Curriculum Development
In the Fairfield Public Schools

Fairfield Public Schools
FAIRFIELD, CONNECTICUT

ASTRONOMY

BOE APPROVED 05/12/2009

ASTRONOMY

Statement of Purpose

Science education promotes essential understandings of the natural world and nurtures students' abilities to apply scientific knowledge as seen through a lens from both a personal and societal perspective. As such, this education requires that the fundamental approach to science be a creative and logical process for investigating, reasoning, critiquing and communicating about ideas, not just a static body of facts to be memorized. Understanding the interconnections between science and technology and their shared impact on the environment and societal issues is essential for all students.

Audience

Grade 11 or 12 students

Prerequisites

Successful completion of 4 credits of science including Biology

Design and Description

This course will focus on the theories and principles of Astronomy, and on the science and practices that are conducted to understand our observations of the universe. Emphasis will be placed on current theories and recent developments in space exploration. Questions about the stars, planets, and universe will be answered through discussion, investigation, and laboratory activities designed to give students a first-hand knowledge of, and appreciation for, the universe in which they live.

Course Objectives

Students will be able to:

- describe the major contributions of Copernicus, Galileo and Kepler to the study of Astronomy.
- explain the concept of the celestial sphere and how we use angular measurement to locate objects in the sky.
- describe how and why the Sun, Moon, and stars appear to change their positions over time.
- demonstrate how the relative motion of the Sun, Earth and Moon lead to eclipses.
- explain how astronomers measure distances and sizes of objects in the universe.
- discuss the nature of electromagnetic radiation.
- relate emission spectra to atomic structure.
- explain the types of information that can be obtained by analyzing the spectra of astronomical objects.
- identify different types of telescopes and their uses.
- examine the limitations of making astronomical observations from the ground.
- outline the theory of solar-system formation.
- discuss the role of collisions in determining planetary characteristics.
- describe the overall scale and structure of the solar system.
- compare and contrast the terrestrial and Jovian planets.

- compare and contrast the characteristics and theories of formation of the Moon and the planets in our solar system.
- trace the production of energy by the Sun.
- summarize the composition and properties of the interstellar medium including dark matter.
- summarize the sequence of events leading to star formation.
- analyze the evolution of stars off the main sequence.
- discuss the observations that help verify the theory of stellar evolution.
- discuss the motions of stars through space and how those motions are measured from Earth.
- summarize the events leading to the violent death of a massive star.
- describe the two types of supernovae.
- discuss the nature of neutron stars, pulsars, gamma ray bursts, and black holes.
- develop an Essential Question, along with subsidiary research questions pertinent to the specific topic.
- utilize a variety of resources for research so as to draw conclusions about the topic.
- utilize appropriate technology with which to present findings to the class.
- properly document all sources using MLA citation format.
- self-assess to determine the quality of their product before submission.

Skill Objectives

Students will:

- calculate astronomical distances using a variety of units including: kilometers, AU, and light years.
- calculate positions in the Earth/Moon system at various points throughout the year.
- graph the Moon's transit at different phases throughout the lunar cycle.
- use simple spectroscopes to identify chemical elements.
- use visible light telescopes to complete visual observations of a variety of celestial objects.
- create a scale model of our solar system.
- use technology to research and share current information about our planetary system.
- use an H-R diagram to identify stellar properties.
- calculate differences between apparent and absolute magnitude.
- observe solar features using appropriate telescopic equipment.
- utilize current resources to obtain information.
- synthesize findings to answer their Essential Question.
- present evidence and conclusions to an audience of their peers and instructors.

Earth Science Enrichment Standards

Earth's Place in the Universe

Earth-based and space-based astronomy reveal the structure, scale and changes in stars, galaxies, and the universe over time

Visual, radio, and x-ray telescopes may be used to collect data that reveal those differences in the life cycles of stars

The differences and similarities among the Sun, the terrestrial planets and the gas planets may have been established during the formation of the solar system

The solar system is located in an outer edge of the disc-shaped Milky Way galaxy, which spans 100,000 light years

The Sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium

Evidence indicates that all elements with an atomic number greater than that of lithium have been formed by nuclear fusion in stars

National Science Education Standard B
Physical Science – Motions and Force
Gravitation is a universal force that each mass exerts on any other mass

The strength of the gravitational attractive force between two masses is proportional to the masses and inversely proportional to the square of the distance between them.

Information & Technology Literacy Standards (ITL Framework January 2006)
Definition and Identification of Information Needs
Students will define their information needs and identify effective courses of action to conduct research and solve problems.

Students will develop essential questions related to a topic and formulate a research hypothesis related to the topic.

Information Processing
Students will apply information from a variety of sources and formats using evaluative criteria to interpret, analyze, organize and synthesize both print and non-print material.

Students will organize, analyze and synthesize information to draw meaningful conclusions through written, oral, numeric and visual communications, independently.

Application
Students will use appropriate information and technology to create written, visual, oral and multimedia products to communicate ideas, information or conclusions to others.

Students will determine appropriate technology(s) and format(s) to clearly present information gathered from a variety of print and non-print resources, for a variety of audiences.

Responsible Use
Students will demonstrate the responsible, legal and ethical use of information resources, computers and other technologies.

Students will apply established citation standards for a wide range of information sources and formats.

Assessment
Students will assess the effectiveness of their information and technology choices for problem-solving and communication.

Students will assess, independently, whether their products meet established standards for process, product and presentation.

Essential Questions

- Why do we study the night sky?
- What is the role of energy in our world?
- What do students need to know prior to using information and technology resources?
- How do students evaluate and use information resources?
- How do students use information and technology to express and communicate ideas?
- What type of technological tools will students use?
- What are student responsibilities regarding the use of information and technology?
- How do students evaluate the process and the final product?
- What is at the edge of our understanding of astronomy?

Focus Questions

- What is the size or scale of the universe?
- How has our understanding of Astronomy changed during human history?
- What are constellations and how are they identified?
- What is Earth's motion in our solar system?
- How is the Moon's orbit tied to the Earth?
- 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?
- How have telescopes been developed historically and how are they used in modern day?
- What is a planet?
- What is the current theory of planetary system formation?
- How do the properties differ between the terrestrial and Jovian planets?
- What is a star?
- How is the creation of chemical elements related to stars?
- What is the structure and properties of our Sun?
- How are stars classified?
- How do a star's properties effect its life cycle?
- Why do we need to continue research on celestial objects that are already known or explored?
- What can science gain from new research and exploration of a variety of celestial objects, both within and beyond our solar system?

- What other things are gained from research and exploration in astronomy beyond knowledge of the celestial object in question?

UNITS OF STUDY

Unit 1: Astronomy and the Universe

National Science Education Standard B
Physical Science – Motions and Force
Gravitation is a universal force that each mass exerts on any other mass

The strength of the gravitational attractive force between two masses is proportional to the masses and inversely proportional to the square of the distance between them.

Essential Question
Why do we study the night sky?

Focus Questions
- What is the size or scale of the universe?
- How has our understanding of Astronomy changed during human history?
- What are constellations and how are they identified?
- What is Earth's motion in our solar system?
- How is the Moon's orbit tied to the Earth?

Core Topics
- Earth's in the universe
- Historical Astronomy
- Constellations
- Earth's motion
- Moon's orbit

Unit Objectives
Students will be able to:
- describe the major contributions of Copernicus, Galileo and Kepler to the study of Astronomy.
- explain the concept of the celestial sphere and how we use angular measurement to locate objects in the sky.
- describe how and why the Sun, Moon, and stars appear to change their positions over time.
- demonstrate how the relative motion of the Sun, Earth and Moon lead to eclipses.
- explain how astronomers measure distances and sizes of objects in the universe.

Skill Objectives
Students will:
- calculate astronomical distances using a variety of units including: kilometers, AU, and light years.
- calculate positions in the Earth/Moon system at various points throughout the year.

- graph the Moon’s transit at different phases throughout the lunar cycle.

Sample Assessment
Lunar transit lab

Pacing
4 weeks

Unit 2: Information from the Universe

Earth Science Enrichment Standards

Earth's Place in the Universe

Earth-based and space-based astronomy reveal the structure, scale and changes in stars, galaxies, and the universe over time

Visual, radio, and x-ray telescopes may be used to collect data that reveal those differences in the life cycles of stars

Essential Question

What is the role of energy in our world?

Focus Questions

- 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?
- How have telescopes been developed historically and how are they used in modern day?

Core Topics

- Radiation
- Atomic structure
- Spectroscopy
- Telescopes

Unit Objectives

Students will be able to:

- discuss the nature of electromagnetic radiation.
- relate emission spectra to atomic structure.
- explain the types of information that can be obtained by analyzing the spectra of astronomical objects.
- identify different types of telescopes and their uses.
- examine the limitations of making astronomical observations from the ground.

Skill Objectives

Students will:

- use simple spectroscopes to identify chemical elements.
- use visible light telescopes to complete visual observations of a variety of celestial objects.

Sample Assessments

- Spectroscopy Lab
- Telescopic observations of celestial objects

Pacing
3 weeks

Unit 3: Our Planetary System

Earth Science Enrichment Standards
Earth's Place in the Universe
Earth-based and space-based astronomy reveal the structure, scale and changes in stars, galaxies, and the universe over time

The differences and similarities among the Sun, the terrestrial planets and the gas planets may have been established during the formation of the solar system

The solar system is located in an outer edge of the disc-shaped Milky Way galaxy, which spans 100,000 light years

Essential Question
What is the role of energy in our world?

Focus Questions
- What is a planet?
- What is the current theory of planetary system formation?
- How do the properties differ between the terrestrial and Jovian planets?

Core Topics
- Formation of planetary systems
- Our solar system
- Terrestrial planets
- Jovian planets

Unit Objectives
Students will be able to:
- outline the theory of solar-system formation.
- discuss the role of collisions in determining planetary characteristics.
- describe the overall scale and structure of the solar system.
- compare and contrast the terrestrial and Jovian planets.
- compare and contrast the characteristics and theories of formation of the Moon and the planets in our solar system.

Skill Objectives
Students will:
- create a scale model of our solar system.
- use technology to research and share current information about our planetary system.

Sample Assessment
Solar System Modeling

Pacing
5 weeks

Unit 4: Stars and Stellar Evolution

Earth Science Enrichment Standards

Earth's Place in the Universe

Earth-based and space-based astronomy reveal the structure, scale and changes in stars, galaxies, and the universe over time

The Sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium

Evidence indicates that all elements with an atomic number greater than that of lithium have been formed by nuclear fusion in stars

Essential Question

What is the role of energy in our world?

Focus Questions

- What is a star?
- How is the creation of chemical elements related to stars?
- What is the structure and properties of our Sun?
- How are stars classified?
- How do a star's properties effect its life cycle?

Core Topics

- The Sun
- Star formation
- Stellar evolution
- Neutron stars and black holes

Unit Objectives

Students will be able to:

- trace the production of energy by the Sun.
- summarize the composition and properties of the interstellar medium including dark matter.
- summarize the sequence of events leading to star formation.
- analyze the evolution of stars off the main sequence.
- discuss the observations that help verify the theory of stellar evolution.
- discuss the motions of stars through space and how those motions are measured from Earth.
- summarize the events leading to the violent death of a massive star.
- describe the two types of supernovae.
- discuss the nature of neutron stars, pulsars, gamma ray bursts, and black holes.

Skill Objectives

Students will:

- use an H-R diagram to identify stellar properties.
- calculate differences between apparent and absolute magnitude.
- observe solar features using appropriate telescopic equipment.

Sample Assessments

- H-R diagram Lab
- Absolute vs. apparent magnitude lab
- Solar observation lab

Pacing

3 weeks

Unit 5: Science Research

Information & Technology Literacy Standards (ITL Framework January 2006)

Definition and Identification of Information Needs

Students will define their information needs and identify effective courses of action to conduct research and solve problems.

Students will develop essential questions related to a topic and formulate a research hypothesis related to the topic.

Information Processing

Students will apply information from a variety of sources and formats using evaluative criteria to interpret, analyze, organize and synthesize both print and non-print material.

Students will organize, analyze and synthesize information to draw meaningful conclusions through written, oral, numeric and visual communications, independently.

Application

Students will use appropriate information and technology to create written, visual, oral and multimedia products to communicate ideas, information or conclusions to others.

Students will determine appropriate technology(s) and format(s) to clearly present information gathered from a variety of print and non-print resources, for a variety of audiences.

Responsible Use

Students will demonstrate the responsible, legal and ethical use of information resources, computers and other technologies.

Students will apply established citation standards for a wide range of information sources and formats.

Assessment

Students will assess the effectiveness of their information and technology choices for problem-solving and communication.

Students will assess, independently, whether their products meet established standards for process, product and presentation.

Essential Question

- What is at the edge of our understanding of astronomy?

Focus Questions

- Why do we need to continue research on celestial objects that are already known or explored?
- What can science gain from new research and exploration of a variety of celestial objects, both within and beyond our solar system?
- What other things are gained from research and exploration in astronomy beyond knowledge of the celestial object in question?

Core Topics
All topics directly related to the science of astronomical and celestial studies.

Unit Objectives
Students will be able to:
- develop an Essential Question, along with subsidiary research questions pertinent to the specific topic.
- utilize a variety of resources for research so as to draw conclusions about the topic.
- utilize appropriate technology with which to present findings to the class.
- properly document all sources using MLA citation format.
- self-assess to determine the quality of their product before submission.

Skill Objectives
Students will:
- utilize current resources to obtain information.
- synthesize findings to answer their Essential Question.
- present evidence and conclusions to an audience of their peers and instructors.

Sample Assessment
Student research project

Pacing
2 Weeks