Madison Public Schools

Earth Science - Unit 1 - Earth's Place in the Universe

Unit Focus

In this unit, students will explore the idea of how the universe may have formed. Students will learn about light and it's composition as well as how it can be used to identify, explain, and predict movements of celestial objects in our galaxy and beyond. Additionally, students will learn how the tools in astronomy and advances in technology are used to acquire information about distant celestial objects and their movements. Working both independently and with their peers, students will explore these concepts using science inquiry skills.

Stage 1: Desired Results - Key Understandings

Standard(s)

Common Core

Science & Technical Subjects: 9-10

- Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9– 10 texts and topics. *CCSS.ELA-LITERACY.RST.9-10.4*
- Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). *CCSS.ELA-LITERACY.RST.9-10.5*
- Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. *CCSS.ELA-LITERACY.RST.9-10.7*
- Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns. *CCSS.ELA-LITERACY.WHST.9-10.1B*

Next Generation Science

High School Earth and Space Sciences: 9 - 12

- 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-ESS1-1*

Transfer

T1 Use the scientific process to generate evidence that addresses the original questions.
T2 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.

Meaning

Understanding(s)	Essential Question(s)
U1 The structure of planetary systems can be learned from observing the movements of celestial objects **U2** The distance of a celestial object from the earth can be determined by its movements **U3** The luminosity of celestial objects are influenced by various factors **U4** Some forms of energy, including light are carried from one place to another by waves **U5** The composition of celestial objects can be inferred from the light they emit. **U6** Stars are celestial objects that are born, change over time, and eventually die **U7** All stars are the result of a balance of forces: the force of gravity compresses atoms in interstellar gas until the fusion reactions begin. **U8** The origin of the universe is supported by the composition of stars.	**Q1** What can scientists learn from the movements of celestial objects? **Q2** What can scientists learn from light emitted by celestial objects? **Q3** How do the fundamental forces of the universe explain the behavior of celestial objects?

Stage 1: Desired Results - Key Understandings

- 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. *HS-ESS1-2*
- Communicate scientific ideas about the way stars, over their life cycle, produce elements. *HS-ESS1-3*

Next Generation Science Standards (DCI)

Science: 9

- The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. *ESS1.9.A1*
- The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. *ESS1.9.A2*
- Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. *ESS1.9.B1*
- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. *PS2.9.B3*
- Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. *PS3.9.D4*
- Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. *PS4.9.B1*

Student Growth and Development 21st Century Capacities Matrix

Critical Thinking

- Analyzing: Students will be able to examine information/data/evidence to make inferences and identify possible underlying assumptions, patterns, and relationships. *MM.1.2*
- Synthesizing: Students will be able to thoughtfully combine information/data/evidence, concepts, texts, and disciplines to draw conclusions, create solutions, and/or verify generalizations for a given purpose. *MM.1.3*

Acquisition of Knowledge and Skill

Knowledge

K1 The distance of a star from earth can be determined by the measured parallax of the star
K2 Stars such as the sun emit a wide range of wavelengths along the electromagnetic spectrum
K3 Visible light is made of various colors, each with a different wavelength
K4 The luminosity of an object depends on its temperature, size, and distance from the observer
K5 Astronomers analyze light from celestial objects in space using a spectroscope to learn about their composition.
K6 Astronomers analyze changes in a celestial object's spectrum, called the Doppler Effect, to learn about their movement
K7 A star is type of celestial object consisting of a plasma held together by its own gravity.
K8 A star is born when atoms of light elements are squeezed under enough pressure for their nuclei to undergo fusion.
K9 Stars are born from giant clouds of gas and dust, from which they mature, age, and eventually die
K10 Stars differ from one another in mass, size, temperature, and distance from Earth.
K11 Constellations are patterns of stars or other celestial bodies that emit light, whereas galaxies are natural groupings of stars held together by gravity
K12 The origin of the universe is explained by the big bang model.
K13 Vocabulary: Electromagnetic radiation, electromagnetic spectrum, continuous spectrum, emission spectrum, absorption spectrum, constellation, apparent magnitude, astronomical unit, light-year, parsec, luminosity, absolute magnitude, Cepheid variable, main sequence, giant star, white dwarfs, nebula, planetary nebula, supernova, neutron star, pulsar, black hole, galaxy, Big Bang model, black dwarf, blue shift, red shift, Doppler effect, circumpolar star, HR diagram

Skill(s)

S1 Apply the concept of parallax, Doppler effect, and spectroscopy through modeling and laboratory investigations to infer the relative distance, movements, and composition of celestial objects from earth
S2 Interpret the HR model to explain the relationship between mass and temperature on luminosity, and to infer stages in stellar evolution.
S3 Model and explain the relationship between the earth / sun alignment and variations in the observable constellations
S4 Construct a model that can be used to explain and predict nucleosynthesis in the composition of a star as a function of mass and the stage of its lifetime.