# Plymouth Public Schools' Science and Technology/Engineering Program High School Environmental Science Learning Standards

STE2053 Environmental Science College Prep 1

An Introduction to the Massachusetts Department of Elementary and Secondary Education Science and Technology/Engineering Curriculum Framework
Effective teaching and learning in science fosters engagement and has rigor, relevance, and coherence embedded within. It couples practice with content to give the context for performance. A program with these components encourages students to analyze and explain phenomena and experience; engages with practices to build, use, and apply knowledge; and builds a storyline over time and among disciplines. The state standards that form this program are outcomes that reflect what a student should know and be able to do as a result of instruction. Science and engineering practices, which are included in these standards, are not teaching strategies; they are important learning goals and skills to be learned, also as a result of instruction. The standards listed below are not intended to represent an exhaustive list of all that could be included in our district's science program, nor should this list prevent students from going beyond the standards where appropriate. (Excerpts from Curriculum Framework)

Disciplinary Core Ideas – ELECTIVE COURSES
By the end of high school, students should have gained a sufficient knowledge of the science and engineering practices and disciplinary core ideas of science and engineering to engage in public discussions on science-related issues, to be critical consumers of scientific information related to everyday lives, and to continue to learn about science throughout their lives. They do so by enrolling in and successfully completing introductory science courses, as well as application level elective courses. Within these elective courses, students come to appreciate that science and engineering are instrumental in addressing major challenges that confront society today and perhaps so excited and inspired to want to pursue science or engineering-based careers as a result. (Excerpts from National Research Council, A Framework for K-12 Science Education)

LS2. Ecosystems: Interactions, Energy, and Dynamics

HS-LS2-6. Analyze data to show ecosystems tend to maintain relatively consistent numbers and types of organisms even when small changes in conditions occur but that extreme fluctuations in conditions may result in a new ecosystem. Construct an argument supported by evidence that ecosystems with greater biodiversity tend to have greater resistance to change and resilience.

Clarification Statement:
Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption, fires, the decline or loss of a keystone species, climate changes, ocean acidification, or sea level rise.

HS-LS2-7. Analyze direct and indirect effects of human activities on biodiversity and ecosystem health, specifically habitat fragmentation, introduction of non-native or invasive species, overharvesting, pollution, and climate change. Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.

Clarification Statement:
Examples of solutions can include captive breeding programs, habitat restoration, pollution mitigation, energy conservation, and ecotourism.

ESS2. Earth's Systems

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems over different time scales result in changes in climate. Analyze and interpret data to explain that long-term changes in Earth's tilt and orbit result in cycles of climate change such as Ice Ages.

Clarification Statement:
Examples of the causes of climate change differ by timescale: large volcanic eruption and ocean circulation over 1–10 years; changes in human activity, ocean circulation, and solar output over tens to hundreds of years; changes to Earth's orbit and the orientation of its axis over tens to hundreds of thousands of years; and long-term changes in atmospheric composition over tens to hundreds of millions of years.

HS-ESS2-6. Use a model to describe cycling of carbon through the ocean, atmosphere, soil, and biosphere and how increases in carbon dioxide concentrations due to human activity have resulted in atmospheric and climate changes.

ESS3. Earth and Human Activity

HS-ESS3-1. Construct an explanation based on evidence for how the availability of key natural resources and changes due to variations in climate have influenced human activity.

Clarification Statements:
1. Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils (such as river deltas), high

concentrations of minerals and fossil fuels, and biotic resources (such as fisheries and forests).
2. Examples of changes due to variations in climate include changes to sea level and regional patterns of temperature and precipitation.

HS-ESS3-2. Evaluate competing design solutions for minimizing impacts of developing and using energy and mineral resources, and conserving and recycling those resources, based on economic, social, and environmental cost-benefit ratios.

Clarification Statement:
Examples include developing best practices for agricultural soil use, mining (for metals, coal, tar sands, and oil shales), and pumping (for petroleum and natural gas).

HS-ESS3-3. Illustrate relationships among management of natural resources, the sustainability of human populations, and biodiversity.

Clarification Statements:
1. Examples of factors related to the management of natural resources include costs of resource extraction and waste management, per capita consumption, and the development of new technologies.
2. Examples of factors related to human sustainability include agricultural efficiency, levels of conservation, and urban planning.
3. Examples of factors related to biodiversity include habitat use and fragmentation, and land and resource conservation.

HS-ESS3-5. Analyze results from global climate models to describe how forecasts are made of the current rate of global or regional climate change and associated future impacts to Earth systems.

Clarification Statement:
Climate model outputs include both climate changes (such as precipitation and temperature) and associated impacts (such as on sea level, glacial ice volumes, and atmosphere and ocean composition).