

State standards: <https://www.uen.org/core/core.do?courseNum=3601#strands>

(Unit 1.1- The Big Bang Theory, Redshift, and Emission Spectrums)

ESS.1.1 Develop a model based on evidence to illustrate the life span of the Sun and the role of nuclear fusion releasing energy in the Sun's core. Emphasize energy transfer mechanisms that allow energy from nuclear fusion to reach Earth. Examples of evidence for the model could include observations of the masses and lifetimes of other stars, or non-cyclic variations over centuries.

ESS.1.2 Construct an explanation of the Big Bang theory based on astronomical evidence of electromagnetic radiation, motion of distant galaxies, and composition of matter in the universe. Emphasize redshift of electromagnetic radiation, cosmic microwave background radiation, and the observed composition and distribution of matter in the universe.

4-Exceeds Standard	3-Meets Standard	2-Approaching Standard	1-Beginning
I can: Create a model of the stages of the Big Bang, showing the formation of <u>matter</u> from <u>energy</u>, and include current evidence supporting the Big Bang theory.	I can: Construct an explanation of the Big Bang Theory and how <u>matter</u> is formed from <u>energy</u>. Explain how light is used as evidence to identify the composition and motion of objects throughout the universe.	I can: Construct an explanation of how emission spectrums are used to identify the motion and direction of objects in space Vocabulary terms: Theory Matter Energy Electromagnetic Energy Redshift Spectroscope Emission Spectrum	I can: Construct an explanation of how emission spectrums are used to identify the composition and <u>matter</u> of objects in space

(Unit 1.2- Fusion, The Nebular Theory, and The Sun Life Cycle)

ESS.1.3 Develop a model to illustrate the changes in matter occurring in a star's life cycle. Emphasize that the way different elements are created varies as a function of the mass of a star and the stage of its lifetime.

ESS.2.1 Analyze and interpret data to construct an explanation for the changes in Earth's formation and 4.6 billion year history. Examples of data could include the absolute ages of ancient Earth materials, the size and composition of solar system objects like meteorites, or the impact cratering record of planetary surfaces.

4-Exceeds Standard	3-Meets Standard	2-Approaching Standard	1-Beginning
I can: Create a model showing how the planets within our solar system formed and why different planets of our solar system vary in <u>matter</u>	I can: Create a model showing the role of nuclear fusion during the sun's life cycle, including how the size of the sun and <u>matter</u> within the sun changes throughout its life cycle.	I can: Create a model showing different types of stars and how their <u>matter</u> varies based on size and composition. Vocabulary terms: Element Fusion Nebula Protostar Main Sequence Star Galaxy Supernova Heavy element Light element	I can: Construct an explanation of how <u>matter</u>, including heavy elements, are formed through the process of nuclear fusion.

(Unit 1.3- Space Exploration)

ESS.1.4 **Design a solution** to a space exploration challenge by breaking it down into smaller, more manageable problems that can be solved through the structure and function of a device. Define the problem, identify criteria and constraints, develop possible solutions using models, analyze data to make improvements from iteratively testing solutions, and optimize a solution. Examples of problems could include, cosmic radiation exposure, transportation on other planets or moons, or supplying energy to space travelers.

https://joshworth.com/dev/pixelspace/pixelspace_solarsystem.html

4-Exceeds Standard	3-Meets Standard	2-Approaching Standard	1-Beginning
I can: Design a solution for a manned mission to inhabit a location away from Earth. Define the <u>structure and function</u> of equipment used to successfully implement the solution	I can: Design a solution for a current space exploration problem. Define the <u>structure and function</u> of devices used as part of the solution.	I can: Explore space exploration problems, and define how the <u>structure and function</u> of current technology helps solve those problems.	I can: Define problems associated with space exploration, and explain how the <u>structure and function</u> of technology has helped increase our knowledge of the universe

(Unit 2.1- Layers of the earth, radioactive decay, and convection)

ESS.2.2 **Develop and use a model** based on evidence of Earth's interior and describe the cycling of matter by thermal convection. Emphasize the density of Earth's layers and mantle convection driven by radioactive decay and heat from Earth's early formation. Examples of evidence could include maps of Earth's three-dimensional structure obtained from seismic waves or records of the rate of change of Earth's magnetic field.

4-Exceeds Standard	3-Meets Standard	2-Approaching Standard	1-Beginning
I can: Develop and use a model of Earth's interior to describe why the layers have different densities and how density is affected by the generation and transfer of heat	I can: Develop and use a model of Earth's interior layers to describe how temperatures are <u>affected</u> by radioactive decay inside the core and convection throughout the mantle	I can: Create a model that shows how thermal convection transfers <u>energy</u> from the earth's core to the surface Vocabulary terms: Density Convection Radioactive decay Crust Mantle Outer core Inner core Asthenosphere Lithosphere	I can: Use data from earthquakes to explain how seismic waves are used to create models of the different layers inside the earth.

(Unit 2.2- Plate tectonics, constructive, and destructive forces)

ESS.2.3 Construct an explanation for how plate tectonics results in patterns on Earth's surface. Emphasize past and current plate motions. Examples could include continental and ocean floor features such as mountain ranges and mid-ocean ridges, magnetic polarity preserved in seafloor rocks, or regional hot spots.

ESS.2.2 Develop and use a model based on evidence of Earth's interior and describe the cycling of matter by thermal convection. Emphasize the density of Earth's layers and mantle convection driven by radioactive decay and heat from Earth's early formation. Examples of evidence could include maps of Earth's three-dimensional structure obtained from seismic waves or records of the rate of change of Earth's magnetic field.

ESS.2.4 Develop and use a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales. Emphasize how the appearance of land and seafloor features are a result of both constructive forces and destructive mechanisms. Examples of constructive forces could include tectonic uplift or mountain building. Examples of destructive mechanisms could include weathering or mass wasting.

ESS.2.6 Evaluate design solutions that reduce the effects of natural disasters on humans. *Define the problem, identify criteria and constraints, analyze available data on proposed solutions, and determine an optimal solution.* Examples of natural disasters could include earthquakes, tsunamis, hurricanes, drought, landslides, floods, or wildfires.

4-Exceeds Standard	3-Meets Standard	2-Approaching Standard	1-Beginning
I can: Develop and use a model to illustrate the <u>scale</u> of natural disasters on the earth and living organisms. Design solutions for how to reduce the <u>effects</u> of destructive forces on humans.	I can: Develop and use a model to illustrate the <u>scale</u> of constructive and destructive forces, both internal and external, on the earth. Evaluate solutions that reduce the <u>effects</u> of natural disasters on humans	I can: Develop and use a model to illustrate the <u>scale</u> of both time and size for how tectonics change the surface of the earth Vocabulary terms: Plate tectonics Constructive forces Destructive forces Natural disaster	I can: Develop a model that shows how forces shape the surface of the earth, emphasizing how the <u>effects</u> of natural disasters help to shape Earth.

(Unit 3.1- The water cycle)

ESS.3.1 Plan and carry out an investigation of the properties of water and its effects on Earth materials and surface processes. Examples of properties could include water's capacity to expand upon freezing, dissolve and transport material, or absorb, store, and release energy.

4-Exceeds Standard	3-Meets Standard	2-Approaching Standard	1-Beginning
I can: Plan and carry out an investigation of the properties of water and design a solution to mitigate its <u>effects</u> on Earth's surface	I can: Plan and carry out an investigation of the properties of water and its <u>effects</u> on Earth's surface	I can: Investigate the properties of water and how it <u>affects</u> Earth's surface Vocabulary terms: Evaporation Vaporization Condensation Freezing Melting Sublimation Deposition	I can: Research how water <u>affects</u> Earth's surface through the water cycle

(Unit 3.2- Weather patterns)

ESS.3.2 Construct an explanation of how heat (energy) and water (matter) move throughout the oceans causing patterns in weather and climate. Emphasize the mechanisms for surface and deep ocean movement. Examples of mechanisms for surface movement could include wind, Sun's energy, or the Coriolis effect. Examples of mechanisms for deep ocean movement could include water density differences due to temperature or salinity.

ESS.3.3 Construct an explanation for how energy from the Sun drives atmospheric processes and how atmospheric currents transport matter and transfer energy. Emphasize how energy from the Sun is reflected, absorbed, or scattered; how the greenhouse effect contributes to atmospheric energy; and how uneven heating of Earth's atmosphere combined with the Coriolis effect creates an atmospheric circulation system.

ESS.3.4 Analyze and interpret patterns in data about the factors influencing weather of a given location. Emphasize the amount of solar energy received due to latitude, elevation, the proximity to mountains and/ or large bodies of water, air mass formation and movement, and air pressure gradients.

4-Exceeds Standard	3-Meets Standard	2-Approaching Standard	1-Beginning
I can: Use evidence, including analyzing data , to construct an explanation of how the rotation of the earth and angle of sunlight influence seasons, weather, and climate <u>patterns</u>	I can: Construct an explanation of how <u>energy</u> and <u>matter</u> drive weather and climate. Analyze and interpret weather data in order to construct an explanation of how the sun drives atmospheric processes.	I can: Analyze data to construct an explanation of how energy from the sun drives weather <u>patterns</u> Vocabulary terms: Weather Climate Atmosphere Stratosphere Currents Coriolis effect Circulation	I can: Provide evidence to construct an explanation of how <u>energy</u> from the sun influences weather

(Unit 3.3- Atmosphere, currents, Greenhouse effect, and feedback loops)

ESS.3.3 Construct an explanation for how energy from the Sun drives atmospheric processes and how atmospheric currents transport matter and transfer energy. Emphasize how energy from the Sun is reflected, absorbed, or scattered; how the greenhouse effect contributes to atmospheric energy; and how uneven heating of Earth's atmosphere combined with the Coriolis effect creates an atmospheric circulation system.

ESS.3.7 Engage in argument from evidence to support the claim that one change to Earth's surface can create climate feedback loops that cause changes to other systems. Examples of climate feedback loops could include ice-albedo or warming oceans.

4-Exceeds Standard	3-Meets Standard	2-Approaching Standard	1-Beginning
I can: Construct an explanation and develop a model of how the greenhouse effect can drive other feedback loops, leading to changes in climate <u>patterns</u>.	I can: Construct an explanation of how the greenhouse effect contributes to atmospheric <u>energy</u> totals and how atmospheric circulation transfers energy across the planet. Use evidence to support an argument that <u>change</u> in one climate feedback loop can cause changes in other systems	I can: Construct an explanation of how the greenhouse effect affects Earth's total <u>energy</u> budget. Use evidence to construct an explanation of how climate feedback loops affect <u>energy</u> distribution. Vocabulary terms: Greenhouse effect Reflect Absorb Scatter Feedback Ice-albedo	I can: Construct an explanation of how the greenhouse effect affects <u>energy</u> totals on the earth. Use evidence to construct an explanation of climate feedback loops.

(Unit 4.1- Carbon cycle, Human activity, and management of resources)

ESS.4.1 Construct an explanation for how the availability of natural resources, the occurrence of natural hazards, and changes in climate affect human activity. Examples of natural resources could include access to fresh water, clean air, or regions of fertile soils. Examples of factors that affect human activity could include that rising sea levels cause humans to move farther from the coast or that humans build railroads to transport mineral resources from one location to another.

ESS.3.5 Develop and use a quantitative model to describe the cycling of carbon among Earth's systems. Emphasize each of Earth's systems (hydrosphere, atmosphere, geosphere, and biosphere) and how the movement of carbon from one system to another can result in changes to the system(s). Examples could include more carbon absorbed in the oceans leading to ocean acidification or more carbon present in the atmosphere leading to a stronger greenhouse effect.

ESS.3.6 Analyze and interpret data from global climate records to illustrate changes to Earth's systems throughout geologic time and make predictions about future variations using modern trends. Examples of data could include average sea surface temperature, average air temperature, composition of gasses in ice cores, or tree rings.

4-Exceeds Standard	3-Meets Standard	2-Approaching Standard	1-Beginning
I can: Design a solution for how humans can utilize natural resources to mitigate the effects of climate change <i>or</i> the impact of natural disasters	I can: Construct an explanation for how the availability of natural resources, the occurrence of natural hazards, and how human activities <u>affect</u> earth's different spheres	I can: Construct an explanation of what natural resources are and how humans <u>affect</u> the distribution of them Vocabulary terms: Carbon cycle Hydrosphere Geosphere Biosphere Atmosphere	I can: Construct an explanation of what the Carbon cycle is and how humans <u>affect</u> the cycle

(Unit 4.2- Sustainability & Renewable energy solutions)

ESS.4.2 Use computational thinking to explain the relationships between the sustainability of natural resources and biodiversity within Earth systems. Emphasize the importance of responsible stewardship of Earth's resources. Examples of factors related to sustainability could include costs of resource extraction, per-capita consumption, waste management, agricultural efficiency, or levels of conservation. Examples of natural resources could include minerals, water, or energy resources.

ESS.4.3 Evaluate **design solutions** for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios on large and small scales. *Define the problem, identify criteria and constraints, analyze available data on proposed solutions, and determine an optimal solution.* Emphasize the conservation, recycling, and reuse of resources where possible and minimizing impact where it is not possible. Examples of large-scale solutions could include developing best practices for agricultural soil use or mining and production of conventional, unconventional, or renewable energy resources. Examples of small- scale solutions could include mulching lawn clippings or adding biomass to gardens

ESS.4.4 Evaluate **design solutions** for a major global or local environmental problem based on one of Earth's systems. *Define the problem, identify criteria and constraints, analyze available data on proposed solutions, and determine an optimal solution.* Examples of major global or local problems could include water pollution or availability, air pollution, deforestation, or energy production.

4-Exceeds Standard	3-Meets Standard	2-Approaching Standard	1-Beginning
I can: Use computational thinking to predict future changes in biodiversity within Earth <u>systems</u> based on integration of alternative energy sources	I can: Use computational thinking to explain the relationships between the responsible use of natural resources and diversity of living organisms within Earth <u>systems</u>	I can: Use computational thinking to explain how responsibly using natural resources will benefit Earth's <u>systems</u> Vocabulary terms: Sustainability Renewable Nonrenewable	I can: Use computational thinking to explain where natural resources are located throughout Earth's <u>systems</u>

