

Astronomy Course Syllabus

Course Description:

In Astronomy Part 1, students will learn the fundamentals of the science of Astronomy, including its history. Students will learn about the tools of Astronomy with emphasis on different types of telescopes. The course also discusses milestones in space exploration, as well as contemporary issues and players in the space travel industry. Students will receive an introduction to the solar system, where they will learn the characteristics of each of the planets in our solar system as well as its other features and formation. Finally, students will learn about the mapping, catalog and identification of the stars, as seen from earth.

In Astronomy Part 2, students will build off the basic knowledge they gained in Part 1 of the course as well as explore additional, specialized topics. Additional foundational topics include Stars and Spectroscopy and Galaxies, where students will delve deep into the life cycles and classification of stars and galaxies. The specialized topic of astrobiology will be taught, as well as an introduction into the idea of the search for life in our solar system and the search for exoplanets in others. Students will learn about space, the interstellar medium, and its properties as well as the unsolved mysteries of dark energy and dark matter. Another unit examines exciting exotic objects and phenomena, like supernovae and black holes. Finally, students will get an introduction to cosmology and will learn the characteristics and current theories about our universe.

Part 1: 5 credit hours

Part 2: 5 credit hours

Course Outline

Next Generation Science Standards (NGSS) California Standards

Astronomy, Part 1

Unit 1: The Science of Astronomy

- 1.1 What is Astronomy?
- 1.2 Ancient Roots of Astronomy
- 1.3 The History of Astronomy
- 1.4 Naked Eye Observations

In this Unit students will learn:

What Astronomy is, its ancient beginnings, and a brief history of Astronomy.

To make some naked eye observations.

[California: Earth Sciences: 1a, 2b]

Unit 2: Tools of Astronomy

- 2.1 History of the Telescope
- 2.2 Reflecting Telescopes
- 2.3 Refracting Telescopes
- 2.4 Radio and Other Telescopes
- 2.5 Space-Based Telescopes
- 2.6 Spectroscopy and Spectroscopes

In this Unit students will learn:

The tools of astronomy, including how they work and what astronomers use them for.

The history of the telescope, how different telescopes work, and how they have developed over time.

The practice of radio Astronomy.

[California: Earth Sciences: 1e, 1g, 2b, 2c, 2d, 2f, 2g]

Unit 3: Space Exploration

- 3.1 A Brief History of Space Exploration
- 3.2 The First Man in Space
- 3.3 The Apollo Missions
- 3.4 Voyager 1
- 3.5 The International Space Station
- 3.6 Private Companies and NGOs
- 3.7 The Future of Human Space Exploration
- 3.8 The Challenges of Interstellar Travel

Unit 4: Introduction to the Solar System

- 4.1 Formation of the Solar System
- 4.2 How the Earth Orbits the Sun
- 4.3 Dwarf Planets and The Pluto Dilemma
- 4.4 The Asteroid Belt
- 4.5 Comets and the Oort Cloud
- 4.6 Size Comparisons of Celestial Bodies

Unit 5: Solar System: The Planets

- 5.1 Mercury
- 5.2 Venus
- 5.3 Earth and Moon
- 5.4 Mars
- 5.5 Jupiter
- 5.6 Saturn
- 5.7 Uranus
- 5.8 Neptune

Unit 6: The Stars as Seen from Earth

- 6.1 Star Charts
- 6.2 Celestial Coordinate Systems
- 6.3 Stellar Magnitudes
- 6.4 Measuring Distances to Stars
- 6.5 Messier Catalog
- 6.6 Star Clusters

In this Unit students will learn:

A brief overview of the history of space exploration, including Voyager 1 and the International Space Station.

The potential future of human space exploration, and the challenges of interstellar travel.

[California: Earth Sciences: 1c, 1d, 1f, 2d]

In this Unit students will learn:

About our Solar System, including its formation.

How the earth orbits the Sun, and the path it takes.

About dwarf planets and the Pluto dilemma.

About the asteroid belt, comets, and the Oort cloud.

The differences in sizes of celestial bodies.

[California: Earth Sciences:1a, 1b, 1c, 1d, 1e, 1f, 2a, 2b, 2c, 2d]

In this Unit students will learn:

About the solar system and the planets, including Mercury, Venus, Earth and the Moon, Mars, Jupiter, Saturn, Uranus, and Neptune.

[NGSS: HS-ESS1-4]

[California: Earth Sciences: 1a, 1b, 1c, 1d, 1e, 2a, 2c]

In this Unit students will learn:

To view the stars from the perspective of Earth, and how to interpret star charts.

The celestial coordinate systems and stellar magnitudes.

To measure distances to stars.

About the Messier catalog and star clusters.

[California: Earth Sciences: 1g, 2b, 2d, 2f]

Course Outline

Next Generation Science Standards (NGSS) California Standards

Unit 1: Stars

- 1.1 What are Stars?
- 1.2 Stellar Evolution and Classification
- 1.3 The Hertzsprung-Russell (H-R) Diagram
- 1.4 Binary Star Systems
- 1.5 Variable Stars
- 1.6 Layers of the Sun

Astronomy, Part 2

In this Unit students will learn:

The basics of stars and spectroscopy, including what stars are and stellar evolution.

To classify stars, and the Hertzsprung-Russell Diagram.

About binary star systems and star clusters, as well as variable stars.

About how stars work and their layers, using the sun as a case study.

[[NGSS: HS-ESS1-1]

[California: Earth Sciences: 1e, 1g, 2b, 2d, 2e, 2f]

Unit 2: Galaxies

- 2.1 Galaxy Types and Classification
- 2.2 Superclusters and the Laniakea Supercluster
- 2.3 The Milky Way
- 2.4 Hubble Deep Field and Ultra Deep Field
- 2.5 Galactic Collisions

In this Unit students will learn:

The basics of galaxies, including their types and classifications.

The Milky Way galaxy and the Laniakea Supercluster.

About the Hubble deep field and ultra deep field, and about galactic collisions.

[California: Earth Sciences: 1g, 2a, 2b]

Unit 3: The Search for Life: Exoplanets and Astrobiology

- 3.1 The Drake Equation
- 3.2 What is Astrobiology?
- 3.3 Exoplanets and Methods of Detecting Exoplanets
- 3.4 The Search for Life in the Solar System: Europa and Enceladus

In this Unit students will learn:

About astrobiology and the status of the search for life in the solar system.

About Europa and Enceladus, and their potential for harboring the existence of life.

More about the search for life elsewhere in the galaxy, and the Drake equation.

About exoplanets, and methods for detecting them.

[California: Earth Sciences: 1g, 2b]

Unit 4: Space and its Properties

- 4.1 The Interstellar Medium
- 4.2 Principles of Spacetime: A Basic Introduction to Einstein's Relativity

In this Unit students will learn:

The properties of space and interstellar medium.

About the principles of Einstein's theory of relativity.

About dark matter and dark energy.

- 4.3 Dark Matter
- 4.4 The Higgs Field and Elementary Particles
- 4.5 Dark Energy
- 4.6 Cosmic Microwave Background Radiation

Unit 5: Exotic Objects and Phenomena

- 5.1 Supernovae
- 5.2 White Dwarfs and Planetary Nebulae
- 5.3 Brown Dwarfs
- 5.4 Neutron Stars
- 5.5 Black Holes, Pulsars and Quasars

Unit 6: The Universe

- 6.1 The Beginning of the Universe
- 6.2 The Expanding Universe
- 6.3 Misconceptions About the Universe
- 6.4 The Accelerating Universe
- 6.5 The Three Fates of the Universe
- 6.6 A Multiverse

The Higgs Field about elementary particles.

[NGSS: HS-ESS1-2, HS-ESS1-3]

[California: Earth Sciences: 2c, 2d, 2e, 2f, 2g]

In this Unit students will learn:

About exotic objects and phenomena, including supernovae, white dwarfs and brown dwarfs, as well as neutron stars, black holes, pulsars and quasars.

[NGSS: HS-ESS1-2]

[California: Earth Sciences: 2b, 2c, 2d, 2e, 2f, 2g]

In this Unit students will learn:

Key characteristics of the universe, including how it began and how it continues to expand.

Common misconceptions about the universe.

That the universe is accelerating, the three potential fates of the universe, and the idea of a multiverse.

[California: Earth Sciences: 2c, 2d, 2e, 2g]