Coherence and Alignment Among Science Curriculum, Instruction, and Assessment (CASCIA) Project

Grade 8 Unit 2: Gravity and Motion of Objects in the Solar System

Family Guidance and Learning Resources for Performance Category 2

October 2023

Grade 8 Unit 2: Gravity and Motion of Objects in the Solar System, Family Guidance and Learning Resources for Performance Category 2 was developed with funding from the U.S. Department of Education under the Competitive Grants for State Assessments Program CFDA 84.368A. The contents of this paper do not represent the policy of the U.S. Department of Education, and no assumption of endorsement by the Federal government should be made.

Purpose

The purpose of this document is to help families understand their student's performance on the Grade 8 Unit 2 Science Assessment and to provide resources and recommendations for engaging their student in science learning at home.

Unit Overview

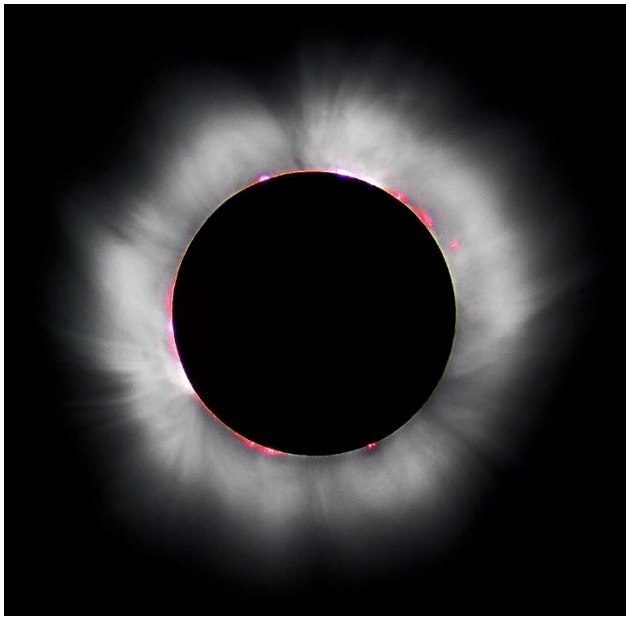
By engaging in this unit, students deepen their knowledge of Earth's place in the universe, the force of gravity between objects with mass, and the role of gravitational force in keeping planetary objects in orbit. Students develop their experience and skills in developing and using models and analyzing and interpreting data to investigate the characteristics of objects in the solar system, explain patterns of the apparent motion of the sun, moon, and stars, and construct and support evidence-based arguments about the connections between gravitational forces and orbital motion.

Performance Category 2: Support Arguments About Earth's Place in the Solar System and Universe

Prompts for this performance category require students to support an argument with evidence, data, or a model to explain:

- the relationship between asteroid diameters and frequency
- the role of Earth's axial tilt in causing seasons
- lunar phases in terms of the relative positions of the sun, Earth, and moon
- the pattern regarding the surface temperatures of planets and their location in a solar system
- the role of gravity in the sequence of events leading to the formation of Earth's solar system

Grade 8 Unit 2: Gravity and Motion of Objects in the Solar System



Credit: "Total solar eclipse" by Luc Viatour
Source: https://Lucnix.be
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Instructions for Parents/Guardians

1. Refer to your student's score report to determine their instructional needs level—red, yellow, or green—for this performance category.
2. Use the Interpretive Guidance (see pages 2-3) to understand what your student likely knows and is able to do based on their instructional needs level.
3. Use the Family Resources and Recommendations (see pages 4-6) to engage with and support your student's science learning at home.

Interpretive Guidance for Performance Category 2: Support Arguments About Earth's Place in the Solar System and Universe		
Red (0-7 score points earned) ➢ **Extensive** additional instruction and reteaching of these skills is recommended. ➢ The student needs significant opportunities to reinforce and apply these skills in future learning.	**Yellow (8-13 score points earned)** ➢ **Moderate** additional instruction on these skills is recommended. ➢ The student needs additional opportunities to strengthen these skills in future learning.	**Green (14-16 score points earned)** ➢ **Minimal to no** additional instruction on these skills is recommended. ➢ The student is ready to extend these skills in future learning.
What These Results Mean		
This student is likely able to: • **Attempt to interpret** provided data in a graph. • Provide some evidence to support an **incomplete or inaccurate** explanation of the spatial and temporal relationships in the Earth-sun-moon system, including seasonal patterns of Earth and the cyclic pattern of the lunar phases. • **Attempt** to describe a relationship or pattern in the data when making inferences based on properties of objects within a solar system. • **Attempt** to develop an explanation of the formation of Earth's solar system with **major conceptual errors**. • Demonstrate **limited** understanding of similarities and differences among solar system objects (e.g., using patterns of	**This student is likely able to:** • Accurately interpret **some** provided data in a graph, using **simple** mathematical thinking, as necessary. • Provide **adequate evidence** to support a **reasonable** explanation of the spatial and temporal relationships in the Earth-sun-moon system, including seasonal patterns of Earth and the cyclic pattern of the lunar phases. • Describe the relationship between variables and identify patterns (qualitative or quantitative) among variables represented in the data, but analyses include **some minor errors**. • Describe **some aspects** of the events leading to the formation of Earth's solar system with **some conceptual errors**. • Demonstrate **partial** understanding of similarities and differences among solar	**This student is likely able to:** • **Accurately interpret** provided data in a graph and **demonstrate mathematical thinking** in their explanation. • Provide **complete and accurate** evidence of the spatial and temporal relationships in the Earth-sun-moon system. • Describe the relationship between variables and identify patterns (qualitative or quantitative) among variables represented in the data with **minimal errors.** • Describe the events leading to the formation of Earth's solar system with **few conceptual errors**. • Demonstrate **complete and accurate** understanding of similarities and differences among solar system objects and **accurately** explain the pattern found regarding the comparison of surface

features when using a model to compare the inner planets to the outer planets).	system objects and **apply some of these concepts** to compare conditions (e.g., surface temperature) of inner planets to outer planets.	temperatures of planets and their location in a solar system.

Family Resources and Recommendations for Performance Category 2: Support Arguments About Earth's Place in the Solar System and Universe	
Resources and Recommendations to Support Science Learning at Home	
Engage in the Topic *Why does Earth have seasons?*	Present the following arguments to your student: • **Veronica** says that we have seasons because Earth's orbit is not a perfect circle. Sometimes, Earth is closer to the sun than other times. • **Nia** says that we have seasons because the Earth is tilted on its axis. Sometimes, the Northern Hemisphere is tilted towards the sun, and sometimes, the Southern Hemisphere is tilted towards the sun. Ask your student which argument they support.

Explore the Topic
What relationships among the Earth-Moon-Sun system describe the cause of Earth's seasons?
	Present the source of evidence used by Veronica and Nia to support their arguments:
	• **Veronica** relies on a diagram of Earth's actual orbital path around the sun.
	  ○ Point out the differences in the distance between the sun and Earth at different seasons during a year.
	• **Nia** presents a diagram showing the angle of sunlight during Earth's winter and summer seasons.
	  ○ State that the tilt of Earth's axis never changes.
	  ○ Point out the tilt of Earth on its axis during the Winter Solstice.
	  ○ Point out the differences in the angle of the sunlight as it hits Earth's surface during different times of the year. Different parts of Earth receive the sun's most direct rays.
	  ○ Describe the difference between direct (Southern latitude during summer) and indirect (Northern latitude during winter) rays of sunlight hitting Earth's surface on December 21.

Explain using Evidence *What role does Earth's tilt play in seasonal changes?*	Ask your student again which argument they support, given the evidence used by Veronica and Nia. Restate Veronica and Nia's explanations. Watch and discuss this website from NASA to reinforce your student's understanding that Earth's tilted axis causes the seasons. • Seasons are caused by the Earth's tilted axis. As the Earth orbits the sun, when the Northern Hemisphere is tilted towards the sun, the surface of Earth receives the most direct rays from the sun. The direct rays from the sun cause Earth to heat up, causing summer temperatures.

	Watch this video [up to 1:59] explaining why Earth has seasons to highlight how Earth's tilted axis causes seasons. • Ask your student if the video gives them more evidence to support Veronica or Nia's argument. Ask your student to explain their response. Your student may speak, write, or draw their response.
Elaborate with New Evidence *What other predictions can be made related to Earth's tilt?*	Work with your student to gather a light source (e.g., flashlight, cell phone light, etc.) and a round object (e.g., basketball, balloon, tennis ball). Using a pen, rubber band, or other means, identify a band around the center of the round object that represents Earth's equator. • Ask your student to use the light source and round object to model summer in the Northern latitude. (*The 'top' half of the object is tilted towards the light source.*) • Ask your student to manipulate the model to correctly depict an explanation of winter in the Northern Hemisphere. (*The 'top' half of the object is tilted away from the light source*.) • Ask your student to manipulate the model to correctly depict an explanation of the effect on temperatures in the Northern and Southern latitudes if Earth's axis had **NO** tilt. (*Neither the top nor bottom half of the object is tilted*.) Extension: Ask your student, "What would Earth be like with no tilt?" (*e.g., The length of day and night would be exactly equal.; There would be no seasons, just an average of the current four seasons.; The types of living organisms on Earth would likely be quite different. Etc.)*

Resources

1. Earth's orbit around the Sun, Diagram by Quora
   [https://qph.cf2.quoracdn.net/main-qimg-632b0986e406299f88f120d9f6b07fb3.webp]
2. Earth at Winter Solstice, Diagram by Weebly
   [https://taylorsciencegeeks.weebly.com/uploads/5/9/2/0/59201005/449811051.png]
3. What Causes the Seasons, Webpage by NASA Space Place
   [https://spaceplace.nasa.gov/seasons/en/]
4. Why Do We Have Different Seasons?, Video by California Academy of Sciences
   [https://youtu.be/WgHmqv_-UbQ]