8/13/18

6th Grade Unit 5 (~27 Days)

Our Universe

Performance Expectations included in Unit 5

6-MS-PS2-4: Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

6-MS-ESS1-1: Develop and use a model of the Earth-sun-moon system to describe the recurring patterns of lunar phases, eclipses of the sun and moon, and seasons.

6-MS-ESS1-2: Use a model to describe the role of gravity in the motions within galaxies and the solar system.

6-MS-ESS1-3: Analyze and interpret data to determine scale properties of objects in the solar system.

Unit 5 Anchor Phenomenon: Solar Eclipse

6-MS-PS2-4 (Motion and Stability: Forces and Interactions) Investigative Phenomenon: Cavendish Experiment

6-MS-PS2-4 (Motion and Stability: Forces and Interactions)

Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

Clarification Statement

Examples of evidence for arguments could include data generated from simulations or digital tools and charts displaying mass, strength of interaction, distance from the Sun, or orbital periods of objects within the solar system, not necessarily including Newton's Law of Gravitation or Kepler's Laws.

Science and Engineering Practice

Engaging in argument from evidence:
Engaging in argument from evidence in 6-8 builds from K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds(s).

* Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Disciplinary Core Idea

TYPES OF INTERACTIONS
Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass (e.g., Earth and the sun.) (MS.PS2B.b)

Concepts

Gravitational interactions are always attractive and depend on the masses of interacting objects.

There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass.

Evidence supporting the claim that gravitational interactions are attractive and depend on the masses of interacting objects could include data generated from simulations or digital tools and charts displaying mass, strength of interaction, distance from the sun, and orbital periods of objects within the solar system.

Objects with mass are sources of gravitational fields and are affected by the gravitational fields of all other objects with mass.

Gravity is a force that acts between masses over very large distances.

The force of gravity is always attractive.

The force of gravity is always present.

The strength of the force of gravity between objects depends on the objects' masses.

An object with a large mass (e.g., Earth) will cause a larger force of gravity between objects when compared to an object with a small mass.

Ways to check for understanding

Students construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

Students use models to represent the gravitational interactions between two masses.

Additional Teacher Resources

Crosscutting Concepts	PS2A - Forces and Motion PS2B - Types of Interactions PS2C - Stability and Instability in Physical Systems
SYSTEMS AND SYSTEM MODELS Models can be used to represent systems and their interactions- such as inputs, processes, and outputs- and energy, matter, and information flows within systems. *Students should be able to: Move beyond simple renderings or maps and begin to incorporate and make explicit the invisible features of a system, such as interactions, energy flows, or matter transfers. Mathematical ideas, such as ratios and simple graphs, should be seen as tools for making more definitive models; eventually, students' models should incorporate a range of mathematical relationships among variables and some analysis of the patterns of those relationships.*	**MS-PS2-4 NGSS Evidence Statement**

Sample Guiding Questions
What is gravity?
What evidence is therefore gravitational attraction?
What evidence suggests that gravity varies depending on the masses of objects?
What factors determine the strength of interaction of gravitational forces?
What is mass?
How does gravity factor into the orbital periods of objects within the solar system?
How does gravity vary depending on an object's distance from the sun?
Using a chart displaying the mass of those objects and the strength of interaction, compare the magnitude of gravitational force on interacting objects of different mass (e.g., the Earth and the sun)

Key Vocabulary
Force, Fields, Magnetism, Charge, Gravity, Electricity, Electron, Distance, Gravitational interactions, Gravitational force, Object's, Mass, Attraction, Systems

Sample Activities
PhET: Exploring Gravity
Your Weight on Other Worlds
Gravity, It's Greeaaaattttttt!
Mass Vs. Weight: Travel to Other Planets

Sample 5E Lesson Plan
6-MS-PS2-4 Sample Lesson Plan

6-MS-ESS1-1 (Earth's Place in the Universe) Investigative Phenomenon: Moon Phases

6-MS-ESS1-1 (Earth's Place in the Universe)
Develop and use a model of the Earth-sun-moon system to describe the recurring patterns of lunar phases, eclipses of the sun and moon, and seasons.

Clarification Statement
Earth's rotation relative to the positions of the moon and sun describes the occurrence of tides; the revolution of Earth around the sun explains the annual cycle of the apparent movement of the constellations in the night sky; the moon's revolution around Earth explains the cycle of spring/neap tides and the occurrence of eclipses; the moon's elliptical orbit mostly explains the occurrence of total and annular eclipses. Examples of models can be physical, graphical, or conceptual.

Science and Engineering Practice	Disciplinary Core Idea
Developing and using models: Modeling in 6–8 builds on K–5	**THE UNIVERSE AND ITS STARS** Patterns of the apparent motion of the sun, the moon,

Concepts
The moon's orbital plane is tilted with respect to the plane of the Earth's orbit around the sun
Earth-moon system orbits the sun once an Earth year
The Earth's rotation axis is tilted with respect to its orbital plane around the sun. Earth maintains the same relative orientation in space, with its North Pole pointed toward the North Star throughout its orbit.
Models can be used to explain the relationship and motion of the sun, the moon, and the stars.
The moon rotates on its axis approximately once a month.
The moon orbits Earth approximately once a month.
The moon rotates on its axis at the same rate at which it orbits Earth so that the side of the moon that faces Earth remains the same as it orbits.
Earth rotates on its tilted axis once an Earth day.

experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena	and stars in the sky can be observed, described, predicted, and explained with models. (MS.ESS1A.a) **EARTH AND THE SOLAR SYSTEM** This model of the solar system can explain eclipses of the Sun and the Moon. Earth's spin axis is fixed in direction over the short term but tilted relative to its orbit around the Sun. The seasons are a result of that tilt and are caused by the differential intensity of Sunlight on different areas of Earth across the year. (MS.ESS1B.b)	The moon orbits Earth approximately once a month. Earth-moon system orbits the sun once an Earth year. The Earth's rotation axis is tilted with respect to its orbital plane around the sun. Earth maintains the same relative orientation in space, with its North Pole pointed toward the North Star throughout its orbit. Models can be used to explain the relationship and motion of the sun, the moon, and the stars. Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed. Patterns of the apparent motion of the sun, the moon, and stars in the sky can be described. Patterns of the apparent motion of the sun, the moon, and stars in the sky can be predicted. Patterns of the apparent motion of the sun, the moon, and stars in the sky can be explained with models. Models of the solar system can be used to explain eclipses of the sun and the moon. In the shadow of the moon that falls on Earth during a total solar eclipse, sunlight is prevented from reaching that part of Earth because the moon is located between the sun and Earth. Earth's axis is tilted relative to its orbit around the sun. As the Earth orbits around the sun, the angle at which the sun's rays strike Earth's surface changes due to the position of Earth's tilted axis relative to the sun. Different seasons are caused by the intensity of sunlight on the Earth at different times of the year. Summer occurs in the Northern Hemisphere at times in the Earth's orbit when the northern axis of Earth is tilted toward the sun. Winter occurs in the Northern Hemisphere at times in the Earth's orbit when the northern axis of Earth is tilted away from the sun.
Crosscutting Concepts		
PATTERNS Patterns can be used to identify cause and effect relationships. *Students should be able to: Develop ways to recognize, classify, and record patterns in the phenomena they observe, and by middle school, students can begin to relate patterns to the nature of microscopic and atomic-level structure—for example, they may note that chemical molecules contain particular ratios of different atoms.*		
Sample Guiding Questions		
What is a lunar eclipse? What causes seasons? What is a gibbous moon? What is a crescent moon? What is a waxing moon? What is a waning moon? Use an Earth-sun-moon model to show that the Earth-moon system orbits the sun once an Earth year and the orbit of the moon around Earth corresponds to a month. Use an Earth-sun-moon model to explain eclipses of the sun and the moon. Use an Earth-sun-moon model to explain how variations in the amount of the sun's energy hitting Earth's surface results in seasons.		
Key Vocabulary		
lunar phases, axis, rotation, revolution, orbit, tilt, Sun-Earth-Moon System, seasons, eclipse, lunar eclipse, solar eclipse, Earth (including tilt of its axis of rotation), sun, moon, seasons, patterns		
Sample 5E Lesson Plan		**Ways to check for understanding**
6-MS-ESS1-1 Sample Lesson Plan		Students will develop and use a physical, graphical, or conceptual model to describe patterns in the apparent motion of the sun, moon, and stars in the sky
		Additional Teacher Resources
		ESS1A - The Universe and its Stars ESS1B - Earth and the Solar System ESS1C - The History of the Earth

MS-ESS1-1 NGSS Evidence Statement

Sample Activities

NASA Eclipse Website
Lunar Phases
Eclipse Interactive
Seasons Interactive
Better Lesson: Phases of the Moon
Moon Phases Investigation
Moon Phases
Seasons Interactive
Eclipse Interactive

6-MS-ESS1-2 (Earth's Place in the Universe) Investigative Phenomenon: Gravity Well

6-MS-ESS1-2 (Earth's Place in the Universe)

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 their school or state).

Science and Engineering Practice	Disciplinary Core Idea
Developing and using models: Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or use a model to predict and/or describe phenomena.	**THE UNIVERSE AND ITS STARS** Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS.ESS1A.b) **EARTH AND THE SOLAR SYSTEM** The solar system consists of the sun and a collection of objects, including planets, their natural satellite(s) (moons), and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS.ESS1B.a) The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS.ESS1B.c)

Crosscutting Concepts

SYSTEMS AND MODELS
Models (e.g., physical, mathematical, computer models) can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.

Concepts

Objects in the solar system have scale properties.
Data from Earth-based instruments, space-based telescopes, and spacecraft can be used to determine similarities and differences among solar system objects.
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.
Time, space, and energy phenomena in the solar system can be observed at various scales, using models to study systems that are too large.
Engineering advances have led to important discoveries in space science, and scientific discoveries have led to the development of entire industries and engineered systems.
Earth is a part of the solar system.
The solar system is part of the Milky Way galaxy.
The Milky Way galaxy is one of many galaxies in the universe.
There are many other galaxies in the universe, each containing many other stars.
The solar system contains the sun, planets, moons, and asteroids.
The solar system is held together by the sun's gravitational force.
The sun's gravity keeps all planets in a predictable orbit around it.
The gravitational forces from the center of the Milky Way cause stars and stellar systems to orbit around the center of the galaxy. The solar system formed from dust and gas.
The components of the solar system are drawn together by gravity.
The result was the formation of moon-planet and planet-sun orbiting systems

flows within systems.

Students should be able to:
Analyze and model more complex systems and to use a broader variety of representations to explicate what they model.

Think about systems in terms of component parts and their interactions, as well as in terms of inputs, outputs, and processes.

Generate questions that can lead to enhanced understanding, to test aspects of their model of the system, and, eventually, to refine their model.

Incorporate and make explicit the invisible features of a system, such as interactions, energy flows, or matter transfers.

Incorporate a range of mathematical relationships among variables (at a level appropriate for grade-level mathematics) and some analysis of the patterns of those relationships.

Sample Guiding Questions

What is gravity?
How to gravity influence objects objects to orbit larger objects?
Differentiate between the different types of galaxies according to shape.
Use a model to identify the solar system as one of many systems orbiting the center of the larger system of the Milky Way galaxy, which is one of many galaxy systems in the universe.
Use a model to describe the relationships and interactions between components of the solar system as a collection of many varied objects held together by gravity.

Key Vocabulary

Milky Way Galaxy, universe, natural satellites, gravitational force, solar system (including sun, planets, moons, and asteroids), orbit motions, systems

Ways to check for understanding

Analyze and interpret data to determine similarities and differences among objects in the solar system.

Additional Teacher Resources

ESS1A - The Universe and its Stars
ESS1B - Earth and the Solar System
ESS1C - The History of the Earth

MS-ESS1-2 NGSS Evidence Statement

Sample Activities

Better Lesson: Gravity
Better Lesson: Why doesn't Earth float off into space?
The Great Gravity Escape
My Solar System
Gravity and Orbits
The Pull of the Planets
Gravity Well

Sample 5E Lesson Plan

6-MS-ESS1-2 Sample Lesson Plan

6-MS-ESS1-3 Investigative Phenomenon: Earth compared to solar system

6-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), atmospheric composition, surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.

Science and Engineering Practice	Disciplinary Core Idea
Analyzing and interpreting data: Analyzing data in 6-8 builds on K-5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation.	**EARTH AND THE SOLAR SYSTEM** The solar system consists of the sun and a collection of objects, including planets, their natural satellite(s) (moons), comets, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS. ESS1B.a)

Concepts

Gravity plays a role in the motions within galaxies and the solar system.

Gravity is the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them.

Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.

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.

The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.

Models can be used to represent the role of gravity in the motions and interactions within galaxies and the solar system.

between correlation and causation, and basic statistical techniques of data and error analysis.

• Analyze and interpret data to determine similarities and differences in findings.

ESS1B.a)

Science assumes that objects and events in the solar systems occur in consistent patterns that are understandable through measurement and observation.

The solar system contains the sun, planets, moons, and asteroids.

The solar system is held together by the sun's gravitational force.

The sun's gravity keeps all planets in a predictable orbit around it.

The gravitational forces from the center of the Milky Way cause stars and stellar systems to orbit around the center of the galaxy.

Ways to check for understanding

Students develop and use models to explain the relationship between the tilt of Earth's axis and seasons.

Crosscutting Concepts

SCALE, PROPORTION, AND QUANTITY
Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Students should be able to: Use estimation to help them not only develop a sense of the size and time scales relevant to various objects, systems, and processes but also to consider whether a numerical result sounds reasonable. They should be able to move back and forth between models at various scales, and develop a sense of the powers-of-10 scales and what phenomena correspond to what scale. Students will explore and interpret different graphs to represent data collected, for example, that a plant gets bigger as time passes or that the hours of daylight decrease and increase across the months. They should be able examine their scientific data to predict the effect of a change in one variable on another, and recognize and apply more complex mathematical and statistical relationships in science

Additional Teacher Resources

ESS1A - The Universe and its Stars
ESS1B - Earth and the Solar System
ESS1C - The History of the Earth

MS-ESS1-3 NGSS Evidence Statement

Sample Activities

Better Lesson: Planetary distances using toilet paper
Solar System: Size and Scale
Scale Model of the Solar System
Solar System Model Inputs
Toilet Paper Solar System
Scale models with playdough

Guiding Questions

How do you find a relative distance between planets in class?

Use data (e.g., statistical information, drawings and photographs, and models) to determine similarities and differences among solar system objects.

Sample 5E Lesson Plan

6-MS-ESS1-3 Sample Lesson Plan

Key Vocabulary

scale, solar system, gravitational pull, orbital radius, telescope, natural satellite, comet, asteroid, crust, Sun, Objects (planets, moons, asteroids) scale proportions (Distance from sun, diameter, surface features (e.g. volcanoes) structure, composition (e.g. ice versus rock versus gas), Instruments (Earth based and space based),