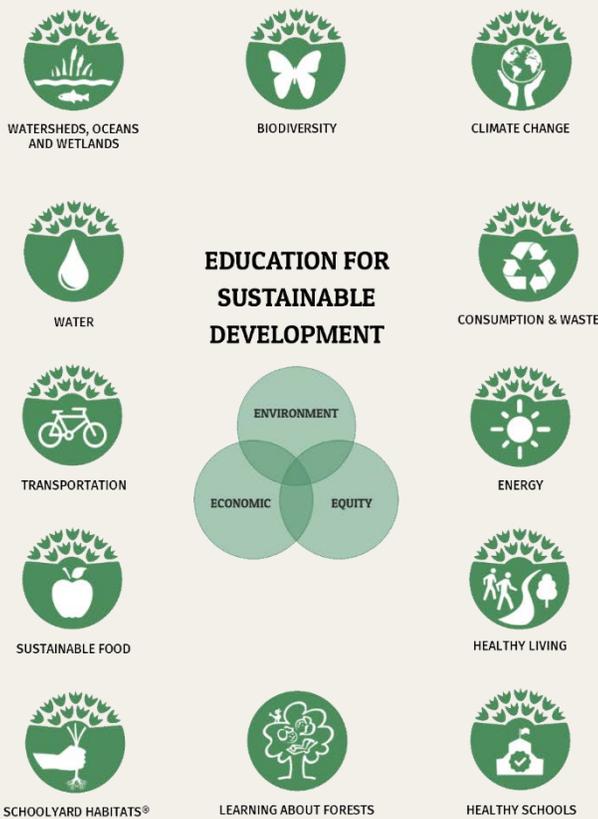




# Pathways to Sustainability

## Alignment to NGSS – MS: Life Science



Students in middle school develop understanding of key concepts to help them make sense of the life sciences. These ideas build upon students’ science understanding from earlier grades and from the disciplinary core ideas, science and engineering practices, and crosscutting concepts of other experiences with physical and earth sciences. There are five life science topics in middle school: 1) Structure, Function, and Information Processing, 2) Growth, Development, and Reproduction of Organisms, 3) Matter and Energy in Organisms and Ecosystems, 4) Interdependent Relationships in Ecosystems, and 5) Natural Selection and Adaptations. The performance expectations in middle school blend core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge across the science disciplines. While the performance expectations in middle school life science couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many science and engineering practices integrated in the performance expectations. The concepts and practices in the performance expectations are based on the grade-band endpoints described in A Framework for K-12 Science Education (NRC, 2012).

The National Wildlife Federation’s Eco-Schools USA programs has aligned two of the five middle school life science topics that meet our learning objectives and outcomes, **Matter and Energy in Organisms and Ecosystems** and **Interdependent Relationships in Ecosystems**.

The Performance Expectations in **Matter and Energy in Organisms and Ecosystems** help students formulate answers to the questions: “How do organisms obtain and use matter and energy? How do matter and energy move through an ecosystem?” Middle school students can use conceptual and physical models to explain the transfer of energy and cycling of matter as they construct explanations for the role of photosynthesis in cycling matter in ecosystems. They can construct explanations for the cycling of matter in organisms and the interactions of organisms to obtain the matter and energy from the ecosystem to survive and grow. Students have a grade-appropriate understanding and



## Pathways to Sustainability Alignment to NGSS

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use of the practices of investigations, constructing arguments based on evidence, and oral and written communication. They understand that sustaining life requires substantial energy and matter inputs and the structure and functions of organisms contribute to the capture, transformation, transport, release, and elimination of matter and energy. Adding to these crosscutting concepts is a deeper understanding of systems and system models that ties the performances expectations in this topic together.

The Performance Expectations in **Interdependent Relationships in Ecosystems** help students formulate an answer to the question, “How do organisms interact with other organisms in the physical environment to obtain matter and energy? To answer the question, middle school students construct explanations for the interactions in ecosystems and the scientific, economic, political, and social justifications used in making decisions about maintaining biodiversity in ecosystems. Students can use models, construct evidence-based explanations, and use argumentation from evidence. Students understand that organisms and populations of organisms are dependent on their environmental interactions both with other organisms and with nonliving factors. They also understand the limits of resources influence the growth of organisms and populations, which may result in competition for those limited resources. Crosscutting concepts of matter and energy, systems and system models, and cause and effect are used by students to support understanding the phenomena they study.

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



### MATTER AND ENERGY IN ORGANISMS AND ECOSYSTEMS

#### Students who demonstrate understanding can:

- MS-LS1-6.** Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- MS-LS1-7.** Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.
- MS-LS2-1.** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS2-3.** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
- MS-LS-2-4.** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.



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Each Performance Expectation is more successfully accomplished by students who have spent significant time outdoors in the natural world. Using the schoolyard as a learning laboratory, provides students with countless experiential opportunities using inquiry based methods during field investigations. Students will be able to develop and use models with greater precision and understanding and have the ability to communicate understanding with fact-based evidence.

Students who have played an integral role in the creation and care of a Schoolyard Habitat, sustainable food project, or biodiversity studies, have the conceptual understanding needed to build new learning around these performance expectation's overarching concepts, cause and effect relationships, cycling of matter and the flow of energy into and out of systems and stability and change.

#### Driving Questions – Examples

- How can we, as entomologists, work with local agencies and community members, to support the needs of our local pollinator species, specifically the monarch butterfly?
- How can we, as foresters, teach others about the role trees play in a community, the environmental, economic and social roles?



### MATTER AND ENERGY IN ORGANISMS AND ECOSYSTEMS - CONTINUED

#### SCIENCE AND ENGINEERING PRACTICES

- Developing and Using Models
- Analyzing and Interpreting Data
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence

#### CONNECTIONS TO NATURE OF SCIENCE

- Scientific Knowledge is Based on Empirical Evidence

#### DISCIPLINARY CORE IDEAS

- LS1.C** Organization for Matter and Energy Flow in Organisms.
- LS2.A** Interdependent Relationships in Ecosystems
- LS2.B** Cycle of Matter and Energy Transfer in Ecosystems
- LS2.C** Ecosystem Dynamics, Functioning and Resilience
- PS3.D** Energy in Chemical Processes and Everyday Life

#### CROSSCUTTING CONCEPTS

- Cause and Effect
- Energy and Matter
- Stability and Change

#### CONNECTIONS TO NATURE OF SCIENCE

- Scientific Knowledge Assumes an Order and Consistency in Natural Systems

Connections to other DCIs to this grade band: **MS.PS1.B** (MS-LS1-6) (MS-LS1-7) (MS-LS2-3); **MS.LS4.C** (MS-LS2-4); **MS.LS4.D** (MS-LS2-4); **MS.ESS2.A** (MS-LS1-6) (MS-LS2-3) (MS-LS2-4); **MS.ESS3.A** (MS-LS2-1) (MS-LS2-4); **MS.ESS3.C** (MS-LS2-1) (MS-LS2-4)

Articulation of DCIs across grade-bands: **3.LS2.C** (MS-LS2-1) (MS-LS2-4); **3.LS4.D** (MS-LS2-1) (MS-LS2-4); **5.PS3.D** (MS-LS1-6) (MS-LS1-7) **5.LS1.C** (MS-LS1-6) (MS-LS1-7); **5.LS2.A** (MS-LS1-6) (MS-LS2-1) (MS-LS2-3); **5.LS2.B** (MS-LS1-6) (MS-LS1-7) (MS-LS2-3); **HS.PS1.B** (MS-LS1-6) (MS-LS1-7); **HS.PS3.B** (MS-LS2-3); **HS.LS1.C** (MS-LS1-6) (MS-LS1-7) (MS-LS2-3); **HS.LS2.A** (MS-LS2-1); **HS.LS2.B** (MS-LS1-6) (MS-LS1-7) (MS-LS2-3); **HS.LS2.C** (MS-LS2-4); **HS.LS4.C** (MS-LS2-1) (MS-LS2-4); **HS.LS4.D** (MS-LS2-1) (MS-LS2-4); **HS.ESS2.C** (MS-LS2-3); **HS.ESS2.D** (MS-LS1-6); **HS.ESS2.E** (MS-LS2-4); **HS.ESS3.A** (MS-LS2-1); **HS.ESS3.B** (MS-LS2-4); **HS.ESS3.C** (MS-LS2-4)



### MATTER AND ENERGY IN ORGANISMS AND ECOSYSTEMS - CONTINUED

#### Common Core State Standards Connections

##### ELA/Literacy

- RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-6) (MS-LS2-1)
- RST.6-8.2** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-6)
- RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1)
- RI.8.8** Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS-4)
- WHST.6-8.1** Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4)
- WHST.6-8.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS1-6)
- WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-6) (MS-LS2-4)
- SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-7) (MS-LS2-3)

##### Mathematics

- 6.EEC.9** Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-6) (MS-LS2-3)



### INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS

#### Students who demonstrate understanding can:

**MS-LS2-2.** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

**MS-LS2-5.** Evaluate competing design solutions for maintaining biodiversity and ecosystem services.



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Students who have played an integral role in the creation and care of a Schoolyard Habitat, sustainable food project, or biodiversity studies, have the conceptual understanding needed to build new learning around these performance expectation's overarching concepts, interdependent relationships, patterns, and stability and change.

#### Driving Questions – Examples

- How can we, as city planners, increase biodiversity and maintain ecosystem services including, provisioning, regulating, nutrient cycles and culture, while at the same time considering our communities development needs?
- How can we, as conservation biologists, understand the needs of the diverse ecosystems in our watershed and engage with and meet the diverse needs of our community using positive action-based activities?



## INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS - CONTINUED

SCIENCE AND ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
<ul style="list-style-type: none"> <li>Constructing Explanations and Designing Solutions</li> <li>Engaging in Argument from Evidence</li> </ul>	<p><b>LS2.A</b> Interdependent Relationships in Ecosystems</p> <p><b>LS2.C</b> Ecosystem Dynamics, Functioning and Resilience</p> <p><b>LS4.D</b> Biodiversity and Humans</p> <p><b>ETS1.B</b> Developing Possible Solutions</p>	<ul style="list-style-type: none"> <li>Patterns</li> <li>Stability and Change</li> </ul> <p><b>CONNECTIONS TO ENGINEERING, TECHNOLOGY AND APPLICATIONS OF SCIENCE</b></p> <ul style="list-style-type: none"> <li>Influence of Science, Engineering and Technology on Society and the Natural World</li> </ul> <p><b>CONNECTIONS TO NATURE OF SCIENCE</b></p> <ul style="list-style-type: none"> <li>Science Addresses Questions About the Natural and Material World</li> </ul>

Connections to other DCIs in this grade band: **MS.LS1.B** (MS-LS2-2); **MS.ESS3.C** (MS-LS2-5)

Articulation of DCIs across grade-bands: **1.LS1.B** (MS-LS2-2); **HS.LS2.A** (MS-LS2-2) (MS-LS2-5); **HS.LS2.B** (MS-LS2-2); **HS.LS2.C** (MS-LS2-5); **HS.LS2.D** (MS-LS2-2); **LS4.D** (MS-LS2-5); **HS.ESS3.A** (MS-LS2-5); **HS.ESS3.C** (MS-LS2-5); **HS.ESS3.D** (MS-LS2-5)

### Common Core State Standards

#### ELA/Literacy

- RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-2)
- RST.6-8.8** Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5)
- RI.8.8** Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS2-5)
- WHST.6-8.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS2-2)
- WHST.6-8.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS-2)
- SL.8.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS2-2)
- SL.8.4** Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (MS-LS2-2)

#### Mathematics

- MP.4** Model with mathematics. (MS-LS2-5)
- 6.RP.A.3** Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-LS2-5)
- 6.SP.B.5** Summarize numerical data sets in relation to their context. (MS-LS2-2)