Fairfield Public Schools
Science Curriculum

Draft
EARTH'S DYNAMIC ENVIRONMENT
March 12, 2018

Earth's Dynamic Environment: Description

This foundational course gives you the tools to begin to interpret and understand the changing world around you. You will investigate Earth's geological history, its natural processes, and the human activities that continue to influence the Earth's current state. Is it getting hot in here? Can you come up with solutions to help us out of our current predicament?

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

Earth's Dynamic Environment

Enduring Understandings

Our Earth is ever-changing in many ways.
We influence the way our Earth changes in certain situations.
We rely on the Earth to provide the resources we need to survive.

Course Essential Questions

- How has the Earth's place in the universe resulted in the diversity we see on our planet today?
- How and why is Earth constantly changing?
- How do Earth's surface processes and human activities affect each other?

Course: Semester-at-a-Glance

Unit	Title	Unit Essential Questions
1	*Earth Systems* Evolution & Biodiversity	• How did Earth's history influence geological climate? • How does Earth's changing dynamic influence biodiversity? • Where are we and why are we here?
2	*Resource Extraction* Mining	• Where do fossil fuels come from and how are they obtained and utilized? • How does mining impact the landscape?
3	*Human Impacts on Earth Systems* Global Climate Change	• How is natural and anthropogenic climate change impacted by feedback loops? • How does global climate change affect us?
4	*Sustainability & Change*	• How do we become less reliant on non-renewable resources? • How might various engineering solutions address the repercussions of climate change?

Unit 1 Earth Systems

Overview

Earth's formation and changing physical dynamic influences geographical climate and creation of our biomes.

Performance Expectations

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

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-ESS2-7. Construct an argument based on evidence about the simultaneous co-evolution of Earth's systems and life on Earth.

Unit Essential Questions

- How did Earth's history influence geological climate?
- How does Earth's changing dynamic influence biodiversity?
- Where are we and why are we here?

Crosscutting Concepts

Cause and Effect

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

Energy and Matter

• The total amount of energy and matter in closed systems is conserved. (HS-ESS2-6)

Stability and Change

• Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS2-7)

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

ESS2.A: Earth Materials and Systems

• 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 time periods. (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)

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 redistribution 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)

ESS1.B: Earth and the Solar System

• 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 Earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (secondary to HS-ESS2-4)

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)

Engaging in Argument from Evidence

• Construct an oral and written argument or counter arguments based on data and evidence. (HS-ESS2-7)

Corresponding CT Core Standards:
ELA/Literacy – RST.11-12.1, WHST.9-12.1, SL11-12.5
Mathematics – MP.2, MP.4, HSN-Q.A1, HSN-Q.A.2, HSN-Q.A.3

Unit 2 Resource Extraction

Overview

Geological and biological processes lead to mineral and fossil fuel deposits. There are a variety of methods of extracting resources based on location and type of resource. Each of these methods has different environmental impacts.

Performance Expectations

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

HS-ESS 3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS-ESS 3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

Unit Essential Questions

- Where do fossil fuels come from and how are they obtained and utilized?
- How does mining impact the landscape?

Crosscutting Concepts

Stability and Change

• Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS3-4)

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

ESS3.A Natural Resources

• All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)

• 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):

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)

Planning and Carrying Out an Investigation

• 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.

Corresponding CT Core Standards:

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

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

Unit 3 Human Impact on Earth Systems

Overview

This unit will explore how natural processes and human activities influence global climate patterns. The various impacts of global climate change will also be discussed.

Performance Expectations

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

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.

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

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's 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 is natural and anthropogenic climate change impacted by feedback loops?
- How does global climate change affect us?

Crosscutting Concepts

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

• 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-ESS3-3), (HS-ESS3-5)

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

Energy and Matter

• The total amount of energy and matter in closed systems is conserved. (HS-ESS2-6)

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

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-ESS2-2)

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-ESS2-2),(HS-ESS2-4)

• Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6)

• Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6), (HS-ESS2-4)

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)

ESS3.D: Global Climate Change

• 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, atmosphere, and biosphere interact and are modified in response to human activities. (HS-ESS3-6)

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-ESS2-6)

Analyzing and Interpreting Data

• Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS2-2), (HS-ESS3-5)

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.11-12.8, WHST.9-12.1, RST.11-12.2, RST.11-12.7

Mathematics – MP.2, MP.4, HSN-Q.A1, HSN-Q.A.2, HSN-Q.A.3

Unit 4 Sustainability & Change

Overview

Students will investigate and evaluate the different possible solutions to environmental issues.

Performance Expectations

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

HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

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

Unit Essential Questions

- How do we become less reliant on non-renewable resources?
- How might various engineering solutions address the repercussions of climate change?

Crosscutting Concepts

Stability and Change

• Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS3-4)

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

ESS3.A: Natural Resources

- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)

ESS3.C: Human Impacts on Earth Systems

- 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):

Engaging in Argument from Evidence

• Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g., economic, societal, environmental, ethical considerations). (HS-ESS3-2)

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.11-12.8

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