FIFTH GRADE: SPACE AND PLANETS

Standards Bundle
Standards are listed within the bundle. Bundles are created with potential instructional use in mind, based upon the potential for related phenomena that can be used throughout a unit.

5-PS2-1 Support an evidence-based argument that the gravitational force exerted by Earth on objects is directed toward the center of the Earth. (SEP: 2; DCI: PS1.A; CCC: Scale/Prop.) *[Assessment boundary: Assessment does not include mathematical representation of gravitational force.]*

5-ESS1-1 Support an argument that differences in the apparent brightness of the sun compared to other stars is due to distances from the Earth. (SEP: 7; DCI: ESS1.A; CCC: Scale/Prop.) *[Assessment boundary: Assessment is limited to relative distances, not sizes of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]*

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. (SEP: 4; DCI: ESS1.B; CCC: Patterns) *[Clarification statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [Assessment boundary: Assessment does not include causes of seasons.]*

Content Overview
This section provides a generic overview of the content or disciplinary core ideas as an entry point to the standards.

The sun is the center of our solar system and is the brightest object in the sky because of its proximity to Earth. Other stars are much brighter or larger, but because of the distance, they appear smaller. Gravity from the sun keeps the planets in orbit, and the gravity from the planets keeps its respective moons in orbit. This gravitational pull always pulls down to the center of the celestial object.

The rotation and revolution of the earth and moon cause patterns of shadows, day and night, and the seasonal appearance of some stars in the night sky. These are the result of the movement of the earth on its axis (rotation) and in its orbit (revolution).

Phenomena
Phenomena can be used at varying levels of instruction. One could be used to anchor an entire unit, while another might be more supplemental for anchoring just a unit. Please remember that phenomena should allow us to engage in the SEP and use the CCC/DCI to understand and explain the phenomenon.

- Two objects of the same mass land on the ground at the same time when dropped from the same height.
- The planets and moons do not collide but stay in their own space.
- The changing of shadows during the day/year. For example, shadows are longer during the morning and evening, but shorter at noon. Shadows are also shorter in winter than in the summer.
- The sun is not the brightest star in the universe.

Storyline

This section aims to decode not only the DCI connections but also the SEP and CCC in a detailed account of how they possibly fit together in a progression for student learning, including both rationale and context for the bundle.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence - Support an argument with evidence, data, or a model. **Analyzing and Interpreting Data** - Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.	**PS2.B: Types of Interactions** - The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. **ESS1.A: The Universe and its Stars** - 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. **ESS1.B: Earth and the Solar System** - 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.	**Cause and Effect** - Cause and effect relationships are routinely identified and used to explain change. **Scale, Proportion, and Quantity** - Natural objects exist from the very small to the immensely large. **Patterns** - Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena.

All objects in the universe exhibit gravity to some degree. Gravity holds the Earth in orbit around the sun and the moon in orbit around the Earth. Earth's gravitational force pulls objects down toward its center which keeps all objects in the universe in place. All celestial objects exhibit gravity, but their size determines their force of gravity. Students can engage in investigations of falling objects of various sizes. They may graph and compare the evidence to support that gravity pulls all objects down.

Students can make models of the Earth, moon, and sun to construct an explanation of rotation and revolution. Students can analyze and interpret data in order to understand the regular patterns of motion such as moon phases, star movements, and eclipses. Using the terms rotation and revolution, students can explain other patterns such as day and night, the changes and direction of shadows, and the changing seasons. As the seasons change, so do the patterns of the stars in the night sky.

Students can collect observational data by observing the stars in the night sky. Students can analyze models to understand the size and scale of the universe in relation to the distance of stars from Earth.

Among all the stars in the sky, the sun appears the brightest. Students can analyze and interpret data about the distance from the Earth, size, brightness, and temperature of a variety of stars to gain an understanding that the sun is an average star, meaning that there are larger and brighter stars and smaller and dimmer stars than the sun. Students can construct an argument using evidence that the sun only appears to be the brightest in our sky because of the proximity of the sun to the Earth. By gaining an understanding of the patterns of the objects in the Universe and solar system, and by understanding size and scale, students will understand the Earth's place in our solar system.

Formative Assessment

Formative assessment is crucial because all learners benefit from timely and focused feedback from others. It promotes self-reflection, self-explanation, and social learning. It can also make learning more relevant. Each of the questions below might be used throughout the formative assessment process. Specific prompts may focus on individual practices, core ideas, or crosscutting concepts, but, together, the components need to support inferences about students' three-dimensional science learning as described in a given bundle, standards, or lesson-level performance expectation.

Engaging in Argument from Evidence
- Use a model as evidence to show how the sun, Earth, and moon work together to create a system.

Cause and Effect
- What effect does gravity have on the solar system?
- Why can you see a star in the summer and not in the spring?

Scale, Proportion, and Quality
- How does a scale model help you understand the size of the sun in comparison to other stars?

Patterns
- Do you notice any patterns in observations of the moon you recorded in your moon log?

Performance Outcomes

These are statements of how students use knowledge and are similar to the standards in how they blend DCI, SEP, and CCC, but at a smaller grain size. These are potential outcomes for instruction as it plays out in lessons and activities in the classroom. It is important to also think of these as smaller outcomes that build toward the larger goal of mastering the standards.

- **Construct an argument using evidence** that *shows the cause* of why the sun appears larger and brighter than other stars because it is the closest star to the Earth.
- **Analyze data** about stars *including distance, size, and brightness*.
- **Develop and use a** *scale* **model** that shows the rotation and revolution.
- **Analyze data from observations** to reveal *patterns in shadows* due to the position of the sun in each season.
- **Develop a model** to explain the orbit of the moon and how it *affects the moon phases.*
- **Plan and carry out investigations** to show that the revolution of the Earth around the sun *causes predictable seasonal changes in the position of stars in the night sky.*
- **Analyze and interpret data** to develop an understanding of *patterns* that as the seasons change, so do observable positions of the stars depending on the day, month, and year.
- **Plan and carry out an investigation** that the *effect* of gravity on the Earth always pulls an object down towards its center.