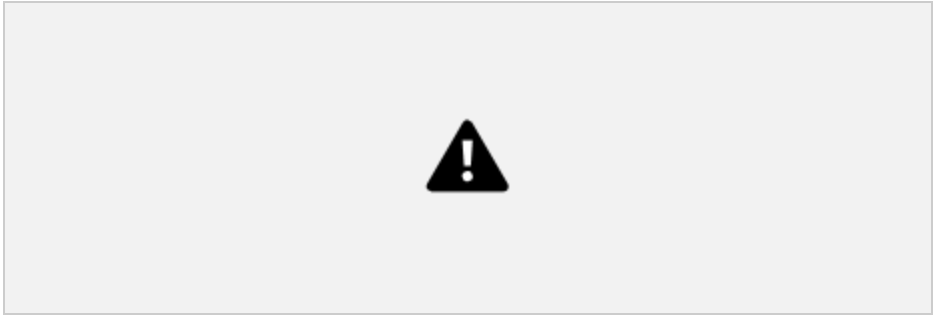
Fairfield Public Schools
Science Curriculum

Marine Science of Long Island Sound



DRAFT

Marine Science of Long Island Sound: 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.

Marine Science of Long Island Sound

Course Essential Questions
● How do the tides affect the biodiversity of LIS? ● How are tides controlled? ● How does the properties of water in different areas of the ocean affect population interactions? ● How does depth affect what forms of life exist in certain areas? ● How have humans impacted the diversity of life in marine fisheries? ● How does temperature impact the solubility of oxygen? ● How is nutrients and materials cycled through ocean and planet? ● How have humans impacted the cycling of nutrients through the ocean? ● How does climate change impact in New England's coastline? ● How does temperature affect the properties of and movement of water and the distribution of weather and climate? ● How does the ocean act as thermoregulator for the planet?

Course: Semester-at-a Glance			

Unit	Title		Unit Essential Questions
1	LIS Intertidal Ecology	Tides Properties of water Critter adaptations Intertidal communities (biotic and abiotic factors: Wave action/desiccation)	How do the tides affect the biodiversity of LIS? How do you humans manage the coastline? How does the properties of water in different areas of the ocean affect population interactions? How do species' adaptations help them live in the intertidal zone?
2	Continental Shelf	Ocean zones and the abiotic factors Fish Nutrient cycling (prop of water)	How does depth affect what forms of life exist in certain areas? How have humans impacted the diversity of life in marine fisheries? How does temperature impact the solubility of oxygen? How is nutrients and materials cycled through ocean and planet? How have humans impacted the cycling of nutrients through the ocean?
3	Climate Change and Marine Ecology	Climate Change Food webs Population dynamics Water properties Thermoregulation	How does climate change impact in New England's coastline? How does temperature affect the properties of and movement of water and the distribution of weather and climate? How does the ocean act as thermoregulator for the planet? How can humans model, predict and manage current and future impacts of global climate change.

Unit 1 LIS Intertidal Ecology

Overview
Our Fairfield students live directly on the coast of Long Island Sound. We work, play and have our economy based on life on the Sound. Humans have a direct impact in how we use, manage and harvest the ecosystem and habitats.An understanding of the make up of the intertidal ecosystem allows us to properly manage this important resource.

Unit Content Objectives
At the conclusion of this unit, students will be able to: ● HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. ● HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. ● HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Unit Essential Questions
● How do the tides affect the biodiversity of LIS? ● How do you humans manage the coastline? ● How does the properties of water in different areas of the ocean affect population interactions? ● How do species' adaptations help them live in the intertidal zone?

Crosscutting Concepts
● Structure and Function ● Cause and Effect ● Stability and Change

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.

LS4.C: Adaptation

- Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-6)

SCIENCE AND ENGINEERING PRACTICES (SEP):

- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data

Corresponding CT Core Standards:
ELA/Literacy –
Mathematics –

Unit 2 Continental Shelf

Overview
Abiotic factors in the different depth zones in the ocean to determine the effect on the diversity of life that exists there. Life over the Continental Shelf is unique and an important ecosystem for humans. How we alter and manage life over the shelf is critical to the survival of the different species of organisms.

Unit Content Objectives
HS-ESS2-6 Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. HSLS 2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems 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-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. 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.

Unit Essential Questions
● How does depth affect what forms of life exist in certain areas? ● How does temperature impact the solubility of oxygen? ● How have humans impacted the diversity of life in marine fisheries? ● How is nutrients and materials cycled through ocean and planet? ● How have humans impacted the cycling of nutrients through the ocean?

Crosscutting Concepts
Energy and Matter Stability and Change Cause and Effect Systems and System Models

NGSS Unit Standards
DISCIPLINARY CORE IDEAS (DCI): ESS2.D: Weather and Climate ● 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 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),*(Note: This Disciplinary Core Idea is also addressed by HS-ESS2-2.)* ESS3.A: Natural Resources ● Resource availability has guided the development of human society. (HS-ESS3-1) ESS3.C: Human Impacts on Earth Systems ● The sustainability of human societies and the biodiversity that supports them requires 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) ETS1.B: Developing Possible Solutions ● 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. (secondary to HS-ESS3-2),(secondary HS-ESS3-4) **SCIENCE AND ENGINEERING PRACTICES (SEP):** ● Interdependence of Science, Engineering, and Technology ● Influence of Engineering, Technology, and Science on Society and the Natural World ● Analyzing and Interpreting Data ● Constructing Explanations and Designing Solutions
Corresponding CT Core Standards: ELA/Literacy – Mathematics –

Unit 3

Overview
Climate change is a real phenomenon that is altering the physical and biological components of Long Island Sound. Changes in the way heat is distributed around the globe is directly related to climate zones and their locations.

Unit Content Objectives
At the conclusion of this unit, students will be able to: ● HS-LS 2-6 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. ● HS-ESS 2-4. 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-ESS3-1 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. ● 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. ● 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-LS 2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. ● HS-LS2-2Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. ● HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity

Unit Essential Questions
● How does climate change impact in New England's coastline and biodiversity? ● How does temperature affect the properties of and movement of water and the distribution of weather and climate? ● How does the ocean act as thermoregulator for the planet? ● How can humans model, predict and manage current and future impacts of global climate change?

Crosscutting Concepts
● Energy and Matter ● Stability and Change ● Cause and Effect

- Scale, Proportion, and Quantity

NGSS Unit Standards

DISCIPLINARY CORE IDEAS (DCI):

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3)
- Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)
- Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5)
- 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)
- 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-LS2-2)
- 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)

ESS2.D: Weather and Climate

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

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)

SCIENCE AND ENGINEERING PRACTICES (SEP):

- Developing and using models
- Using mathematics and computational thinking
- Construction explanations and designing solutions
- Scientific Knowledge is Open to Revision in Light of New Evidence

Corresponding CT Core Standards:
ELA/Literacy –
Mathematics –