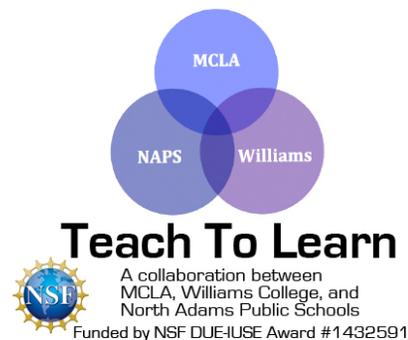


The Evolution of the T2L Science Curriculum

Over the last four years, the Teach to Learn program created 20 NGSS-aligned science units in grades K-5 during our summer sessions. True to our plan, we piloted the units in North Adams Public Schools, and asked and received feedback from our science fellows and our participating teachers. This feedback served as a starting point for our revisions of the units. During year 2 (Summer of 2015), we revised units from year 1 (Summer/Fall 2014) and created new units to pilot. In year 3, we revised units from years 1 and 2 and created new units of curricula, using the same model for year 4. Our understanding of how to create rich and robust science curriculum grew, so by the summer of 2018, our final summer of curriculum development, we had created five exemplar units and established an exemplar unit template which is available in the T2L Toolkit.

We made a concerted effort to upgrade all the existing units with exemplar components. We were able to do much, but not all. So, as you explore different units, you will notice that some contain all elements of our exemplar units, while others contain only some. The fully realized exemplar units are noted on the cover page. We did revise all 20 units and brought them to a baseline of “exemplar” by including the Lessons-At-A-Glance and Science Talk elements.

Grade 5 Earth's Place in the Universe



T2L Curriculum Unit



Earth's Place in the Universe

Earth and Space Science / Grade 5

In this unit, students will explore patterns of the motion pertaining to the sun, moon and stars. They will observe, describe, and learn to predict these patterns. Hands-on activities and educational videos supplement the class discussions and lectures in order to aid student comprehension.



Creation and Revision History

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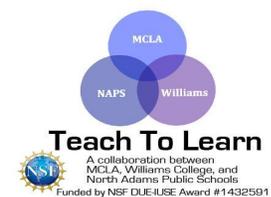


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Unit Plan

Stage 1 Desired Results		
<p>[2006] 3-5-ES-13. Recognize that the earth is part of a system called the “solar system” that includes the Sun (a star), planets, and many moons. The earth is the third planet from the Sun in our solar system.</p> <p>ELA Reading Standard: 2. Determine one or more main ideas of a text and explain how they are supported by key details; summarize a text.</p> <p>ELA Writing Standard:</p> <ul style="list-style-type: none"> Write opinion pieces on topics or texts, supporting a point of view with reasons and information. Introduce a topic or text clearly, state an opinion, and create an organizational structure in which ideas are logically grouped in paragraphs and sections to support the writer’s purpose. Provide logically ordered reasons that are supported by facts and details. <p>5-ESS1-1. Use observations, first-hand and</p>	<i>Meaning</i>	
	<p>UNDERSTANDINGS</p> <p><i>Students will understand that...</i></p> <ul style="list-style-type: none"> Patterns of the motion of the sun, moon and stars can be observed, described and predicted. Seasonal patterns of seasonal changes can be observed, described and predicted. 	<p>U</p>
<i>Student Learning Targets</i>		
<p><i>Students “I can” statements</i></p> <ul style="list-style-type: none"> I can summarize an article about the solar system I can restate key points from an article I can identify evidence that supports the main idea of the text I can identify that the Earth is the third planet, and that there are other planets in the solar system I can recognize the Sun appears to be the closest to the earth compared to other stars I can recognize the Sun as the center of our solar system Use a calendar to support the idea that the Earth revolves around the Sun once a year (365 days) I can use a model to explain how the Earth’s rotation on its axis causes day and night I can create a model to illustrate the distances between the planets in the Solar System I can know the order in which the planets are aligned in the Solar System I can name the inner and outer planets I can describe the properties of the inner and outer planets 		

from various media, to argue that the Sun is a star that appears larger and brighter than other stars because it is closer to Earth.

State Assessment Boundary: Other factors that affect apparent brightness (such as stellar masses, age, or stage) are not expected in state assessment

[2006] 3-5-14. Recognize that the earth Revolves around (orbits) the Sun in a year's time and that the earth rotates on its axis once approximately every 24 hours. Make connections between the rotation of the earth and day/night, and the apparent movement of the sun, moon, and stars across the sky.

[2006] 3-5-ES-15. Describe the changes that occur in the observable shape of the moon over the course of a month.

5.ESS1-2. Use a model to communicate Earth's relationship to the Sun, Moon, and other stars that explain (a) why people on Earth experience day and night, (b) patterns in daily changes in length and direction of shadows over a day, and (c) changes in the apparent position of the Sun, Moon, and stars at different times during a day, over a

- I can describe the differences between the inner and outer planets
- I can identify that the Earth rotates on its axis every 24 hours
- I can identify and name the phases of the moon
- I can draw a diagram of the Sun, Earth, and Moon for a specific phase
- I can draw a picture of the moon for a specific phase
- I can use a calendar to calculate the length of time it takes the Moon to go through a full cycle
- I can give an example of a force
- I can explain how gravitational force works.

<p>month, and over a year.</p> <p>Clarification Statement: Models should illustrate that the Earth, Sun, and Moon are spheres; include orbits of the Earth around the Sun and of the Moon around Earth; and demonstrate Earth’s rotation about its axis.</p> <p>State Assessment Boundary: Causes of lunar phases or seasons, or use of Earth’s tilt are not expected in state assessment.</p> <p>5-PS2-1. Support an argument with evidence that the gravitational force exerted by Earth on objects is directed toward Earth’s center.</p> <p>State Assessment Boundary: Mathematical representations of gravitational force are not expected in state assessment.</p>	
Stage 2 – Evidence	
Evaluative Criteria	Assessment Evidence
Pre-unit Assessment (if any)	End of Unit Assessment OE 1. Exit Tickets 2. Science Journals 3. Class Discussions 4. Think Pair Share 5. Group Presentations

Stage 3 – Learning Plan

Prior Grade Level Knowledge: *Please be aware that the needs of your class may vary and some topics may need to be revisited.*

PreK -ESS1-1(MA). Demonstrate awareness that the Moon can be seen in the day and night, and that the moon changes shapes over the course of a month. **Clarification Statement:** The names of moon phases or sequencing of moon phases is not expected.

PreK-ESS1-2(MA). Observe and use evidence to describe that the Sun is in different places in the sky during the day.

Grade 1- ESS1-1. Use observations of the Sun, Moon, and stars to describe that each appears to rise in one part of the sky, move across the sky, and sets.

Grade 1- ESS1-2. Understand relationships among seasonal patterns of change, including sunrise and sunset, seasonal temperature and rainfall or snowfall patterns. **Clarification Statement:** Examples of seasonal changes to the environment can include foliage changes, bird migration, and differences in amount of insect activity.

Grade 4- ESS1-1. Use evidence from a given landscape that includes simple landforms and rock layers to support a claim about the role of erosion or deposition in the formation of the landscape over long periods of time. **Clarification Statements:** 1) Examples of evidence and claims could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from deposition on land to deposition in water over time; and a canyon with rock layers in the walls and a river in the bottom, indicating that a river eroded the rock over time. 2) Examples of simple landforms can include valleys, hills, mountains, plains, and canyons. 3) Focus should be on relative time. **State Assessment Boundary:** Specific details of the mechanisms of rock formation or specific rock formations and layers are not expected in state assessment

Lesson 1: Our Solar System—Activate prior knowledge by completing the lesson opening which requires students to discuss their ideas about the solar system and create a working definition. The students will be introduced to vocabulary through a PowerPoint and then will be broken up into groups of 4 to complete a jigsaw activity with the provided article.

Lesson 2: The Sun - Our Most Important Star—Students will learn that the Sun is the center of the solar system. The students will observe that the Sun is the largest and brightest star because it is closest to the Earth. Students will learn that the Earth revolves around the sun. Videos will be used as visual aids within the lesson.

Lesson 3: Planets—Students will learn the order of the planets as well as the traits that every planet has in common. The class will participate in an activity where they create a scale model of the solar system to understand the distance between the planets and the Sun. The students will learn that there are inner and outer planets which are separated by the asteroid belt.

Lesson 4: Inner Planets—Students will learn to describe and compare the inner planets. Students will learn most of the information from a PowerPoint presentation. This information will be reinforced through research. At the end, each group of students will present a presentation about a specific inner planet.

Lesson 5: Outer Planets—Students will learn about the properties of the outer planets. Students will learn about planets that have rings around them and that some planets can be gaseous (unlike Earth which has a rocky surface). The students will read an article with facts about the outer planets and will do an investigation with jello.

Lesson 6: Earth - Rotation, Tilt, and Revolution—In this lesson, students will learn that the Earth rotates on its axis every 24 hours which makes up a day. The students will also learn that the Earth revolves the Sun once every year or 365 days.

Lesson 7: Earth's Moon Phases—In this lesson, students will watch a video about the first human moon landing to create excitement around the topic. Then, they will watch a rap video about the phases of the moon. Students will participate in three activities focused on the phases of the moon. The activities involve making moon phases out of Oreos, creating a personal single phase moon viewer, and using the full cycle cardboard moon phase viewer. These three activities will help students draw diagrams of the positions of the earth, sun, and moon.

Lesson 8: Earth's Gravitational Force—Students will learn how gravity works by watching videos and participating in activities which demonstrate the power of gravity.

Adapted from Massachusetts Department of Elementary and Secondary Education's Model Curriculum Unit Template. Originally based on Understanding by Design 2.0 © 2011 Grant Wiggins and Jay McTighe. Used with Permission July 2012

Lessons at a Glance

 KEY Independent online student research  Tech Integration  YouTube Video  Outdoor education  Kinesthetic		
Lesson	Core Activities	Aspects of Lesson
1. Our Solar System	<ul style="list-style-type: none"> • Solar System Vocab • Powerpoint • Our Solar System Article 	
2. The Sun: Our Most Important Star	<ul style="list-style-type: none"> • Kinesthetic Modeling of Rotation and Revolution • Other Rotation and Revolution Models • Make a Sundial 	  
3. Planets	<ul style="list-style-type: none"> • Planets Around the Sun • Scale Model Article • Distances Between Planets • Creating a Solar System 	 
4. Inner Planets	<ul style="list-style-type: none"> • Inner Planets Powerpoint • Inner Planet Presentation 	 
5. Outer Planets	<ul style="list-style-type: none"> • Characteristics of the Outer Planets 	

	<ul style="list-style-type: none"> ● Modeling Planets with Fruit 	
6. Earth-Rotation, Tilt and Revolution	<ul style="list-style-type: none"> ● Earth's Rotation ● Earth's Seasons ● Spinning Counterclockwise ● Earth's Rotation and Sunlight ● Rotation/Revolution Models 	 
7. Earth's Moon and Its Phases	<ul style="list-style-type: none"> ● Moon Rap Lyrics ● Oreo Phases of the Moon 	
8. Earth's Gravitational Force	<ul style="list-style-type: none"> ● Falling Objects ● Weight is a Measure of Earth's Gravity on an Object 	

Lesson Feature Key

Lessons in this unit include a number of features to help instructors. This key is a quick guide to help identify and understand the most important features.

Icons



Talk science icon: Look for this icon to let you know when to use some of the talk science strategies (found in the unit resources of this unit)



Anchor phenomenon icon: Indicates a time when an anchoring scientific phenomenon is introduced or when an activity connects back to this important idea.

Text Formatting:

[SP#:] Any time you see a set of brackets like this, it indicates that students should be engaged in a specific science or engineering practice.

Underlined text in the lesson:

This formatting indicates important connections back to the central scientific concepts, and is useful to note these connections as an instructor, as well as for students.

Callouts

Teaching Tip

In these call out boxes, you'll find tips for teaching strategies or background information on the topic.

Student Thinking Alert

Look out for common student answers, ways in which students may think about a phenomenon, or typical misconceptions.

Tiered Vocabulary List

Tier One	Tier Two	Tier Three
Gravity Star Planet Sunrise Sunset Rocky Clockwise Counterclockwise Degrees Orbit	Magnitude Distance Inner Planets Outer Planets Rotation Revolution Orbit Phase Waxing Waning	Solar Gravity Asteroids Meteoroid Solar System Solar Flare Sunspots Asteroid Belt Satellites Gaseous Jovian Planets Axis Crescent Gibbous

Lesson 1: Our Solar System

BACKGROUND

Overview of the Lesson

Prior knowledge will be activated by completing the lesson opening which requires students to discuss their ideas about the solar system and create a working definition. The students will be introduced to vocabulary through a PowerPoint and then will be broken up into groups of 4 students to complete a jigsaw activity with the provided article.

Focus Standard(s)

[2006] 3-5-ES-13. Recognize that the earth is part of a system called the “solar system” that includes the Sun (a star), planets, and many moons. The earth is the third planet from the Sun in our solar system.

5.RI.2. Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

ELA (2017) Reading Standard: Determine one or more main ideas of a text and explain how they are supported by key details; summarize a text.

ELA (2017) Writing Standard:

- Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
 - Introduce a topic or text clearly, state an opinion, and create an organizational structure in which ideas are logically grouped in paragraphs and sections to support the writer’s purpose.
 - Provide logically ordered reasons that are supported by facts and details.

Learning Targets

- I can summarize an article about the solar system.
- I can identify evidence that supports the main idea of the text with supporting details.
- I can identify that the Earth is the third planet, and that there are other planets in the solar system.

Assessment

Exit Ticket: What holds the planets and other objects of our solar system in orbit around the sun?

- a) The gravitational forces between the planets
- b) The gravitational forces between the Sun and the planets**
- c) The rotation of the objects
- d) The atmosphere

Key Vocabulary

Tier 1: gravity, star, planet

Tier 2: orbit

Tier 3: asteroid, meteoroid, solar system, galaxy

RESOURCES AND MATERIALS

Quantity	Item	Source
1 per student	Our Solar System Article	Binder
1 per student	Science Journal	Classroom Teacher
8 pieces	Large Chart Paper	Classroom Teacher
	"The Universe: Introduction to Vocabulary" PowerPoint	CMC Website

****Items in bold should be returned for use next year****

LESSON DETAILS

Lesson Opening/ Activator

The classroom teacher should set up a “four corners” activity with four different posters around the classroom and label the top of them with the words “Space,” “Solar System,” “Earth,” and “Sun.” Put the students into groups of four; these groups will be used multiple times throughout this lesson. Have the students discuss the word at the top of the poster and give each group a different colored marker to add any information they know about the word on the poster. After the groups have visited all four posters, bring them to the front of the classroom to discuss the information listed, asking prompting questions to get students to continue thinking about these words. The teacher should guide this discussion in order to touch on important concepts and to ensure the accuracy.

During the Lesson

1. **Solar System Vocab:** Introduce the following vocabulary terms from which will be addressed in the article. Write the following words on the board, make sure the words are big enough for the students to read. Explain to the students that they will create working definitions by reading an article.
 - a. Solar
 - b. Gravity
 - c. Orbit
 - d. Asteroid
 - e. Meteoroid
 - f. Solar System
 - g. Galaxy

Teaching Tip

Use pictures to introduce the vocabulary. Keep them posted while reading. Visuals help to reinforce understanding. Teach the vocabulary before reading the article.

2. **Powerpoint:** Set up the PowerPoint and project it at the front of the classroom. As each slide comes up, the teacher should check the presentation notes for questions to ask the class or clarifications to make. The article that they will be read later will use these words, so make sure the class has some basic level of understanding of each word.

3. Ask the students to get back into their groups from the opening activity and assign each member of the group a number. Explain that each member of the group will be responsible for reading one section of the article corresponding with their assigned number. The students should write down the vocabulary words in their science journals that appear in their section as well as a working definition based on contextual clues and prior knowledge.

4. **Our Solar System Article:** Pass out a copy of the Our Solar System article (in binder and also on CMC Website) to each student. You may want to suggest that students use a pen or highlighter to circle or underline important information that helps them write their definitions.

Teaching Tip

Differentiate here for your low readers, or do small guided reading group while the rest are doing paired or individual reading.

Teaching Tip

This lesson requires synthesizing or summarizing. Teacher should **model** this skill before expecting the students to do it.

5. Give the groups time to read their assigned section of article- remind students to read quietly in their head as to not disrupt others. Once the students have finished reading their section have each student summarize their section for the rest of the group. Provide students with graphic organizers such as two column notes, webs, etc.

6. The groups should synthesize a complete summary of the article based on their combined readings and will write this summary on a piece of chart paper. They will include the previously mentioned list of vocabulary on this chart paper as well as their contextual definitions for these words. Students may include tiny sketches besides their definitions as a visual aid for visual learners. The groups will then present their summary and definitions to the class.

Lesson Closing

Ask the students to write one new word they learned today, one new fact they learned today, and two questions they have about the solar system in their science journal.

Assessment

Exit Ticket: What holds the planets and other objects of our solar system in orbit around the sun?

- a. The gravitational forces between the planets
- b. The gravitational forces between the Sun and the planets
- c. The rotation of the objects
- d. The atmosphere

Lesson 2: The Sun: Our Most Important Star

BACKGROUND

Overview of the Lesson

Students will learn that the Sun is the center of the solar system. The students will observe that the Sun is the largest and brightest star in our solar system because it is closest to the Earth. Students will learn that the Earth revolves around the sun. Videos will be used as visual aids within the lesson.

Focus Standard(s)

5-ESS1-1. Use observations, firsthand and from various media, to argue that the Sun is a star that appears larger and brighter than other stars because it is closer to Earth.

[2006] 3-5-14. Recognize that the earth revolves around (orbits) the Sun in a year's time and that the earth rotates on its axis once approximately every 24 hours. Make connections between the rotation of the earth and day/night, and the apparent movement of the sun, moon, and stars across the sky.

Learning Targets

- I can recognize the Sun appears to be the closest to the earth compared to other stars.
- I can recognize the Sun as the center of our solar system.
- I can use a calendar to support the idea that the Earth revolves around the Sun once a year (365 days).
- I can use a model to explain how the Earth's rotation on its axis causes day and night.

Assessment

Exit Ticket

1. The Sun is the largest body in the solar system. The Sun is a...
 - a. moon
 - b. planet
 - c. satellite
 - d. star

2. The Sun appears to move across the sky each day, rising in the east and setting in the west. What causes this apparent motion?
 - a. The rotation of Earth on its axis
 - b. The revolution of the Earth around the Sun
 - c. The Earth's distance from the Sun
 - d. The properties of Earth's atmosphere

WIDA Language Objectives

(Dependent on the needs of your ELL students.)

Key Vocabulary

Tier 1: sunrise, sunset

Tier 2: magnitude

Tier 3: solar flare, sunspots

RESOURCES AND MATERIALS

Quantity	Item	Source
	Crayons or Markers	Classroom Teacher
	Scissors	Classroom Teacher
1 Box	Pushpins	Bin
1 per student	Paper Plate	Bin
1 per student	Plastic Straws	Bin
1 per student	Pencils	Classroom Teacher
	Earth's Rotation and Revolution: https://www.youtube.com/watch?v=l64YwNl1wr0	CMC website
	I'm So Hot Video: https://www.youtube.com/watch?v=t-kzdR93bqw	CMC website
1-2	Globe	Classroom Teacher
1	Flashlight	Bin
1 copy for teacher	Sundial Directions: https://www.nwf.org/kids/family-fun/crafts/sundial.aspx	Binder
1 per student	Science Journals	Classroom Teacher

****Items in bold should be returned for use next year****

LESSON DETAILS

Lesson Opening/ Activator

Have the students review what they've learned in the previous lesson (as well as what they already know about this subject). The teacher should draw a concept map on the whiteboard and ask students "What ways does the Sun help the Earth?" Then, play the I'm so Hot Video from CMC website (or YouTube <https://www.youtube.com/watch?v=t-kzdR93bqw>) After watching the video, make sure the students understand the importance of the Sun being the closest star to Earth.



During the Lesson

Tell the students that nothing is more important to us on Earth than the Sun. Without the Sun's heat and light, the Earth would be a lifeless ball of ice-coated rock. Give students a few minutes to brainstorm ways that the Sun helps Earth and then call on a few students for answers. Next, name the other ways the Sun is essential to Earth's survival. For instance, the Sun warms our seas, stirs our atmosphere, generates our weather patterns, and gives energy to the growing green plants that provide the food and oxygen for life on Earth. The only reason the Sun is able to do this is because of the distance from the Earth. Tell the students that the sun is actually a star.

Possible Discussion Questions: What do you think would happen if we had no sunlight? What do we turn on to see when the Sun sets? What do plants such as vegetables and fruit need to grow? Would we be able to eat plants if there was no sunlight? Which season is warmer? Summer or winter? Why do you think so? Think about how much sunlight we receive in summer in comparison to winter.

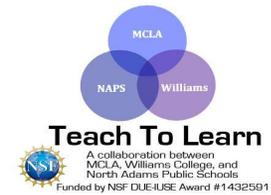
1. When the Sun rises and sets, we are actually watching the Earth rotate on its axis. Project an image of the earth on the whiteboard, then point out how the axis is an imaginary line that runs from the North pole to the South pole. When your location on Earth faces the Sun, that is the day. When your location faces away, it is night. This is a single rotation (1 Day). When this process has happened 365 times it is a revolution (1 Year). Now play the earth rotation video: <https://www.youtube.com/watch?v=l64YwNl1wr0>. Ask the students to come up with working definitions of "revolution" and "rotation" before providing them with the correct definitions (if necessary). Once the class agrees on one definition for "revolution" and "rotation", students should write these definitions in their science journals.
2. **Kinesthetic Modeling of Rotation and Revolution** After watching the video have students demonstrate the Earth's rotation and revolution. Have the two students demonstrate this to the class, with one acting as the Sun while the other



(the Earth) spins while also revolving around the sun. Then have students work in groups of two, so they can model how the Earth revolves around the Sun. Then, the partners can switch roles. The teacher can say “Revolve” or “Rotate on your axis” to ensure students can demonstrate the differences between these concepts. Not directly modeled in this activity are the tilt of the Earth or the shape of the Earth’s orbit. These additional topics (tilt of the Earth’s axis causes seasons and shape of orbit is close to circular) can be discussed, if appropriate.

3. **Other Rotation and Revolution Models** After the students have demonstrated rotation and revolution with their bodies, use a globe and a flashlight to demonstrate how the Earth looks when the Sun is shining on it at different positions (Follow the procedure in the video from step 2. Make sure that the room is completely dark.)

This is a good breaking point if there are time constraints. Lesson continues on next page.



4. **Make a Sundial. Note:** *This project is best done on a sunny day. It may be best to begin this activity in the morning so students can observe their sundial throughout the day.* Before beginning the project have students make predictions in their science journals as to where the shadow will fall throughout the day. We cannot assume that students know what a sundial is, or how they work. A mini lesson incorporated here would flow nicely into the lesson. **[SP-3: Planning and Carrying out Investigations]**

5. The Sun appears to move across the sky because of the rotation of the Earth. Sundials are among the oldest known instruments for telling time. The surface of a sundial has markings for each hour of daylight. As the Sun moves across the sky, another part of the sundial casts a shadow on these markings. The position of the shadow shows what time it is. Explain to students that they will be making sundials which were used to tell time before there were clocks. Pass out the sundial direction worksheet to each student and let them know they will be going outside to test them.
 - a. **Note:** This project is best done on a sunny day. Give each student their own paper plate, a pencil or pair of scissors, and a straw. Use the pencil or scissors to poke a hole through the center of the paper plate- this is where they will place their straw. Following these directions when making the sundials: <https://www.nwf.org/kids/family-fun/crafts/sundial.aspx>. You can print these directions out for students to follow if that would be helpful. Make sure to model how to make the sundial for the students. There should be a sundial model for students to also see.

 - b. At noon have the class go outside to set up their sundials (following the directions on the website). You may need to use push pins or something heavy to hold down the sundials to ensure they don't blow away. Then, students will sketch their sundials and write down the time (12:00 pm) next to their sketch. After, check back on the sundials every hour, for at least a few hours. Each time the students check their sundials, they should draw a sketch of the sundials and label it with the time, so they can see how the sun marks the passage of time.

Sundial Extension: Student groups or pairs could brainstorm and possibly build one or two outside using organic materials such as rocks and sticks.

Assessment

Exit Ticket

1. The Sun is the largest body in the solar system. The Sun is a...

- a. moon
- b. planet
- c. satellite
- d. star

2. The Sun appears to move across the sky each day, rising in the east and setting in the west. What causes this apparent motion?

- a. The rotation of Earth on its axis
- b. The revolution of the Earth around the Sun
- c. The Earth's distance from the Sun
- d. The properties of Earth's atmosphere



Lesson 3: Earth- Rotation, Tilt, and Revolution

BACKGROUND

Overview of the Lesson

In this lesson, students will learn that it takes 24 hours for the Earth to rotate on its axis once. Therefore, one day is made up of 24 hours. The students will also learn that the Earth revolves around the Sun once every year or 365 days.

Focus Standard(s)

5-ESS1-2 Earth's Place in the Universe Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

Old Standard [2006] 3-5-14. Recognize that the earth revolves around (orbits) the Sun in a year's time and that the earth rotates on its axis once approximately every 24 hours. Make connections between the rotation of the earth and day/night, and the apparent movement of the sun, moon, and stars across the sky.

Learning Targets

I can identify that the Earth rotates on its axis every 24 hours.

I can explain why the length of daylight changes slightly every day.

Assessment

Students will write a paragraph about the rotation and revolution of the Earth in their science journals.

Key Vocabulary

Tier 1: clockwise, counterclockwise, degrees, orbit

Tier 2: rotation, revolution

Tier 3: axis

RESOURCES AND MATERIALS

Quantity	Item	Source
1	Crash Course Earth' Rotation Video	CMC Website
6	Styrofoam Balls	Bin
6	Tennis Balls	Bin
1 container	Toothpicks	Bin
1 per student	Rotation Activity Worksheet	Binder
3 sets	Pictures of the Sun, Earth, and Moon (cut out and put into Ziploc bags)	Bin

****Items in bold should be returned for use next year****

LESSON DETAILS

Lesson Opening/ Activator

Review lesson by introducing the necessity of the sun and how Earth rotates on its axis and revolves around the sun. Also review the concepts of revolution, rotation, and axis from lesson two.

Then, divide the students into groups of three. Hand each group a Ziploc bag that contains cut-outs of the Earth, the sun, and the moon. Ask the students in each group to pick one picture from the baggie. Now have the person holding the Sun stand in front and then the students holding the Earth and the moon stand behind them. Instruct the students to demonstrate with their bodies how these planets orbit in the solar system. After the students have played around with this

concept for awhile, have them write in their journals how they think the Earth, moon, and Sun interact with each other.

During the Lesson

1. **Earth’s Rotation:** Watch the video: Crash Course Earth’s Rotation on the CMC Website or can be located on YouTube

2. **Earth’s Seasons:** Pair Read the article on Seasons [Kids science:](#)

[Earth's Seasons - Ducksters](#)

3. After the video, write the definition of the word rotation on the board.

Rotate is to spin around.

4. Now write the word clockwise on the board and demonstrate what it means to spin clockwise.

5. **Spinning Counterclockwise:** Now write the word counterclockwise on the board. First, demonstrate this word by spinning counterclockwise. Then, have the students stand up and spin counterclockwise. Tell the students that this is the way the Earth rotates on its axis-from west to east.



6. **Now ask: (Science Talk: Think-Pair-Share):** Have students answer this question; what would happen if the Earth did not rotate? (One side of the Earth would have constant sunlight and the other side would have no sunlight). Give the students a few minutes to talk amongst their peers.

7. **Earth’s Rotation and Sunlight:** Next, introduce the concept that the earth rotates on its axis every day; this movement creates night and day for us. The half of the Earth that faces the Sun experiences daylight. During that same time, the other half of the Earth which faces away from the Sun experiences night time. Remember to explain to students that the Earth does not rotate with its axis vertically because the axis is actually tilted 23 degrees.

8. Finally ask the students...What would happen if the Earth did not tilt? [Answer: We would not have seasons.]

Teaching Tip

Depending on students reading levels you may want to consider reading “Earth’s Season” whole group followed by a class discussion to gage comprehension. Another option is to assign each group a section of the reading and have each write down three facts that they learned. Each group can then present their section.

How it is presented is teacher discretion. Students can write the facts in their journals, on a poster board, or predetermined worksheet. Struggling readers can work with a teacher, assistant, or Science Fellow on their section.

Rotation/Revolution Models [SP-2: Developing and Using Models]

1. Now take a small Styrofoam ball and insert two toothpicks in the top and bottom of it to represent the earth's axis. A 23 degree tilt is almost 1/3 of a 90 degree angle.
2. Now ask one student to hold a tennis ball which will represent the sun.
3. The teacher will tilt the Styrofoam ball and demonstrate counterclockwise rotation of the earth with a tilt of 23 degrees.
4. Note that the tilt remains the same as it rotates on its axis and revolves.
5. The teacher will write the definition of revolve on the board. *Revolve is to move around another object.*
6. Finally, introduce the word, orbit. The orbit for the Earth's revolution is the path that it takes around the sun.
7. Then, the teacher will demonstrate revolving by walking around the student holding the sun.
8. Note that the earth revolves also in a counterclockwise direction too.
9. A complete demonstration of the earth rotating on its axis and revolving around the Sun will be done by holding the Styrofoam ball, tilting it 23 degrees, rotating it counterclockwise while walking in a counterclockwise direction around the student holding the sun.
10. The teacher will ask the following question: How many times does the earth rotate on its axis to complete one revolution of the sun? Hopefully, one of the students will answer 365 times which is one year for us.
11. Split the students up into groups of four or five and pass out a rotation activity worksheet to each student.
12. Have them follow the directions on the worksheet and complete the investigation.
13. When they complete the investigation, each group will present what they brainstormed about revolution and rotation.

Teaching Tip

If students are struggling to answer, give them a hint such as one complete revolution of the sun is one year for us. How many days are in a year?

Assessment

Students will write a paragraph about the Earth's rotation and revolution in their science journal



Lesson 4: Planets

BACKGROUND

Overview of the Lesson

Students will learn the order of the planets as well as the traits that every planet has in common. The class will participate in an activity where they create a scale model of the solar system to get a sense of the distance between planets and the sun. The students will learn that there are inner and outer planets which are separated by the asteroid belt.

Focus Standard(s)

[2006] 3-5-ES-13. Recognize that the earth is part of a system called the “solar system” that includes the Sun (a star), planets, and many moons. The earth is the third planet from the Sun in our solar system.

ELA Reading Standards

- Determine one or more main ideas of a text and explain how they are supported by key details; summarize a text.
- Speaking and Listening: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others’ ideas and expressing their own clearly.

Learning Targets

- I can create a model to illustrate the distances between the planets.
- I can express and know the order in which the planets are aligned in the Solar System.

Assessments

- Have the students complete the labeling planets worksheet.
- Students respond to the following prompt in their journals: “You are sent on a space mission and arrive at a planet other than Earth. Write a letter back to your family telling them which planet you landed on and some interesting facts about that planet that you learned in class today.”

Key Vocabulary

Tier 1: planet

Tier 2: distance

Tier 3: orbit

RESOURCES AND MATERIALS

Quantity	Item	Source
1	Large Open Space (Field of Gymnasium)	Classroom Teacher
	Toilet Paper Rolls	Bin
	How the Solar System was Formed: https://www.youtube.com/watch?v=Uhy1fucSRQI	CMC Website
1 per student	Planets Label Worksheet	Binder
	To Scale the Solar System: https://www.youtube.com/watch?v=zR3Igc3Rhfg	CMC Website
1 per student	Science Journals	Classroom Teacher

****Items in bold should be returned for use next year****

LESSON DETAILS

Lesson Opening/ Activator



(Science Talk: think-pair-share): Begin the lesson with a review of what has been learned in previous lessons through a think-pair-share activity and use this discussion to lead into the video and activity that follows. Show the following video: <https://www.youtube.com/watch?v=Uhy1fucSRQI>. This video will cover the formation of the solar system and explain some key facts about each planet which will be addressed more in the inner and outer planet lessons.

During the Lesson



1. **Planets Around the Sun (Science Talk: think-pair-share):** Review the vocabulary from previous lesson here before moving on to next lesson. Tell the class that today they will be exploring the size of the solar system. In the last lesson they studied the sun, and today they will be studying the planets that revolve around the Sun. Ask the students how big they think the solar system is and how big some planets might be compared to each other. (Biggest to Smallest: Jupiter, Saturn, Uranus, Neptune, Earth, Venus, Mars, Mercury). it might be a good idea to see what they know about the planets and their location in the solar by giving groups of students sets of cards to arrange by order of size.

Student Thinking Alert

If a student mentions Pluto, tell them that they are correct that it is a planet. However, the class will be focusing on large planets. Since Pluto is a dwarf planet, the class will not learn

2. The teacher should guide this discussion making sure that the information is correct. Then, show the following video

<https://www.youtube.com/watch?v=zR3lgc3Rhfg> about creating a scale model of the solar system in both size and distance. After the video, students should write a journal entry. Their entry can answer questions such as:

One fact that I learned...

I think that it's cool...

I think that it is interesting that...

I liked the video because...

One fun fact that I learned....

I think that it's cool.....

Once they have had time to write their entries, let the class know that they will now be making a smaller scale model of the solar system together.

3. **Scale Model Article:** Read the Article of famous Scale Model in Gainesville, Florida

4. **Distances Around the Sun:** Students will measure the distance between planets in our scaled model by ripping strips of toilet to symbolize the distances between planets. Use the given distances in the table below. There are 2 versions of the activity so be sure to use the correct scale (100ft or 100m). Tell the students that unlike the video, we are not going to focus on scaling the size of the planets because they would be too small. They already know the Sun is the largest body in the solar system, so for reference let them know that if we are using the 100ft scale, we are shrinking the solar system until the Sun is about $\frac{1}{3}$ of a dime. If we are using the 100 m scale, tell them the Sun is about the size of a dime.

Teaching Tip

Teaching scale is a difficult concept. Pre-teaching and practice will be needed for this portion of the lesson before doing the actual activity.

walk

paper

5. **Creating a Solar System:** (Showing a model first might help the students better visualize the activity.) Next, the teacher should bring the class outside (or the gymnasium if there is bad weather) and group the students, so that everyone is assigned to a planet or the Sun. Then, tell the students to line up behind the sun. The students should place

the toilet paper strips between the Sun and Mercury. Then, students should continue placing down toilet paper until the distances between the planets and Sun are correctly scaled. Ask the students what they notice about the distances between the planets. They are likely to notice the inner planets are crowded together very close to the Sun and the outer planets being much more spread out. Now ask them guiding questions in order to allow them to come to the conclusion that a planet's distance from the Sun affects its properties. Some good questions could relate to temperature or how long it takes planets to orbit the Sun, etc. Possible Questions: How do you think the planets' distance from the sun affects them? Do you think that all of the planets' orbits are the same? Do you think that some planets are warmer than others? Why is that?

Have the students return to the classroom and ask them if they think it takes longer for the inner or outer planets to move all the way around the Sun and why they believe their answer is correct. Allow students the opportunity to share their answer and rationale. If students need some support, possible sentence starters: I think "insert inner or outer planet" will take "longer or shorter" to orbit the Sun because.....

Planet distances from the Sun

Planet	100ft Scale (length of toilet paper from last object)	100m Scale (length of toilet paper from last object)
Mercury	15" (15")	1.3 m (1.3 m)
Venus	29" (14")	2.4 m (1.1 m)
Earth	40" (11")	3.3 m (0.9 m)
Mars	61" (21")	5.1 m (1.8 m)
Jupiter	17' 3" (12' 2")	17.3 m (12.2 m)

Saturn	31' 9" (14' 6")	31.8 m (14.5 m)
Uranus	63' 9" (32' 0")	63.8 m (32.0 m)
Neptune	100' (36' 3")	100 m (34.2 m)

Lesson Closing

For the closing, teach the students a mnemonic device to remember the order of the planets. You can either come up with one as a class, or a great one is "My Very Excellent Mother Just Served Us Nachos". After learning and practicing the mnemonic device a few times have the class come together and ask for volunteers to list the order of the planets.

Assessments

- Have the students complete the labeling planets worksheet.
- Students respond to the following prompt in their journals: "You are sent on a space mission and arrive at a planet other than Earth. Write a letter back to your family telling them which planet you landed on and some interesting facts about that planet that you learned in class today." You could differentiate this assessment by having students write postcards from their planets and list 2-3 facts they learned then draw a picture on the front.



Lesson 5: Inner Planets

BACKGROUND

Overview of the Lesson:

Students will learn to describe and compare the inner planets. Students will receive most of the material by watching a PowerPoint presentation. This information will be reinforced through research and a presentation from each student group about a specific inner planet.

Focus Standard(s)

[2006] 3-5-ES-13. Recognize that the Earth is part of a system called the “solar system” that includes the Sun (a star), planets, and many moons. The Earth is the third planet from the Sun in our solar system.

ELA Reading Standards

- Determine one or more main ideas of a text and explain how they are supported by key details; summarize a text.
- Speaking and Listening: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others’ ideas and expressing their own clearly.

Learning Targets

I can name the 4 inner planets.

I can describe the properties of the inner planets.

Assessments

Students will respond to the following prompts in their science journals:

- What are some characteristics found in common among all the inner planets?
- What are some characteristics unique to Earth that might help us live on it?"

WIDA Language Objectives

(Dependent on the needs of your ELL students.)

Key Vocabulary

Tier 1: Planets, Rocky

Tier 2: Inner Planets, Outer Planets

Tier 3: Asteroid Belt, satellites

RESOURCES AND MATERIALS

Quantity	Item	Source
4 per student	Inner Planets PowerPoint	CMC Website
1 per student	iPad/laptop	Classroom Teacher
1 per student	Inner Planets Presentation Facts Worksheet	Binder
1 per student	Science Journals	Classroom Teacher

****Items in bold should be returned for use next year****

LESSON DETAILS

Lesson Opening/ Activator

Begin with a review of what was taught in previous lessons through a think-pair-share activity. Have the pairs share what they found most interesting from the previous lessons. Next, tell the class that they will be focusing on the four planets closest to the Sun; these are called the inner planets. Ask the class to list the four inner planets using the mnemonic device taught in the previous lesson.

Teaching Tip

Remind students what mnemonic means. You may also have to remind them of the order of the planets.

During the Lesson

1. **Inner Planet Powerpoint:** Show the class the inner planets PowerPoint. Be sure to have the class pay close attention to the information you are presenting because there will be a short quiz at the end. Consider giving out a note taking worksheet to help students understand the main points of the powerpoint. You may want to ask some questions after you present each planet to ensure there is understanding.
2. **Inner Planet Presentation: [SP-8: Obtaining, Evaluating, and Communicating Information]** Now divide the class into four groups. Tell the class that each group will create a presentation about one of the inner planets. Assign each group a different planet and pass out the iPads/laptops along with the inner planets presentation worksheet. Using internet access, the groups should each fill out the facts about their planet and then come up with a way to present all the information, using at least two visual aids. Students should fill out graphic organizers such as venn diagrams, webs, etc. Then they should use the graphic organizers to create a poster with facts and visuals. If any groups are having a hard time coming up with interesting facts, suggest that they look to see if NASA has ever sent a mission to their planet or when and by whom the planet was first discovered. Before the groups present, hand out three blank worksheets to each student, so that the students can fill them out for each presentation. By the end of the class they should have a worksheet for each of the inner planets.

Lesson Closing



(Science Talk: class discussion): At the conclusion of the presentations, the teacher should then lead the class in a discussion. Have students talk about what they learned, share differences and similarities between the inner planets, and their experience researching information for the presentation. Students should draw a venn diagram in their science journals to compare and contrast the inner planets.

Assessments

Students will respond to the following prompts in their science journals:

- What are some characteristics found in common among all the inner planets?
- What are some characteristics unique to Earth that might help us live on it?"



Lesson 6: Outer Planets

BACKGROUND

Overview of the Lesson

Students will learn about the properties of the outer planets. Students will learn about planets that have rings around them and planets that are gaseous (unlike Earth which has a rocky surface). The students will read an article with facts about the outer planets and will then do an investigation with jello.

Focus Standard(s)

[2006] 3-5-ES-13. Recognize that the earth is part of a system called the “solar system” that includes the Sun (a star), planets, and many moons. The earth is the third planet from the Sun in our solar system.

ELA Reading Standards

- Determine one or more main ideas of a text and explain how they are supported by key details; summarize a text.
- Speaking and Listening: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others’ ideas and expressing their own clearly.

ELA Writing Standards

- Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Learning Targets

- I can identify the outer planets.
- I can describe the properties of the outer planets.

- I can describe the differences between the inner and outer planets.

Assessment

Journal Entry: In their journal, students will write a paragraph long summary about the planets. Students will identify if the planet is an inner planet or an outer planet.

Key Vocabulary

Tier 1: planet

Tier 2: inner, outer

Tier 3: gaseous, asteroid belt, satellites, jovian planets

RESOURCES AND MATERIALS

Quantity	Item	Source
1 per student	<i>Characteristics of the Outer Planets</i> Article	Binder
1 package	Index Cards	Bin
1	Small- Medium Plastic Bins (that can be filled with a few inches of water)	Bin
5	Oranges: to represent Saturn (need to be peeled- you will only be using the peel so try and peel it off in one piece)	Contact Sue Beauchamp
1 bunch	Grapes: to represent Earth	Contact Sue Beauchamp

****Items in bold should be returned for use next year****

LESSON DETAILS

Start with a review of the inner planets. (Ex: Have students list list them in the order from the sun, maybe give a fact about each, each, etc...). The teacher could also ask a student to name the four inner planets and write the names in column form on the board. Then, ask the students to share what they learned about each inner planets from the previous lesson. As they share, the teacher can write down key points and leave it on the board for students to review/reference.

Student Thinking Alert
When asking the students to brainstorm about the outer planets, remember that their facts can be as simple as it's a gaseous planet, it's red, it has rings, etc...) Their info is all coming from previous knowledge.

Divide the class into groups of four students and give each group four index cards. Each card will be labeled with one of the outer planets (Jupiter, Saturn, Uranus, and Neptune). The teacher will instruct the groups to brainstorm and write down 3 facts about each planet on the index card. Give the students about 5-10 minutes to complete this task.

Assign a planet to each student in every group. Each student in each group should then get into the correct planet order. Then, each student will tell the teacher 3 or more facts about their planet. Students will then discuss and identify true and false facts given by their group members.

Tell the students that they will be learning more about the outer planets today and they will see if the facts they brainstormed are accurate or not.

During the Lesson

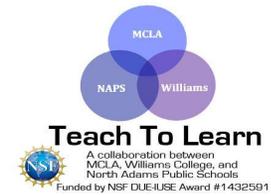
1. Now split the students into pairs.
2. **Characteristics of the Outer Planets:** Give the students the article, *Characteristics of the Outer Planets*. Prior to having the pairs read the article, give the students suggestions of how to guide their reading.
3. After the pair is finished reading, have them complete the worksheet (which is at the end of the reading).



4. Come back together as a class and discuss how the four outer planets are similar and how they might differ. Organize this information in a venn diagram and have the students copy it down. Make sure to underline the important facts about each of the outer planets on the board so that students can reference/review them later on.
5. Ask the students the following questions to get them thinking about the surfaces of the outer planets: If the planets do not have a solid surface, what kind of surface do they have? What could it feel like? Could you land on an outer planet? Why or why not? Students should answer these questions in their journals to assess their understanding and learning.
[SP-7: Engaging in Arguments from Evidence]

Possible Extension: Students could do as they did in Lesson 45 and create informational posters for the outer planets with visuals and facts followed by a presentation.

6. Research, synthesising, discussions, presenting with a graphic organizer.
7. Include commonalities between the outer planets
8. **Modeling Planets with Fruit:** Follow the activity outlined here (only need to do steps 5-9 but you can do the entire activity if you'd like): http://www.lpi.usra.edu/education/explore/solar_system/activities/bigKid/dunking/
9. You do not need to have a fruit to represent every planet, instead you can use an orange peel or coconut to represent Saturn and a grape to represent Earth.
10. Have the class gather around a plastic bin filled with water and have them make predictions of what will happen when you put the fruit into the water- you can have them write these predictions in their science journals.
11. You can do the entire activity, but the only essential steps are 5-9 in the activity section.
12. Once you've completed the activity, have the students write a few sentences about what they observed. Also, students should write whether or not their predictions were correct or incorrect. Encourage the students to use pictures and diagrams to show what they observed.



Lesson Closing

Ask the students a few questions about both the inner and outer planets. What are some characteristics of the inner planets? What are some characteristics of the outer planets? What do the inner planets have in common with the outer planets? What makes them different from each other?

Assessment

Journal Entry: In their journal, students will identify all the planets in their order and writing a summary about what they learned about one or more of them. (Teacher will set up a rubric of what he/she is looking for to measure understanding and progress toward intended outcomes).

Lesson 7: Earth's Moon and Its Phases

BACKGROUND

Overview of the Lesson

In this lesson, students will watch a video of the first human moon landing to create excitement around the topic. Then, they will watch a rap video about the phases of the moon. Students will participate in three activities focused on the phases of the moon. The activities involve making moon phases out of Oreos, creating a personal single phase moon viewer, and using the full cycle cardboard moon phase viewer. These three activities will help students draw diagrams of the positions of the earth, sun, and moon.

Focus Standard(s)

[2006] 3-5-ES-15. Describe the changes that occur in the observable shape of the moon over the course of a month.

5.ESS1-2. Use a model to communicate Earth's relationship to the Sun, Moon, and other stars that explain (a) why people on Earth experience day and night, (b) patterns in daily changes in length and direction of shadows over a day, and (c) changes in the apparent position of the Sun, Moon, and stars at different times during a day, over a month, and over a year.

Clarification Statement: Models should illustrate that the Earth, Sun, and Moon are spheres; include orbits of the Earth around the Sun and of the Moon around Earth; and demonstrate Earth's rotation about its axis. State Assessment Boundary: Causes of lunar phases or seasons, or use of Earth's tilt are not expected in state assessment



ELA Reading Standards

- Determine one or more main ideas of a text and explain how they are supported by key details; summarize a text.
- Speaking and Listening: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

Learning Targets

- I can identify and name the phases of the moon.
- I can draw a diagram of the Sun, Earth, and Moon for a specific phase.
- I can draw a picture of the moon for a specific phase.
- I can use a calendar to calculate the length of time it takes the Moon to go through a full cycle.

Assessment

The teacher should use the students' participation in the closing think-pair-share discussion to assess their level of understanding. Students will also be assessed on the powerpoint activity which will be projected on the whiteboard. The PowerPoint, "Moon Phase Assessment", will have slides that will either be: 1) a name of a phase of the moon, 2) a picture of the moon, or 3) a diagram of the Sun, Earth, and Moon in a specific position. For each numbered slide, the students should provide the other two pieces of information in their science journal.

WIDA Language Objectives

(Dependent on the needs of your ELL students)

Key Vocabulary

Tier 2: orbit, phase, waxing, waning

Tier 3: satellite, crescent, gibbous

RESOURCES AND MATERIALS

Quantity	Item	Source
1	Projector	Classroom Teacher
1 per student	Science Journals	Classroom Teacher
1 per student	“Moon Rap Lyrics”	Binder
1	“Moon Phase Assessment” PowerPoint	CMC Website
1	Pack of Oreos	Bin
1 per student	Plastic Spoons	Bin
1 set	Moon diagrams	CMC Website
1	Lunar calendar http://www.moonconnection.com/moon_phases_calendar.phtml	Classroom Teacher
1	Neil Armstrong Video	CMC Website
1	Mr Lee. Phases of the Moon Rap	CMC Website
1	Moon Phase Viewer Video	CMC Website

****Items in bold should be returned for use next year****

LESSON DETAILS

Lesson Opening/ Activator

Tell the class that they will learn about the moon and its phases in this lesson. Introduce the first video of the moon landing from 1969. Tell them that the spacecraft is the Apollo 11 and that the voice they hear is Neil Armstrong, an astronaut.

<https://www.youtube.com/watch?v=cwZb2mqld0A>. His quote “That’s one small step for man, one giant leap for mankind” is incredibly famous. After the video, tell the class that he was the first man on the moon. This was a giant leap for mankind because it showed progress.

During the Lesson

1. **Moon Rap Lyrics:** Pass out the worksheet titled “Moon Rap Lyrics” to each student to follow along with the video. Now show the Mr. Lee Rap video on the CMC website (or YouTube <https://www.youtube.com/watch?v=79M2ISVZiY4>), which shows a rap about the phases of the moon. Tell them to watch and listen closely to information about Apollo 11, the space mission they just watched land on the moon. After the video, re-emphasize that the difference between waxing and waning moon phases can be easily figured out by one simple trick. “Waxing rhymes with relaxing which starts with an R for right. So if the right side of the moon is lit up it is in the waxing period.” Teachers may want to show this video twice and have students take notes in their journals. Tell them this will be especially helpful to remember in the following activity with the Oreos. Then, use a calendar to calculate that the moon goes through a full cycle in just under a month (28-30 days). This lunar calendar can be found online at http://www.moonconnection.com/moon_phases_calendar.phtml, or the classroom may already have a lunar calendar that can be hung on a wall and observed at over the next few weeks.

2. **Oreo Phases of the Moon**

Divide the students into groups of 4-5 and give each student an Oreo. Ask them to use the Oreos to create every phase of the moon. The students should take off the top cookie of each Oreo to expose the filling. Using spoons, they should scrape out the shape of the new moon, crescent moon, quarter moon, gibbous moon, and full moon. Then, the teacher should walk around and have each group use their cookies to demonstrate the order of the phases of the moon from the song. This is a good time to remind them about waxing rhyming with relaxing, so waxing phases have the right side lit up. Students will sketch each phase of the moon in their science journals and label whether it is waxing or waning. Once the group has correctly demonstrated a cycle of the moon (they will need to change the orientation on some of them to complete both waxing and waning), they can eat the Oreos.



Optional Extension: Use google cardboards and have students see what it would look like to explore in space.

Lesson Closing

Ask each student to write down a few facts about the moon that they learned today. Have them read over the lyrics to the rap again to try and pull out information. The students should then pair with a neighbor and use both of their lists to create an even larger list of moon facts.

Assessment

The teacher should use the students' participation in the closing think-pair-share discussion to assess their level of understanding. Students will also be assessed on the powerpoint activity which will be projected on the whiteboard. The PowerPoint, "Moon Phase Assessment", will have slides that will either be: 1) a name of a phase of the moon, 2) a picture of the moon, or 3) a diagram of the Sun, Earth, and Moon in a specific position. For each numbered slide, the students should provide the other two pieces of information in their science journal.

Lesson 8: Earth's Gravitational Force

BACKGROUND

Overview of the Lesson

Students will learn how gravity works by watching videos and participating in activities which demonstrate the power of gravity.

Focus Standard

5-PS2-1. Support an argument with evidence that the gravitational force exerted by Earth on objects is directed toward Earth's center. **State Assessment Boundary:** Mathematical representations of gravitational force are not expected in state assessment.

ELA Writing Standards

- Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Learning Targets

I can give an example of a force.

I can explain how gravitational force works.

Assessment

Have students answer the following prompt in their science journals: What evidence supports the fact that gravity on Earth pulls objects toward the center of the planet instead of toward some other point on Earth?

Scoring Rubric

2-point response:

- Student identifies that a dropped object falls down.
- Student identifies that this downward motion occurs at every place on Earth, so that means objects move toward the center of the planet.

1-point response:

Student does not note that the downward motion of a falling object is the same everywhere on Earth.

0-point response:

The response shows no understanding of the task/problem.

Key Vocabulary

Tier 1: Mass, Force

Tier 2: Gravitational Force

Tier 3: Air Resistance

RESOURCES AND MATERIALS

Quantity	Item	Source
	Defining Gravity Video	CMC Website
12	Pennies	Bin
5	Rulers	Classroom Teacher
4	Bathroom or kitchen scales	Bin
6	Object for weighing	Classroom Teacher
5	Stopwatches	Bin

****Items in bold should be returned for use next year****

LESSON DETAILS

Lesson Opening/ Activator

Ask students what they know about gravity. How does gravity work? Where does it come from? Continue the conversation until you have extracted all of the possible knowledge they have. Show the gravity video to give a brief overview.

During the Lesson

1. **Falling Objects:** Students will investigate different falling objects to see that no matter which direction an object travels, it always falls down to the Earth.
 - a. Split students into groups of 4-5. Students will rotate roles within the group, with at least the following roles: “dropper,” “observer,” and “recorder.” The “dropper” is the one dropping the coins, the “observer” is the one watching to see which object hits the ground first, and the “recorder” writes down the data in their science journal. Technology (such as iPads or stopwatches) can be used to record the drops or to record the times, but this is not required.
 - b. In groups, students will start by confirming that when two coins are dropped from the same height, they will hit the ground at the same time. They can try using their hands and may realize that it’s difficult to drop them at the exact same time. See if they can figure out a strategy to consistently drop the two coins at the same time (pushing them off the side of a desk or other surface works well).
 - c. Now, students will predict which coin will hit the ground first, depending on how they are dropped. For instance, they will dropped one coin as before and push the other coin sideways, but they must release the coins at the same time. Students should record their predictions in their science journals, along with an explanation for why they think this will occur. They can talk in their groups or you can have the whole class discuss briefly. The teacher should create or have a chart with different trials students can test and record.



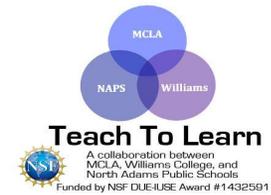
d. Once the predictions have been recorded, students will do a number of trials to see which coin (pushed or dropped) hits the ground first. It may take some practice to get both coins to be released at the same time, but this is critical to have a fair comparison. Using a ruler to push off one of the coins works well. Students may be surprised that the coins hit at the same time, and you can engage them in small group or whole class discussions about why this might be happening. The main takeaway for students is that even though one of the coins travels further horizontally (to the side), it still hits at the same time because gravity always pulls it down in the same way as the other coin.

2. **Weight is a measure of Earth's gravity on an object:** students will now use scales to see how weight can change.

- a. Using the scales from the bins and in small groups of 4-5, students should record the weight of a large object (help them select something from the classroom that is heavy enough to register on the scale).
- b. Once the weight is recorded in their science journals, students should see if they can get the weight to change by pushing or lifting on the object. They should observe that even though the object isn't changing its weight, the object appears to get larger or smaller depending on whether they are pushing or lifting it.
- c. Students can now experiment by holding the scale vertically (for example, placing it against a wall) and seeing how their object's weight changes. They should notice that the object has no weight when the scale is not between the object and the Earth/floor.
- d. The main takeaway for students is that gravity always "pulls objects down," which is shown by the fact that objects only have weight when the scale is between the object and Earth.

Assessment

Have students answer the following prompt in their science journals: What evidence supports the fact that gravity on Earth pulls objects toward the center of the planet instead of toward some other point on Earth?



Scoring Rubric

2-point response:

- Student identifies that a dropped object falls down.
- Student identifies that this downward motion occurs at every place on Earth, so that means objects move toward the center of the planet.

1-point response:

Student does not note that the downward motion of a falling object is the same everywhere on Earth.

0-point response:

The response shows no understanding of the task/problem.

Science Talk and Oracy in T2L Units

Science talk is much more than talking about science. In line with the science and engineering practices, students are expected to make a claim that can be supported by scientific evidence. The MA STE Standards (and the NGSS) value the importance of engaging in an argument from evidence. NGSS defines how this practice takes form in the real world: *“In science, reasoning and argument are essential for identifying the strengths and weaknesses of a line of reasoning and for finding the best explanation for a natural phenomenon. Scientists must defend their explanations, formulate evidence based on a solid foundation of data, examine their own understanding in light of the evidence and comments offered by others, and collaborate with peers in searching for the best explanation for the phenomenon being investigated.”*

Students are asked to participate in articulate and sensible conversations in which they are able to communicate their ideas effectively, listen to others to understand, clarify and elaborate ideas, and reflect upon their understanding. These forms of talk can be developed using scaffolds such as the A/B Talk protocol (below) and strategies for class discussions (from the Talk Science Primer, link below). Oracy is developed in the physical, linguistic, cognitive, and social-emotional realms; each of these realms can be expanded upon over time in order to develop a thoughtful speaker. Being able to display appropriate body language, use proper tone and grammar, be thoughtful and considerate thinkers, and allow space for others thoughts and opinions are all important facets of oracy to work on and through with students. Incorporating the appropriate scaffolding is an important aspect of fostering these skills. Techniques for teaching effective science talk often include modeling, discussion guidelines, sentence-starters, and generating roles, while gradually putting more responsibility on students to own their thinking and learning.

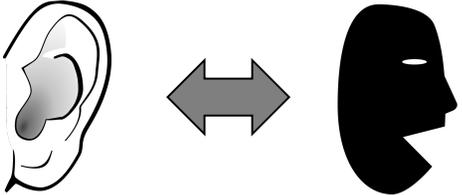
Part of creating a safe school environment for students is allowing them a space that is comfortable enough for them to express ideas and ask questions, while being validated for their thoughts and questions; students should feel comfortable and confident when speaking and listening for understanding. Effective talk is an important part of being an active, intelligent member of a community and society. Successful development in oracy is important for future employability and general well-being of adults.

The following resources should be helpful examples of how to employ effective use of progressive oracy and science talk in your classrooms.

- Oracy in the Classroom: <https://www.edutopia.org/practice/oracy-classroom-strategies-effective-talk>
- Science Talk Primer: https://inquiryproject.terc.edu/shared/pd/TalkScience_Primer.pdf

A/B Talk Protocol

Adapted from <https://ambitioussciencelearning.org/ab-partner-talk-protocol/>

<p>1. Share your ideas</p>  <p>Partner A</p> <ul style="list-style-type: none"> • I think ____ happened because... • Evidence that supports my idea is... • The activity we did with ____ helps me know more about ____ because... • One thing I'm wondering about is... 	<p>2. Listen to Understand</p>  <p>Partner B</p> <ul style="list-style-type: none"> • I heard you say _____. What makes you think that? • I heard you say _____. • What if _____? • Can you explain the part about _____ again? • What do you mean when you say _____?
<p>3. Clarify and elaborate</p>  <p>Partner A</p> <p>Answer partner's questions or ask for clarification in order to understand a question.</p>	<p>4. Repeat steps 2 & 3 until all questions are answered</p>  
<p>5. Switch roles and repeat steps 1-4</p> 	<p>6. Reflect on your understanding in writing</p> <ul style="list-style-type: none"> • My idea about ____ changed when my partner said _____. • I will add ____ to my idea about ____ because... • I still have questions about... • I may be able to answer my question(s) if I could investigate _____.

List of Unit Resources

Lesson 1

Quantity	Item	Source
1 per student	Our Solar System Article	Binder
1 per student	Science Journal	Classroom Teacher
8 pieces	Large Chart Paper	Classroom Teacher
	“The Universe: Introduction to Vocabulary” PowerPoint	CMC Website

Lesson 2

Quantity	Item	Source
	Crayons or Markers	Classroom Teacher
	Scissors	Classroom Teacher
1 Box	Pushpins	Bin
1 per student	Paper Plate	Bin
1 per student	Plastic Straws	Bin
1 per student	Pencils	Classroom Teacher
	Earth’s Rotation and Revolution: https://www.youtube.com/watch?v=l64YwNl1wr0	CMC Website
	I’m So Hot Video: https://www.youtube.com/watch?v=t-kzdR93bqw	CMC Website
1-2	Globe	Classroom Teacher
1	Flashlight	Bin
1 copy for teacher	Sundial Directions: https://www.nwf.org/kids/family-fun/crafts/sundial.aspx	Binder
1 per student	Science Journals	Classroom Teacher

Lesson 3

Quantity	Item	Source
1	Large Open Space (Field of Gymnasium)	Classroom Teacher
	Toilet Paper Rolls	Bin
	How the Solar System was Formed: https://www.youtube.com/watch?v=Uhy1fucSRQI	CMC Website
1 per student	Planets Label Worksheet	Binder
1	To Scale the Solar System: https://www.youtube.com/watch?v=zR3Igc3Rhfg	CMC Website
1 per student	Science Journals	Classroom Teacher

Lesson 4

Quantity	Item	Source
4 per student	Inner Planets PowerPoint	CMC Website
1 per student	iPad/laptop	Classroom Teacher
1 per student	Inner Planets Presentation Facts Worksheet	Binder
1 per student	Science Journals	Classroom Teacher

Lesson 5

Quantity	Item	Source
1 per student	<i>Characteristics of the Outer Planets</i> Article	Binder
1 package	Index Cards	Bin
1	Small- Medium Plastic Bins (that can be filled with a few inches of water)	Bin



5	Oranges: to represent Saturn (need to be peeled- you will only be using the peel so try and peel it off in one piece)	Contact Sue Beauchamp
1 bunch	Grapes: to represent Earth	Contact Sue Beauchamp

Lesson 6

Quantity	Item	Source
1	Crash Course Earth' Rotation Video	CMC Website
6	Styrofoam Balls	Bin
6	Tennis Balls	Bin
1 container	Toothpicks	Bin
1 per student	Rotation Activity Worksheet	Binder
3 sets	Pictures of the Sun, Earth, and Moon (cut out and put into Ziploc bags)	Bin

Lesson 7

Quantity	Item	Source
1	Projector	Classroom Teacher
1 per student	Science Journals	Classroom Teacher
1 per student	"Moon Rap Lyrics"	Binder
1	"Moon Phase Assessment" PowerPoint	CMC Website
1	Pack of Oreos	Bin
1 per student	Plastic Spoons	Bin
1 set	Moon diagrams	CMC Website
1	Lunar calendar	Classroom Teacher





	http://www.moonconnection.com/moon_phases_calendar.phtml	
1	Neil Armstrong Video	CMC Website
1	Mr Lee. Phases of the Moon Rap	CMC Website
1	Moon Phase Viewer Video	CMC Website

Lesson 8

Quantity	Item	Source
	Defining Gravity Video	CMC Website
12	Pennies	Bin
5	Rulers	Classroom Teacher
4	Bathroom or kitchen scales	Bin
6	Object for weighing	Classroom Teacher
5	Stopwatches	Bin

