Unit 4: Earth, the Moon, and the Stars

Content Area: **Science**
Course(s): **Integrated Science 5**
Time Period: **1 marking period**
Length: **8 Weeks**
Status: **Published**

Unit Overview

Students are introduced to the unit's anchoring phenomenon of gravity. In this unit, students explore the force of gravity on Earth in different locations. They will also observe that Earth's gravity pulls on objects in space, such as meteoroids. Objects in space, like the sun and moon, have gravity too. Last, students will create a training program for new cadets to prepare them for life on a space station. To prepare the training program, they must first study gravity and light patterns here on Earth.

Transfer

Students will be able to independently use their learning to...

- Develop an affinity for wide reading on topics of astronomy
- Investigate a career in science, technology, engineering, or math
- Apply knowledge of shadows on Earth to track the time of day and year
- Track the movement of Earth's moon to use a navigation guide
- Determine what daytime, nighttime, and shadows would be like in space

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For more information, read the following article by Grant Wiggins.

http://www.authenticeducation.org/ae_bigideas/article.lasso?artid=60

Meaning

Understandings

- The apparent motion of the Sun across the sky, the Moon's phases, and eclipses result from the motions of Earth around the Sun and of the Moon around Earth.
- Gravitational interaction between the Sun, Moon, and Earth produces tides on Earth.
- The Sun is the major source of energy for Earth.
- Sunspots occur in predictable cycle and influence space weather.

Essential Questions

Lesson 1: What does gravity do?

Lesson 2: Why is the sun brighter than other stars?

Lesson 3: Why is there day and night?

Lesson 4: How do shadows change during the day and year?

Lesson 5: How do stars seem to move during the night and year?

Lesson 6: How does the moon seem to move and change shape?

Lesson 7: What tools do scientists use to observe space?

Application of Knowledge and Skill

Students will know...

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- The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.
- The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and

night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.
- The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.
- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well eah takes the constraints into account.
- Basic laws of nature are the same everywhere in the universe.
- Science findings are based on recognizing patterns.

Students will be skilled at...

Students will be skilled at...

- represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.
- analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
- Use data to evaluate and refine design solutions.
- Construct and/or support an argument with evidence, data, and/or model.
- Compare and refine arguments based on an evaluation of the evidence presented.
- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
- Organize simple data sets to reveal patterns that suggest relationships.
- Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems.
- Develop and/or use models to describe and/or predict phenomena.
- Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
- Identify limitations of a model.
- Use evidence to construct or support an explanation or design a solution to a problem.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.
- Identify the evidence that supports particular points in an expression.

Academic Vocabulary

Lesson 1	Lesson 5
gravity	astronomer
meteor	constellation
orbit	
Lesson 2	Lesson 6

apparent brightness
light-year

full moon
moon phases
new moon
waning
waxing

Lesson 3
axis
rotate
rotation
time zone

Lesson 4
shadow
sundial

Lesson 7
lens
radio telescope
reflecting telescope
refracting telescope
space telescope
telescope

Learning Goal 1

Students will be able to support an argument that the gravitational force exerted by Earth on objects is directed down.

SCI.5-PS2-1	Support an argument that the gravitational force exerted by Earth on objects is directed down.

Target 1 (Lesson 1)

Identify the direction of gravitational force.

Target 2 (Lesson 1)

Describe the various effects of gravity on objects in Earth and space.

Target 3 (Lesson 1)

Explain the force used to measure gravity.

Learning Goal 2

Students will be able to represent data in graphical displays to reveal patterns of daily changes in length and directions of shadows, day and night, and the seasonal appearance of some stars in the night sky.

SCI.5-ESS1-2	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.

Target 1 (Lesson 3)

Explain why there is day and night.

Target 2 (Lesson 4)

Collect data on Sun's apparent motion in the sky due to the rotation of the Earth to compare winter and summer shadows.

Target 3 (Lesson 6)

Identify the how the moon moves and the reasons for its various shapes.

Target 4 (Lesson 7)

Identify the tools sceintists use to observe stars.

Learning Goal 3

Students will be able to support an argument that differences in the apparent brightness of the Sun compared to other stars is due to their relative distances from Earth.

SCI.5-ESS1-1	Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.

Target 1 (Lesson 5)

Discuss why the stars seem to move during the night and year.

Target 2 (Lesson 5)

Utilize appropriate tools that scientists use to observe space.

Target 3 (Lesson 2)

Recall why the Sun is brighter than other stars.

Formative Assessment and Performance Opportunities

- notebook checks
- quiz
- science notebook
- student displays & presentations
- student experiments
- student observations
- student sheets
- teacher observation
- test
- think/pair/share
- web concept map

Summative Assessment

All assessments are differentiated and aligned to the science standards and curriculum. Alternate assessment may include projects or presentations, or a common paper/pencil assessment, or both. Common summative assessments, which include inquiry reflection are developed based on corresponding TCI Units and are computer based (LinkIt).

Accommodations/Modifications

Accomodations available through the TCI program include read aloud, Spanish text and presentations, leveled

text, text highlighting, and notetaking.

English Language Learners

- Connect constellations to student cultures
- Have student take a picture walk before reading
- Have students give examples of patterns they have learned previously
- Have students research the time zone of their home country to make connections with day and night
- Preteach and review vocabulary
- Provide students with answer to the notebook questions but mix them up. Have students discuss which answer goes with which
- Provide support for students as they write their claims and evidence
- Provide the written script for the video in Lesson 5

Special Education Students

- Complete notes in pairs
- For the Lesson 3 diagram, provide the student with diagram assistance by deleting parts or all of the labels and have them fill it in.
- Have students round each date point to the nearest ten for the graphic activity in Lesson 5
- Help the students fill out the graph in Lesson 6 by identifying the various parts of the graph and practice plotting points with a simple time such as midnight.
- Model how to fill out the data for the Investigation in Lesson 6
- Model Part 1 of the Investigation in Lesson 1
- Provide pre-built sundials

Talented and Gifted Students

- Additional Investigation on Apparent Brightness in Lesson 1
- Create skits about gravity
- Have students conduct research about how moon phases are created.
- Have students create physical models to show the relationship between the sun and earth
- Have students read books from additional reading list
- Have students research more information on sundials
- Introduce Circumpolar Constellations

- Reverse the challenge in Part 2 of the investigation in Lesson 5.
- Use an additional simulation to model Earth's rotation

Unit Resources

Lesson 1

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 274-285.

Materials

- Interactive Spanish Network
- Lesson Guide
- Notebook Answer Key
- Spanish Interactive Spanish Network

Links

- Kidipede (website): https://quatr.us/physics
- PhET Interactive Simulations (simulation): https://phet.colorado.edu/en/simulation/gravity-and-orbits
- Your Weight on Other Planets. https://www.exploratorium.edu/ronh/weight/

Additional Reading

The following books offer opportunities to extend the content in this lesson.

Gut-Wrenching Gravity and Other Fatal Forces (Disgusting & Dreadful Science) by Anna Claybourne. (New York, NY: Crabtree Publishing Company, 2013)

Gravity keeps people on the ground, but it's not always pleasant! Read all about how astronauts have to deal with gravity problems in space and many more gross or painful facts about gravity.

Gravity (Mysteries of the Universe) by Jim Whiting. (Mankato, MN: The Creative Company, 2012)

How does gravity work? Learn all about the science and scientists who gave us our modern understanding of

gravity.

Lesson 2

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 286-295.

Materials

- D-size batteries
- Flashlights
- Graph Paper
- Inflatable Earth Model
- Interactive Student Notebook
- Lesson Guide
- Notebook Answer Key
- Ruler
- Spanish Interactive Student Notebook

Links

- How Far Is a Light-Year (video): https://www.youtube.com/watch?v=Rj1sDWjvgjM
- If the Moon Were Only 1 Pixel (simulation): http://joshworth.com/dev/pixelspace/pixelspace_solarsystem.html
- Sun|trek (website): http://www.suntrek.org/

Additional Reading

The following books offer opportunities to extend the content in this lesson.

Solar Science – Exploring Sunspots, Seasons, Eclipses, and More by Dennis Schatz and Andrew Fraknoi. (Arlington, VA: NSTA Press, 2015)

How does the sun affect our daily life on earth? Read about how the sun affects us, from different seasons to solar eclipses, in this book that combines facts with many different hands-on projects.

Light (Mysteries of the Universe) by Jim Whiting. (Mankato, MN: The Creative Company, 2012)

You'd be blind without light, but how does it work? Learn about the science behind light and the scientists who have made these important discoveries.

Lesson 3

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 296-305.

Materials

- 60 Watt Light Bulb
- Inflatable Earth Model
- Interactive Student Notebook
- Lesson Guide
- Notebook Answer Key
- Porcelain Light Socket with Cord
- Porcelain Light Socket with Cord
- Spanish Interactive Student Notebook
- Sticker

Links

- Earth's Rotation & Revolution: Crash Course Kids 8.1 (video): https://www.youtube.com/watch?v=l64YwNl1wr0
- E-Learning for Kids: Day & Night (simulation): https://www.e-learningforkids.org/science/

Additional Reading

The following books offer opportunities to extend the content in this lesson.

Solar and Lunar Eclipses (Explore Outer Space) by Ruth Owen. (New York, NY: Powerkids Press, 2015)

In ancient times, people thought eclipses were signs of horrible things to come, but we know now that eclipses aren't bad, just fascinating! Read all about the science behind these amazing natural events.

Journey to Earth (Spotlight on Space Science) by Betsy Oates. (New York, NY: Powerkids Press, 2015)

How does the Earth's orbit affect your daily life? Learn all about how earth's orbit and rotation work, as well as many other fun facts about the Earth, in this book that examines what makes our planet different from and similar to the rest of the solar system.

Lesson 4

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 306-315.

Materials

- 3 x 3" Sticky Notes
- 60 Watt Light Bulb
- Inflatable Earth Model
- Interactive Student Notebook
- Large Paper Clip
- Lesson Guide
- Notebook Answer Key
- Paper Bowl
- Porcelain Light Socket with Cord
- Ruler
- Scotch Tape
- Spanish Interactive Student Notebook
- White Chalk

Links

- E-Learning for Kids: Shadows (Simulation): https://www.e-learningforkids.org/science/
- The Children's University of Manchester: Shadows (simulation): http://www.childrensuniversity.manchester.ac.uk/

Additional Reading

The following books offer opportunities to extend the content in this lesson.

Dark as a Shadow (I Wonder Why) by Lawrence F. Lowery. (Arlington, VA: NSTA Kids, 2014)

Your shadow follows you everywhere, but why? Learn all about how shadows work and how to make your own in this rhyming book full of colorful pictures.

Journey Through Eclipses (Spotlight on Space Science) by Carolyn L. Hill. (New York, NY: Powerkids Press, 2015)

Eclipses are just really big shadows, but how do they work? Read about the different types of eclipses and what makes them happen when they do.

Lesson 5

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 316-329.

Materials

- Audio Transcript
- Inflatable Earth Model
- Interactive Student Notebook
- Lesson Guide
- Notebook Answer Key
- Placards A-N
- Spanish Interactive Student Notebook
- Yellow Posterboard

Links

- Brain POP: Constellations (video): https://www.brainpop.com/science/
- E-Learning for Kids: All About Stars (simulation): https://www.e-learningforkids.org/science/

Additional Reading

The following books offer opportunities to extend the content in this lesson.

Stars: A Family Guide to the Night Sky by Adam Ford. (Boulder, CO: Roost Books, 2016)

You can see stars every night, but how do you know which stars are which? Use this book, which talks about different types of constellations and how to identify them, to become an expert stargazer.

Stars (Mysteries of the Universe) by Jim Whiting. (Mankato, MN: The Creative Company, 2013)

For as long as people can remember, humans have been fascinated by stars. Learn what early scientists thought about stars, and how researches like Galileo and many others have changed our view of these celestial objects.

Journey Through Galaxies (Spotlight on Space Science) by Lori Smyer. (New York, NY: Powerkids Press, 2015)

At night, you can see the stars of the Milky Way, but there are many more galaxies in the world! Read about how scientists study galaxies to learn how galaxies are formed in this book full of pictures from real scientist's telescopes.

Lesson 6

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 330-341.

Materials

- Cardstock Paper
- Colored Pencils
- Handout: Moonrise and Moonset Times
- Interactive Student Notebook
- Lesson Guide
- Notebook Answer Key
- Spanish Handout: Moonrise and Moonset Times
- Spanish Interactive Student Notebook

Links

- Lunar Cycle, Why The Moon Changes Shapes, 8 Phases Of The Moon, Learning Videos for Children (video): https://www.youtube.com/watch?v=NCweccNOaqo
- Moonrise and Moonset Calculator (website): https://www.timeanddate.com/moon/

Additional Reading

The following books offer opportunities to extend the content in this lesson.

Race to the Moon (The Story of Space) by Steve Parker. Illustrations by David West. (Mankato, MN: Smart Apple Media, 2015)

The moon is the closest thing in the solar system to Earth, but nobody had ever landed on it until the 1960s. Learn all about how the United States and the Soviet Union competed to put a man on the moon in this book that talks bout about the history and science of the moon.

Journey to the Moon (Spotlight on Space Science) by Laurence Dyson. (New York, NY: Powerkids Press, 2015)

Why can't you see the moon every night? Learn about the different phases of the moon and how it affects the Earth in this beautifully photographed book.

Lesson 7

Text: Chamberliss, Marilyn, et al. *Bring Science Alive! Exploring Science Practices*. Rancho Cordova: Teachers' Curriculum Institute, 2015. pp. 342-353.

Materials

- Cardboard Tube 4.71" L
- Cardboard Tube 5.86" L
- Cardstock Paper
- Construction Paper (Assorted Colors)
- Double Concave Lens, FL 10 cm

- Double Convex Lens, FL 10 cm
- Double Convex Lens, FL 15 cm
- Handout A: Sample Spyglass Design
- Handout B: Vision Test Chart
- Interactive Student Notebook
- Lesson Guide
- Masking Tape
- Notebook Answer Key
- Safety Gloves
- Scotch Tape
- Spanish Handout A: Sample Spyglass Design
- Spanish Handout B: Vision Test Chart
- Spanish Interactive Student Notebook
- Vinyl Apron
- Yard Sticks

Links

- Australia Telescope Compact Array Time-lapse (video): https://vimeo.com/73104737

Additional Reading

The following books offer opportunities to extend the content in this lesson.

This Is Rocket Science: True Stories of the Risk-taking Scientists Who Figure Out Ways to Explore Beyond Earth by Gloria Skurzynski. (Des Moines, IA: National Geographic Children's Books, 2010)

Who are the scientists behind the space race? Learn all about the history of space science, from the first fireworks to Mars missions, and the people who put themselves in danger to give us the knowledge that we have today, in this book that has been checked by NASA scientists themselves.

Mapping Earth from Space (Science Missions) by Robert Snedden. (Chicago, IL: Raintree, 2011)

How do scientists know what the Earth looks like from above? Learn all about how satellites have helped us map the Earth's surface in this book full of pictures from the actual satellites that scientists use.

Space Stations (The Story of Space) by Steve Parker. Illustrations by David West. (Mankato, MN: Smart Apple Media, 2015)

Did you know that some people have lived in space for more than a year? Space stations allow people to stay in space for long periods of time to research the galaxy. Learn about how scientists created space stations and

what the daily life on a station is like.

I, Galileo by Bonnie Christensen. (New York, NY: Knopf Books for Young Readers, 2012)

Nowadays, we think of Galileo as one of the pioneers of modern science, but in his time he was widely mistrusted by the church and even put under house arrest! In this compelling biography, written in the first person, learn all about Galileo's life and his accomplishments, and see how his research has influenced scientists to this day.

Performance Assessment

Materials

- Handout A: Earth Data
- Handout B: One Day on Earth on the ISS
- Lesson Guide
- Notebook Answer Key
- Notebook Answer Key
- Performance Assessment
- Performance Assessment
- Performance Assessment Rubric
- Spanish Handout A: Earth Data
- Spanish Handout B: One Day on Earth on the ISS
- Spanish Performance Assessment
- Spanish Performance Assessment
- Spanish Performance Assessment Rubric

21st Century Life and Careers

CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater

	good.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP5.1	Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.
CRP.K-12.CRP11.1	Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.
CRP.K-12.CRP12.1	Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.

Interdisciplinary Connections

LA.W.5.8	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.
LA.RI.5.1	Quote accurately from a text and make relevant connections when explaining what the text says explicitly and when drawing inferences from the text.
LA.RI.5.2	Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.
LA.RI.5.3	Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.
LA.RI.5.4	Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.
LA.RI.5.5	Compare and contrast the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in two or more texts.
MA.5.G.A.2	Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

MA.5.MD.B	Represent and interpret data.
SCI.3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
SCI.3-5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
SCI.3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
TECH.8.1.5	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.5.A.1	Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.
TECH.8.1.5.A.3	Use a graphic organizer to organize information about problem or issue.
TECH.8.1.5.A.4	Graph data using a spreadsheet, analyze and produce a report that explains the analysis of the data.