Fairfield Public Schools
Science Curriculum

Draft Units

Science of the Earth's Waters

Science of the Earth's Waters: 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.

Science of the Earth's Oceans

Course Essential Questions
● How is the ocean floor still changing? ● How does plate tectonic movement affect and alter the ocean? ● How is the ocean explored? ● How do humans contribute to oceanic pollution? ● How does pollution impact ocean biodiversity? ● How do ocean currents affect the accumulation of waste in concentrated areas? ● How does climate change affect the world's ocean? ● How does the melting of glaciers affect the ocean properties? ● How are marine mammals affected by hunting and commercial shipping? ● How is the Fairfield coast line changing? (beaches/coral reefs) ● How does human induced oceanic change impact weather? (Barrier island and storms) ● How does ocean acidification impact the diversity of life? ● How do the physical changes to the oceans affect marine life?

Course: Year-at-a Glance

Unit	Title		Unit Essential Questions
1	Changes in the Earth's Surface	Tsunamis Plate tectonics Thermal vent ecology	How is the ocean floor still hanging? How does plate tectonic movement affect and alter the ocean? How is the ocean explored?
2	Physical Changes to the World's Oceans	Currents Water pollution	How do humans contribute to oceanic pollution? How does pollution impact ocean biodiversity? How do ocean currents affect the accumulation of waste in concentrated areas? How does climate change affect the world's ocean? How does the melting of glaciers affect the ocean properties?
3	Biological Changes to the World's Oceans	Mammals Corals	How are marine mammals affected by hunting and commercial shipping? How is the Fairfield coast line changing? (beaches/coral reefs) How does human induced oceanic change impact weather? (Barrier island and storms) How does ocean acidification impact the diversity of life? How do the physical changes to the oceans affect marine life?

Unit 1: Changes in the Earth's Surface

Overview
The Earth's crust is constantly changing, new earth is being formed and old earth is being melted. These changes result in different climates and ecosystems.

Unit Content Objectives
At the conclusion of this unit, students will be able to: ● Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. ● 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. ● 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. ● 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 based on evidence of Earth's interior to describe the cycling of matter by thermal convection.

Unit Essential Questions
● How is the ocean floor still changing? ● How does plate tectonic movement affect and alter the ocean? ● How is the ocean explored?

Crosscutting Concepts
● Asking Questions and Defining Problems ● Influence of Science, Engineering, and Technology on Society and the Natural World ● Patterns ● Stability and Change ● Energy and Matter

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

ETS 1: Engineering Design

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.ETS1.A
- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. ETS1.C

ESS1: Earth's Place in the Universe

- 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. ESS1.C

ESS2: Earth's Systems

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. ESS2.A
- 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, 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. ESS2.A
- 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. ESS2.B

ESS3: Earth and Human Activity

- Resource availability has guided the development of human society. ESS3.A

SCIENCE AND ENGINEERING PRACTICES (SEP):

Influence of Science, Engineering, and Technology on Society and the Natural World
Constructing Explanations and Designing Solutions
Engaging in Argument from Evidence
Cause and Effect
Developing and Using Models
Scientific Knowledge is Based on Empirical Evidence

Corresponding CT Core Standards:

ELA/Literacy –

Mathematics –

Unit 2: Physical Changes to the World's Oceans

Overview

The ocean is a non-renewable resource that humans rely heavily on for society. Humans input an excessive amount of pollution into the earth's natural nutrient cycles. This input alters the system in many ways.

● Unit Content Objectives

At the conclusion of this unit, 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.
- 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.
- Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
- 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
- Evaluate or refine a technological solution that reduces impacts of human activities on natural systems

Unit Essential Questions

- How do humans contribute to oceanic pollution?
- How does pollution impact ocean biodiversity?
- How does ocean acidification impact the diversity of life?
- How do ocean currents affect the accumulation of waste in concentrated areas?
- How does climate change affect the world's ocean?
- How does the melting of glaciers affect the ocean properties?

Crosscutting Concepts

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

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

ETS 1: Engineering Design

- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. ETS1.A

ESS2: Earth's Systems

- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6),(HS-ESS2-4)
- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1),(HS-ESS2-2)

ESS3: Earth and Human Activity

- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)
- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)
- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)
- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ESS3-4)

SCIENCE AND ENGINEERING PRACTICES (SEP):

- Developing and Using Models
- Analyzing and Interpreting Data
- Scientific Investigations Use a Variety of Methods
- Scientific Knowledge is Based on Empirical Evidence
- Using Mathematics and Computational Thinking
- Constructing Explanations and Designing Solutions

Corresponding CT Core Standards:

ELA/Literacy –

Mathematics –

Unit 3: Biological Changes to the World's Oceans

Overview
Human activity has a direct impact on the ocean. The biodiversity of organisms and their ability to survive is related to our activities.

Unit Content Objectives
At the conclusion of this unit, students will be able to: ● Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. ● Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. ● Analyze data using computational models in order to make valid and reliable scientific claims. ● Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. ● Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. ● Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Unit Essential Questions
● How does human activity —including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change, disrupt an ecosystem and threaten the survival of some species? ● How are marine mammals affected by hunting and commercial shipping? ● How do the physical changes to the oceans affect marine life? ● How doe these human activities affect world wide coastlines, including Fairfield?

Crosscutting Concepts
● Cause and Effect ● Stability and Change ● Influence of Science, Engineering, and Technology on Society and the Natural World ● Science is a Human Endeavor ● Systems and System Models ● Scale, Proportion, and Quantity

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

ETS 1: Engineering Design

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. ETS1.B
- Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-3

ESS3: Earth and Human Activity

- Resource availability has guided the development of human society. HS-ESS3-1
- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. HS-ESS3-3
- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. HS-ESS3-5

LS2: Ecosystems

- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. HS-LS2-1, HS-LS2-2
- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. HS-LS2-2
- Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. HS-LS2-7
- Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. HS-LS2-8

LS4: Biological Evolution: Unity and Diversity

- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. HS-LS4-6

SCIENCE AND ENGINEERING PRACTICES (SEP):

Constructing Explanations and Designing Solutions
Using Mathematics and Computational Thinking
Analyzing and Interpreting Data
Scientific Investigations Use a Variety of Methods

Scientific Knowledge is Based on Empirical Evidence Engaging in Argument from Evidence
Corresponding CT Core Standards:- **ELA/Literacy –** **Mathematics –**