Astronomy

UNIT I: Describing the Sky and History of Astronomy

Goal 1. **The student will demonstrate the ability to describe the cycles of nature used in astronomy and their historical background to explain the behavior of celestial objects in the sky.**

Objectives - The student will be able to:
    a.   Examine astronomical cycles in nature and apply them to the daily, monthly, and yearly cycles of Earth, such as, day-night (rotation), seasons (revolution), month (moon phase cycle), planet "wanderer" positions, and constellations.
    b.   Discuss the contributions, in the development of various astronomical models, by the following individuals: Ptolemy, Copernicus, Kepler, Brahe, Galileo, Newton, and Einstein.

Goal 2. **The student will demonstrate the ability to contrast the scientific method with pseudo-science and non-scientific approaches to understanding phenomena.**

Objectives - The student will be able to:
    a.   Describe the scientific method and the role of critical thinking in science.
    b.   Differentiate among the scientific facts, laws (principles), hypotheses, and theories.
    c.   Contrast the scientific use of the word "theory" with its more popular uses.
    d.   Identify pseudo-sciences (e.g. astrology) and describe their lack of valid hypothesis testing.
    e.   Discuss how other approaches to understanding our world (e.g. Art, Philosophy, Theology) complement, rather than contradict, the scientific approach.

Goal 3. **The student will demonstrate the ability to conduct astronomical laboratory and field investigations.**

Objectives - The student will be able to:
    a.   Demonstrate appropriate skills and techniques for using equipment for visual, binocular, and telescopic observations.
    b.   Recognize safe observation procedures.
    c.   Demonstrate the correct handling of equipment while conducting observations.

UNIT II: Light and Technology

Goal 1.   The student will demonstrate the ability to describe the electromagnetic spectrum, its wave-like properties, and the technology that uses the electromagnetic spectrum to study space.

Objectives - The student will be able to:
- a.   Explain the general behavior of wave energy found within electromagnetic radiation.
- b.   Define the concepts that describe the electromagnetic spectrum including wave shape and speed, reflection, refraction, diffraction, interference, polarization, Doppler effect, blackbody curves, and wave/particle duality.
- c.   Describe current efforts and technologies used to study the Universe, such as optical telescopes, radio telescopes, spectroscopes, satellites, space probes, and manned missions.

UNIT III: Members of the Sun's Solar System

Goal 1.   The student will demonstrate the ability to use Earth's characteristics as a model planet to compare and identify distinguishing features about other members of the solar system.

Objectives - The student will be able to:
- a.   Explain the role of natural forces and the conservation of angular momentum as they apply to the objects in our Universe including the formation of planets and satellites and the retention of an atmosphere.
- b.   Describe and compare Earth's physical properties to the other planets' physical properties including the properties of mass, volume, and density, differentiated structure, dynamic activity (plate tectonics), age, surface features, magnetic fields, and atmospheric activities.
- c.   Cite general similarities and differences between the terrestrial planets and the Jovian planets, as well as unique features of each, including distance from sun, period of rotation and period of revolution, number and characteristics of their satellites, atmospheric gases, and rings.
- d.   Identify and describe the minor members of the solar system, including asteroids, comets, and meteors.

UNIT IV: The Sun, Our Star

Goal 1.   The student will demonstrate the ability to explain solar activities based on the physical characteristics of the sun as a model star.

Objectives - The student will be able to:
- a.   Discuss the identified layers (core, zone of radiation, zone of convection, chromosphere, photosphere, corona) and the internal mechanisms (thermonuclear reactions, magnetic fields, differential rotation) of a typical star such as our Sun.

b. Describe and diagram the surface features of a typical star including granulations, spicules, sunspots, prominences, flares, solar wind, and coronal mass ejections.
c. Investigate research methods used to analyze a typical star, such as solar neutrino detectors, helioseismology, spectroscopy, and Doppler shift detections of extrasolar planets.

UNIT V: Stars and Their Life Cycles

Goal 1. **The student will demonstrate the ability to summarize the attributes of a great variety of stars and determine their positions on the Hertzsprung-Russell diagram.**

Objectives - The student will be able to:
a. Outline the methods astronomers use to find the following physical properties of stars including surface temperature, luminosity, chemical composition, size (radius or diameter), mass, interstellar medium, motion, and distance.
b. Discuss the stellar evolution of individual stars and describe the location of each on the Hertzsprung-Russell diagram, including protostars, main sequence stars, giant and supergiants, nova and supernova stars, variable stars, white dwarfs, neutron stars/pulsars, and black holes.
c. Differentiate various multiple star systems, including binary stars, globular clusters, and open clusters.

UNIT VI: The Milky Way and Other Galaxies

Goal 1. **The student will demonstrate the ability to identify the features of the Milky Way Galaxy and compare them to features of other types of galaxies in the Universe.**

Objectives - The student will be able to:
a. Describe the historical perspective and characteristics of the Milky Way Galaxy, including size, shape, rotation, and stellar distribution.
b. Sketch the shapes and debate the origin of the Hubble Classification System of Galaxies including elliptical galaxies, spiral galaxies, barred-spiral galaxies, and irregular galaxies.
c. Discuss active galaxies that do not conform to the original Hubble Classification System, including radio galaxies, Seyfert galaxies, and quasars.

UNIT VII: Cosmology

Goal 1. **The student will demonstrate the ability to contrast models and determine the best explanation of cosmology using current scientific evidence.**

Objectives - The student will be able to:
a. Discuss the origin of the Universe including Steady State, Big Bang, and Oscillating theories.

b. Describe various cosmological models, including an open universe and a closed universe.
c. Cite evidence in support of an open universe, including Hubble's Law, mass-energy density of the universe, and deuterium abundance.