01 Earth's Systems

Content Area: **Science**
Course(s):
Time Period: **Full Year**
Length: **5 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

Environmental Science covers major environmental topics such as acid rain, global warming, pollution, and renewable and non-renewable energy sources. The interdependence of earth's systems, the human population, the loss of biodiversity and the trade-offs between the environment and society will be studied. The course includes laboratory and field investigations.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Students investigate the energy within the Earth as it drives Earth's surface processes. Students evaluate evidence of the past and current movements of continental and oceanic crust for theory of plate tectonics to explain the ages of crustal rocks. Finally, students develop a model based on evidence of the Earth's interior to describe the cycle of matter by thermal convection. The crosscutting concepts of patterns and stability, cause and effect, stability and change, energy and matter, and systems and systems models are called out as organizing concepts for these disciplinary core ideas.

CONTENT AREA STANDARDS

SCI.HS-ESS1-5	Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
SCI.HS-ESS2-1	Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
SCI.HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
SCI.HS-PS2-5	Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
SCI.HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
SCI.HS-PS2-1	Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

Reason abstractly and quantitatively. (HS-PS2-1), (HS-PS4-1), (HS-ESS1-5), (HS-ESS2-1), (HS-ESS2-3) **MP.2**

Model with mathematics. (HS-PS2-1), (HS-PS4-1), (HS-ESS2-1), (HS-ESS2-3) **MP.4**

Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS2-1), (HS-PS2-5), (HS-ESS1-5), (HS-ESS2-1), (HS-ESS2-3) **HSN.Q.A.1**

Define appropriate quantities for the purpose of descriptive modeling. (HS-PS2-1), (HS-PS2-5), (HS-ESS1-5), (HS-ESS2-1), (HS-ESS2-3) **HSN.Q.A.2**

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS2-1), (HS-PS2-5), (HS-ESS1-5), (HS-ESS2-1), (HS-ESS2-3) **HSN.Q.A.3**

Interpret expressions that represent a quantity in terms of its context. (HS-PS2-1), (HS-PS2-4), (HS-PS4-1) **HSA.SSE.A.1**

Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS2-1), (HS-PS4-1) **HSA.SSE.B.3**

Create equations and inequalities in one variable and use them to solve problems. (HS-PS2-1) **HSA.CED.A.1**

Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (HS-PS2-1) **HSA.CED.A.2**

Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (HS-PS2-1) (HS-PS4-1) **HSA.CED.A.4**

Graph functions expressed symbolically and show key features of the graph, by in hand in simple cases and using technology for more complicated cases. (HS-PS2-1) **HSF-IF.C.7**

Represent data with plots on the real number line (dot plots, histograms, and box plots). (HS-PS2-1) **HSS-IS.A.1**

LA.RL.11-12.1	Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
LA.RL.11-12.2	Determine two or more themes or central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.
LA.RI.11-12.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
LA.RI.11-12.7	Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.
LA.W.11-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, trying a new approach, or consulting a style manual (such as MLA or APA Style), focusing on addressing what is most significant for a specific purpose and audience.
TECH.9.4.12.CT	Critical Thinking and Problem-solving
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
	Modeling links classroom mathematics and statistics to everyday life, work, and decision-making. Modeling is the process of choosing and using appropriate mathematics and statistics to analyze empirical situations, to understand them better, and to improve decisions. Quantities and their relationships in physical, economic, public policy, social, and everyday situations can be modeled using mathematical and statistical methods. When making mathematical models, technology is valuable for varying assumptions, exploring consequences, and comparing predictions with data.

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will understand that:

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.
- Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history.
- Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust.
- Change and rates of change can be quantified and modeled over very short or very long periods of time.
- Some system changes are irreversible.
- Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of
- Earth with a hot but solid inner core, a liquid outer core, and a solid mantle and crust.
- Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior.
- The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection.
- Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet.
- Energy drives the cycling of matter within and between Earth's systems.
- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.
- Science knowledge is based on empirical evidence.
- Science disciplines share common rules of evidence used to evaluate explanations about natural systems.
- Science includes the process of coordinating patterns of evidence with current theory.
- Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old.
- Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history.
- Spontaneous radioactive decay follows a characteristic exponential decay law.
- Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.
- Empirical evidence is needed to identify patterns in crustal rocks.

Procedural Knowledge

Students will be able to:

- Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- Develop a model to illustrate how the appearance of land features and sea-floor features are a result of both constructive forces and destructive mechanisms.
- Quantify and model rates of change of Earth's internal and surface processes over very short and very long periods of time
- Develop an evidence-based model of Earth's interior to describe the cycling of matter by thermal convection.
- Develop a one-dimensional model, based on evidence, of Earth with radial layers determined by density to describe the cycling of matter by thermal convection.
- Develop a three-dimensional model of Earth's interior, based on evidence, to show mantle convection and the resulting plate tectonics.
- Develop a model of Earth's interior, based on evidence, to show that energy drives the cycling of matter by thermal convection.
- Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
- Evaluate evidence of plate interactions to explain the ages of crustal rocks.

EVIDENCE OF LEARNING

Formative Assessments

Homework

Notes

Do-Now's

Labs/Experiments/Projects

Activities

Video Clips/Animations

Summative Assessments

- Benchmarks – departmental benchmark given at the end of MP1, MP2, and MP3
- Alternative Assessments

- Lab inquiries and investigations
- Lab Practicals
- Exploratory activities based on phenomenon
- Gallery walks of student work
- Creative Extension Projects
- Build a model of a proposed solution
- Let students design their own flashcards to test each other
- Keynote presentations made by students on a topic
- Portfolio

RESOURCES (Instructional, Supplemental, Intervention Materials)

Talk to CP Environmental Science teacher about shared resources.

Global Science by Christensen and Christensen

Biozone - Earth and Space Science NGSS

INTERDISCIPLINARY CONNECTIONS

Mathematics

Physcis

English

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.