03 Human Activity and Climate 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

In this unit of study, students evaluate claims, analyze and interpret data, and develop and use models to explore the core ideas centered on the Earth's climate system. Students evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by the atmosphere and Earth's various surfaces. They apply these core ideas when they use a quantitative model to describe how variations in the flow of energy into an out of the Earth's systems result in changes in climate, and how carbon is cycle through all of the Earth's spheres. They analyze geoscience data to make the claim that one change to Earth's surface can cause changes to other Earth systems, such as the climate system. Finally, students analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. The crosscutting concepts of cause and effect, stability and change, energy and matter, and structure and function are called out as an organizing concept for these disciplinary core ideas.

CONTENT AREA STANDARDS

SCI.HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
SCI.HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
SCI.HS-ESS3-5	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
SCI.HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
SCI.HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

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

Reason abstractly and quantitatively. (HS-ESS2-2), (HS-ESS2-4), (HS-ESS2-6), (HS-ESS3-5) **MP.2**

Model with mathematics. (HS-ESS2-4), (HS-ESS2-6) **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-ESS2-2), (HS-ESS2-4), (HS-ESS2-6), (HS-ESS3-5) **HSN-Q.A.1**

Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS2-4), (HS-ESS2-6), (HS-ESS3-5) **HSN-Q.A.2**

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS2-2), (HS-ESS2-4), (HS-ESS2-6), (HS-ESS3-5) **HSN-Q.A.3**

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.
SCI.HS-PS4-4	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will understand that:

- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.
- Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes.
- The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles.
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
- Science arguments are strengthened by multiple lines of evidence supporting a single explanation
- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.

- The total amount of energy and matter in closed systems is conserved.
- The total amount of carbon cycling among and between the hydrosphere, atmosphere, geosphere, and biosphere is conserved.
- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.
- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.
- Feedback (negative or positive) can stabilize or destabilize a system.
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

Procedural Knowledge

Students will be able to:

- Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
- Use empirical evidence to differentiate between how variations in the flow of energy into and out of Earth's systems result in climate changes.
- Use multiple lines of evidence to support how variations in the flow of energy into and out of Earth's systems result in climate changes.
- Develop a model based on evidence to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
- Develop a model based on evidence to illustrate the biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere, providing the foundation for living organisms.
- Analyze geoscience data using tools, technologies, and/or models (e.g., computational, mathematical) to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

EVIDENCE OF LEARNING

Formative Assessments

Homework

Notes

Do-Now

Labs/Experiments/Projects

Activities

Video Clips/Annimations

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)

Global Science by Christensen and Christensen

Biozone - Earth and Space Science NGSS sections ESS2D&E Weather, Climate and Biogeology and ESS3D Global Climate Change

INTERDISCIPLINARY CONNECTIONS

Physical Science

Life Science

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.