATION OF INSTRUCTION

Differentiation for this lesson will include less research requirements guided by IEP and ML plans. iPads can be used to translation help or text to talk using the Google Translate App. Students are allowed to present in their home language if needed. I will confer with students that need support navigating website and research support.

REAL-WORLD CONNECTIONS FOR STUDENTS

Connections to student's lives includes the constant wonder about where our Moon can from the folklore that surrounds our Moon. A majority of my students cultural includes some of these Moon's folklores. The NASA Artemis Missions have brought renewed wonder for the Moon in the student's eyes.

POSSIBLE PRIOR or MISCONCEPTIONS

Misconceptions could include ideas about the moon's origins (sorry kids the moon is not made of cheese). Students not knowing what NASA missions really do and the amount of Moon missions NASA has completed.

LESSON PROCEDURE

5E	Details of 5E Lesson Implementation *(Visit BSCS to learn more about the 5E instructional model)*
Engage In this lesson students will use data from NASA missions to Earth's Moon to compare the Moon's composition and features to Earth's composition and features. Phenomenon: Exploring the folklore involving the Moon and why we have a Moon and what the Moon does for us. Discussions: Cultural folklore involving the moon and where the folklores originated	**Lesson Objective** • Day 1: Scientists will be able to research and identify the rock and mineral found on Earth and the Moon. **Standards Addressed** Science and Engineering Practices • Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. • Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-ESS1-5) **Materials & Resources** • Website for the Phenomenon: https://orbitaltoday.com/2023/06/16/the-legacy-of-the-universe-moon-myths-and-folklore/#:~:text=According%20to%20the%20Native%20American,to%20help%20humanity%20at%20night • See-Think-Wonder T Chart **Procedure:**

from. Students do a See-Think-Wonder about the Moon and Earth's composition.	• Teacher: Show a picture of Earth's Moon • Students": Complete a See-Think-Wonder T Chart about the Moon picture. • Class Group Discussion: Using the phenomenon website discuss the folklore around the Moon. • Students learning in this phase is using and creating schema about the Moon. **Formative/Summative Assessments** • **Formative:** See-Think-Wonder T Chart **Modifications** • IEP and ML can use an iPad for translation and text to talk. Can talk to me personally if not wanting to share with the class discussion.
Explore Students will be using the various websites to research data that supports their idea of where the Moon is from. Students are encouraged to look at multiple moon missions to decide the best evidence.	**Lesson Objective** • Scientists will be able to compare the Earth and Moon rocks and minerals data and assess if the Moon was part of the Earth as one point. **Standards Addressed** • ESS1.C: The History of Planet Earth • Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (HS-ESS1-6) • ESS2.A: Earth Materials and Systems • Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1) (Note: This Disciplinary Core Idea is also addressed by HS-ESS2-2.) • PS1.C: Nuclear Processes • Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to HS-ESS1-5),(secondary to HS-ESS1-6) **Materials & Resources** • https://app.discoveryeducation.com/learn/techbook/units/2c10966f-d0e2-44b6-8617-5116e7a53f29/concepts/47acd64e-ef98-4969-92fc-c3046cc978ad/tabs/759da9a7-2edf-4cde-9515-7081ca990764/pages/3ae9908c-f666-4821-8dcd-144125c3578c o This is the textbook I use for class. Students will take notes on What Chemical and Physical Features

	Distinguish the Inner Planets and Their Moons.
	• https://science.nasa.gov/moon/facts/
	  o Students will use this NASA site to research Moon facts
	• https://science.nasa.gov/moon/missions/
	  o Students will use this NASA site to research Moon Missions for evidence of the Moons composition.
	• https://science.nasa.gov/moon/composition/
	  o Students will use this NASA site to research the Moon's Composition
	• https://serc.carleton.edu/mel/teaching_resources/moon_mel.html
	  o Students will this site that describe evidence and alternative explanations for the formation of the Moon.
	
	Procedure:
	• Teacher: Short lecture/notes using Discovery Ed Textbook. Reminds students what they are needing to research and that the research is supporting/unsupporting facts that the moon was once part of Earth.
	• Students: Using the NASA website to conduct research
	• Teacher: Confers with students during the research phase. Asking questions and checking for understanding
	
	Formative/Summative Assessments
	• Formative: Research conducted and expressing what data is being collected (this will be assess during student conferring)
	
	Modifications
	• Extra conferring time and research support to help find valid data points.

Explain Students will compile the research and data to explain their findings if the moon was once part of Earth or was formed from something else.	**Lesson Objective** • Scientists will be able to compare the Earth and Moon rocks and minerals data and assess if the Moon was part of the Earth as one point. **Standards Addressed** • Patterns • Empirical evidence is needed to identify patterns. (HS-ESS1-5) • Stability and Change • Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS1-6) MATHEMATICS High School, Standard 3. Data, Statistics, and Probability • HS.S-IC.B. Making Inferences & Justifying Conclusions: Make inferences and justify conclusions from sample surveys, experiments, and observational studies. • HS.S-ID.B. Interpreting Categorical & Quantitative Data: Summarize, represent, and interpret data on two categorical and quantitative variables.

	Materials & Resources
	• https://science.nasa.gov/moon/facts/
	  o Students will use this NASA site to research Moon facts
	• https://science.nasa.gov/moon/missions/
	  o Students will use this NASA site to research Moon Missions for evidence of the Moons composition.
	• https://science.nasa.gov/moon/composition/
	  o Students will use this NASA site to research the Moon's Composition
	• https://serc.carleton.edu/mel/teaching_resources/moon_mel.html
	  o Students will this site that describe evidence and alternative explanations for the formation of the Moon.
	• PowerPoint or Google Slides: Helping to organize thoughts, research, and data collected
	
	Procedure:
	• Teacher: Remind students what the end state of the project is (presented data collect to link the origins of Earth's Moon.
	• Students: Compiled collect data and start a PowerPoint to collect their thoughts and data.
	• Teacher: Confers with students during the research phase. Asking questions and checking for understanding
	
	Modifications
	• Extra conferring time and research support to help find valid data points.

Elaborate Students will finalize PowerPoint presentations that support the research and data that was collected	**Lesson Objective** Scientists will be able to create a presentation that analyzes collected data points to present their findings. **Standards Addressed** • Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. (HS-ESS1-6) Reading, Writing and Communicating: Ninth/Tenth Grade Band, Standard 4. Research Inquiry and Design • 1. Synthesize multiple, authoritative literary and/or informational sources, creating cohesive research projects that show an understanding of the subject. **Materials & Resources** • Research should be completed but if not refer to the websites from previous days

	• PowerPoint or Google Slides for presentation **Procedure:** • Teacher: Remind students what the end state of the project and presentation requirements. • Students: Complete the PowerPoint and prepare for presentations • Teacher: Confers with students and help finalize presentation **Modifications** • Length of presentation shortened according to IEP or ML accommodations • Presentation material can be in both native language and English
Evaluate Students will present their presentation with data from NASA missions to Earth's Moon to compare the Moon's composition and features to Earth's composition and features.	**Lesson Objective** Scientists will be able to present findings about Earth and Moon research and describe the potential Moon's origins. **Standards Addressed** -- Connections to Nature of Science ---- • Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena • Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. (HS-ESS1-6) • Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-ESS1-5) Reading, Writing and Communicating: Ninth/Tenth Grade Band, Standard 1. Oral Expression and Listening • 2. Organize and develop credible presentations tailored to purpose and audience. Ninth/Tenth Grade Band, Standard 4. Research Inquiry and Design • 1. Synthesize multiple, authoritative literary and/or informational sources, creating cohesive research projects that show an understanding of the subject. **Materials & Resources** • PowerPoint/Google Slides for presentation **Procedure:** • Teacher: Final reminder about presentations expectations and audience expectations • Students: Present presentation and be a great audience for your fellow classmates **Formative/Summative Assessments** • Summative: PowerPoint Presentation information and Ability to voice and communicate the research and data collected. **Modifications** • Length of presentation shortened according to IEP or ML plans • Presentation material can be in both native language and English • Can Present in home language

REFERENCES

Composition - NASA Science. (n.d.). Science.nasa.gov. https://science.nasa.gov/moon/composition/

Enthusiast, S. (2023, June 16). *The Moon myths and folklore of different nations*. Orbital Today. https://orbitaltoday.com/2023/06/16/the-legacy-of-the-universe-moon-myths-and-folklore/#:~:text=According%20to%20the%20Native%20American

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