

Astronomy SEEd Standards Draft

Introduction

The Astronomy High School Elective SEEd Standards explore the patterns, forces, relationships, and systems of matter and energy found in the Universe. Students develop models and investigate patterns observed on Earth and in the night sky of phenomena that affect life on Earth. Students ask questions and model objects in our solar system and design solutions to determine where and how humans could colonize off of our planet some day. Students build models and construct arguments for the life and death of stars predicting the final stage of stars based on their mass. Students develop models and explain the formation and characteristics of the Universe.

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ASTR.1: Patterns observed on Earth and in the Night Sky affect life on Earth and space exploration

The study of astronomy started as curious people observed and tried to explain phenomena observed on Earth by looking up at the sky. Models help to investigate and explain these phenomena using evidence for our current understanding. Space Exploration helps us better understand our planet and cause leaps in technology, culture, knowledge, and inspiration.

- 1.1 **Develop and use models** to evaluate the relationship between the relative positions of the Earth, Sun, and Moon and the phenomena caused by the relationship as observed from Earth. Emphasize how the location of the Earth, Sun, and Moon cause the phenomena. Examples of observable phenomena may include day/night, season, equinox, and solstice, moon phase, eclipse, or tides.
- 1.2 **Plan and carry out an investigation** using the celestial sphere to explain how latitude and time of year affect the visibility of constellations, planets, and other celestial objects.
- 1.3 **Obtain, evaluate, and communicate information** about how patterns in ancient structures, instruments, philosophies, and civilizations influenced the study of astronomy. Examples of philosophies could include astronomical models (e.g. geocentric, heliocentric), Aristotelian physics, or Ptolemaic models with epicycles.
- 1.4 **Plan and carry out an investigation** to analyze patterns in telescopic data of various electromagnetic spectra to explain astronomical phenomena. Emphasize evaluating the uses and advantages of data to explain phenomena.
- 1.5 **Construct an argument based on evidence** for the significance of historical and future space exploration as they relate to affecting leaps in technology, cultural cooperation, knowledge, and inspiration. Emphasize that historical space exploration begins with Sputnik and continues to the present day.

ASTR.2: Structures in the Solar System and their formation

Earth is one part of a larger solar system and other objects in the solar system can be compared based on their classification. The objects and motion in the solar system provide evidence for the formation of the solar system. The solar system shares common forces, energy, and matter that can explain its characteristics and motion. Advances in technology make space travel and colonization possible if risks and constraints can be evaluated and overcome.

- 2.1 **Ask questions to investigate and communicate** the structure and properties of objects in our solar system and the zones they inhabit. Emphasize grouping the objects found in the solar system into different categories based on their major properties. Examples of objects in the solar system could include planets, dwarf planets, major moons, asteroid belt, comets, Kuiper belt, and the Oort cloud.
- 2.2 **Develop and use models**, based on evidence, to explain the formation of the solar system leading to differing proportions of matter and energy within varying areas of the system. Emphasize the cause of observed patterns of matter distribution in the solar system. Examples of matter distribution could include low amounts of ices found inside the frost line or the location of gas planets.
- 2.3 **Use computational thinking** to model gravitational force at varying scale and proportion that explain motion and interaction of objects in the solar system. Emphasize that these forces are also at play throughout the universe.
- 2.4 **Design a solution** (plan) for a functioning human colony on an object in the solar system other than Earth. *Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data to make improvements from iteratively testing solutions, and optimize the solution.* Emphasize analyzing which planet/world(moons of jovian planets) of the solar system would have the best chance for a successful colony based on specific criteria. Examples of specific criteria could include distance from earth, available energy sources, amounts of water or solvent, protection from solar radiation, or amount of resources/building materials.

ASTR.3: Stability and Change in the Life of Stars

Stars are born and die over a period of time in a process called stellar evolution. During a star's existence they may change in elemental composition, density, luminosity, temperature, and other ways. These changes can both be recognized and predicted.

- 3.1 **Develop and use models** to explain stability and change during the process of stellar evolution from birth to death of a star. Emphasize the causes for the changes during stellar evolution and the evidence that supports current understanding.
- 3.2 **Construct an argument based on evidence** from the Hertzsprung-Russell diagram to investigate properties (structure) of stars. Examples of properties of stars could include density, luminosity, temperature, rates of fusion, or spectral class.
- 3.3 **Ask questions** to evaluate evidence that predicts the stability and change of a star during its lifespan and its final stage of stellar evolution based on mass. Emphasize stellar remnants and events such as neutron stars, pulsars, black holes, and supernovae.

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ASTR.4: Matter and Energy in Galaxies and the Universe

All matter and energy in the universe originates from a single event called the Big Bang. Since that time, matter in the form of different elements were formed through the birth and death of stars. Dark matter and energy exist in the universe and affect its evolution. Galaxies also form and change through galactic evolution.

- 4.1 **Construct an argument from evidence** to explain the patterns that describe the formation of the universe. Emphasize the scientific theory of the Big Bang and evidence that supports it. Examples of evidence for the Big Bang could include the cosmological principle, cosmic microwave background radiation, and time-space expansion.
- 4.2 **Use models** to describe the conditions of the early universe that led the formation and evolution of matter including the birth of the first stars and galaxies.
- 4.3 **Construct an explanation** using evidence to support the existence of dark matter and dark energy. Emphasize indirect evidence to support their existence.
- 4.4 **Develop and Use models** to relate the cause for how galactic evolution occurs. Emphasize the processes of mergers and collisions.

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