Astronomy (grades 5-8)
Classroom kit

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices (SEPs)

Asking questions

3-5: Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.

6-8: Ask questions:

- that arise from careful observation of phenomena, models, or unexpected results.
- to clarify and/or seek additional information.
- that can be investigated within the scope of the classroom.

Defining Problems

3-5: Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

6-8: Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Developing and using models

3-5: Develop a diagram or simple physical prototype to convey a proposed object, tool or process. Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system. Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

3-5/6-8: Develop and/or use models to describe and/or predict phenomena.
6-8: Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.

Planning and Carrying Out Investigations

3-5: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. Make predictions about what would happen if a variable changes. Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.

6-8: Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. Collect data about the performance of a proposed object, tool, process or system under a range of conditions.

Constructing explanations

3-5: Construct an explanation of observed relationships. Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation. Identify the evidence that supports particular points in an explanation.

6-8: Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments).

Designing Solutions

3-5: Use evidence (e.g., measurements, observations, patterns) 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 solution.

6-8: Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and retesting.

Using mathematics and computational thinking

3-5: Organize simple data sets to reveal patterns that suggest relationships. Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.

6-8: Apply mathematical concepts and/ or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.

Obtaining, evaluating, and communicating information

3-5: Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

6-8: Gather, read, synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.

Disciplinary Core Ideas (DCIs)

3-PS2.A: Forces and Motion

The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it.

5-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.

MS-ESS1.A: The Universe and Its Stars

Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.

MS-ESS1.B: Earth and the Solar System

The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.

MS-ESS1.C: The History of Planet Earth

The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.

MS-ETS1.C: Optimizing the Design Solution

Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3). The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)

Crosscutting Concepts (CCCs)

Patterns

3-5: Students identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.

6-8: Students identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.

Cause and effect

3-5: Students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

6-8: Students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or

designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Related Performance Expectations

3-PS2-2. **Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]

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.** [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.]

MS-ESS1-2. **Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.** [Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).] [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]

MS-ESS1-3. **Analyze and interpret data to determine scale properties of objects in the solar system.** [Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.]

MS-ETS1-4. **Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.**