Unit 8.4 Earth In Space

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Course(s): **Science 8**
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Essential Questions

Unit Question How are we connected to the patterns we see in the sky and space?

Lesson 1 How are we connected to the patterns we see in the sky?

Lesson 2 What patterns are happening in the sky that I have experienced and can observe (through models and tools)?

Lesson 3 How can we explain the Sun's path change over time?

Lesson 4 How do these changes in sunlight impact us here on Earth?

Lesson 5 How can we explain phenomena like Manhattanhenge?

Lesson 6 Why do we see the shape of the Moon change?

Lesson 7 Why do we see eclipses and when do we see them?

Lesson 8 What does a lunar eclipse look like and how can we explain it?

Lesson 9 Why do the Moon and Sun appear to change color near the horizon?

Lesson 10 How does light interact with matter in the atmosphere?

Lesson 11 How does the shape of a water droplet or an ice crystal cause sunlight to form into a rainbow?

Lesson 12 Why does the Moon always change color during a lunar eclipse?

Lesson 13 What new patterns do we see when we look more closely at other objects in the sky?

Lesson 14 Why do some solar system objects orbit planets and others orbit the Sun?

Lesson 15 How did the solar system get to be the way it is today?

Lesson 16 What patterns and phenomena are beyond our solar system that we cannot see with just our eyes?

Lesson 17 How are we connected to all of the systems in space beyond the planet we live on?

Big Ideas

Unit Summary and Storyline

Humans have always been driven by noticing, recording, and understanding patterns and by trying to figure out how we fit within much larger systems. In this unit, students begin observing the repeating biannual pattern of the Sun setting perfectly aligned between buildings in New York City along particular streets and then try to explain additional patterns in the sky that they and others have observed. Students draw on their own experiences and the stories of family or community members to brainstorm a list of patterns in the sky. And listen to a series of podcasts highlighting indigenous astronomies from around the world that emphasize how patterns in the sky set the rhythms for their lives, their communities, and all life on Earth, and these are added to their growing list of related phenomena (other patterns in the sky people have observed).

In the first two lesson sets (Lessons 1–5 and 6–7), students develop models for the Earth-Sun and Earth-Sun-Moon systems that explain some of the patterns in the sky that they have identified, including seasons, eclipses, and lunar phases. In the third lesson set (Lessons 8–12), students investigate a series of related phenomena motivated by their questions and ideas for investigations. In the final lesson set (Lessons 13–17), students explore the remaining questions on their Driving Question Board, related to planets and other objects farther out in space (beyond the stars they can see with the unaided eye).

Anchoring phenomenon It is launched by a phenomenon known as Manhattanhenge. Students analyze how the Sun aligns with the Manhattan skyline one day each year and develop an initial model to explain this engaging and puzzling phenomenon. Although Manhattanhenge is specific to New York City, alignment of the Sun with various human-made structures is a universal experience, and there is guidance in the teacher guide on how to localize for your context. Solar alignment happens every year and is something students can see themselves, whether in a highly urban setting or a local context. Several locations across the country have locally famous solar alignments, such as Chicagohenge (on the Chicago skyline) and Scrippshenge (through a pier in California), but students can also observe solar alignments between pieces of playground equipment or over a school building. People have tracked this phenomena across cultures, and throughout human history, planning construction to align with the Sun on solstices, for example, Carhenge in Nebraska (built in 1987) or the layout of the Cahokia Mounds in Southern Illinois (built sometime around 1100). Students use these patterns to begin making connections between the position of the sunset on Earth, connect it to our daily lives, and brainstorm other interesting patterns that link our lives to the sky. Students also bring in stories from family or community members about patterns in the sky they have seen or heard about and discuss how these might be connected to the rhythms of human life. In a classroom jigsaw, students explore a series of podcasts to learn about ways that humans across cultures and throughout time have relied on and made connections to the sky, and students listen for additional patterns that the astronomers in the podcasts identify. By broadening the set of prior experiences, we can expand the anchor of the unit to build upon the knowledge of students, their families, and the Indigenous communities shared in the podcasts. Students are now personally connected not just to a single phenomena but also to the shared experiences of their peers and all of humanity, and they are able to access more patterns than they may be able to observe directly in the sky where they live. While the anchoring phenomenon for this unit is Manhattanhenge, students expand quickly from this event, and their questions cover a range of celestial patterns that are meaningful to humans and that can all be explained by the deceptively simple mechanics of our solar system.

Enduring Understandings

NGSS Performance Expectations

- MS-PS2-3: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
- MS-PS2-5: Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
- MS-PS3-2: Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
- MS-PS2-2*: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
- MS-PS3-1*: Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
- MS-PS3-5*: Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object (p. 61).

Disciplinary Core Ideas

The unit expands students' understanding of forces and energy transfer, which include these grades 6-8 DCI elements:

PS2.B: Types of Interactions

- Electrical and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3)
- Forces that act at a distance (electrical, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, a magnet, or a ball, respectively). (MS-PS2-5)

PS3.A: Definitions of Energy

- A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2)
- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)

The parts of the DCI elements that are not developed in this unit are crossed out. In the OpenSciEd Scope and Sequence, students will develop an understanding of gravity in OpenSciEd Unit 8.4. Electricity is treated as an extension opportunity within this unit. The placement of this OpenSciEd Unit 8.3 and associated units within the OpenSciEd Middle School Scope and Sequence.

Crosscutting Concepts

- Cause and Effect: This unit intentionally develops this crosscutting concept through the application of cause-effect sentence frames. Students routinely identify, test, and use relationships to explain change throughout.
- Systems and System Models: This crosscutting concept is key to the sensemaking in this unit.Students spend the unit breaking down and modeling the speaker system, describing and explaining the system

in terms of its components and interactions
- Energy and Matter: This crosscutting concept is key to the sensemaking in this unit. Students figure out and apply the idea that energy can be transferred in various ways and between objects in order to explain how the speaker system works.
- The following crosscutting concepts are also key to the sensemaking in this unit:
    - Patterns
    - Scale, Proportion, and Quantity

CRLLKS- Career Education

9.2.8.B.3 Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.

9.2.8.B.4 Evaluate how traditional and nontraditional careers have evolved regionally, nationally, and globally.

9.2.8.B.5 Analyze labor market trends using state and federal labor market information and other resources available online.

9.2.8.B.6 Demonstrate understanding of the necessary preparation and legal requirements to enter the workforce.

Connection:

Instruct students to include a section about career options that go along with their research project topic. Example, if the research topic is high cholesterol and its harmful effects, students should connect careers in food science and/or in the medical field.

Cross-Curricular Integration

Additional Mathematics and ELA integration can be found within each lesson plan

Integration Area: Language Arts

W.IW.8.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

A. Introduce a topic clearly, previewing what is to follow; and organize ideas, concepts, and information, using text structures (e.g., definition, classification, comparison/contrast, cause/effect, etc.) and text features (e.g., headings, graphics, and multimedia) when useful to aid in comprehension.

B. Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other

information and examples.

C. Use appropriate transitions to create cohesion and clarify the relationships among ideas and concepts.

D. Use precise language and domain/grade-level- specific vocabulary to inform about or explain the topic.

E. Establish and maintain a formal style/academic style, approach, and form.

F. Provide a concluding statement or section (e.g., sentence, part of a paragraph, paragraph, or multiple paragraphs) that synthesizes the information or explanation presented.

Activity:

Students will use CERs (Claim, Evidence & Reason) to explore Climate Change to show if students are able to convey their thinking and decision making in written form.

- Students will be answering the question, "What are causes of cancer and mutations?"
- Students provide evidence that supports their claim.
- Students will then write a reasoning that explains what their claim is, state knowledge they have on the topic, evidence to prove their topic, and close their reasoning with their claim again.

Integration Area: Math

8.EE.C.7.a Give linear equations in one variable.

Activity:

Students will take notes on a lesson about Punnett Squares which relates to probability, fractions, and percentages. Once Punnett Squares is taught, the students will work in groups to complete a worksheet on different scenarios relating to the possible outcomes of the offspring of varied traits of sexual reproductive parents: homozygous recessive and dominant as well as heterozygous.

Language Arts Companion Standards:

W.IW.8.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

A. Introduce a topic clearly, previewing what is to follow; and organize ideas, concepts, and information, using text structures (e.g., definition, classification, comparison/contrast, cause/effect, etc.) and text features (e.g., headings, graphics, and multimedia) when useful to aid in comprehension.

B. Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.

C. Use appropriate transitions to create cohesion and clarify the relationships among ideas and concepts.

D. Use precise language and domain/grade-level- specific vocabulary to inform about or explain the topic.

E. Establish and maintain a formal style/academic style, approach, and form.

F. Provide a concluding statement or section (e.g., sentence, part of a paragraph, paragraph, or multiple paragraphs) that synthesizes the information or explanation presented.

RL.CI.8.2. Determine a theme of a literary text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

RI.CI.8.2. Determine a central idea of an informational text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

Activity:

Water on Earth: One way in which NJ residents could help control the mosquito population is to eliminate or decrease the amount of standing water around their homes. Using evidence from one or more credible sources, explain why this procedure might be effective to reduce the mosquito population? Be sure to explain how this evidence supports your claim.

Diversity

Race and Ethnicity

Objective:

- Students should be able to identify the genetic diversity within the classroom.
- Students should be able to explain how genetic diversity relates to biodiversity.
- Students should be able to gather the information from their survey to find the population of students who carry specific traits.
- Students should be able to graph this information in a pie chart.

Activity:

Students will obtain a list of traits they need to look for within their class. They are to mingle and record the data on the phenotypes of the students.

They must determine if the traits they are recording are acquired or genetic.

They will use a tool to create polls and/or pie chart on their findings.

Science and Engineering Practices

- Developing and Using Models: Students develop, use, and revise models beginning in Lesson 1 and throughout the unit to explain patterns in the sky ranging from why Manhattahenge occurs twice a year in the same spot, why the seasons in Australia are opposite of seasons in the Northern Hemisphere, why the Moon appears redder during a lunar eclipse but does not go completely dark, why planets go around the Sun and moons go around planets, our place in the solar system and galaxy, and more.
- Analyzing and Interpreting Data: Students use multiple graphical displays (e.g., maps, scatter plots) of large data sets to identify and explain patterns in sky (such as solar elevation, length of day, location and paths of motion for objects in the sky, and the organization of the solar system.
- Obtaining, Evaluating, and Communicating Information: Throughout the unit students are gathering, reading, synthesizing and information from multiple sources (e.g., text, data, maps, graphs, images). This is an 8th grade unit toward the end of the year, so students have already had much experience in this practice so while students are given several close reading or listening protocols, some of the scaffolding has been removed from previous units so they can execute the practice on their own.

Science and Society

Robert Hooke

The cell was first discovered and named by Robert Hooke in 1665. He remarked that it looked strangely similar to ‘cellula’ or small rooms which monks inhabited, thus deriving the name.

Theodor Schwann

Schwann demonstrated that animal tissues contained cells, and in 1839 concluded that all tissues are made up of cells: this laid the foundations for the cell theory. Combined with Schleiden’s findings of plant tissue containing cells, they concluded that all living things are made up of cells and that cells are the basic units of life.

Robert Virchow

Concluded that all cells come from pre-existing cells

Antonie Van Leeuwenhoek

The first to observe living bacteria and protista.

Gregor Mendel

Discovered the basic principles of genetics concerning dominant and recessive traits within pea plants. He also proved that traits undergo independent assortment; traits are able to separate from each other.

Rosalind Franklin

Rosalind Franklin was a chemical physicist (1920–1958), who used x-ray diffraction to determine the structure of DNA.

Francis Crick and James Watson

Crick and Watson, together with Maurice Wilkins, won the 1962 Nobel Prize in Medicine for their discovery of the structure of DNA. Watson and Crick created the first accurate 3D model of DNA.

Charles Darwin

English naturalist whose scientific theory of evolution by natural selection became the foundation of modern evolutionary studies. Darwin stated that animals and humans shared a common ancestor.

CSDT Technology Integration

8.2.8.NT.4: Explain how a product designed for a specific demand was modified to meet a new demand and led to a new product
Action: Students will identify, compare, and contrast the evolution of the microscope. Students will work with the compound light microscope, identify the parts, and explain how it works.

Digital Driving Question Boards (DQB)

Lessons 1, 4, and 15 to guide the entire investigation. Transitioning this to a digital platform like Padlet or Canva Whiteboards allows students to contribute "Notice and Wonder" post-its from their own devices, which can then be easily categorized and saved throughout the 31-day unit. A digital DQB is particularly effective for Lesson 15's "Putting the Pieces Together" phase, as teachers can instantly pull up questions from the first day of class to show students exactly how much they have figured out about the connection between ancient and modern organisms.

Interactive Fossil Timelines and Maps

Using Google Earth or HHMI BioInteractive's EarthViewer, students can manipulate a global timeline to see how plate tectonics moved continents over millions of years. This helps explain why the "Pedro" fossil was discovered in Peru and how the local environment changed from an ancient coastline to its current state. By using virtual tours of natural history museums, students can also perform "virtual observations" of whale and horse fossil structures, bridging the gap between the classroom and real-world paleontological evidence.

Collaborative Data Analysis

Students can use a shared Google Sheet where each group enters their population data. This tech integration allows the class to generate live, side-by-side bar graphs of trait distributions. Instead of spending time manually drawing graphs on posters, students can spend more time on the high-level analysis of why certain traits became more common, using the collective data of the entire class to validate their General Model for

Natural Selection.

Service Learning

Community Issue: Students will choose between one of these issues to research, create a presentation on how they can help with this issue in Milltown, and then make a pamphlet to be posted.

Focus Areas:

- **Mosquito Pathogens:** Investigate the diseases and viruses mosquitoes carry. Determine the most prevalent pathogens as well as their effects on humans and other organisms. Using the internet, library, and other resources, students can create a PowerPoint or brochure to share with the community.
- **Mosquito Population Control:** Learn about the breeding grounds of mosquitoes and how to reduce their population. Using the internet, library, and other resources, students can create a PowerPoint or brochure to share with the community.
- **Natural Predators:** Use the internet and other resources to gather information about mosquito preditors and the predator's ideal environments. Students will research the cost, the materials needed, and the placement of these objects in the environment. The information can be shared with the public.
- **Natural Pest Control:** Learn alternative methods of pest control and the different impacts that these methods have on the environment. Create a brochure to demonstrate how everyone in town can do this and not use harmful pesticides.

Activity:

- **Pre-Reflection:**
  - Students in their groups, will look over the list of types of projects they can do their project on.
  - They will talk about what they already know about mosquitos, their breeding seasons, and what they can do to share their information with the community in the most effective way. Using their previous knowledge, they will choose the best project for their group.
- **Research:**
  - Students will research their topic. They will brainstorm and come up with a concept map of how they want to create their presentation Google Slides and their pamphlet in Google Docs.
- **Presentation & Pamphlet:**
  - Students will take all of their research on their chosen topic and create a presentation in Google Slides. This presentation will be presented to the class.
  - Students will also come up with a pamphlet summarizing their presentations that can be shared on Parent Square to help bring awareness to the Milltown Community.
- **Reflection:**
  - Students will then reflect (in a Google Doc) on how they think their project went, and how they will use the suggestions they provided to help the environment.

Resources

Scientific Inquiry

MS-LS1-1 Plant, Animal, Bacteria Lab
MS-LS1-2 Cell Organelle Project - Inner Life of a Cell Multiple Project Choice, 2D Cell Project, 3D Cell Project
MS-LS3-1 Strawberry DNA Lab
MS-LS4-5 Technologies that Influence Inheritance of Traits
MS-LS4-1 Investigating Natural Selection
MS-LS4-3 Comparative Embryology