Fairfield Public Schools
Science Curriculum

Draft Units

Science of the Cosmos

Science of the Cosmos: Description

Standards for this course are taken from the *Next Generation Science Standards* and are of three types:

Disciplinary Core Ideas (DCIs): Shown as content objectives, these standards define what students should know about the most essential ideas in the major science disciplines. The focus is on a limited number of core ideas in science and engineering both within and across the disciplines to avoid the shallow coverage of a large number of topics and to allow more time for teachers and students to explore each idea in greater depth. Reduction of the sheer sum of details to be mastered is intended to give time for students to engage in scientific investigations and argumentation and to achieve depth of understanding of the core ideas presented.

Science and Engineering Practices (SEP): These standards enable students to apply the content in the DCI's and the skills of practicing scientists and engineers to explain phenomena and solve real world problems. Engaging in the practices of science helps students understand how scientific knowledge develops; such direct involvement gives them an appreciation of the wide range of approaches that are used to investigate, model, and explain the world. Engaging in the practices of engineering likewise helps students understand the work of engineers, as well as the links between engineering and science.

Crosscutting Concepts: These standards provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas. These broad concepts tie together the influence of engineering, technology, and science on society and the natural world.

http://www.nextgenscience.org/next-generation-science-standards

CROSS CUTTING CONCEPTS

Patterns: Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

Structure and function. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Science of the Cosmos

Course Essential Questions

Essential Questions

- Why do we study the night sky?
- Over history, how has the cosmos been explained?
- How is the solar system organized?
- How do distances govern the structure of the universe?
- What is at the edge of our understanding of astronomy?
- How do students use information and technology to express and communicate ideas?

Course: Semester-at-a Glance

Unit	Title		Unit Essential Questions
1	Astronomy and the Universe	Constellations and observable night sky Moon and phases Seasons and Sun's path	What is the celestial sphere and how does the coordinate system work? What are constellations and how are they formed in the night sky? How are they identified? How do astronomers use triangulation and parallax to determine distances? How does the Sun appear to travel across the sky over time? What controls the seasons? How is the Moon's orbit tied to the Earth? What controls tides?
2	History and Tools of Astronomy	Geocentric & Heliocentric theories Spectroscopy & Radiation Telescopes	How has our understanding of astronomy changed during human history? How have telescopes been developed historically and how are they used today? How do professional and backyard astronomers choose the tools, techniques, and equipment they need to make observations? What is the electromagnetic spectrum and how is it useful in astronomy? Why is spectroscopy a significant tool in astronomical observations?
3	Our Planetary System and Motion Laws	The Planets and other bodies Newton's and Kepler's Laws	What is a planet? What is the size and scale of the solar system? What is the current theory of planetary formation? How do the properties differ between the terrestrial and Jovian planets? How do the laws of Newton and Kepler explain planetary motion?
4	Stars and Stellar Evolution	Life cycle of stars Star properties The H-R Diagram	What is a star? How is the creation of chemical elements related to stars? What is the structure and properties of the Sun? How are stars classified? How do a star's properties affect its life cycle? How does the Hertzsprung-Russell diagram compare stars?

Unit 1

Overview

The Earth's place in space is elucidated as the view in the sky is studied. During the day, the Sun's apparent motion is studied. At night, the constellations are identified and the Earth's and the Moon's orbital motions are described. For finding long distances, students learn triangulation and parallax techniques.

Unit Content Objectives

At the conclusion of this unit, students will be able to:

- Use the celestial sphere and locate objects on the celestial sphere using celestial coordinates
- Find constellations and understand how they change throughout the year
- Determine the cause of the seasons and observe seasonal changes in the observable sky
- Predict where the sun's rays are striking directly during the equinoxes and solstices
- Locate the appropriate path the sun will take in the sky during the different seasons
- Identify the different moon phases and when they occur
- The length of a lunar cycle
- Understand how solar and lunar eclipses work and the differences between them

Unit Essential Questions

- What is the celestial sphere and how does the coordinate system work?
- What are constellations and how are they formed in the night sky? How are they identified?
- How do astronomers use triangulation and parallax to determine distances?
- How does the Sun appear to travel across the sky over time?
- What controls the seasons?
- How is the Moon's orbit tied to the Earth? What controls tides?

Crosscutting Concepts

- Patterns
- Cause and Effect

- Scale Proportion and Quantity
- Energy and Matter
- Stability and Change

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

MS-ESS1-1 Earth's Place in the Universe

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-ESS1-3 Earth's Place in the Universe

Analyze and interpret data to determine scale properties of objects in the solar system.

SCIENCE AND ENGINEERING PRACTICES (SEP):

Developing and Using Models
Using Mathematical and Computational Thinking
Science Models Laws and Mechanisms

Corresponding CT Core Standards: **ELA/Literacy-** **SL. 8.5** **Mathematics** **MP.4** **6.RP.A.1.** **7.RP.A.2.**

Unit 2

Overview

The history of astronomy involves studying the geocentric theories understood for thousands of years as well as the more modern heliocentric theory. The invention of the telescope led to proof of the heliocentric theory. Then, the technological advances in telescopes has led to spectroscopy. Students will learn about types of telescopes and forms of incoming electromagnetic radiation we detect.

Unit Content Objectives

At the conclusion of this unit, students will be able to:

- Compare the geocentric model of the universe versus the modern heliocentric model of the solar system.
- Understand why the geocentric model was flawed
- Identify the evidence that suggested a heliocentric model of the universe
- Identify who invented the telescope and its early design
- Compare the different types of telescopes such as reflector and refractor
- Determine the different types of radiation and how they are useful in astronomy
- Understand the importance of radio waves and finding extraterrestrial life
- Identify the spectra of common elements
- Understand the specific type of information that spectroscopy can tell us

Unit Essential Questions

- How has our understanding of astronomy changed during human history?
- How have telescopes been developed historically and how are they used today?
- How do professional and backyard astronomers choose the tools, techniques, and equipment they need to make observations?
- What is the electromagnetic spectrum and how is it useful in astronomy?
- Why is spectroscopy a significant tool in astronomical observations?

Crosscutting Concepts

- Scale, Proportion and Quantity
- Energy and Matter
- Scientific Knowledge Assumes and Order and Consistency in Natural Systems

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

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.

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 AND ENGINEERING PRACTICES (SEP):

- **Developing and Using Models**
- **Constructing Explanations and Designing Solutions**
- **Science Models, Laws, Mechanisms, and Theories Explain the Natural Phenomenon**

Corresponding CT Core Standards:
ELA/Literacy –
RST.11-12.1
WHST .9-12.2

Mathematics
MP.2
MP.4
HSN-Q.A.1
HSN-Q.A.2
HSN-Q.A.3
HSA-SSE.A.1
HSA-CED.A.2
HSA-CED.A.4

Unit 3

Overview

Students will research and describe the planets of the solar system, both terrestrial and Jovian. To understand planetary motion, the laws of Newton and Kepler will be studied.

Unit Content Objectives

At the conclusion of this unit, students will be able to:

- Characterize a planet versus other bodies
- Explain the formation of the solar system and planets
- Make a scale model of the solar system
- Describe properties of each planet, and contrast terrestrial planets with Jovian planets
- To understand Newton's Laws including gravitation and Kepler's Laws regarding elliptical orbits and how they relate to planetary orbits

Unit Essential Questions

- What is a planet?
- What is the size and scale of the solar system?
- What is the current theory of planetary formation?
- How do the properties differ between the terrestrial and Jovian planets?
- How do the laws of Newton and Kepler explain planetary motion?

Crosscutting Concepts

- Scale, Proportion and Quantity
- Stability and Change
- Interdependence of Science, Engineering, and Technology

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

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

HS-ESS1-6 Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

HS-ESS2-7 Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

SCIENCE AND ENGINEERING PRACTICES (SEP):

Using Mathematical and Computational Thinking
Science, Models, Laws, Mechanisms, and Theories Explain Natural Phenomenon
Engaging in Argument

Corresponding CT Core Standards:

ELA/Literacy –
RST.11-12.1
RST.11-12.8
WHST.9-12.1
WHST.9-12.2

Mathematics –
MP2
HSN-Q.A.1
HSN-Q.A.2
HSN-Q.A.3
HSA-CED.A.2
HSS-ID.B.6

Unit 4

Overview
Students will learn about star formation, evolution, and death. Studying star properties will allow stars, including the Sun, to be classified and compared. It will be shown that the Hertzsprung-Russell diagram compares many star properties at once.

Unit Content Objectives

At the conclusion of this unit, students will be able to:

- Define a star and the various types of stars
- Describe nuclear fusion
- Diagram the layers of the Sun track sunspots
- Classify stars
- Describe the life cycle of a star based off of its mass
- Understand how high mass elements are created through star evolution and supernovas
- Interpret the Hertzsprung-Russell diagram in order to compare stars.

Unit Essential Questions

- What is a star?
- What is nuclear fusion?
- What is the structure and properties of the Sun?
- How are stars classified?
- How do a star's properties affect its life cycle?
- How is the creation of chemical elements related to stars and their life cycle?
- How does the Hertzsprung-Russell diagram compare stars?

Crosscutting Concepts

- Energy and Matter

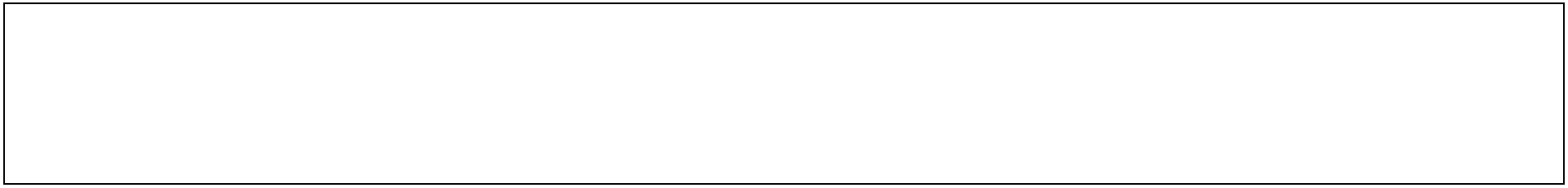
NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):
HS-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements.

SCIENCE AND ENGINEERING PRACTICES (SEP):
Obtaining, Evaluating, and Communicating Information

Corresponding CT Core Standards:
ELA/Literacy – WHST.9-12.2

Mathematics – MP.2



Unit Essential Questions
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Crosscutting Concepts
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NGSS Unit Standards
DISCIPLINARY CORE IDEAS (DCI): **SCIENCE AND ENGINEERING PRACTICES (SEP):**
Corresponding CT Core Standards: **ELA/Literacy –** **Mathematics –**