Unit 3: Astronomy

Content Area: **Science**
Course(s): **Science**
Time Period: **Marking Period 2**
Length: **8-10 Weeks**
Status: **Published**

Unit Overview

This unit helps students formulate answers to the questions: "What is Earth's place in the Universe?" and "What makes up our solar system and how can the motion of Earth explain seasons and eclipses?" Students examine Earth's place in relation to the solar system, Milky Way galaxy, and universe. There is a strong emphasis on a systems approach, using models of the solar system to explain astronomical and other observations of the cyclical patterns of eclipses, tides, and seasons. In addition, there is a strong connection to engineering through the instruments and technologies that have allowed us to explore the objects in our solar system and obtain data that support theories that explain the formation and evolution of the universe.

Performance Expectations

MS-ESS1-1	Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
MS-ESS1-2	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
MS-ESS1-3	Analyze and interpret data to determine scale properties of objects in the solar system.
MS-PS2-1	Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.
MS-PS2-2	Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.
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.

Three Dimensions

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.

- Plan an investigation individually and collaboratively and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS2-2)

Developing and Using Model

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 use a model to describe phenomena. (MS-ESS1-1), (MS-ESS1-2)

Analyzing and Interpreting Data

Analyzing data in 6-8 builds on K-5 experiences and progesses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similarities and differences in findings. (MS-ESS1-3)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific ideas or principles to design an object, tool, process, or system. (MS-PS2-1)

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 world(s).

- Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for phenomenon or a solution to a problem. (MS-PS2-4)

Connections to Nature of Science

Scientific Knowledge Is Based on Empirical Evidence

- Scientific knowledge is based on logical and conceptual connections between evidence and explanations. (MS-PS2-4)

Disciplinary Core Ideas

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-ESS1-1)
- Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2)

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-ESS1-2), (MS-ESS1-3)
- 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-ESS1-1)
- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2)

PS2.A: Forces and Motion

- The motion of an ojbect is determined by the sun of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a alrger change in motion. (MS-PS2-2)
- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitarily chosen units of size. In order to share information with other people, these choices must also be shared. (MS-PS2-2)

PS2.B: Types of Interactions

- Gravitational forces are always attractive. There is a gravitationl 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-PS2-4)

Crosscutting Concepts

Patterns

- Patterns can be used to identify cause and effect relationships. (MS-ESS1-1)

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. (MS-ESS1-3)

Systems and System Models

- Models can be used to represent systems and their interactions. (MS-ESS1-2), (MS-PS2-4)

Stability and Change

- Explanations of stability and change in natural or designed systems can be constructed by examing the changes over time and forces at different scales. (MS-PS2-2)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and enginnered systems. (MS-ESS1-3)

Knowledge, Skills, and Assessment

Essential Insights and Understandings/Guiding Questions	Critical Knowledge and Skills	Recomm
How do Earth, the moon, and the sun interact?	On a clear night, you may see stars, the moon, planets, meteors, and comets. A constellation is a pattern or grouping of stars imagined by people to represent figures. The apparent motion of objects in the sky depends on the motions of Earth. **Skill: SWBAT...** • **Identify objects and constellations visible without a telescope in the night sky.** • **Describe the apparent motions of stars and planets throughout the year.**	**Activity**: PhET C Interactive Simul gravitational forc adjust the propert properties affects **Activity:** Reason will observe how amount of solar e Earth.
	Earth moves in space in two major ways: rotation and revolution. Earth has seasons because its axis is tilted as it revolves around the sun.	**Activity:** BBC S *the Moon?* - Stud *Moon?* to unders focusing on tides seasons, and the

Skill: SWBAT...

the documentary, writing explainin

- **Demonstrate how Earth moves in space.**
- **Explain what causes the cycle of seasons on Earth.**

The strength of the force of gravity between two objects depends on two factors: the masses of the objects and the distance between them. Newton concluded that inertia and gravity combine to keep Earth in orbit around the sun and the moon in orbit around Earth.

Skill: SWBAT...

- **Identify what determines the strength of the force of gravity between two objects.**
- **Describe two factors that keep the moon and Earth in orbit.**

The changing relative positions of the moon, Earth, and sun cause the phases of the moon. A solar eclipse occurs when the moon passes directly between Earth and the sun, blocking sunlight from Earth. During a lunar eclipse, Earth blocks sunlight from reaching the moon.

Skill: SWBAT . . .

- **Explain what causes the phases of the moon.**
- **Describe solar and lunar eclipses.**

Tides are caused by differences in how much gravity from the moon and the sun pulls on different parts of Earth. Changes in the positions of Earth, the moon, and the sun affect the heights of the tides during a month.

Skill: SWBAT...

- **Explain what causes tides.**

The moon is dry and airless and has an irregular surface. Compared to Earth, the moon is small and has large variations in its surface temperature.

Skill: SWBAT...

- **Describe the features and characteristics of the moon.**

How does exploring space benefit people on Earth?

The space race was the rivalry between the United States and the Soviet Union to explore space, including the Apollo missions. NASA has used space shuttles to take satellites into orbit, repair damaged satellites, and carry astronauts to and from space stations. A space station provides a place for experiments in space. Space probes collect data about the solar system.

Skill: SWBAT...

- **Track the history of human spaceflight, including the space race and highlight factors that caused changes in the NASA program.**
- **Describe the modern and future plans for crewed space exploration.**
- **Summarize past and future uses of space probes in space exploration.**

Conditions in space that differ from those on Earth include near vacuum, extreme temperatures, and microgravity. The space program has led to the development of many thousands of products, among them consumer products, new materials, medical devices, and communications satellites. Satellites are used for communications and for collecting weather data and other scientific data.

Skill: SWBAT...

- **Describe conditions in space, including near vacuum, extreme temperatures, and microgravity.**
- **Identify the benefits that space technology has provided for modern society.**
- **Describe some uses of satellites orbiting Earth.**

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Activity: Upper l Earth, gravity trie feet. Without the movement, huma black-out. In Eart gravity are dimin continues at the s fluid shift that cre a thinning of the students will perf as fluid shift.

Assessment: Spa the course of its c mission needs, N innovative techno uses outside of th surprising us by e daily lives. In this understanding tha today are a produ learn which popu well as, match N/ of the product.

Why are objects in the Solar System different from each other?

In a geocentric model, Earth is at the center. Copernicus worked out the arrangement of the known planets and how they orbit the sun. Kepler found that planets' orbits are ellipses and how they orbit the sun. Evidence from Galileo Galilei convinced others that the heliocentric model was correct.

Skill: SWBAT...

- **Describe the geocentric model of the solar system.**
- **Create a model of the geocentric and heleocentric theories.**
- **Recognize how scientists such as Copernicus, Kepler, and Galileo contributed to the acceptance of the heliocentric model of the solar system.**

Our solar system consists of the sun, the planets, their moons, and smaller objects. The solar system formed about 4.6 billion years ago from a cloud of hydrogen, helium, rock, ice, and other materials pulled together by gravity.

Skill: SWBAT...

- **Identify the objects that make up the solar system.**
- **Explain how the solar system formed.**

The inner planets are small and dense and have rocky surfaces. Mercury is the smallest terrestrial planet and the planet closest to the sun. Venus has a thick atmosphere and the hottest surface of any planet. Earth has a suitable temperature range and atmosphere for living things to survive. Mars has ice and may have had liquid water in the past.

Skill: SWBAT...

- **Describe the characteristics that the inner planets have in common.**
- **Identify the main characteristics that distinguish each of the inner planets.**

The outer planets are much larger than Earth and do not have solid surfaces. Jupiter is the largest and most massive planet.

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	Saturn has the most spectacular rings of any planet. Uranus's axis of rotation is tilted at an angle of about 90 degrees from the vertical. Neptune is a cold, blue planet with visible clouds. **Skill: SWBAT...** • **Describe characteristics that the gas giants have in common.** • **Identify characteristics that distinguish each outer planet.**	
	Scientists classify small objects based on their sizes, shapes, compositions, and orbits. The major categories include dwarf planets, comets, asteroids, and meteoroids. **Skill: SWBAT...** • **Explain how scientists classify small bodies in the solar system.**	
How do astronauts learn about distant objects in the universe?	Astronomers often use parallax to measure distances to nearby stars. Since the numbers astronomers use are often very large or very small, they frequently use scientific notation to describe sizes and distances in the universe. They use a unit called the light-year to measure distances between the stars. **Skill: SWBAT...** • **Describe how astronomers measure distances to the stars.** • **Explain how astronomers describe the scale of the universe.**	**Activity**: The Sca very big. But just scheme can be qu distances and size experience. This difficulty by exar through an online down to 10^{-35} all **Assessment:** Sci Students will be a numbers using sc be able to unders writing.
	The Big Bang Theory provides information about the formation of the universe, describing how gravity brought together dust and gas. **Skill: SWBAT...**	**Assessment:** Big create a children's The book will be appropriate scien

• **Describe what the big bang theory says about the universe.**	addressed include of energy, the cre the creation of ou system.

Suggested Resources

ck12.org

Star Constellations

- http://www.ck12.org/earth-science/Star-Constellations/

Rotation of Earth

- http://www.ck12.org/earth-science/Rotation-of-Earth/

Revolutions of Earth

- http://www.ck12.org/earth-science/Revolutions-of-Earth/

Seasons

- http://www.ck12.org/earth-science/Seasons/

Mass vs. Weight

- http://www.ck12.org/physics/Mass-vs-Weight/

Gravity

- http://www.ck12.org/physics/Gravity/

Inertia

- http://www.ck12.org/physical-science/Inertia-in-Physical-Science/

Lunar Phases

- http://www.ck12.org/earth-science/Lunar-Phases/

Solar Eclipses

- http://www.ck12.org/earth-science/Solar-Eclipses/

Lunar Eclipses

- http://www.ck12.org/earth-science/Lunar-Eclipses/

Tides

- http://www.ck12.org/earth-science/Tides/

Moon

- http://www.ck12.org/earth-science/Moon/

Satellites, Shuttles, and Space Stations

- http://www.ck12.org/earth-science/Satellites-Shuttles-and-Space-Stations/

Inner Planets

- http://www.ck12.org/section/Lesson-25.2%3A-Inner-Planets-%3A%3Aof%3A%3A-MS-TE-The-Solar-System-%3A%3Aof%3A%3A-CK-12-Earth-Science-For-Middle-School-Teachers-Edition/

Outer Planets

- http://www.ck12.org/section/Outer-Planets-%3A%3Aof%3A%3A-MS-The-Solar-System-%3A%3Aof%3A%3A-CK-12-Earth-Science-For-Middle-School/

Dwarf Planets

- http://www.ck12.org/earth-science/Dwarf-Planets/

Scientific Notation

- http://www.ck12.org/algebra/Scientific-Notation/

Universe

- http://www.ck12.org/earth-science/Universe/

Big Bang

- http://www.ck12.org/earth-science/Big-Bang/

Technology Integration

ck12 Flexbook

Chromebooks

iPads

Cellular Devices

Internet

SmartBoard

Differentiation

Differentiation for special education:

- General modifications may include:
  - Modifications & accommodations as listed in the student's IEP
  - Assign a peer to help keep student on task
  - Modified or reduced assignments
  - Reduce length of assignment for different mode of delivery
  - Increase one-to-one time
  - Working contract between you and student at risk
  - Prioritize tasks
  - Think in concrete terms and provide hands-on-tasks
  - Position student near helping peer or have quick access to teacher
  - Anticipate where needs will be
  - Break tests down in smaller increments
- Content specific modifications may include:
  - address misconceptions relating to astronomy
  - pre-generated graphs
  - mathematical formulas provided
  - teach with visuals
  - scale models
  - lab demonstrations

Differentiation for ELL's:

- General modifications may include:
  - Strategy groups
  - Teacher conferences
  - Graphic organizers
  - Modification plan
  - Collaboration with ELL Teacher
- Content specific vocabulary important for ELL students to understand include: satellite, planet, meteor, comet, star, constellation, axis, rotation, revolution, orbit, calendar, solstice, equinox, force, gravity, law of universal gravitation, mass weight, inertia, Newton's first law of motion, phase, eclipse, solar eclipse, umbra, penumbra, lunar eclipse, tide, spring tide, neap tide, maria, crater, meteoroid, space shuttle, space station, space probe, rover, vacuum, microgravity, space spinoff, remote sensing, geostationary orbit, geocentric, heliocentric, ellipse, solar system, astronomical unit (AU), planet, dwarf planet, planetesimal, terrestrial planet, greenhouse effect, gas giant, ring, asteroid belt, Kuiper belt, Oort cloud, comet, coma, nucleus, asteroid, meteoroid, meteor, meteorite, parallax, universe, light-year, scientific notation, big bang, Hubble's law, cosmic background radiation, dark matter, dark energy

Differentiation to extend learning for gifted students may include:

- **How People Use Constellations** Identify and research one way in which people have used constellations.
- **Make an Illustration** Create an illustration that explains apparent motion.
- **Calculate Earth's Movements** Earth moves at a speed of about 30 km/sec as it travels around the sun. Students will calculate the following: How many kilometers does Earth travel in a minute? An hour? A day? A year?
- **Information Literacy** Research more about Earth's analemma.
- **Write and Model** Students will choose a place on the globe that they are not familiar with and write a description of the amount of sunlight received there throughout the year.
- **Design and Investigation** Design an investigation to demonstrate inertia using simple materials.
- **Identifying How Full Moons Were Named** Before artificial lighting, the phases of the moon were important in planning activities. Students will research the names of the different full moons.
- **Track the Tides** Using the Internet, track the height of high and low tides at a location of their choice for at least two weeks.
- **Aitken Basin** Research, interpret, and explain the features of a topographical map of the far side of the Aitken Basin.
- **Columbia** Research and report on the debate that occurred after the *Columbia* disaster in 2003, about whether to continue the space shuttle program.
- **Space Probe Missions** Research either the *Lunar Prospector, Cassini,* Mars Exploration Rover (*Opportunity* and *Spirit*), and *New Horizons* probes.
- **Write a News Report** Write a brief news story that includes details on a new space probe's mission and how it works. What planet will it explore? What questions will it try to answer?
- **Design and Experiment** Think of and write about a way scientists can use satellites to determine whether a rain forest is becoming smaller over time.
- **Speeding Around the Sun** Design an experiment to determine how a planet's distance from the sun affects its period of revolution.
- **Research Solar System Formation** Research the hypothesis that some scientists think energy from a nearby supernova started the collapse of the gas cloud that formed the solar system.
- **Create a Diagram** Use a computer graphics program to create and label a scale diagram showing Earth's layers.
- **Musical Planets** Students will listen to one of the seven pieces from Gustav Holst's *The Planets* and write a paragraph describing how he used the music to represent the planet.
- **Photo Research** Find images that show Jupiter's moon, their relative sizes, and at least one distinguishing characteristic of each.
- **Create Fact Sheets** Create two fact sheets about Saturn and its moons. The first should include facts known about the planet and its moons before the *Huygens* and *Cassini* probes. The second should include facts learned since those missions.
- **Research Planet Names** Research the origin of the name of Jupiter, Saturn, Uranus, or Neptune.
- **Research Ceres** Research and write about Ceres.
- **How Can we Tell Stars and Galaxies Are Moving?** Investigate red shifts and blue shifts in light, including spectral analysis of stars.

21st Century Skills

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP9	Model integrity, ethical leadership and effective management.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.