ASTRONOMY

UNIT 1: The Night Sky

ESSENTIAL QUESTION	BIG IDEAS
What are the patterns in the sky?	• Students understand seasons and phases of the Earth and Moon. • Students use a model to locate objects on a celestial sphere. • Students understand the significance of planetary position in our solar system. • Students understand the origin of objects in our solar system • Students can apply Newton's Universal Law of Gravity and Kepler's three laws of planetary motion to predict motion of celestial objects.

GUIDING QUESTIONS

Content: HS-ESS1-4

- What are the predictable patterns caused by Earth's movement in the solar system?
- How do astronomers use the celestial sphere to map the night sky?
- What are the characteristics and properties of the solar system?
- What is the evidence supporting solar system formation?
- How does Newton and Kepler's laws explain celestial motion?

Process:

- How are proportions used to determine the distance to near-by stars?
- How are seasonal patterns demonstrated using an elliptical model of Earth's orbit?
- How do you compare the planet distances and diameters using a scale model?

Reflective

- What is the significance of early astronomers creating the heliocentric model?
- Why are the terrestrial planets different from the Jovian planets?

FOCUS STANDARDS

HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

Science & Engineering Practice(s):

Using Mathematical and Computational Thinking: Use mathematical or computational representations of phenomena to describe explanations.

Disciplinary Core Idea(s):

ESS1.B: Earth and the Solar System: Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with other objects in the solar system.

Crosscutting Concept(s):

Scale, Proportion, and Quantity: Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

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UNIT 2: Tools of Astronomy

ESSENTIAL QUESTION	BIG IDEAS
What tools do Astronomers use to observe the night sky?	• Students understand how electromagnetic radiation is used to observe objects in space. • Students can use a spectroscope and a telescope to interpret the composition of a star. • Students can differentiate the importance of ground based and space based telescopes.

GUIDING QUESTIONS

Content **ESS1.A**

- What is the nature of light?
- How do astronomers use spectroscopy and telescopes to study light?
- What does research tell us about the use of ground based and space based telescopes?

Process

- How do electromagnetic wavelengths compare?
- How do spectroscopes work?
- What wavelengths are detectable is ground based and space based telescopes and what are they used to observe?

Reflective

- What technology is available for us to study space?

FOCUS STANDARDS

Disciplinary Core Idea(s):
ESS1.A: The Universe and Its Stars: The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.
Science & Engineering Practice(s):
Obtaining, Evaluating, and Communicating Information: Communicate scientific ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
PS4.B: Electromagnetic Radiation: Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities.

ASTRONOMY

UNIT 3: Stellar Evolution

ESSENTIAL	BIG IDEAS

QUESTION

What are the characteristics of stars?

- Students understand the process of nuclear fusion.
- Students describe the features of our Sun.
- Students classify stars.
- Students investigate the process of stellar evolution.

GUIDING QUESTIONS

Content **ESS1.A**:

- What is the process of nuclear fusion?
- What is the cycle of solar activity for our sun?
- How are stars classified?
- How does mass affect the life cycle of a star?

Process

- How are stars plotted using the HR diagram?
- How is an HR diagram used to analyze stellar evolution?
- How does nucleosynthesis occur with high mass stars?

Reflective

- How does space weather affect humans?
- What is the future of the Sun and how does it impact Earth?

FOCUS STANDARDS

HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of Radiation.

Science & Engineering Practice(s):

Developing and Using Models: Develop a model based on evidence to illustrate the relationships between systems or between components of a system.

Disciplinary Core Idea(s):

PS3.D: Energy in Chemical Processes and Everyday Life: Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation.

Crosscutting Concept(s):

Scale, Proportion, and Quantity: The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.

Disciplinary Core Idea(s):

ESS1.A: The Universe and Its Stars: Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including certain massive stars achieve a supernova stage and explode.

Crosscutting Concept(s):

Energy and Matter: In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

ASTRONOMY

UNIT 4: Understanding the Universe

ESSENTIAL QUESTION	BIG IDEAS

What processes are involved in the formation of local and distant galaxies?	• Students understand the characteristics of the Milky Way. • Students can classify galaxies. • Students can provide evidence to support the Big Bang.

GUIDING QUESTIONS

Content **ESS1.A:**

- What type of galaxy do we live in?
- What are the sequence of events that occur for galaxy formation?
- How are galaxies classified?
- How do we determine the age of a galaxy?

Process

- How is the Hubble Tuning Fork model used for galaxy evolution and classification?
- How can real-time internet tools help students identify galaxies?

Reflective

- How was the Big Bang Theory formulated?
- What is the future of our Universe?

FOCUS STANDARDS

HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
Science & Engineering Practice(s):

- **Constructing Explanations and Designing Solutions:** Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories a laws that describe the natural world operate today as they did in the past and will continue tc so in the future

Disciplinary Core Idea(s):

- **ESS1.A:** The Universe and Its Stars: The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.