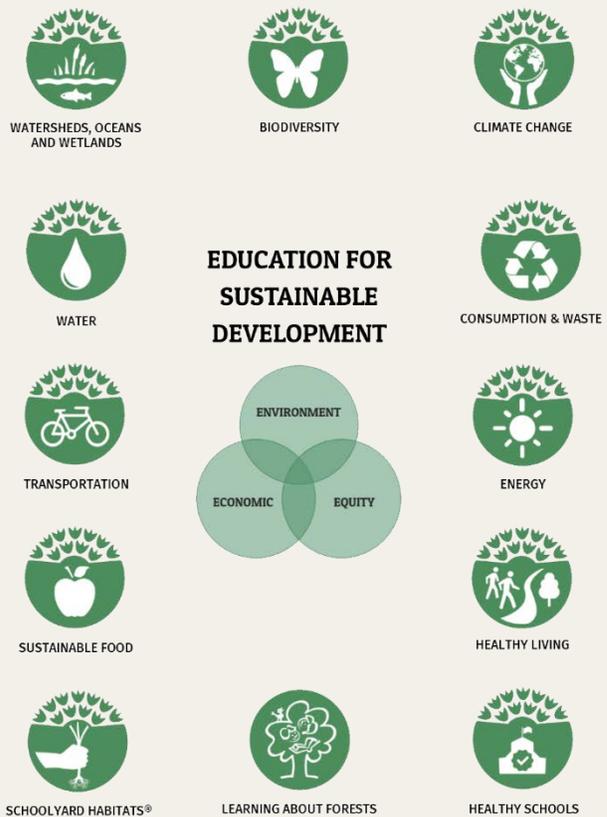




Pathways to Sustainability

Alignment to NGSS – HS: Earth Science

Students in high school develop understanding of a wide range of topics in Earth and space sciences that build on science concepts from middle school through more advanced content, practice, and crosscutting themes. The content of the performance expectations is based on current community-based geoscience literacy efforts such as the Earth Science Literacy Principles, and is presented with a greater emphasis on an Earth systems science approach. There are strong connections to mathematical practices of analyzing and interpreting data. The performance expectations strongly reflect the many societally relevant aspects of the Earth and space sciences (resources, hazards, environmental impacts) with an emphasis on using engineering and technology concepts to design solutions to challenges facing human society. While the performance expectations shown in high school Earth and space sciences couple particular practices with specific disciplinary cores ideas, instructional decisions should include use of many practices that lead to the performance expectations.



The National Wildlife Federation’s Eco-Schools USA program learning objectives align with three of the five Earth and Space Science standard topics, **Earth’s Systems**, **Weather and Climate** and **Human Impacts**.

Earth’s Systems

The performance expectations in Earth’s Systems help students formulate answers to the questions: “How do the major Earth systems interact?” and “How do the properties and movements of water shape Earth’s surface and affect its systems?” Students can develop models and explanations for the ways that feedbacks between different Earth systems control the appearance of Earth’s surface. Central to this is the tension between internal systems, which are largely responsible for creating land at Earth’s surface (e.g., volcanism and mountain building), and the sun-driven surface systems that tear down land through



Pathways to Sustainability Alignment to NGSS

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weathering and erosion. Students understand the role that water plays in affecting weather. Students understand chemical cycles such as the carbon cycle. Students can examine the ways that human activities cause feedbacks that create changes to other systems. The crosscutting concepts of energy and matter; structure and function; stability and change; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the HS. Earth's Systems performance expectations, students are expected to demonstrate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, and engaging in argument from evidence and to use these practices to demonstrate understanding of the core ideas.

Weather and Climate

The performance expectations in **Weather and Climate** help students formulate an answer to the question, "What regulates weather and climate?" Students understand the system interactions that control weather and climate, with a major emphasis on the mechanisms and implications of climate change. Students can understand the analysis and interpretation of different kinds of geoscience data allow students to construct explanations for the many factors that drive climate change over a wide range of timescales. The crosscutting concepts of cause and effect and stability and change are called out as organizing concepts for these disciplinary core ideas. In the HS. Weather and Climate performance expectations, students are expected to demonstrate proficiency in developing and using models and analyzing and interpreting data and to use these practices to demonstrate understanding of the core ideas.

Human Impacts

The performance expectations in Human Impacts help students formulate answers to the questions: "How do humans depend on Earth's resources?" and "How do people model and predict the effects of human activities on Earth's climate?" Students understand the complex and significant interdependencies between humans and the rest of Earth's systems through the impacts of natural hazards, our dependencies on natural resources, and the environmental impacts of human activities. The crosscutting concepts of cause and effect; systems and system models; stability and change; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the HS. Human Impacts performance expectations, students are expected to demonstrate proficiency in using mathematics and computational thinking, constructing explanations and designing solutions, and engaging in argument from evidence and to use these practices to demonstrate understanding of the core ideas.

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.



Pathways to Sustainability Alignment to NGSS

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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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EARTH'S SYSTEMS

Students who demonstrate understanding can:

- HS-ESS2-2.** Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
- HS-ESS2-6.** Develop quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere and biosphere.



CLIMATE CHANGE



ENERGY

Each Performance Expectation is more successfully accomplished by students who have spent significant time outdoors in the natural world. Connecting to nature improves student engagement, focus, creativity and innovation. Connecting to nature also builds an appreciation and respect for the community, state, country, and world we live in. This appreciation and respect allows students to better understand the impacts of climate change on our built and natural systems.

Engaging students using the Energy and Climate Change Pathways provides them with age appropriate knowledge, skills and tools to make meaningful change in their community while increasing their understanding of the fact-based science related to climate change, such as the flow of energy through Earth's systems and associated feedback loops. Ultimately, we want students to feel they have the confidence and resources to change and/or mitigate the negative impacts on wildlife and wild places.

Driving Questions – Examples

- How can we, as climate scientists, help our community understand the feedback loops related to impacts from a warming climate?
- How can we, as high school students, design a model to teach middle school students how carbon cycles through Earth's systems and that a variety of variables impact the rate and amount?



Pathways to Sustainability Alignment to NGSS

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EARTH'S SYSTEMS - CONTINUED

SCIENCE AND ENGINEERING PRACTICES

- Developing and Using Models
- Analyzing and Interpreting Data

DISCIPLINARY CORE IDEAS

- ESS2.A.** Earth Materials and Systems
ESS2.D Weather and Climate

CROSSCUTTING CONCEPTS

- Energy and Matter
- Stability and Change

CONNECTIONS TO ENGINEERING, TECHNOLOGY AND APPLICATIONS OF SCIENCE

- Influence of Engineering, Technology and Science on Society and the Natural World

Connections to other DCIs to this grade band: **HS.PS1.A** (HS-ESS2-6); **HS.PS1.B** (HS-ESS2-6); **HS.PS3.B** (HS-ESS2-2); **HS.PS3.D** (HS-ESS2-6); **HS.PS4.B** (HS-ESS2-2) (HS-ESS2-6); **HS.LS1.C** (HS-ESS2-6); **HS.LS2.B** (HS-ESS2-2) (HS-ESS2-6); **HS.LS2.C** (HS-ESS2-2); **HS.LS4.D** (HS-ESS2-2); **HS.ESS3.C** (HS-ESS2-2) (HS-ESS2-6); **HS.ESS3.D** (HS-ESS2-2) (HS-ESS2-6)

Articulation of DCIs across grade-bands: **MS.PS1.A** (HS-ESS2-6); **MS.PS3.D** (HS-ESS2-2) (HS-ESS2-6); **MS.PS4.B** (HS-ESS2-2) (HS-ESS2-6); **MS.LS2.B** (HS-ESS2-2) (HS-ESS2-6); **MS.LS2.C** (HS-ESS2-2); **MS.LS4.C** (HS-ESS2-2); **MS.ESS2.A** (HS-ESS2-2) (HS-ESS2-6); **MS.ESS2.B** (HS-ESS2-2) (HS-ESS2-6); **MS.ESS2.C** (HS-ESS2-2) (HS-ESS2-6); **MS.ESS2.D** (HS-ESS2-2); **MS.ESS2.E** (HS-ESS2-2) (HS-ESS2-6); **MS.ESS3.C** (HS-ESS2-2) (HS-ESS2-6); **MS.ESS3.D** (HS-ESS2-2) (HS-ESS2-6)

Common Core State Standards Connections

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-ESS2-2)
- RST.11-12.2** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (HS-ESS2-2)

Mathematics

- MP.2** Reason abstractly and quantitatively. (HS-ESS2-2) (HS-ESS2-6)
- MP.4** Model with mathematics. (HS-ESS2-6)
- 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-ESS2-2) (HS-ESS2-6)
- HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS2-6)
- HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS2-2) (HS-ESS2-6)



Pathways to Sustainability

Alignment to NGSS

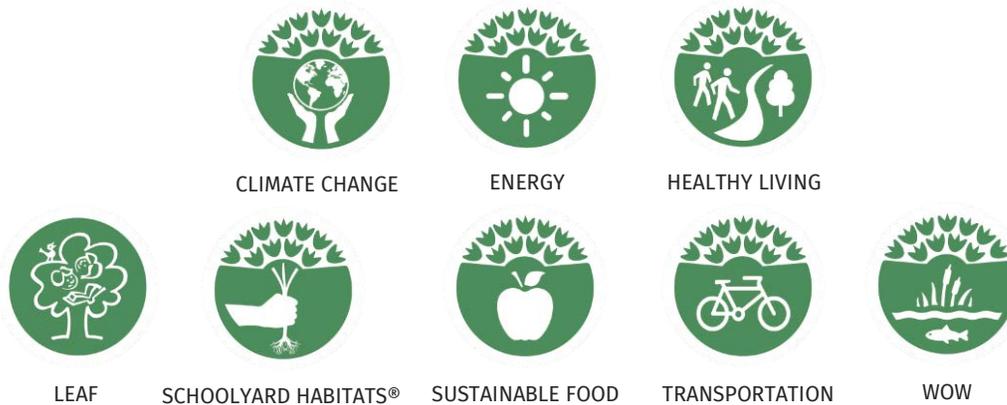
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WEATHER AND CLIMATE

Students who demonstrate understanding can:

HS-EES2-4. Use a model to describe how variations in the flow of energy into and out of Earth systems results in changes in climate.

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make and evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.



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.

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, cause and effect and stability and change.

Driving Questions – Examples

- How can we, as high school students create a model to teach middle school students about Earth's energy budget?
- How can we, as climate scientists, use data simulation tools to model impacts to Earth's systems based on different possible scenarios, in an effort to persuade the city council to adopt a climate resiliency plan?



WEATHER AND CLIMATE - CONTINUED

SCIENCE AND ENGINEERING PRACTICES

- Developing and Using Models
- Analyzing and Interpreting Data

CONNECTIONS TO NATURE OF SCIENCE

- Scientific Investigations Use a Variety of Methods
- Scientific Knowledge is Based on Empirical Evidence

DISCIPLINARY CORE IDEAS

- ESS1.B** Earth and the Solar System
- ESS2.A** Earth Materials and Systems
- ESS2.D** Weather and Climate
- ESS3.D** Global Climate Change

CROSCUTTING CONCEPTS

- Cause and Effect
- Stability and Change

Connections to other DCIs in this grade band: **HS.PS3.A** (HS-ESS2-4); **HS.PS3.B** (HS-ESS3-5); **HS.PS3.D** (HS-ESS3-5); **HS.PS4.B** (HS-ESS2-4); **HS.LS1.C** (HS-ESS3-5); **HS.LS2.C** (HS-ESS2-4); **HS.ESS1.C** (HS-ESS2-4); **HS.ESS2.D** (HS-ESS3-5); **HS.ESS3.C** (HS-ESS2-4); **HS.ESS3.D** (HS-ESS2-4)

Articulation of DCIs across grade-bands: **MS.PS3.A** (HS-ESS2-4); **MS.PS3.B** (HS-ESS2-4) (HS-ESS3-5); **MS.PS3.D** (HS-ESS2-4) (HS-ESS3-5); **MS.PS4.B** (HS-ESS2-4); **MS.LS1.C** (HS-ESS2-4); **MS.LS2.B** (HS-ESS2-4); **MS.LS2.C** (HS-ESS2-4); **MS.ESS2.A** (HS-ESS2-4) (HS-ESS3-5); **MS.ESS2.B** (HS-ESS2-4); **MS.ESS2.C** (HS-ESS2-4); **MS.ESS2.D** (HS-ESS2-4) (HS-ESS3-5); **MS.ESS3.B** (HS-ESS3-5); **MS.ESS3.C** (HS-ESS2-4) (HS-ESS3-5); **MS.ESS3.D** (HS-ESS2-4) (HS-ESS3-5)

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-ESS3-5)
- RST.11-12.2** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (HS-ESS3-5)
- 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-ESS3-5)
- SL.11-12.5** Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-ESS2-4)

Mathematics

- MP.2** Reason abstractly and quantitatively. (HS-ESS2-4) (HS-ESS3-5)
- MP.4** Model with mathematics. (HS-ESS2-4)
- 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-ESS2-4) (HS-ESS3-5)
- HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS2-4) (HS-ESS3-5)
- HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS2-4) (HS-ESS3-5)



HUMAN SUSTAINABILITY

Students who demonstrate understanding can:

- HS-ESS3-1.** 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.** Evaluate competing design solutions for developing, managing and utilizing energy and mineral resources based on cost-benefit ratios.
- HS-ESS3-3.** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations and biodiversity.
- HS-ESS3-4.** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- HS-ESS3-5.** 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.
- HS-ESS3-6.** Use a computation representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.



BIODIVERSITY



CLIMATE CHANGE



CONSUMPTION & WASTE



ENERGY



HEALTHY LIVING



HEALTHY SCHOOLS



LEAF



SCHOOLYARD HABITATS®



SUSTAINABLE FOOD



TRANSPORTATION



WATER



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.



Pathways to Sustainability

Alignment to NGSS

HUMAN IMPACTS- CONTINUED

Each Pathway to Sustainability help students better understand the Earth system and the impact human activities have on those systems. 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, systems and system models, stability and change, science as a human endeavor and the influence engineering, technology and science have on society and the natural world.

Driving Questions – Examples

- How can we, as electrical engineers, determine the potential for non-renewable energy systems for our school or district, develop a model demonstrating its effectiveness and cost analysis to include a return on investment?
- How can we, as waste managers, evaluate our waste systems at our school or district, design a better solution that will reduce cost, waste and impact on community resources?

SCIENCE AND ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
<ul style="list-style-type: none"> • Analyzing and Interpreting Data • 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 Investigations Use a Variety of Methods • Scientific Knowledge is Based on Empirical Evidence 	<p>ESS2.D Weather and Climate</p> <p>ESS2.A Natural Resources</p> <p>ESS3.B Natural Hazards</p> <p>ESS3.C Human Impacts on Earth Systems</p> <p>ESS3.D Global Climate Change</p> <p>ETS1.B Developing Possible Solutions</p>	<ul style="list-style-type: none"> • Cause and Effect • Systems and System Models • Stability and Change <p>CONNECTIONS TO ENGINEERING, TECHNOLOGY AND APPLICATIONS TO SCIENCE</p> <ul style="list-style-type: none"> • Influence of Science, Engineering and Technology on Society and the Natural World <p>CONNECTIONS TO NATURE OF SCIENCE</p> <ul style="list-style-type: none"> • Science is a Human Endeavor • Science Addresses Questions About the Natural and Material World

Connections to other DCIs in this grade band: **H.S.P.S1.B** (HS-ESS3-3); **HS.P.S3.B** (HS-ESS3-2) (HS-ESS3-5); **HS.PS3.D** (HS-ESS3-2) (HS-E.SS3-5); **H.S.L.S1.C** (HS-ESS3-5); **H.S.L.S2.A** (HS-ESS3-2) (HS-ESS3-3); **HS.LS2.B** (HS-ESS3-2) (HS-ESS3-3) (HS-ESS3-6); **HS.LS2.C** (HS-ESS3-3) (HS-ESS3-4) (HS-ESS3-6); **H.S.L.S4.D** (HS-E.SS3-2) (HS-ESS3-3) (HS-ESS3-4) (HS-ESS3-6); **H.S.ESS2.A** (HS-ESS3-2) (HS-ESS3-3) (HS-ESS3-6); **H.S.ESS2.D** (HS-ESS3-5); **HS.ESS2.E** (HS-ESS3-3)



Pathways to Sustainability

Alignment to NGSS

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Articulation of DCIs across grade-bands: **MS.PS1.B** (HS -E SS3-3); **MS.PS3.B** (HS-ESS3-5); **MS.PS3.D** (HS-ESS3-2) (HS-ESS3-5); **MS.LS2.A** (HS-ESS3-1) (HS-ESS3-2) (HS-ESS3-3); **MS.LS2.B** (HS-ESS3-2) (HS-ESS3-3); **MS.LS2.C** (HS-ESS3-3) (HS-ESS3-4) (HS-ESS3-6); **MS.LS4.C** (HS-ESS3-3); **MS.LS4.D** (HS-ESS3-1) (HS-ESS3-2) (HS-ESS3-3); **MS.ESS2.A** (HS-ESS3-1) (HS-ESS3-3) (HS-ESS3-4) (HS-ESS3-5) (HS-ESS3-6); **MS.ESS2.C** (HS-ESS3-6); **MS.ESS2.D** (HS-ESS3-5); **MS.ESS3.A** (HS-ESS3-1) (HS-ESS3-2) (HS-ESS3-3); **MS.ESS3.B** (HS-ESS3-1) (HS-ESS3-4) (HS-ESS3-5); **MS.ESS3.C** (HS-ESS3-2) (HS-ESS3-3) (HS-ESS3-4) (HS-ESS3-5) (HS-ESS3-6); **MS.ESS3.D** (HS-ESS3-4) (HS-ESS3-5) (HS-ESS3-6)

HUMAN IMPACTS- 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-ESS3-1) (HS-ESS3-2) (HS-ESS3-4) (HS-ESS3-5)
- RST.11-12.2** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (HS-ESS3-5)
- 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-ESS3-5)
- 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-ESS3-2) (HS-ESS3-4)
- WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (HS-ESS3-1)

Mathematics

- MP.2** Reason abstractly and quantitatively. (HS-ESS3-1) (HS-ESS3-2) (HS-ESS3-3) (HS-ESS3-4) (HS-ESS3-5) (HS-ESS3-6)
- MP.4** Model with mathematics. (HS-ESS3-3) (HS-ESS3-6)
- 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-ESS3-1) (HS-ESS3-4) (HS-ESS3-5) (HS-ESS3-6)
- HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS3-1) (HS-ESS3-4) (HS-ESS3-5) (HS-ESS3-6)
- HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS3-1)



Pathways to Sustainability

Alignment to NGSS

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(HS-ESS3-4) (HS-ESS3-5) (HS-ESS3-6)