

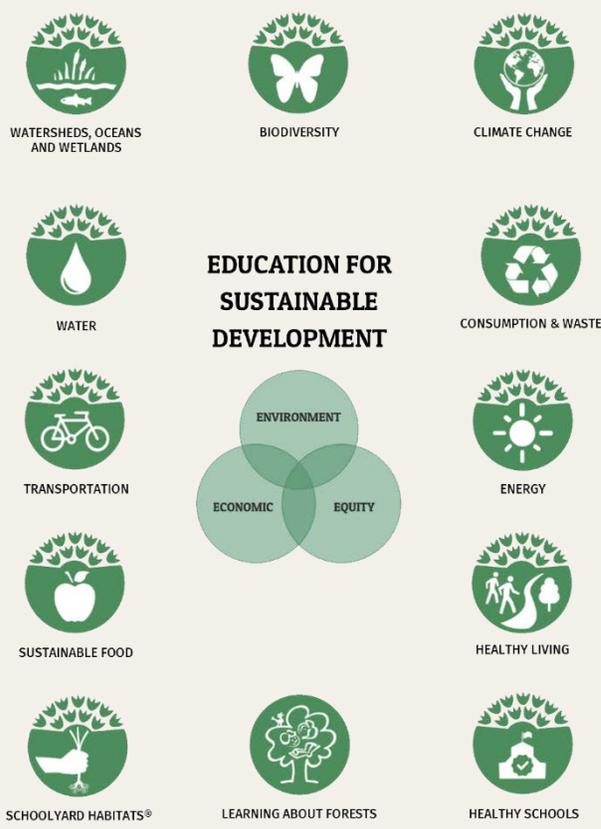


Pathways to Sustainability

Alignment to NGSS – HS: Life Science

Students in high school develop understanding of key concepts that help them make sense of life sciences. The ideas are building upon students' science understanding of disciplinary core ideas, science and engineering practices, and crosscutting concepts from earlier grades. There are five life science topics in high school. The performance expectations for high school life sciences blend core ideas with science and engineering practices and crosscutting concepts to support students in developing useable knowledge that can be applied across the science disciplines. While the performance expectations in high school life sciences couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices underlying the performance expectations. The performance expectations are based on the grade-band endpoints described in the NRC Framework.

The National Wildlife Federation's Eco-Schools USA program learning objectives align with three of the five Earth and Space Science standard topics, **Matter and Energy in Organisms and Ecosystems, Interdependent Relationships in Ecosystems and Natural Selection and Evolution.**





Pathways to Sustainability

Alignment to NGSS

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Matter and Energy in Organisms and Ecosystems

The performance expectations in the topic **Matter and Energy in Organisms and Ecosystems** help students answer the questions: “How do organisms obtain and use energy they need to live and grow? How do matter and energy move through ecosystems?” High school students can construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. They can apply mathematical concepts to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration and develop models to communicate these explanations. They can relate the nature of science to how explanations may change in light of new evidence and the implications for our understanding of the tentative nature of science. Students understand organisms’ interactions with each other and their physical environment, how organisms obtain resources, change the environment, and how these changes affect both organisms and ecosystems. In addition, students can utilize the crosscutting concepts of matter and energy and systems and system models to make sense of ecosystem dynamics.

Interdependent Relationships in Ecosystems

The performance expectations in the topic **Interdependent Relationships in Ecosystems** help students answer the question, “How do organisms interact with the living and non-living environment to obtain matter and energy?” This topic builds on the other topics as high school students demonstrate an ability to investigate the role of biodiversity in ecosystems and the role of animal behavior in the survival of individuals and species. Students have increased understanding of interactions among organisms and how those interactions influence the dynamics of ecosystems. Students can generate mathematical comparisons, conduct investigations, use models, and apply scientific reasoning to link evidence to explanations about interactions and changes within ecosystems.

Natural Selection and Evolution

The performance expectations in the topic **Natural Selection and Evolution** help students answer the questions: “How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms? How does biodiversity affect humans?” High school students can investigate patterns to find the relationship between environment and natural selection. Students demonstrate understanding of the factors causing natural selection and the process of evolution of species over time. They demonstrate understanding of how multiple lines of evidence contribute to the strength of scientific theories of natural selection and evolution. Students can demonstrate an understanding of the processes that change the distribution of traits in a population over time and describe extensive scientific evidence ranging from the fossil record to genetic relationships among species that support the theory of biological evolution. Students can use models, apply statistics, analyze data, and produce scientific communications about evolution. Understanding of the crosscutting concepts of patterns, scale, structure and function, and cause and effect supports the development of a deeper understanding of this topic.



Pathways to Sustainability Alignment to NGSS

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The National Wildlife Federation's Eco-Schools USA program has aligned their program Pathways of Sustainability to the Next Generation Science Standards, NGSS. As a part of the Eco-Schools Seven Step Framework, linking to the curriculum is a priority. This alignment is designed to highlight the natural connections between the NGSS and the Eco-Schools USA program.

Our program icons are used to denote pathway connections to the NGSS Performance Expectations and alignment to the Common Core State Standards, CCSS, English Language Arts, ELA and Mathematics.

Green STEM is an initiative of NWF's Eco-Schools USA program and is focused on identifying best practice in the STEM fields as it relates to environment-based learning. These elements include:

- Project, problem and place-based learning
- Utilizing the school, both inside and outside, as a learning laboratory
- Interdisciplinary approach
- Innovation space
- A commitment to stewardship
- An inclusive culture, where all students can learn, participate and take action



Pathways to Sustainability Alignment to NGSS

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MATTER AND ENERGY IN ORGANISMS

Students who demonstrate understanding can:

HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

HS-LS2-4. Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere and geosphere.



CLIMATE CHANGE



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Each Performance Expectation is more successfully accomplished by students who have numerous opportunities to engage in inquiry-based learning experiences using the school and natural world as laboratories for learning. Students will develop and use models with greater precision and understanding and have the ability to communicate and apply understanding using fact-based, empirical evidence. It is critical students have a foundation in the cross-conceptual nature of science, for example seeing the role chemistry and physics play in biological and ecological systems.

Students who have played an integral role in making meaningful changes on their campus have the conceptual understanding needed to build new learning around these Performance Expectation's overarching concepts, systems and system models and energy and matter.

Driving Questions – Examples

- How can we, as nature center educators, teach students coming to the center about the chemical process occurring in our local trees?
- How can we, as foresters, quantify how matter cycles and energy flows through our forest systems, in an effort to convince the city council to protect the space from dumping and harmful runoff?



MATTER AND ENERGY IN ORGANISMS - CONTINUED

SCIENCE AND ENGINEERING PRACTICES

- Developing and Using Models

DISCIPLINARY CORE IDEAS

- LS1.C** Organization for Matter and Energy Flow in Organisms
- LS2.B** Cycles of Matter and Energy Transfer in Ecosystems
- PS3.D** Energy in Chemical Processes

CROSCUTTING CONCEPTS

- Systems and System Models
- Energy and Matter

Connections to other DCIs in this grade band: **HS.PS1.B** (HS-LS1-5) (HS-LS2-5); **HS.PS3.B** (HS-LS1-5)(HS-LS2-4); **HS.PS3.D** (HS-LS2-4); **HS.ESS2.D** (HS-LS2-5)

Articulation of DCIs across grade-bands: **MS.PS1.B** (HS-LS1-5); **MS.PS3.D** (HS-LS1-5) (HS-LS2-4) (HS-LS2-5); **MS.LS1.C** (HS-LS1-5) (HS-LS2-4) (HS-LS2-5); **MS.LS2.B** (HS-LS1-5) (HS-LS2-4) (HS-LS2-5); **MS.ESS2.A** (HSL2-5)

Common Core State Standards

ELA/Literacy

N/A

Mathematics

MP.2 Reason abstractly and quantitatively. (HS-LS2-4)

MP.4 Model with mathematics. (HS-LS2-4)

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-LS2-4)

HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2-4)

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-LS2-4)



INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS

Students who demonstrate understanding can:

- HS-LS2-1.** Use mathematical and/or computational representation to support explanations that affect carrying capacity of ecosystems at different scales.
- 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.
- 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-LS2-7.** Design, evaluate and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-LS4-6.** Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.



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CONSUMPTION & WASTE



ENERGY



HEALTHY LIVING



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SUSTAINABLE FOOD



TRANSPORTATION



WOW

Each Performance Expectation is more successfully accomplished by students who have numerous opportunities to engage in inquiry-based learning experiences using the school and natural world as laboratories for learning. Students will develop and use models with greater precision and understanding and have the ability to communicate and apply understanding using fact-based, empirical evidence. Real world learning experiences, such as investigating ecosystem(s) health, benefits and services, regardless of location around the nation, positively impact the local community.



INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS - CONTINUED

Each Pathway to Sustainability help students better understand the Earth system. Students take on leadership roles in helping to build a sustainable school community and neighborhood. The experiences students have as a part of the Eco-Schools USA program prepare them to take on similar roles and responsibilities as young adults; the leaders in sustainable partnerships, design and innovation, community problem solving and as overall engaged members of their community. In addition, students have the conceptual understanding needed to build new learning around these performance expectation’s overarching concepts including, cause and effect relationships, scale, proportion and quantity and stability and change.

Driving Questions – Examples

- How can we, as concerned citizens, demonstrate to our city council, the impacts on local biodiversity when development is not sustainable and provide solutions that are environmentally, equitably and economically feasible?
- How can we, as ecologists, quantify the carrying capacity of the coastal dunes ecosystem to ensure our city planners and tourism board understand their environmental importance and to encourage a collaborative partnership?

SCIENCE AND ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSCUTTING CONCEPTS
<ul style="list-style-type: none"> • Using Mathematics and Computational Thinking • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence <p>CONNECTIONS TO NATURE OF SCIENCE</p> <ul style="list-style-type: none"> • Scientific Knowledge is Open to Revision in Light of New Evidence 	<p>LS2.A Interdependent Relationships in Ecosystems</p> <p>LS2.C Ecosystem Dynamics, Functioning and Resilience</p> <p>LS4.C Adaptation</p> <p>LS4.D Biodiversity and Humans</p> <p>ETS1.B Developing Possible Solutions</p>	<ul style="list-style-type: none"> • Cause and Effect • Scale, Proportion and Quantity • Stability and Change

Connections to other DCIs in this grade band: **HS.ESS2.D** (HS-LS2-7) (HS-LS4-6); **HS.ESS2.E** (HS-LS2-2) (HS-LS2-6) (HS-LS2-7) (HS-LS4-6); **HS.ESS3.A** (HS-LS2-2) (HS-LS2-7) (HS-LS4-6); **HS.ESS3.C** (HS-LS2-2) (HS-LS2-7) (HS-LS4-6); **HS.ESS3.D** (HS-LS2-2) (HS-LS4-6); **HS.ESS3.E** (HS-LS4-6)

Articulation of DCIs across grade-bands: **MS.LS1.B** (HS-LS2-7); **MS.LS2.A** (HS-LS2-1) (HS-LS2-2) (HS-LS2-6); **MS.LS2.C** (HS-LS2-1) (HS-LS2-2) (HS-LS2-6) (HS-LS2-7) (HS-LS4-6); **MS.ESS3.A** (HS-LS2-1); **MS.ESS3.C** (HS-LS2-1) (HS-LS2-2) (HS-LS2-6) (HS-LS2-7) (HS-LS4-6); **MS.ESS3.D** (HS-LS2-7); **MS.ESS2.E** (HS-LS2-6)



INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS - CONTINUED

Common Core State Standards

ELA/Literacy

- RST.11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS2-1) (HS-LS2-2) (HS-LS2-6)
- RST.11-12.7** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-LS2-6) (HS-LS2-7)
- RST.9-10.8** Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (HS-LS2-6) (HS-LS2-7)
- RST.11-12.8** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS2-6) (HS-LS2-7)
- WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (HS-LS2-1) (HS-LS2-2)
- WHST.9-12.5** Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS2-3) (HS-LS4-6)
- WHST.9-12.7** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS2-7) (HS-LS4-6)

Mathematics

- MP.2** Reason abstractly and quantitatively. (HS-LS2-1) (HS-LS2-2) (HS-LS2-6) (HS-LS2-7)
- MP.4** Model with mathematics. (HS-LS2-1) (HS-LS2-2)
- HSN-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-LS2-1) (HS-LS2-2) (HS-LS2-7)
- HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2-1) (HS-LS2-2) (HS-LS2-7)
- HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-LS2-1) (HS-LS2-2) (HS-LS2-7)
- HSS-ID.A.1** Represent data with plots on the real number line. (HS-LS2-6)
- HSS-IC.A.1** Understand statistics as a process for making inferences about population parameters based on a random sample from that population. (HS-LS2-6)
- HSS-IC.B.6** Evaluate reports based on data. (HS-LS2-6)



Pathways to Sustainability Alignment to NGSS

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NATURAL SELECTION AND EVOLUTION

Students who demonstrate understanding can:

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may results in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.



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Each Performance Expectation is more successfully accomplished by students who have numerous opportunities to engage in inquiry-based learning experiences using the school and natural world as laboratories for learning. Students will develop and use models with greater precision and understanding and have the ability to evaluate, communicate and apply understanding using fact-based, empirical evidence.

Each Pathway to Sustainability help students better understand the Earth system. Students take on leadership roles in helping to build a sustainable school community and neighborhood. The experiences students have as a part of the Eco-Schools USA program prepare them to take on similar roles and responsibilities as young adults; the leaders in sustainable partnerships, design and innovation, community problem solving and as overall engaged members of their community. In addition, students have the conceptual understanding needed to build new learning around these performance expectation's overarching concept cause and effect relationships.

How can we as, climate scientists, support claims that changing environmental conditions will impact biodiversity?

How can we, as a parks and recreation department, understand and support the science related to biological changes in light of changing environmental conditions to prepare for how we manage the public spaces and engage the community?



Pathways to Sustainability Alignment to NGSS

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NATURAL SELECTION AND EVOLUTION - CONTINUED

SCIENCE AND ENGINEERING PRACTICES

- Engaging in Argument from Evidence

DISCIPLINARY CORE IDEAS

LS4.C Adaptation

CROSCUTTING CONCEPTS

- Cause and Effect

Connections to other DCIs in this grade band: **HS.LS2.A** (HS-LS4-5); **HS.LS2.D** (HS-LS4-5); **HS.LS3.B** (HS-LS4-5); **HS.ESS2.E** (HS-LS4-5); **HS.ESS3.A** (HS-LS4-5)

Articulation of DCIs across grade-bands: **MS.LS2.A** (HS-LS4-5); **MS.LS2.C** (HS-LS4-5); **MS.LS4.C** (HS-LS4-5); **MS.ESS3.C** (HS-LS4-5)

Common Core State Standards

ELA/Literacy

- RST.11-12.8** Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS4-5)
- WHST.9-12.9** Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS4-5)

Mathematics

- MP.2** Reason abstractly and quantitatively. (HS-LS4-5)