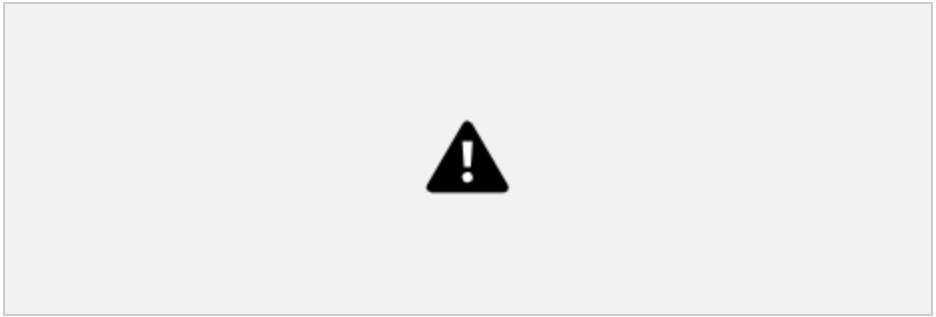
Fairfield Public Schools
Science Curriculum

Draft Units

The Science of Natural Disasters



EES - The Dangerous Planet: Natural Disasters and Catastrophes Description

Standards for this course are taken from the *Next Generation Science Standards* and are of three types:

Disciplinary Core Ideas (DCIs): Shown as content objectives, these standards define what students should know about the most essential ideas in the major science disciplines. The focus is on a limited number of core ideas in science and engineering both within and across the disciplines to avoid the shallow coverage of a large number of topics and to allow more time for teachers and students to explore each idea in greater depth. Reduction of the sheer sum of details to be mastered is intended to give time for students to engage in scientific investigations and argumentation and to achieve depth of understanding of the core ideas presented.

Science and Engineering Practices (SEP): These standards enable students to apply the content in the DCI's and the skills of practicing scientists and engineers to explain phenomena and solve real world problems. Engaging in the practices of science helps students understand how scientific knowledge develops; such direct involvement gives them an appreciation of the wide range of approaches that are used to investigate, model, and explain the world. Engaging in the practices of engineering likewise helps students understand the work of engineers, as well as the links between engineering and science.

Crosscutting Concepts: These standards provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas. These broad concepts tie together the influence of engineering, technology, and science on society and the natural world.

http://www.nextgenscience.org/next-generation-science-standards

CROSS CUTTING CONCEPTS

Patterns: Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

Structure and function. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

The Dangerous Planet: Natural Disasters and Catastrophes

Course Essential Questions
• How is the earth structured, and what implications does that have for life on the surface? • How does the hydrosphere interact with the geosphere? • What are the interactions between weather, climate and humans?

Course: Year-at-a Glance

Unit	Title		Unit Essential Questions
1	Earthquakes, tsunamis and volcanoes	Plate tectonics and large-scale system interaction Wave properties Earth materials and systems	Why does the ground shake? Why are tsunami waves so devastating? Why are there no volcanoes in CT? Where did the igneous rock come from?
2	Floods	The roles of water in Earth's surface properties Human impacts on Earth's systems Natural Resources & Hazards	Why do certain areas flood? How can we design against flooding? How do humans cause flooding?
3	Hurricanes and typhoons	Weather and Climate Human impacts on Earth's systems Biogeology	Are hurricanes getting stronger? How can we protect ourselves from hurricanes?

Unit 1 - Earthquakes, tsunamis and volcanoes

Overview

Radioactive decay in the core provides the energy that powers movement within the earth, causing many natural disasters. Movement of the plates results in earthquakes (and secondarily tsunamis) and volcanoes.

Unit Content Objectives

At the conclusion of this unit, students will be able to:

- **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. (HS-ESS1-5)**
- **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. (HS-ESS2-1)**
- **Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. (HS-ESS2-5)**
- **Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. (HS-ESS2-3)**

Unit Essential Questions

- Why does the ground shake?
- Why are tsunami waves so devastating?
- Why are there no volcanoes in CT? Where did the igneous rock come from?

Crosscutting Concepts

- Energy and matter
- Stability and change
- Cause and effect
- Influence of Engineering, Technology, and Science on Society and the Natural World

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI): Plate tectonics and large-scale system interaction, Wave properties, Earth materials and systems

ESS2.B: Plate Tectonics and Large-Scale System Interactions

• 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. (HS-ESS2-3)

• 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. (ESS2.B Grade 8 GBE), (HS-ESS2-1)

• Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. (ESS2.B Grade 8 GBE), (HS-ESS2-1)

PS4.A Wave properties

• Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet. (secondary to HS-ESS2-3)

ESS2.A - Earth materials and systems

• Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1), (HS-ESS2-2)

• 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. (HS-ESS2-3)

• The geologic 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 timescales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4)

SCIENCE AND ENGINEERING PRACTICES (SEP):

Engaging in Argument from Evidence

• Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-ESS1-5)

Developing and Using Models

• Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS2-1), (HS-ESS2-3)

Planning and Carrying Out Investigations

• Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-ESS2-5)

Corresponding CT Core Standards: **ELA/Literacy –** WHST.9-12.2, RST.11-12.8, RST.11-12.1, RST.11-12.2, WHST.9-12.7, SL11-12.5 **Mathematics –** MP.2, MP.4, HSN-Q.A.1, HSN-Q.A.2, HSN-Q.A.3

Unit 2 Floods

Overview

Floods drastically alter the earth and can take place in a matter of minutes. It's up to us to adapt to and interact with the environment in a safe and meaningful way.

- **Unit Content Objectives**
- **Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.**

Unit Essential Questions

- Why do certain areas flood?
- How can we design against flooding?
- How do humans cause flooding?

Crosscutting Concepts

- Stability and Change
- Systems and system models
- Cause and Effect
- Influence of Engineering, Technology, and Science on Society and the Natural World

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

ESS2.C: The Roles of Water in Earth's Surface Processes
• The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb,store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5)
ESS3.A: Natural Resources
• Resource availability has guided the development of human society. (HS-ESS3-1)
ESS3.B: Natural Hazards
• Natural hazards and other geologic events have shaped the course of human history; they have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)
ESS3.C: Human Impacts on Earth Systems
• The sustainability of human societies and the biodiversity that supports them require responsible management of natural resources. (HS-ESS3-3)
• Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

SCIENCE AND ENGINEERING PRACTICES (SEP):

Planning and Carrying out Investigations
• Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-ESS2-5)
Using Mathematics and Computational Thinking
• Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-ESS3-3)
Constructing Explanations and Designing Solutions
• Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS3-1)
• Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ESS3-4)

Corresponding CT Core Standards:
ELA/Literacy – WHST.9-12.7, RST.11-12.1, RST.11-12.8, WHST.9-12.2

Mathematics – MP.2, MP.4, HSN-Q.A.1, HSN-Q.A.2, HSN-Q.A.3

Unit 3 Hurricanes, and Tsunamis

Overview

Water's ability to absorb solar energy contributes to the formation of hurricanes and typhoons. Engineers can design buildings to withstand the impact of high impact winds and flooding. We can also engineer natural solutions to increase an area's natural ability to absorb an impact.

Unit Content Objectives

At the conclusion of this unit, students will be able to:

- **Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.**
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Unit Essential Questions

- Are hurricanes getting stronger?
- How can we protect ourselves from hurricanes?

Crosscutting Concepts

- Energy and matter
- Stability and change
- Cause and effect
- Influence of Engineering, Technology, and Science on Society and the Natural World

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

ESS2.D: Weather and Climate
• 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. (HS-ESS2-4)
• Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6), (HS-ESS2-7)
• Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6), (HS-ESS2-4)
ESS2.E: Biogeology
• The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7)
ESS3.C: Human Impacts on Earth Systems
• The sustainability of human societies and the biodiversity that supports them require responsible management of natural resources. (HS-ESS3-3)
• Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

SCIENCE AND ENGINEERING PRACTICES (SEP):

Developing and Using Models
• Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS2-1), (HS-ESS2-3), (HS-ESS2-6)
• Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4)
Connections to Nature of Science
• Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4)
Using Mathematics and Computational Thinking
• Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-ESS3-3)
Constructing Explanations and Designing Solutions
• Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ESS3-4)

Corresponding CT Core Standards:
ELA/Literacy – RST.11-12.1, WHST.9-12.1, WHST.9-12.7, SL11-12.5, RST.11-12.8

Mathematics – MP.2, MP.4, HSN-Q.A.1, HSN-Q.A.2, HSN-Q.A.3