# Bartlett Environmental Course Curriculum



# Introduction

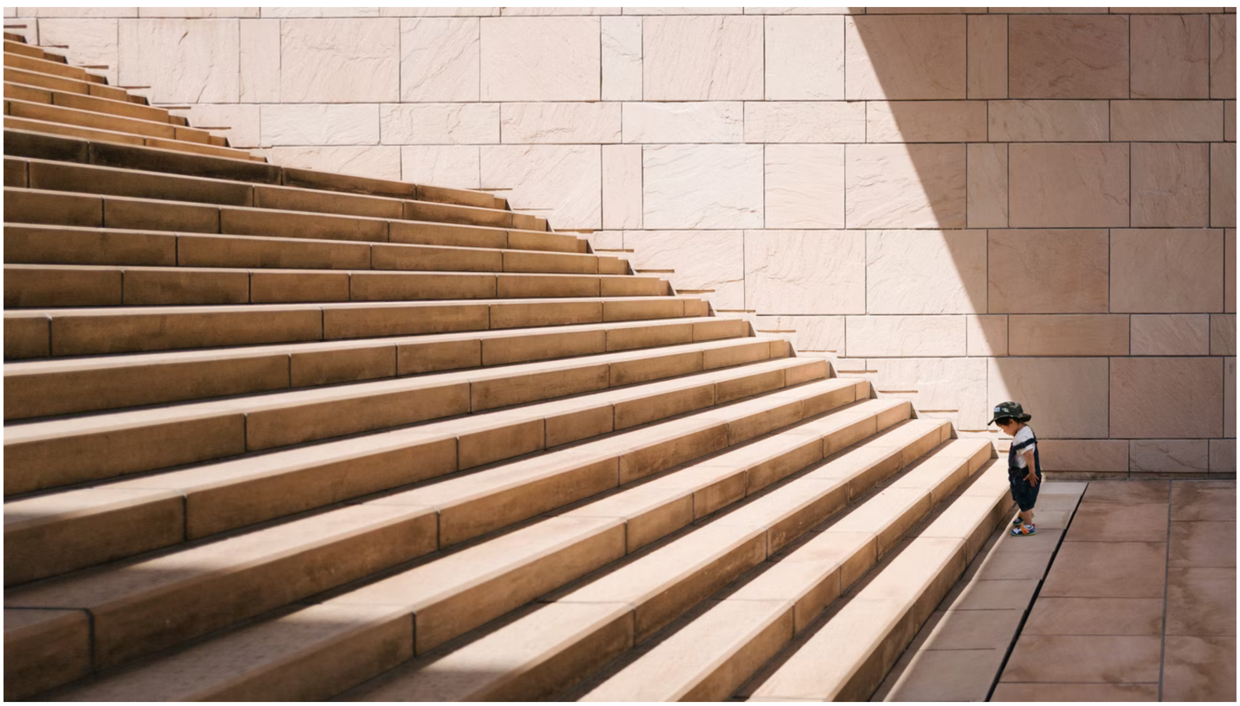
This brief introduction to this Environment Science course does several things: *describing* the goals for the course; *discussing* the design principles employed; *outlining* the Essential Questions and Big Ideas/Enduring Understandings; and *outlining* the Massachusetts learning standards addressed.

## Goal of the Course

The goal of this Environment Science course is threefold:

1. **Enhance** the science experience of incoming freshmen.
2. Allow students to **explore** the key concepts of the course through student-centered pedagogical strategies, such as: project-based learning, design thinking, and inquiry-based learning.
3. Provide students with a **rich experience** of environmental science, sustainability, and human impact on the environment.

## Essential Questions and Big Ideas/Enduring Understandings



### Essential Questions for the Course

1. Living and non-things things are connected via **complex, adaptive systems**. When you touch one thing, you touch everything.
2. Living systems tend toward **homeostasis**, however humans have an outsized impact on the environment which threatens this homeostasis.
3. People can learn to come together to design solutions that can positively influence the **sustainability** of our world.

### Big Ideas/Enduring Understandings for the Course

1. How do living and non-living systems work and work together and respond to one another?
2. What is the value of diversity in terms of living and non-living systems, and how can this diversity be expanded?
3. In what ways have we had negative impacts on our world and how can we repair the damage we have caused?

## Learning Standards Addressed

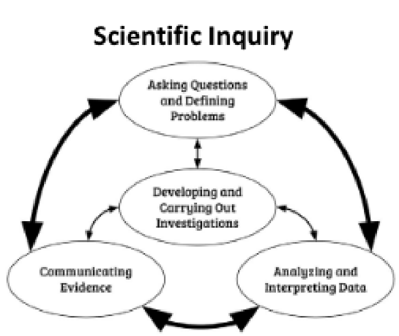
This curriculum has been designed to address the Massachusetts 2016 Science and Technology Engineering Framework .

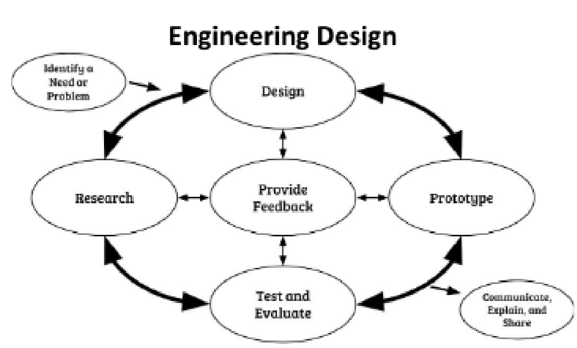
| Standard | 9-12 Description |
|---|---|
| ESS.1.5 Earth's Place in the Universe | Evaluate evidence of the past and current movements of continental and oceanic crust, the theory of plate tectonics, and relative densities of oceanic and continental rocks to explain why continental rocks are generally much older than rocks of the ocean floor. |
| ESS2.A Earth materials and systems | Feedback effects exist within and among Earth’s systems. |
| ESS2.C The roles of water in Earth’s surface processes | The planet’s dynamics are greatly influenced by water’s unique chemical and physical properties. |
| ESS2.D Weather and climate | The role of radiation from the Sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. |
| ESS3.A Natural resources | Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits, including to global climate. |
| LS1.C Organization for matter and energy flow in organisms | Organisms are constantly breaking down and reorganizing matter. The hydrocarbon backbones of sugars produced through photosynthesis are used by organisms to make amino acids and other macromolecules that can be assembled into proteins or DNA. During cellular respiration, the bonds of macromolecules and oxygen are broken down to build new products and transfer energy. |
| LS2.A Interdependent relationships in ecosystems | Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects genetic diversity within populations and biodiversity within ecosystems. |
| LS2.B Cycles of matter and energy transfer in ecosystems | Photosynthesis captures energy in sunlight and stores it in chemical bonds of matter. Most organisms rely on cellular respiration to release energy in these bonds to power life processes. About 90% of available energy is lost from one trophic level to the next, resulting in fewer organisms at higher levels. At each link in an ecosystem, elements are combined in different ways and matter and energy are conserved. Photosynthesis, cellular respiration and decomposition are key components of the global carbon cycle. |

| Standard | 9-12 Description |
| --- | --- |
| LS2.C Ecosystem dynamics, functioning, and resilience | If a biological or physical disturbance to n ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex interactions within the ecosystem. The ability of an ecosystem to both resist and recover from change is a measure of its overall health. |
| PS1.B Chemical reactions | Chemical processes and reaction rates are understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved. Knowledge of conservation of atoms with chemical properties and electrical charges can be used to describe and predict chemical reactions. Main types of reactions include transfer of electrons (redox) or hydronium ions (acids/bases). Changes in pressure, concentration, or temperature affect the balance between forward and backward reaction rates (equilibrium). Ionic and covalent bonds can be predicted based on the types of attractive forces between particles. |
| PS2.B Types of interactions | Electrical forces between electrons and the nucleus of atoms explain chemical patterns. Intermolecular forces determine atomic composition, molecular geometry and polarity, and, therefore, structure and properties of substances. The kinetic-molecular theory describes the behavior of gas in a system. |
| PS3.A and 3.B Definition and conservation of energy and energy transfer | The total energy within a physical system is conserved. Energy transfer within and between systems can be described and predicted in terms of energy associated with the motion or configuration of particles. |
| | |

## Scientific Inquiry and Engineering Design Processes

Additionally, this curriculum addresses and embraces the Scientific Inquiry process and Engineering Design process outlined in that standards framework.



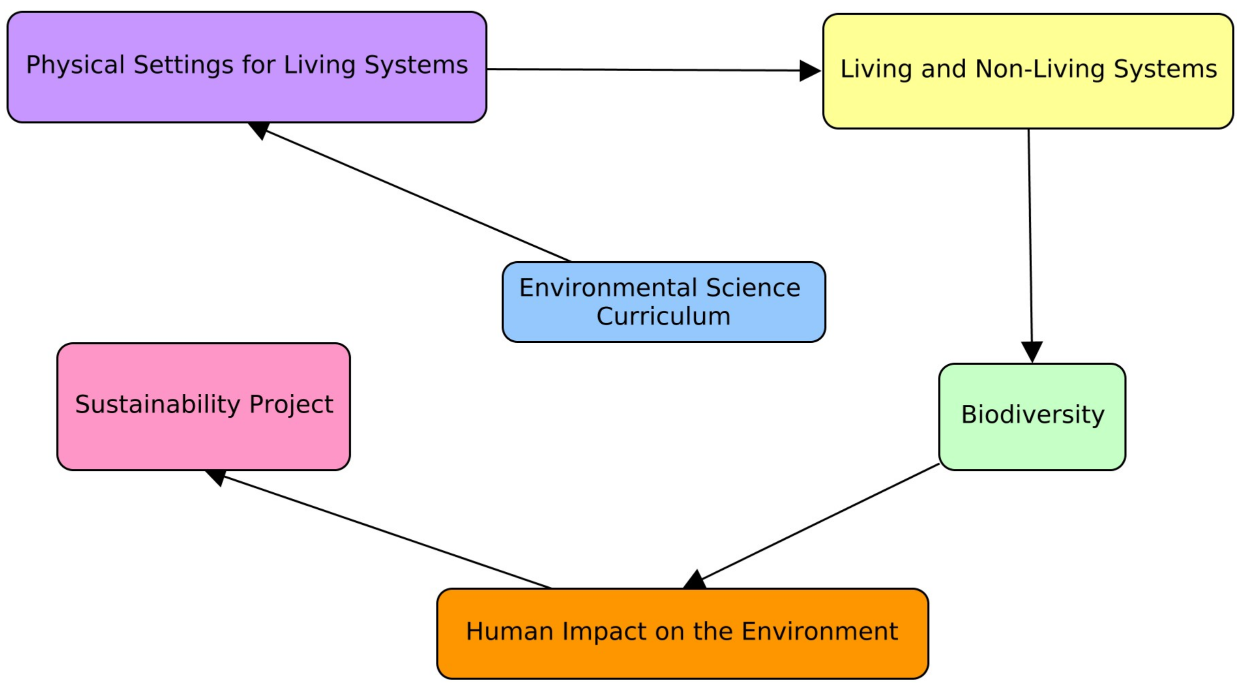
## Design Principles

This course was built with several design principles in mind:

1. **Interdisciplinarity**. We believe that the scientific concepts of this course, as well as the sociological ones, are inherently interdisciplinary in nature. Hence, connections between them are considered important and necessary.
2. **Hands On**. We believe that adolescents learn best when they can engage directly with materials and concepts, and so this course has been designed to include lots of hands on experiences.
3. **Autonomy Support**. We believe that adolescents learn best when they are encouraged and allowed to engage with their learning with as much autonomy as possible, consistent with research into Self Determination Theory.
4. **UN Sustainable Development Goals (SDG).** This course has been designed to engage adolescents deeply in the United Nations Sustainable Development Goals (SDG) and to encourage them as Earth Citizens.
5. **Core Science/Math/Literacy Skills**. This course has been designed to support the development and application of core science, mathematics, and literacy skills.

# Topics/Units of Study

This curriculum includes fivethese topics/units of study.



| Topic/Unit of Study (35 weeks of instruction) | Key Ideas/Concepts |
|---|---|
| *Physical Settings for Living Systems* (4-6 weeks) | History of the Earth<br>Chemistry of Geological and Atmospheric Processes<br>Weather/Evolution of Weather on Earth |
| *Living and Non-Living Systems* (4-6 weeks) | Chemistry of Living Things<br>Flow of energy through living and non-living systems<br>Homeostasis in systems<br>Trophic Levels |
| *Biodiversity* (4-6 weeks) | What is biodiversity?<br>Why is biodiversity important?<br>What are the threats to biodiversity?<br>What are some solutions to the threats of biodiversity? |
| *Sustainability/ Human Impacts on the Environment* (8 weeks) | The dynamic relationship between humans and the environment.<br>Deforestation & Habitat loss<br>Climate change<br>Species decline<br>Pollution<br>Attempts to Repair Impacts to the Environment |
| *Final Project* (8 weeks) | Deconstruct a **"Wicked Problem"** related to sustainability.<br>*Research* the problem. *Propose* a solution. *Design* a prototype. *Involve* the community. *Share* your work. |

## Course Units

### Unit 1: Physical Settings for Living Systems

### Unit 2: Living and Non-Living Systems

### Unit 3: Biodiversity

### Unit 4: Sustainability/Human Impacts on the Environment

### Unit 5: Final Project