Fairfield Public Schools
Science Curriculum

The Planet's Oceans

The Planet's Oceans: Description

In this course, you will get to know the ocean world: plate tectonics, ocean currents, deep depths, tides and waves. You will discover how the changing ocean floor, climate, and circulation patterns affect marine life and the coastlines we live on.

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

- Human activities can have an adverse impact on the Earth's ocean.
- The ocean floor is observed indirectly or directly with various technologies.
- The changing crust results in changing physical features, coastlines and ocean life.
- The changing Earth's systems are interacting which cause feedback effects.

The Planet's Oceans

Enduring Understandings

Course Essential Questions
● How are humans having an impact on the Earth's oceans and climate? ● What are some ways that we can observe and learn about the ocean? ● Does tectonic plate movement affect the oceans? ● Does the climate affect the ocean or does the ocean affect the climate?

The Planet's Oceans: Semester-at-a-Glance

Unit	Title	Unit Essential Questions
1	Changes in the Earth's Surface	● How is the ocean floor still changing? ● How does plate tectonic movement affect and alter the ocean? ● How is the ocean explored?
2	Physical Changes to the World's Oceans	● 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 the sun and the moon affect the Earth's oceans? ● 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	● 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.

Performance Expectations

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

HS-ESS1-3.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-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.

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.

HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.

HS-ESS3-1. 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.

Unit Essential Question

- How is the ocean floor still changing?
- How does plate tectonic movement affect and alter the ocean?
- How is the ocean explored?

Crosscutting Concepts

Energy and Matter

- In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HSESS1-3)
- Energy drives the cycling of matter within and between systems. (HS-ESS2-3)

Patterns

- Empirical evidence is needed to identify patterns. (HS-ESS1-5)

Stability and Change

- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS2-1)

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1)

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

ESS1.A: The Universe and Its Stars

- The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-ESS1-3)
- Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1- 2),(HS-ESS1-3)

ESS1.C: The History of Planet Earth

- 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. (HS-ESS1-5)

PS1.C: Nuclear Processes

- Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to HS-ESS1-5),(secondary to HS-ESS1-6)

ESS2.A: Earth Materials and Systems

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HSESS2-1),(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, 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)

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

SCIENCE AND ENGINEERING PRACTICES (SEP):

Obtaining, Evaluating, and Communicating Information

- Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-ESS1-3)

Engaging in Argument from Evidence

- Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-ESS1-5)
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Corresponding CT Core Standards:

ELA/Literacy – RST.11-12.1, RST.11-12.8, WHST.9-12.2, SL.11-12.4

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

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.

Performance Expectations

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

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.

HS-ESS2-2. 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.

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.

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

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

Stability and Change

- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS2-1)
- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS2- 2)

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
- (HS-ESS2-4)

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6)

Stability and Change

- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS2-2) (HSESS3-4)

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

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

- 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

- 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)

Analyzing and Interpreting Data

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-ESS2-2)

Using Mathematics and Computational Thinking

- Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6)

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, RST.11-12.2, SL.11-12.5

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

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.

Performance Expectations

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

HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

HS-LS2-8. 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 do these human activities affect worldwide coastlines, including Fairfield?

Crosscutting Concepts

Stability and Change

- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS2-1) (HSESS3-3),(HS-ESS3-5)
- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS2-2) (HSESS3-4)

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6)

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-8)

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

ESS3: Earth and Human Activity

- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (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)

Using Mathematics and Computational Thinking

- Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6)

LS2: Ecosystems

- Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. (HS-LS2-8)

SCIENCE AND ENGINEERING PRACTICES (SEP):

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-8)

Stability and Change

- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HSESS3-3),(HS-ESS3-5)
- Feedback (negative or positive) can stabilize or destabilize a system. (HSESS3-4)

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6)

Corresponding CT Core Standards:

ELA/Literacy – RST.9-10.8, RST.11-12.1, RST.11-12.8

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