

Sustainability

as Taught in the Curriculum of



Concord Public Schools &
Concord Carlisle High School

January 18, 2022

Sustainability is directly taught in three different ways.

- 1) students learn informally through the structures in our built environment; examples include the gardens at our elementary schools, the outdoor classroom at CMS, and the heating and cooling system at CCHS.
- 2) students learn through the school and classroom practices, such as paper waste reduction and recycling; dining halls employing reusable trays and utensils; and, composting in our school dining halls.
- 3) the formal curriculum includes many lessons preK - 12 on **Sustainability**.



State and National Standards

The curriculum of the Concord Public Schools and Concord Carlisle High School follow state and national standards which have been created, reviewed, and adopted by expert panels. The concepts that students explore are outlined by grade level in the:



[Massachusetts Curriculum Framework in Science 2016](#)

[Next Generation Science Standards](#)

In the Massachusetts Curriculum Framework, there are four strands of science outlined: [Life Science](#); [Physical Sciences](#); [Technology/Engineering](#); and [Earth and Space Science](#). Within Earth and Space Science, there is a strand called, “Earth and Human Activity.” This is where [Sustainability](#) is directly addressed.



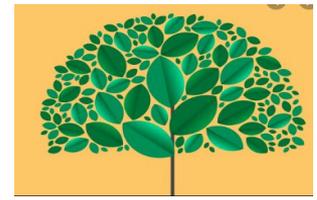
Levels: PreK - grade 3; grades 4 - 5; grades 6 - 8, and grades 9 - 12

A description of what is taught and assessed in the formal curriculum

There are examples of some of the key lessons, experiences, and projects on **Sustainability**.

At the bottom of each section are the Massachusetts standards by grade level which pertain to **Sustainability**.

Grades PreK - 3



Students in preK - grade 3 study all four areas of science: Life Science; Physical Sciences; Technology/Engineering; and Earth and Space Science. The Full Option Science System (**FOSS**) curriculum is used with our students. The focus is on science that the students can physically observe and experiment with. All students keep science notebooks to record their observations. FOSS is designed around learning as a developmental progression, providing experiences that allow students to continually build on their initial notions and develop more complex science and engineering knowledge.

Grade	Physical Science	Earth Science	Life Science
3	Motion and Matter	Water and Climate	Structures of Life
2	Solids and Liquids	Pebbles, Sand, and Silt	Insects and Plants
1	Sound and Light	Air and Weather	Plants and Animals
K	Materials and Motion	Trees and Weather	Animals Two by Two

PreK-ESS3-2(MA). Observe and discuss the impact of people's activities on the local environment.

Sample of curriculum that exposes students to concepts of conservation and sustainability (through human impact) prior to formal teaching:

- Kindergarten: Study of trees, visit to Landsake Farm
- K, 1 & 2: Life cycles of plants and insects, school gardens/initiatives
- Grade 2: Resources maps in geography, energy/circuits
- Grade 3: Water and Climate unit (the critical roles of water in Earth's surface processes and how industry, agriculture and everyday life impact the environment)

K-ESS3-3. Communicate solutions to reduce the amount of natural resources an individual uses.* Clarification Statement: • Examples of solutions could include reusing paper to reduce the number of trees cut down and recycling cans and bottles to reduce the amount of plastic or metal used.

The curriculum in these early years provides the basic scientific understanding and skills that students will need to formally begin their work on Sustainability in grades 4 and 5.

Grade 4



Grade	Physical Science	Earth Science	Life Science
4	Energy	Soils, Rocks, and Landforms	Environments

In Grade 4, energy conservation, alternative sources of energy, and renewable versus nonrenewable resources are explored through a FOSS unit. Students explore circuits and the idea of storing energy. Electric car/bus technology, solar cells, and more are examined and connected to prior knowledge. Different kinds of fuel are explored such as coal, natural gas, oil, wood, and the transfer of energy from these sources to create light, sound, motion, heat, etc. and students seek out benefits and drawbacks of these sources.

4-ESS2-2. Analyze and interpret maps of Earth’s mountain ranges, deep ocean trenches, volcanoes, and earthquake epicenters to describe patterns of these features and their locations relative to boundaries between continents and oceans.

4-ESS3-1. Obtain information to describe that energy and fuels humans use are derived from natural resources and that some energy and fuel sources are renewable and some are not.

Clarification Statements:

- Examples of renewable energy resources could include wind energy, water behind dams, tides, and sunlight.
- Non-renewable energy resources are fossil fuels and nuclear materials.

4-ESS3-2. Evaluate different solutions to reduce the impacts of a natural event such as an earthquake, blizzard, or flood on humans.

Grade 5

Grade	Physical Science	Earth Science	Life Science
5	Mixtures and Solutions	Earth and Sun	Living Systems

In Grade 5, students consider how the atmosphere, hydrosphere, and geosphere interact. They investigate energy transfer on Earth. Specifically, they study how Earth's uneven heating creates air and ocean currents that affect weather and climate. They also explore the complexities of the water cycle as they simulate the travels of a drop of water through the process. In real-world applications of their knowledge, they test different designs for solar water heaters. At the end of this unit, students are introduced to world climate regions and global climate change.

Students examine life in the ocean and how it is impacted by water quality. We travel to the Merrimack River and spend the day on a research vessel that allows students hand-on opportunities to test water properties and collect and study samples of the organisms that live in the river's estuary. This is a very engaging trip that helps students put together all the lessons they have learned from the year in an experience that makes them more aware of our collective responsibility for protecting and preserving our natural resources.

Concord's Department of Public Works visits each classroom to outline the town's water supplies and public water system, groundwater versus surface water, show a groundwater model demonstration and investigate the importance of protecting our water resources. New this year, the CPW will talk to students about the town's role in processing storm water.



Designing a device to clean garbage out of the oceans



Taking water measurements

Standards from Grade 5



5-ESS2-1. Use a model to describe the cycling of water through a watershed through evaporation, precipitation, absorption, surface runoff, and condensation.

5-ESS3-1. Obtain and combine information about ways communities reduce human impact on the Earth's resources and environment by changing an agricultural, industrial, or community practice or process. Clarification Statement:

- Examples of changed practices or processes include treating sewage, reducing the amounts of materials used, capturing polluting emissions from factories or power plants, and preventing runoff from agricultural activities.

State Assessment Boundary: Climate change or social science aspects of practices such as regulation or policy are not expected in state assessment.

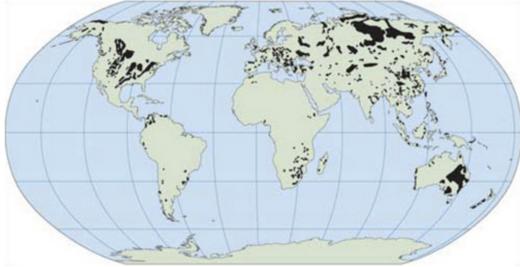
5-ESS3-2(MA). Test a simple system designed to filter particulates out of water and propose one change to the design to improve it.

5-LS2-1. Develop a model to describe the movement of matter among producers, consumers, decomposers, and the air, water, and soil in the environment to (a) show that plants produce sugars and plant materials, (b) show that animals can eat plants and/or other animals for food, and (c) show that some organisms, including fungi and bacteria, break down dead organisms and recycle some materials back to the air and soil.

5-LS2-2(MA). Compare at least two designs for a composter to determine which is most likely to encourage

6th Grade

Dark shading shows locations of coal deposits.



- Diversity of Life unit: Biodiversity and pollinators
- Earth History unit: Mineral and fossil fuel resources
- End of year Personal Passion Projects (P³): Choose a topic of interest = many sustainability and climate change themes

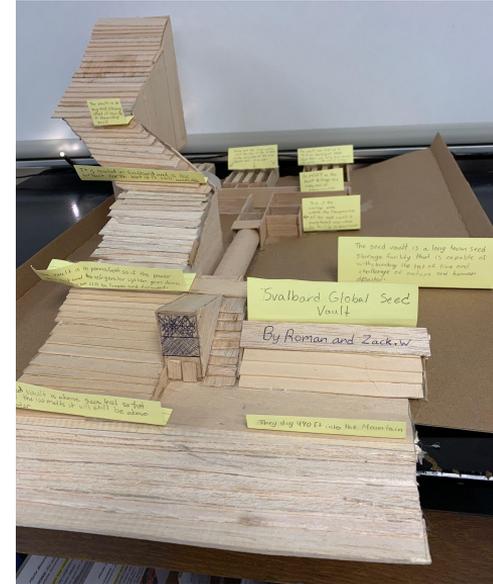


7.MS-LS2-6(MA). Explain how changes to the biodiversity of an ecosystem—the variety of species found in the ecosystem—may limit the availability of resources humans use.

7.MS-LS2-4. Analyze data to provide evidence that disruptions (natural or human-made) to any physical or biological component of an ecosystem can lead to shifts in all its populations.

8.MS-ESS3-1. Analyze and interpret data to explain that the Earth's mineral and fossil fuel resources are unevenly distributed as a result of geologic processes.

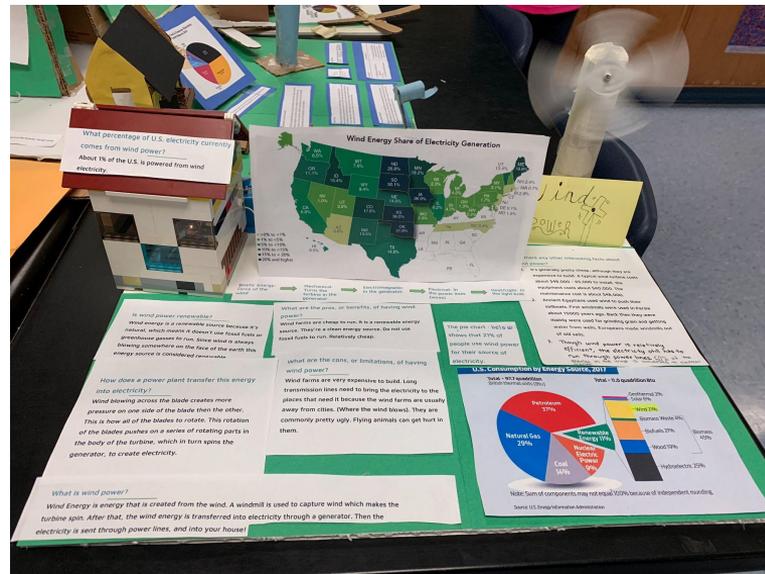
8.MS-ESS3-5. Examine and interpret data to describe the role that human activities have played in causing the rise in global temperatures over the past century.



P³ 3D model of the Global Seed Vault

7th Grade

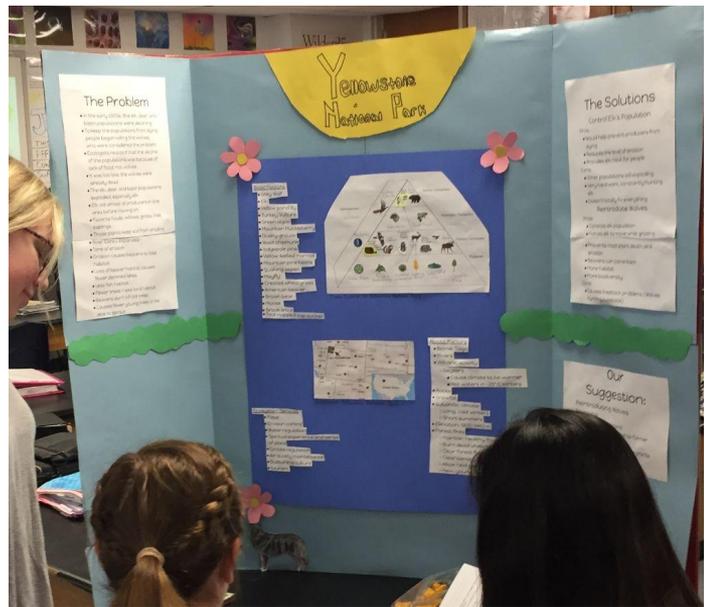
- Energy & Electromagnetic Force unit: Energy Shack project
- Populations & Ecosystems unit: Ecoscenario project
- Weather & Water unit: Build a Better Bus Stop (passive solar and insulation challenge) and Climate Change Passion Project



*7.MS-PS3-3. Apply scientific principles of energy and heat transfer to design, construct, and test a device to minimize or maximize thermal energy transfer.**

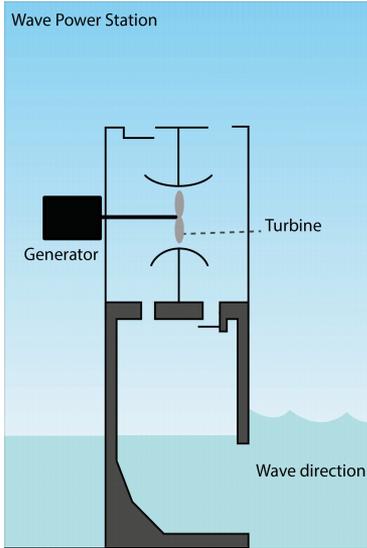
*7.MS-LS2-5. Evaluate competing design solutions for protecting an ecosystem. Discuss benefits and limitations of each design.**

7.MS-ESS3-4. Construct an argument supported by evidence that human activities and technologies can mitigate the impact of increases in human population and per capita consumption of natural resources on the environment.



8.MS-ESS3-5. Examine and interpret data to describe the role that human activities have played in causing the rise in global temperatures over the past century.

8th Grade

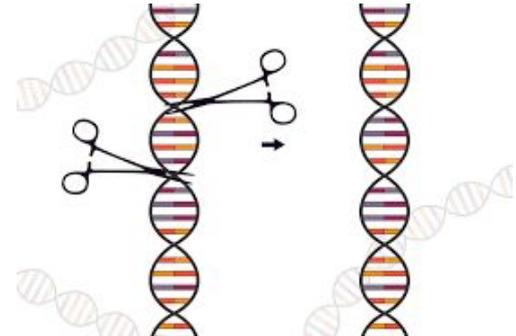
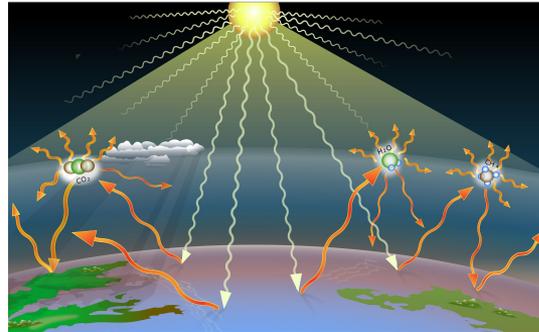


- Chemical Interactions unit: “Better Living through Chemistry” topics
- Planetary Science unit: Runaway Greenhouse Effect on Venus; Tidal power
- Heredity & Adaptation unit: shifts in populations over time; selective breeding & genetic engineering
- Critical thinking about the role of science in the increasingly challenging interplay between humans and the environment

7.MS-LS2-4. Analyze data to provide evidence that disruptions (natural or human-made) to any physical or biological component of an ecosystem can lead to shifts in all its populations.

8.MS-LS4-5. Synthesize and communicate information about artificial selection, or the ways in which humans have changed the inheritance of desired traits in organisms.

7.MS-ESS3-4. Construct an argument supported by evidence that human activities and technologies can mitigate the impact of increases in human population and per capita consumption of natural resources on the environment.



Middle School Enrichment: Ponds, Pools, & Produce



Field Study:

Water, Soil, Plant Surveys,
Microscope Observations



Local Wetlands:

Dugan Brook
Vernal Pools



Produce:

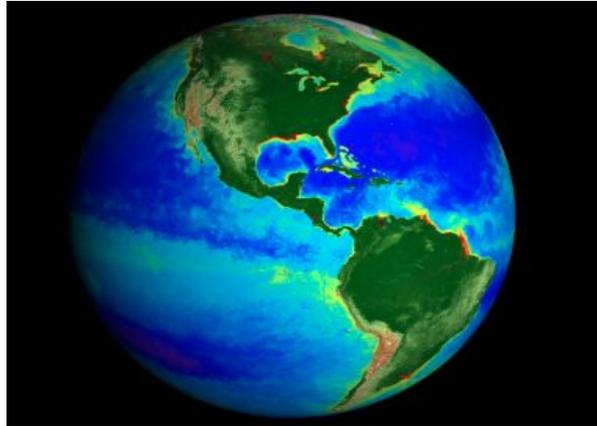
Growing & harvesting
for FACS & cafeteria

Grow Racks, made possible by a Concord Ed Fund grant, are used in:

- 6th grade science
- 7th grade FACS, Science, and Enrichment:
- 8th grade Enrichment: Regional Foods of the US



Grade 9 All ninth graders take a course that is called, **Planet Earth!** It is an earth science course with a focus on **Sustainability**.



HS-ESS2-4 Earth's Systems 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-ESS2-6 Earth's Systems Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

HS-ESS3-1 Earth and Human Activity 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-ESS3-2 Earth and Human Activity Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

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

HS-ESS3-4 Earth and Human Activity (not included by MA) Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS-ESS3-5 Earth and Human Activity 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.

Examples of Grade 9 sustainability work and topics

- Group presentations: [Debunking the Climate Denier Myths](#)
- Self-reflection on individual communities and carbon footprints:
 - [New Year, Greener You!](#)
 - [Make a Green Pledge](#)
 - [U.S. Land Use](#)
 - [EdPuzzle - How Recycling Works](#)
- Understanding the Greenhouse Effect and Anthropogenic CO₂'s impact
 - [What Will Climate Change *Change*?](#)
 - [IPCC Article and Questions](#)



Grades 10, 11, and 12

Sustainability is touched upon throughout the biology curriculum but with a strong focus in the ecology unit of biology. The topics include: organisms, populations, communities, and the effects on habitats and ultimately on ecosystems. The regional climate influences on the distribution of terrestrial communities are studied including changes to aquatic biomes like coral reefs. The different types of human diets (plant-based, carnivore, omnivore) are discussed, specifically the strain on ecosystems (eg. rainforests-clear cutting). In chemistry, we teach a unit on energy which includes renewable (wind, solar etc.) and nonrenewable resources (eg. fossil fuels).

As Juniors or seniors in high school, students can choose to take AP Environmental Science. AP Environmental Science is a course that completely focuses on Sustainability.



Content in AP Environmental Science Related to Sustainability

5.12 Intro to Sustainability

5.15 Sustainable Agriculture

5.17 Sustainable Forestry

6.1 Renewable and Nonrenewable Energy Sources

6.13 Energy Conservation

7.6 Reduction of Air Pollutants

9.2 Reducing Ozone Depletion



Examples of Sustainability Work in AP Environmental Science

Self Reflection

[Sustainable Plate - Source Your Food](#)

[Ecological Footprint Calculation](#)

[Chart Your Water Use](#)

[Personal Waste Audit](#)

Projects

[Clear Cutting Debate](#)

Developing a Sustainable Energy Infrastructure Project (In Development)

Develop a Sustainable City (In Development)



References and Thank YOU!!!!

[Massachusetts Curriculum Framework in Science 2016](#)

[Next Generation Science Standards](#)

North American Association of Environmental Educators

<https://naaee.org/our-work/programs/environmental-literacy-framework>

