Linking Environmental Literacy and the Next Generation Science Standards

Tool for Mapping an Integrated Curriculum

North American Association for Environmental Education

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A Tool for Mapping an Integrated Curriculum

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PART 1

Introduction and Overview

How environmental education is conceptualized and implemented in elementary and secondary schools is critical if we are to meet our ultimate goal of environmental literacy. Integrated across the curriculum, environmental education draws upon the natural and physical sciences, social sciences, and humanities. These disciplines are connected not only through the medium of the environment, but also through the development of environmental issue investigation and action skills needed for civic engagement. In the end, however, the ability of school systems to provide comprehensive environmental education will depend on its systematic and cohesive integration into the standards-based curriculum. Although we know that curriculum can be designed that supports both academic achievement *and* the development of environmental literacy, we also know that this type of curriculum planning takes work. It requires a thorough understanding of the standards and of the components of environmental literacy.

With the recent publication of the Next Generation Science Standards (NGSS Lead States 2013), a new vision of science education has been articulated. As teachers and other educators begin the process of mapping their curriculum and developing the instructional strategies necessary to implement NGSS fully, we felt it would be useful to provide a resource that highlights some of the linkages between this vision of science education and environmental literacy. Companion documents that illustrate the linkages between environmental literacy and the Common Core State Standards are also available for download at eelinked.net/n/guidelines.

A Framework for Environmental Literacy

Excellence in Environmental Education - Guidelines for Learning (K-12) (first published by NAAEE in 1999 and most recently revised in 2010) offers a detailed curriculum and instructional framework and vision for environmental education that promotes progress toward sustaining a healthy environment and quality of life. By setting specific expectations for what young people should *know and be able to do* by the time they complete fourth, eighth, and twelfth grades, *Guidelines for Learning (K-12)* translates general notions about environmental literacy into an age-appropriate framework for effective and comprehensive environmental education programming. The guidelines emphasize the development of conceptual knowledge as well as thinking, investigation, and action skills necessary for civic engagement. They rest on the idea that environmental literacy must be a goal of society and that environmental education must play an integral role throughout educational systems.

Essential Underpinnings

Environmental education builds from a core of key principles that inform its approach to education. Some of these important underpinnings are:

Systems: Systems help make sense of a large and complex world. A system is made up of parts. Each part can be understood separately. The whole, however, is understood only by understanding the relationships and interactions among the parts.

Interdependence: Human well-being is inextricably bound with environmental quality. Humans are a part of the natural order. We and the systems we create – our societies, political systems, economies, religions, cultures, technologies – impact the total environment. Since we are part of nature rather than outside it, we are challenged to recognize the ramifications of our interdependence.

The importance of where one lives: Beginning close to home, learners forge connections with, explore and understand their immediate surroundings. The sensitivity, knowledge, and skills needed for this local connection provides a base for moving out into larger systems, broader issues, and an expanding understanding of causes, connections, and consequences.

Integration and infusion: Disciplines from the natural sciences to the social sciences to the humanities are connected through the medium of the environment and environmental issues. Environmental education offers opportunities for integration and works best when infused across the curriculum, rather than being treated as a separate discipline or subject.

Roots in the real world: Learners develop knowledge and skills through direct experience with the environment, environmental issues, and society. Investigation, analysis, and problem solving are essential activities and are most effective when relevant to the real world.

Lifelong learning: critical and creative thinking, decision-making, and communication, as well as collaborative learning, are emphasized. These skills are essential for active and meaningful learning, both in school and over a lifetime.

How are the *Guidelines for Learning (K-12)* Organized?

Ultimately, environmentally literate individuals possess a sophisticated set of knowledge, skills, and dispositions that allow them to solve novel environmental problems and determine the best set of actions; they are engaged in civic decision-making and action. Four key elements of environmental literacy have been articulated and further delineated in guidelines:

Strand 1: Questioning, Analysis and Interpretation Skills

Environmental literacy depends on a willingness and ability to ask questions about the surrounding world, speculate and hypothesize, seek and evaluate information, and develop answers to questions. Learners must be familiar with inquiry, master fundamental skills for gathering and organizing information, and interpret and synthesize information to develop and communicate explanations.

This strand is comprised of seven guidelines, each of which details specific skills:

a.) Questioning
b.) Designing investigations
c.) Collecting information
d.) Evaluating accuracy and reliability
e.) Organizing information
f.) Working with models and simulations
g.) Drawing conclusions and developing explanations

Strand 2: Knowledge of Environmental Processes and Systems

Environmental literacy is contingent upon a deep understanding of the environmental processes and systems that are typically included in the Earth system sciences and the ecological sciences. Importantly, environmental literacy is also dependent on an equally deep understanding

of human systems, including political, economic, cultural systems and their relationships and interactions with Earth's physical and living systems. Understanding the ramifications of the interdependence of these systems is essential.

Strand 2.1: The Earth as a Physical System
a.) Process that shape the Earth
b.) Changes in matter
c.) Energy

Strand 2.2: The Living Environment
a.) Organisms, populations, and communities
b.) Heredity and evolution
c.) Systems and connections
d.) Flow of matter and energy

Strand 2.3: Humans and Their Societies
a.) Individuals and groups
b.) Culture
c.) Political and economic systems
d.) Global connections
e.) Change and conflict

Strand 2.4: Environment and Society
a.) Human/environment interactions
b.) Places
c.) Resources
d.) Technology
e.) Environmental issues

Strand 3: Skills for Understanding and Addressing Environmental Issues
Environmental literacy is not limited to conceptual knowledge. The environmentally literate individual is able to identify, investigate, and formulate potential solutions to environmental issues. Environmentally literate individuals have the skills needed to determine what if any action is warranted and to make reasoned decisions about their own involvement.

Strand 3.1: Skills for Analyzing and Investigating Environmental Issues
a.) Identifying and investigating issues
b.) Sorting out the consequences of issues
c.) Identifying and evaluating alternative solutions and courses of action
d.) Working with flexibility, creativity, and openness

Strand 3.2: Decision-making and Citizenship Skills

a.) Forming and evaluating personal views
b.) Evaluating the need for citizen action
c.) Planning and taking action
d.) Evaluating the results of actions

Strand 4: Personal and Civic Responsibility

Individual dispositions are also critical to environmental literacy. Environmentally literate individuals accept the premise that true civic engagement depends on the recognition of rights and responsibilities. They are willing and able to act on their own conclusions about what should be done to ensure environmental quality. As they develop and apply concept-based learning and skills for inquiry, analysis, and action, they understand that what they do as individuals and in groups makes a difference and they are willing to take responsibility for the effects of their actions.

a.) Understanding societal values and principles
b.) Recognizing citizens' rights and responsibilities
c.) Recognizing efficacy
d.) Accepting personal responsibility

Next Generation Science Standards

How are the Next Generation Science Standards organized?

Developed using *A Framework for K-12 Science Education* (NRC 2012) as its foundation, NGSS provides a developmentally appropriate vision for science education. The NRC *Framework* describes, in detail, three dimensions of science education: Practices, Crosscutting Concepts and Disciplinary Core Ideas. These dimensions, taken together, describe what it means to be scientifically literate. NGSS combines each of these three dimensions into performance expectations that reflect underlying learning progressions and describe specific assessment targets across benchmark grade levels. It is important to note that NGSS was conceived as a document that would guide assessment. Because NGSS was designed with assessment in mind, it was decided that writing performance expectations that cut evenly across the *Framework* would have set up unreasonable expectations. Consequently, NGSS concentrates only on a portion of the knowledge and skills presented in the *Framework*.

Dimension 1: Practices

Asking questions (for science) and defining problems (for engineering)
Developing and using models
Planning and carrying out investigations
Analyzing and interpreting data
Using mathematics and computational thinking

Constructing explanations (for science) and designing solutions (for engineering)
Engaging in argument from evidence
Obtaining, evaluating, and communicating information

Dimension 2: Crosscutting Concepts

Patterns
Cause and effect
Scale, proportion, and quantity
Systems and system models
Energy and matter
Structure and function
Stability and change
Interdependence of Science, Engineering, and Technology
Influence of Science, Engineering, and Technology on Society and the Natural World

Dimension 3: Disciplinary Core Ideas

Physical Sciences
- Matter and its Interactions
- Motion and Stability
- Energy
- Waves and Their Applications

Life Sciences
- From Molecules to Organisms
- Ecosystems
- Heredity
- Biological Evolution

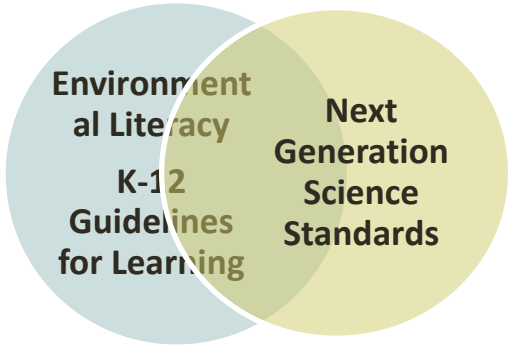
Earth and Space Sciences
- Earth's Place in the Universe
- Earth's Systems
- Earth and Human Activity

Engineering Design

Linking Environmental Education to Academic Standards

Intentionally, the *Guidelines for Learning (K-12)* make clear the argument that environmental education is not separate from mandated education priorities, but should be integral to them. The conceptual framework can be used to craft a comprehensive environmental education program that leads towards environmental literacy while also helping educators meet the requirements of the officially sanctioned and

assessed standards-based curriculum. We envision a Win-Win solution. Building a standards-based curriculum is not a simple task, however. And, in the case of looking at the linkages between environmental literacy and NGSS it must be understood that environmental literacy depends on more than science skills and understandings. Environmental literacy also requires skills and understandings that are most often found within the social studies and humanities curriculum. Similarly, NGSS and its foundational *Framework* (NRC 2012) are not limited to environmental science. There is, however, an important and necessary intersection between environmental literacy and NGSS that may be best visualized as a Venn diagram:



As with many Venn diagrams, the amount of overlap – the intersection between the two circles – is not proscribed or precise. This document was designed to provide insights into the connections that can be found between NGSS and the *Guidelines for Learning (K-12)*. To illustrate these linkages, a series of detailed matrices, displayed in Parts 2-6, have been created that cross reference the intersections between key elements of NGSS and the *Guidelines for Learning (K-12).* These matrices were developed with two distinct purposes in mind: 1) to help educators identify natural opportunities to connect the curriculum through a comprehensive, cohesive vision of environmental literacy and 2) to help educators identify how environmental education can support science education and the implementation of NGSS. Ultimately, this document is meant to be used as a tool for curriculum development and instructional design.

Comparing the Environmental Literacy Framework and NGSS

When all of the cross-references between NGSS performance expectations and the environmental literacy framework as articulated in the *Guidelines for Learning (K-12)* are taken together, distinct patterns emerge. These patterns help us answer two questions important to curriculum development: 1) how can environmental literacy instruction best support the implementation of NGSS and 2) how can instruction designed to address NGSS performance expectations also support the development of environmental literacy. Table 1 displays an overview of the linkages between the *Guidelines for Learning (K-12)* and NGSS. The linkages are drawn from the more detailed matrices found in Parts 2-6 of this document. For ease of interpretation, the level or degree of cross referencing is coded, with darker shading indicating a stronger connection and lighter or no shading indicating little or no connection.

How can environmental literacy instruction best support the implementation of NGSS?

Reading down the columns offers insight into specific places where instruction focusing on environmental literacy could also support NGSS. As might be expected, Strand 1 (Questioning, Analysis and Interpretation Skills) provides the strongest links across the NGSS performance expectations. For the most part, the skills described in Strand 1 align well with NGSS Science and Engineering Practices (see Part 2). Strand 1 also corresponds well with Engineering Design (see Part 4). Cells where no or weak linkages are found typically reflect a lack of cross referencing with the Disciplinary Core Ideas embodied in those cells, rather than weak linkages with the NGSS Science and Engineering Practices.

Strand 2: Knowledge of Environmental Processes and Systems considers the development of understandings typically included in Earth system sciences (2.1) and ecological sciences (2.2). Strand 2 also includes understandings of human systems (2.3) and the relationships and interactions between human societies and the environment (2.4). The Earth as a Physical System (2.1) which includes understandings related to the processes that shape Earth, changes in matter, and energy, cuts across the Physical Sciences (Matter and its Interactions and Energy) and Earth and Space Sciences. As one might expect, Strand 2.2 – The Living Environment is most closely aligned with the Life Sciences. Although Strand 2.4 – Environment and Society does align with LS2 Ecosystems, it is probably not too surprising that it strongly supports the performance expectations associated with ESS3 Earth and Human Activity.

The final linkages of note relate to Strand 3.1 – Skills for Analyzing and Investigating Environmental Issues. Strand 3.1 focuses on the skills needed to identify and investigate environmental issues, explore the consequences of issues, evaluate alternative solutions and courses of action, and work with flexibility and openness. These skills align most closely with Engineering Design. In addition, they are supportive of the performance expectations associated with ESS3 Earth and Human Activity.

What is missing is also of interest. Environmental literacy and science literacy are different and NGSS articulates important understandings that are typically not included with environmental literacy instruction. The linkages with ESS1 Earth's Place in the Universe are only moderate, the linkages with PS2 Motion and Stability are weak, and there are no linkages to PS4 Waves and Their Applications.

How can science education (NGSS) support the development of environmental literacy?

By reading across the rows of Table 1 a vision of the intersection between NGSS and environmental literacy can be garnered. As was discussed above, there are strong connections between the NGSS Science and Engineering Practices embodied in each of the performance expectations and Strand 1: Questioning, Analysis and Interpretation Skills. NGSS supports the development of understandings related to Strand 2.1 – The Earth as a Physical System with cross references to the Physical Sciences (PS1, PS3) and Earth and Space Sciences (ESS1, ESS2, ESS3). NGSS also supports the development of understandings related to Strand 2.2 – The Living Environmental with cross references to the Life Sciences (LS1, LS2, LS3, LS4) and to a somewhat lesser degree Earth and Space Sciences (ESS2, ESS3).

The connections between NGSS and the more science oriented sub strands (2.1 and 2.2) would be expected. What is perhaps most interesting is to look at where NGSS cuts across more than one Strand. Moderate to strong linkages are found between ESS3 Earth and

Human Activity and Strand 1, Strand 2.1, Strand 2.2, Strand 2.4, and Strand 3.1. Multiple linkages, although more modest in nature, can also be found between LS2 Ecosystems and Strand 1, Strand 2.1, Strand 2.2, Strand 2.3, Strand 2.4, and Strand 3.1.

It should not be surprising that NGSS does not support all of the environmental literacy strands. As has been stated before, environmental literacy depends on understandings and skills from the sciences, social sciences, and the humanities. There are rare linkages with Strand 2.3 – Humans and their Societies. There are no linkages with Strand 3.2 – Decision-Making and Citizenship Skills and Strand 4: Personal and Civic Responsibilities. These skills and understandings are more typically part of a social science curriculum that focuses on civic engagement.

Table 1: Overview of Linkages between the Guidelines for Learning (K-12) and NGSS

Key: Level or degree of linkage	None	Limited	Moderate	Strong

NGSS	Strand 1	Strand 2				Strand 3		Strand 4
		2.1	2.2	2.3	2.4	3.1	3.2	
Physical Sciences								
PS1 Matter & its Interactions								
PS2 Motion & Stability								
PS 3 Energy								
PS4 Waves & Their Applications								
Life Sciences								
LS1 From Molecules to Organisms								
LS2 Ecosystems								
LS3 Heredity								
LS 4 Biological Evolution								
Earth & Space Sciences								
ESS1 Earth's Place in the Universe								
ESS2 Earth's Systems								
ESS3 Earth and Human Activity								
Engineering Design								

It should be noted, as something of a disclaimer, that any attempt to identify linkages between environmental literacy and NGSS is based on perspective, interpretation, and ultimate use. Some may well "see" linkages that are not identified in this document. Others may well feel that weak or non-existing linkages were identified. Our task was to try to find a middle ground – one where we provide reasonable guidance to the natural overlaps and gaps between NGSS and environmental literacy. A great deal of the final interpretation will rest in our own practices and how we build curriculum and instruction to address both environmental literacy and NGSS.

PART 2

Linking Science and Engineering Practices and NAAEE *Excellence in Environmental Education: Guidelines for Learning (K-12)*

Eight science and engineer practices are articulated in the NRC *Framework* (NRC 2012) and further developed as learning progressions in Appendix F of NGSS. The following provides a cross-referencing of these practices to Strand 1: Questioning, Analysis, and Interpretation Skills. Depending on the investigation, skills outlined in Strand 3 may also be appropriate.

NGSS – Science and Engineering Practices	NAAEE: Guidelines for Learning K-12
1. Asking questions (for science) and defining problems (for engineering)	1 Questioning, Analysis and Interpretation Skills 1. A. Questioning
2. Developing and using models	1 Questioning, Analysis and Interpretation Skills 1.F. Working with models and simulations.
3. Planning and carrying out investigations	1 Questioning, Analysis and Interpretation Skills 1.B. Designing investigations
4. Analyzing and interpreting data	1 Questioning, Analysis and Interpretation Skills 1.C. Collecting information
5. Using mathematics and computational thinking	
6. Constructing explanations (for science) and designing solutions (for engineering)	1 Questioning, Analysis and Interpretation Skills 1G Drawing conclusions and developing explanations
7. Engaging in argument from evidence	1 Questioning, Analysis and Interpretation Skills 1.D. Evaluating accuracy and reliability
8. Obtaining, evaluating, and communicating information	1 Questioning, Analysis and Interpretation Skills 1.E. Organizing information

PART 3

Linking Crosscutting Concepts and NAAEE *Excellence in Environmental Education: Guidelines for Learning (K-12)*

Seven crosscutting concepts are articulated in the NRC *Framework* (NRC 2012) and further developed as learning progressions in Appendix G of NGSS. Two additional crosscutting concepts that link to science, engineering and technology were included in the final publication of NGSS. Crosscutting concepts are designed to bridge all of the disciplines. As one of the three dimensions, along with the science and engineering practices and the disciplinary core ideas, the crosscutting concepts are integrated throughout the NGSS performance expectations. The following provides sample linkages between the NGSS crosscutting concepts and the environmental literacy strands. Although there are numerous linkages to the environmental literacy strands, there are also linkages between the environmental education Essential Underpinnings and the NGSS crosscutting concepts.

NGSS – Crosscutting Concepts	NAAEE: Guidelines for Learning K-12
1. Patterns.	**Strand 2.1: The Earth as a Physical System** a.) Process that shape the Earth
2. Cause and effect - Mechanism and explanation.	**Essential Underpinning: *Systems***: Systems help make sense of a large and complex world. A system is made up of parts. Each part can be understood separately. The whole, however, is understood only by understanding the relationships and interactions among the parts. **Strand 2.1: The Earth as a Physical System** a.) Process that shape the Earth b.) Changes in matter **Strand 2.2: The Living Environment** b.) Heredity and evolution c.) Systems and connections **Strand 2.4: Environment and Society** a.) Human/environment interactions
3. Scale, proportion and quantity.	**Strand 2.1: The Earth as a Physical System** a.) Process that shape the Earth **Strand 2.2: The Living Environment** a.) Organisms, populations, and communities
4. Systems and system models.	**Essential Underpinning: *Systems***: Systems help make sense of a large and complex

NGSS – Crosscutting Concepts	NAAEE: Guidelines for Learning K-12
	world. A system is made up of parts. Each part can be understood separately. The whole, however, is understood only by understanding the relationships and interactions among the parts. **Strand 2.4: Environment and Society** a.) Human/environment interactions
5. Energy and matter – Flows, cycles, and conservation.	**Strand 2.1: The Earth as a Physical System** c.) Energy **Strand 2.2: The Living Environment** d.) Flow of matter and energy
6. Structure and function.	**Strand 2.2: The Living Environment** a.) Organisms, populations, and communities b.) Heredity and evolution c.) Systems and connections
7. Stability and change.	**Strand 2.1: The Earth as a Physical System** a.) Process that shape the Earth b.) Changes in matter **Strand 2.4: Environment and Society** a.) Human/environment interactions
8. Interdependence of Science, Engineering, and Technology	**Essential Underpinning: *Interdependence***: Human well-being is inextricably bound with environmental quality. Humans are a part of the natural order. We and the systems we create – our societies, political systems, economies, religions, cultures, technologies – impact the total environment. Since we are part of nature rather than outside it, we are challenged to recognize the ramifications of our interdependence. **Strand 2.4: Environment and Society** a.) Human/environment interactions d.) Technology
9. Influence of Science, Engineering, and Technology on Society and the Natural World	**Essential Underpinning: *Interdependence***: Human well-being is inextricably bound with environmental quality. Humans are a part of the natural order. We and the systems we create – our societies, political systems, economies, religions, cultures, technologies – impact the total environment. Since we are part of nature rather than outside it, we are challenged to recognize the ramifications of our interdependence. **Strand 2.4: Environment and Society** a.) Human/environment interactions d.) Technology

PART 4

Linking Engineering Design (ETS) and NAAEE *Excellence in Environmental Education: Guidelines for Learning (K-12)*

NGSS identifies performance expectations related to Engineering Design for each of the four grade bands. There are three overarching ideas for engineering design: 1) Defining and delimiting engineering problems; 2) Designing solutions to engineering problems; and 3) Optimizing the design solutions. A thorough explanation of Engineering Design and its learning progressions across the grade bands can be found in Appendix I of NGSS. As might be expected, depending on the engineering question, linkages draw primarily from Strand 1: Questioning, Analysis and Interpretation Skills and Strand 3.1: Skills for Analyzing and Investigating Environmental Issues. It should be remembered that not all environmental issues lend themselves to engineering design solutions.

KINDERGARTEN – SECOND GRADE	
NGSS – K-2-ETS1 Engineering Design	**NAAEE: Guidelines for Learning K-4**
K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	**1 Questioning, Analysis and Interpretation Skills** **1. A. Questioning –** Learners are able to develop questions that help them learn about the environment and do simple investigations. **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.A. Identifying and investigating issues** – Learners are able to identify and investigate issues in their local environment and communities.
K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations – L**earners understand that relationships, patterns, and processes can be represented by models.
K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **1.E Organizing information** – Learners are able to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics.

THIRD – FIFTH GRADE	
NGSS – 3-5-ETS1 Engineering Design	**NAAEE: Guidelines for Learning K-4 and 5-8**
3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost.	**1 Questioning, Analysis and Interpretation Skills** **1.A. Questioning**-Learners are able to develop questions that help them learn about the environment and do simple investigations (K-4). **1.A. Questioning** – Learners are able to develop, focus, and explain questions that help them learn about the environment and do environmental investigations (grades 5-8). **1.B. Designing investigations** – Learners are able to design simple investigations (K-4). **1.B. Designing investigations** – Learners are able to design environmental investigations to answer particular questions – often their own questions (grades 5-8). **3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.A. Identifying and investigating issues** – Learners are able to identify and investigate issues in their local environment and communities (K-4). **3.1A. Identifying and investigating issues –** Learners are able to use primary and secondary sources of information, and apply growing research and analytical skills, to investigate environmental issues, beginning in their own community (grades 5-8). **3.1.B. Sorting out the consequences of issues** – As learners come to understand that environmental and social phenomena are linked, they are able to explore the consequences of issues (k-4). **3.1.B. Sorting out the consequences of issues** – Learners are able to apply their knowledge of ecological and human processes and systems to identify the consequences of specific environmental issues (grades 5-8)
3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners understand there are many approaches to resolving issues (K-4). **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and develop action strategies for addressing particular issues (grades 5-8).
3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	**1 Questioning, Analysis and Interpretation Skills** **1.B. Designing investigations –** Learners are able to design simple investigations (K-4). **1.B. Designing investigations** – Learners are able to design environmental investigations to answer particular questions—often their own questions (grades 5-8). **1.D. Evaluating accuracy and reliability –** Learners understand the need to use reliable information to answer their questions. They are familiar with some basic factors to consider in judging the merits of

THIRD – FIFTH GRADE	
NGSS – 3-5-ETS1 Engineering Design	**NAAEE: Guidelines for Learning K-4 and 5-8**
	information (K-4). **1.D. Evaluating accuracy and reliability** – Learners are able to judge the weaknesses and strengths of the information they are using (grades 5-8). **1.F. Working with models and simulations –** Learners understand that relationships, patterns, and processes can be represented by models (K-4). **1.F. Working with models and simulations** – Learners understand many of the uses and limitations of models (grades 5-8).

MIDDLE SCHOOL – GRADES 6-8	
NGSS - MS-ETS1 Engineering Design	**NAAEE: Guidelines for Learning Grades 5-8**
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.A. Identifying and investigating issues** – Learners are able to use primary and secondary sources of information, and apply growing research and analytical skills, to investigate environmental issues, beginning in their own community. **3.1.B. Sorting out the consequences of issues** – Learners are able to apply their knowledge of ecological and human processes and systems to identify the consequences of specific environmental issues. **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and develop action strategies for addressing particular issues. **3.1.D. Working with flexibility, creativity, and openness –** Learners are able to consider the assumptions and interpretations that influence the conclusions they and others draw about environmental issues.
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and develop action strategies for addressing particular issues. **3.1.D. Working with flexibility, creativity, and openness –** Learners are able to consider the assumptions and interpretations that influence the conclusions they and others draw about environmental issues.
MS-ETS1-3. Analyze data from tests to determine similarities and differences among	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to

MIDDLE SCHOOL – GRADES 6-8	
NGSS - MS-ETS1 Engineering Design	**NAAEE: Guidelines for Learning Grades 5-8**
several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	identify and develop action strategies for addressing particular issues.
MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	**1 Questioning, Analysis and Interpretation Skills** **1F. Working with models and simulations** – Learners understand many of the uses and limitations of models.

HIGH SCHOOL – GRADES 9-12	
NGSS - HS-ETS1 Engineering Design	**NAAEE: Guidelines for Learning Grades 9-12**
HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	**2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs. **2.4.E. Environmental issues** – Learners are familiar with a range of environmental issues at scales that range from local to national to global. They understand that these scales and issues are often linked. **3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.A. Identifying and investigating issues** – Learners apply their research and analytical skills to investigate environmental issues ranging from local issues to those that are regional or global in scope. **3.1.B. Sorting out the consequences of issues** – Learners are able to evaluate the consequences of specific environmental changes, conditions, and issues for human and ecological systems. **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and propose action strategies that are likely to be effective in particular situations and for particular purposes. **3.1.D. Working with flexibility, creativity, and openness** – While environmental issues and investigations can bring to the surface deeply held views, learners are able to engage each other in peer review conducted in the spirit of open inquiry. **4 Personal and Civic Responsibility** **4.A. Understanding societal values and principles** – Learners know how to analyze the influence of

HIGH SCHOOL – GRADES 9-12	
NGSS - HS-ETS1 Engineering Design	**NAAEE: Guidelines for Learning Grades 9-12**
	shared and conflicting societal values.
HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.A. Identifying and investigating issues** – Learners apply their research and analytical skills to investigate environmental issues ranging from local issues to those that are regional or global in scope. **3.1.B. Sorting out the consequences of issues** – Learners are able to evaluate the consequences of specific environmental changes, conditions, and issues for human and ecological systems. **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and propose action strategies that are likely to be effective in particular situations and for particular purposes. **3.1.D. Working with flexibility, creativity, and openness** – While environmental issues and investigations can bring to the surface deeply held views, learners are able to engage each other in peer review conducted in the spirit of open inquiry.
HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	**3.2 Decision-Making and Citizenship Skills** **3.2.D. Evaluating the results of actions** – Learners are able to evaluate the effects of their own actions and actions taken by other individuals and groups, including possible intended and unintended consequences of actions.
HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.B. Sorting out the consequences of issues** – Learners are able to evaluate the consequences of specific environmental changes, conditions, and issues for human and ecological systems. **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and propose action strategies that are likely to be effective in particular situations and for particular purposes.

PART 5

Linking NGSS Performance Expectation and NAAEE *Excellence in Environmental Education: Guidelines for Learning (K-12)*

NGSS performance expectations are articulated for each of the following grade bands: kindergarten, first grade, second grade, third grade, fourth grade, fifth grade, middle school (6^{th} – 8^{th} grades), and high school (9^{th} – 12^{th} grades). Performance expectations for Physical Sciences (PS), Life Sciences (LS) and Earth and Space Sciences (ESS) are provided. Since NGSS reflects the learning progressions presented in Appendix I and was developed as a tool to guide assessment, it should be noted that not all of the Disciplinary Core Ideas were included in the resultant performance expectations.

For the following matrices, NGSS performance expectations form the anchors with linkages made to applicable environmental education guidelines. For ease of decoding, skills related guidelines – those from Strands 1 and 3 – are displayed in blue font.

KINDERGARTEN	
NGSS Performance Expectations	**NAAEE: Guidelines for Learning K-4**
K-PS2 Motion and Stability: Forces and Interactions	
K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.	
K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.	
K-PS3 Energy	
K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **2.1 The Earth as a Physical System** **2.1.C. Energy** – While they may have little understanding of formal concepts associated with energy,

KINDERGARTEN	
NGSS Performance Expectations	**NAAEE: Guidelines for Learning K-4**
	learners are familiar with the basic behavior of some different forms of energy.
K-PS3-2. Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.	**1 Questioning, Analysis and Interpretation Skills** **1.B. Designing investigations –** Learners are able to design simple investigations. **2.1 The Earth as a Physical System** **2.1.C. Energy** – While they may have little understanding of formal concepts associated with energy, learners are familiar with the basic behavior of some different forms of energy. **2.4 Environment and Society** **2.4.A. Human/environment interactions –** Learners understand that people depend on, change, and are affected by the environment.
K-LS1 From Molecules to Organisms: Structures and Processes	
K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.	**1 Questioning, Analysis and Interpretation Skills** **1.E. Organizing information –** Learners are able to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat. **2.2.D. Flow of matter and energy** – Learners know that living things need some source of energy to live and grow.
K-ESS2 Earth's Systems	
K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **1.E. Organizing information –** Learners are about to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners are able to identify changes and differences in the physical environment.

KINDERGARTEN	
NGSS Performance Expectations	**NAAEE: Guidelines for Learning K-4**
K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners can develop simple explanations that address their questions about the environment. **2.2 The Living Environment** **2.2.C. Systems and connections** – Learners understand basic ways in which organisms are related to their environments and other organisms. **2.4 Environment and Society** **2.4.A Human/environment interactions** – Learners understand that people depend on, change, and are affected by the environment.
KESS3 Earth and Human Activity	
K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners understand that relationships, patterns, and processes can be represented by models. **2.2 The Living Environment** **2.2.C. Systems and connections** – Learners understand basic ways in which organisms are related to their environments and other organisms. **2.4 Environment and Society** **2.4.A Human/environment interactions** – Learners understand that people depend on, change, and are affected by the environment. **2.4.B Places** – Learners understand that places differ in their physical and human characteristics.
K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.	**1 Questioning, Analysis and Interpretation Skills** **1. A. Questioning –** Learners are able to develop questions that help them learn about the environment and do simple investigations. **2.4 Environment and Society** **2.4.A. Human/environment interactions –** Learners understand that people depend on, change, and are affected by the environment.
K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land,	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners can develop simple explanations

KINDERGARTEN	
NGSS Performance Expectations	**NAAEE: Guidelines for Learning K-4**
water, air, and/or other living things in the local environment.	that address their questions about the environment. **3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of actions** – Learners understand there are many approaches to resolving issues. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that people depend on, change, and are affected by the environment. **2.4.C. Resources –** Learners understand the basic concepts of resource and resource distribution. **2.4.E. Environmental** issues – Learners are familiar with some local environmental issues and understand that people in other places experience environmental issues as well.

FIRST GRADE	
NGSS Performance Expectations	**NAAEE: Guidelines for Learning K-4**
1-PS4 Waves and their Applications in Technologies for Information Transfer	
1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.	
1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated.	
1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.	
1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.	

FIRST GRADE	
NGSS Performance Expectations	**NAAEE: Guidelines for Learning K-4**
1-LS1 From Molecules to Organisms: Structures and Processes	
1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of actions** – Learners understand there are many approaches to resolving issues. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat.
1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **2.2 The Living Environment** **2.2.C. Systems and connections** – Learners understand basic ways in which organisms are related to their environments and other organisms.
1-LS3 Heredity: Inheritance and Variation of Traits	
1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **2.2 The Living Environment** **2.2.B Heredity and evolution** – Learners understand that plants and animals have different characteristics and that many of the characteristics are inherited.
1-ESS1 Earth's Place in the Universe	
1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners are able to identify changes and differences in the physical environment.

FIRST GRADE	
NGSS Performance Expectations	**NAAEE: Guidelines for Learning K-4**
1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners are able to identify changes and differences in the physical environment.

SECOND GRADE	
NGSS Performance Expectations	**NAAEE: Guidelines for Learning K-4**
2-PS1 Matter and its Interactions	
2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.	**1 Questioning, Analysis and Interpretation Skills** **1.B. Designing investigations –** Learners are able to design simple investigations. **2.1 The Earth as a Physical System** **2.1.B. Changes in matter** – Learners are able to identify basic characteristics of and changes in matter.
2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.	**1 Questioning, Analysis and Interpretation Skills** **1.E. Organizing information** – Learners are able to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics. **2.1 The Earth as a Physical System** **2.1.B. Changes in matter** – Learners are able to identify basic characteristics of and changes in matter.
2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.	
2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners can develop simple explanations that address their questions about the environment.

SECOND GRADE	
NGSS Performance Expectations	**NAAEE: Guidelines for Learning K-4**
	2.1 The Earth as a Physical System **2.1.B. Changes in matter** – Learners are able to identify basic characteristics of and changes in matter.
2-LS2 Ecosystems: Interactions, Energy, and Dynamics	
2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow	**1 Questioning, Analysis and Interpretation Skills** **1. B. Designing investigations –** Learners are able to design simple investigations. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat. **2.2D Flow of matter and energy** – Learners know that living things need some source of energy to live and grow.
2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners understand that relationships, patterns, and processes can be represented by models. **2.2 The Living Environment** **2.2.C. Systems and connections** – Learners understand basic ways in which organisms are related to their environments and other organisms.
2-LS4 Biological Evolution: Unity and Diversity	
2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat. **2.2.C. Systems and connections** – Learners understand basic ways in which organisms are related to their environments and other organisms.
2-ESS1 Earth's Place in the Universe	
2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics.

SECOND GRADE	
NGSS Performance Expectations	**NAAEE: Guidelines for Learning K-4**
	2.1 The Earth as a Physical System **2.1.A. Processes that shape the Earth** – Learners are able to identify changes and differences in the physical environment.
2-ESS2 Earth's Systems	
2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of actions** – Learners understand there are many approaches to resolving issues. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners are able to identify changes and differences in the physical environment. **2.4 Environment and Society** **2.4.A. Human/environment interactions –** Learners understand that people depend on, change, and are affected by the environment.
2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners understand that relationships, patterns, and processes can be represented by models. **2.1 The Earth as a Physical System** **2.1. A. Processes that shape the Earth** – Learners are able to identify changes and differences in the physical environment.
2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners are able to identify changes and differences in the physical environment.

THIRD GRADE	
NGSS – Performance Expectations	**NAAEE: Guidelines for Learning K-4**
3-PS2 Motion and Stability: Forces and Interactions	
3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.	
3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.	
3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.	
3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.	
3-LS1 From Molecules to Organisms: Structures and Processes	
3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations** – Learners understand that relationships, patterns, and processes can be represented by models. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat.
3-LS2 Ecosystems: Interactions, Energy, and Dynamics	
3-LS2-1. Construct an argument that some animals form groups that help members survive.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners can develop simple explanations that address their questions about the environment. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat.
3-LS3 Heredity: Inheritance and Variation of Traits	
3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits	**1 Questioning, Analysis and Interpretation Skills**

THIRD GRADE	
NGSS – Performance Expectations	**NAAEE: Guidelines for Learning K-4**
inherited from parents and that variation of these traits exists in a group of similar organisms.	**1.E. Organizing information** – Learners are able to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat. **2.2B. Heredity and evolution** – Learners understand that plants and animals have different characteristics and that many of the characteristics are inherited.
3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners can develop simple explanations that address their questions about the environment. **2.2 The Living Environment** **2.2.B. Heredity and evolution** – Learners understand that plants and animals have different characteristics and that many of the characteristics are inherited. **2.2.C. Systems and connections** – Learners understand basic ways in which organisms are related to their environments and to other organisms.
3-LS4 Biological Evolution: Unity and Diversity	
3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.	**1 Questioning, Analysis and Interpretation Skills** **1.E. Organizing information** – Learners are able to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat. **2.2.B. Heredity and evolution** – Learners understand that plants and animals have different characteristics and that many of the characteristics are inherited. **2.2.C. Systems and connections** – Learners understand basic ways in which organisms are related to their environments and to other organisms.
3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners can develop simple explanations that address their questions about the environment. **2.2 The Living Environment**

THIRD GRADE	
NGSS – Performance Expectations	**NAAEE: Guidelines for Learning K-4**
	2.2.A. Organisms, populations, and communities – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat. **2.2.B. Heredity and evolution** – Learners understand that plants and animals have different characteristics and that many of the characteristics are inherited. **2.2.C. Systems and connections** – Learners understand basic ways in which organisms are related to their environments and to other organisms.
3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners can develop simple explanations that address their questions about the environment. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat. **2.2.B. Heredity and evolution** – Learners understand that plants and animals have different characteristics and that many of the characteristics are inherited. **2.2.C. Systems and connections** – Learners understand basic ways in which organisms are related to their environments and to other organisms.
3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of actions** – Learners understand there are many approaches to resolving issues. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat. **2.2.B. Heredity and evolution** – Learners understand that plants and animals have different characteristics and that many of the characteristics are inherited. **2.2.C. Systems and connections** – Learners understand basic ways in which organisms are related to their environments and to other organisms.
3-ESS2 Earth's Systems	
3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.	**1 Questioning, Analysis and Interpretation Skills** **1. E. Organizing information** – Learners are about to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics. **2.1 The Earth as a Physical System**

THIRD GRADE	
NGSS – Performance Expectations	**NAAEE: Guidelines for Learning K-4**
	2.1.A. Processes that shape the Earth – Learners are able to identify changes and differences in the physical environment.
3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **1.E. Organizing information** – Learners are about to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners are able to identify changes and differences in the physical environment.
3-ESS3 Earth and Human Activity	
3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of actions** – Learners understand there are many approaches to resolving issues. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that people depend on, change, and are affected by the environment. **2.4.D. Technology** – Learners understand that technology is an integral part of human existence and culture.

FOURTH GRADE	
NGSS – Performance Expectations	**NAAEE: Guidelines for Learning K-4**
4-PS3 Energy	
4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.	
4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **2.1 The Earth as a Physical System** **2.1.C. Energy** – While they may have little understanding of formal concepts associated with energy, learners are familiar with the basic behavior of some different forms of energy.
4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.	
4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.	**2.1 The Earth as a Physical System** **2.1.C. Energy** – While they may have little understanding of formal concepts associated with energy, learners are familiar with the basic behavior of some different forms of energy.
4-PS4 Waves and their Applications in Technologies for Information Transfer	
4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.	
4-PS4-2 Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.	
4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.	

FOURTH GRADE	
NGSS – Performance Expectations	**NAAEE: Guidelines for Learning K-4**
4-LS1 From Molecules to Organisms: Structures and Processes	
4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners can develop simple explanations that address their questions about the environment. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat.
4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations** – Learners understand that relationships, patterns, and processes can be represented by models. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat. **2.2.C. Systems and connections** – Learners understand basic ways in which organisms are related to their environments and other organisms.
4-ESS1 Earth's Place in the Universe	
4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners are able to identify changes and differences in the physical environment. **2.1.B. Changes in matter** – Learners are able to identify basic characteristics of and changes in matter.
4-ESS2 Earth's Systems	
4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners are able to identify changes and differences in the physical environment.

FOURTH GRADE	
NGSS – Performance Expectations	**NAAEE: Guidelines for Learning K-4**
	2.1.B. Changes in matter – Learners are able to identify basic characteristics of and changes in matter.
4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.	**1 Questioning, Analysis and Interpretation Skills** **1.E. Organizing information** – Learners are about to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics. **The Earth as a Physical System** **2.1.A. Processes that shape the** Earth – Learners are able to identify changes and differences in the physical environment.
4-ESS3 Earth and Human Activity	
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **1.E. Organizing information** – Learners are about to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that people depend on, change, and are affected by the environment. **2.4.C. Resources** – Learners understand the basic concepts of resource and resource distribution. **2.4.E. Environmental issues** – Learners are familiar with some local environmental issues and understand that people in other places experience environmental issues as well.
4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of actions** – Learners understand there are many approaches to resolving issues. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that people depend on, change, and are affected by the environment.2.4 Environment and Society **2.4.C Resources** – Learners understand the basic concepts of resource and resource distribution. **2.4.E. Environmental issues** – Learners are familiar with some local environmental issues and understand that people in other places experience environmental issues as well.

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5-PS1 Matter and Its Interactions	
5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.	
5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.	
5-PS1-3. Make observations and measurements to identify materials based on their properties.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **2.1 The Earth as a Physical System** **2.1.B. Changes in matter** – Learners understand the properties of the substances that make up objects or materials found in the environment.
5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.	
5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.	
5-PS3 Energy	
5-PS3-1 Use models to describe that that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations** – Learners understand many of the uses and limitations of models. **2.1.C. Energy** – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects. **2.2 The Living Environment**

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	2.2.D. Flow of matter and energy – Learners understand how energy and matter flow among the abiotic and biotic components of the environment.
5-LS1 From Molecules to Organisms: Structures and Processes	
5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **2.2 The Living Environment** **2.2.D. Flow of matter and energy** – Learners understand how energy and matter flow among the abiotic and biotic components of the environment.
5-LS2 Ecosystems: Interactions, Energy, and Dynamics	
5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations** – Learners understand many of the uses and limitations of models. **2.2 The Living Environment** **2.2.C. Systems and connections** – Learners understand major kinds of interactions among organisms or populations or organisms. **2.2.D. Flow of matter and energy** – Learners understand how energy and matter flow among the abiotic and biotic components of the environment.
5-ESS1 Earth's Place in the Universe	
5-ESS1-1 Support an argument that differences in the apparent brightness of the sun compared to other starts is due to their relative distance from Earth.	
5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearances of some stars in the night sky.	**1 Questioning, Analysis and Interpretation Skills** **1.E. Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.

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5-ESS2 Earth's Systems	
5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations** – Learners understand many of the uses and limitations of models. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns. **2.1.B. Changes in matter** – Learners understand the properties of the substances that make up objects or materials found in the environment.
5-ESS2-2 Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.	**1 Questioning, Analysis and Interpretation Skills** **1.E. Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns. **2.4 Environment and Society** **2.4.C. Resources** – Learners understand that uneven distribution of resources influences their use and perceived value.
5-ESS3 Earth and Human Activity	
5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect information about the environment and environmental topics. **2.3 Humans and Their Societies** **2.3.A. Individuals and groups** – Learners understand that how individuals perceive the environment is influenced in part by individual traits and group membership or affiliation. **2.4 Environment and Society** **2.4.E. Environmental issues** – Learners are familiar with a range of environmental issues at scales that range from local to national to global. They understand that people in other places around the world experience environmental issues similar to the ones they are concerned about locally.

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MS-PS1 Matter and Its Interactions	
MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations** – Learners understand many of the uses and limitations of models. **2.1 The Earth as a Physical System** **2.1.B. Changes in matter** – Learners understand the properties of the substances that make up objects or materials found in the environment.
MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	**1 Questioning, Analysis and Interpretation Skills** **1.E .Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **2.1 The Earth as a Physical System** **2.1.B. Changes in matter** – Learners understand the properties of the substances that make up objects or materials found in the environment.
MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect reliable information about the environment or environmental topics using a variety of methods and sources. **1.D. Evaluating accuracy and reliability** – Learners are able to judge the weaknesses and strengths of the information they are using. **1.E. Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **2.1 The Earth as a Physical System** **2.1.B. Changes in matter** – Learners understand the properties of the substances that make up objects or materials found in the environment.
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners understand many of the uses and limitations of models. **2.1 The Earth as a Physical System** **2.1.B. Changes in matter** – Learners understand the properties of the substances that make up objects or materials found in the environment.

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	2.1.C. Energy – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.
MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners understand many of the uses and limitations of models. **2.1 The Earth as a Physical System** **2.1.B. Changes in matter** – Learners understand the properties of the substances that make up objects or materials found in the environment.
MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.	**1 Questioning, Analysis and Interpretation Skills** **1.B. Designing investigations** – Learners are able to design environmental investigations to answer particular questions – often their own questions. **1.C. Collecting information** – Learners are able to locate and collect reliable information about the environment or environmental topics using a variety of methods and sources. **1.D. Evaluating accuracy and reliability** – Learners are able to judge the weaknesses and strengths of the information they are using. **1.E. Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and develop action strategies for addressing particular issues. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.
MS-PS2 Motion and Stability: Forces and Interactions	
MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.	

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MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.	
MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.	**1 Questioning, Analysis and Interpretation Skills** **1.A. Questioning** – Learners are able to develop, focus, and explain questions that help them learn about the environment and do environmental investigations. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.
MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.	
MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	
MS-PS3 Energy	
MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.	**1 Questioning, Analysis and Interpretation Skills** **1.E .Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.
MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners understand many of the uses and limitations of models. **2.1 The Earth as a Physical System**

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	2.1.C. Energy – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.
MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.	**1 Questioning, Analysis and Interpretation Skills** **1.A. Questioning** – Learners are able to develop, focus, and explain questions that help them learn about the environment and do environmental investigations. **1.B. Designing investigations** – Learners are able to design environmental investigations to answer particular questions – often their own questions. **1.C. Collecting information** – Learners are able to locate and collect reliable information about the environment or environmental topics using a variety of methods and sources. **1.D. Evaluating accuracy and reliability** – Learners are able to judge the weaknesses and strengths of the information they are using. **1.E. Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.
MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.	**1 Questioning, Analysis and Interpretation Skills** **1.A. Questioning** – Learners are able to develop, focus, and explain questions that help them learn about the environment and do environmental investigations. **1.B. Designing investigations** – Learners are able to design environmental investigations to answer particular questions – often their own questions. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.
MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations.

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	2.1 The Earth as a Physical System **2.1.C. Energy** – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.
MS-PS4 Waves and Their Applications in Technologies for Information Transfer	
MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	
MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	
MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.	
MS-LS1 From Molecules to Organisms: Structures and Processes	
MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.	
MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.	
MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.	
MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners are able to judge the weaknesses and strengths of the information they are using. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations.

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respectively.	**2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments.
MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability –** Learners are able to judge the weaknesses and strengths of the information they are using. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments.
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.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability –** Learners are able to judge the weaknesses and strengths of the information they are using. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **2.2 The Living Environment** **2.2.D. Flow of matter and energy** – Learners understand how energy and matter flow among the abiotic and biotic components of the environment.
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.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations** – Learners understand many of the uses and limitations of models. **2.2 The Living Environment** **2.2.D. Flow of matter and energy** – Learners understand how energy and matter flow among the abiotic and biotic components of the environment.
MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.	
MS-LS2 Ecosystems: Interactions, Energy, and Dynamics	
MS-LS2-1. Analyze and interpret data to	**1 Questioning, Analysis and Interpretation Skills**

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provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.	**1.E. Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments. **2.2.C. Systems and connections** – Learners understand major kinds of interactions among organisms or populations of organisms. **2.4 Environment and Society** **2.4.C. Resources** – Learners understand that uneven distribution of resources influences their use and perceived value.
MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments. **2.2.C. Systems and connections** – Learners understand major kinds of interactions among organisms or populations of organisms.
MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners understand many of the uses and limitations of models. **2.1 The Earth as a Physical System** **2.1.B Changes in matter** – Learners understand the properties of the substances that make up objects or materials found in the environment. **2.1.C. Energy** – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects. **2.2 The Living Environment**

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	2.2.D. Flow of matter and energy – Learners understand how energy and matter flow among the abiotic and biotic components of the environment.
MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners are able to judge the weaknesses and strengths of the information they are using. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments. **2.2.C. Systems and connections** – Learners understand major kinds of interactions among organisms or populations of organisms. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.
MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and develop action strategies for addressing particular issues. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments. **2.2.C. Systems and connections** – Learners understand major kinds of interactions among organisms or populations of organisms. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.

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MS-LS3 Heredity: Inheritance and Variation of Traits	
MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.	
MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations** – Learners understand many of the uses and limitations of models. **2.2 The Living Environment** **2.2.B. Heredity and evolution** – Learners have a basic understanding of the importance of genetic heritage.
MS-LS4 Biological Evolution: Unity and Diversity	
MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.	**1 Questioning, Analysis and Interpretation Skills** **1.E. Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments. **2.2.B. Heredity and evolution** – Learners have a basic understanding of the importance of genetic heritage. **2.2.C. Systems and connections** – Learners understand major kinds of interactions among organisms or populations of organisms.
MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners are able to judge the weaknesses and strengths of the information they are using. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations.

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	2.2 The Living Environment **2.2.A. Organisms, populations, and communities** – Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments. **2.2B. Heredity and evolution** – Learners have a basic understanding of the importance of genetic heritage. **2.2.C. Systems and connections** – Learners understand major kinds of interactions among organisms or populations of organisms.
MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.	**1 Questioning, Analysis and Interpretation Skills** **1.E. Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **2.2 The Living Environment** **2.2B. Heredity and evolution** – Learners have a basic understanding of the importance of genetic heritage.
MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners are able to judge the weaknesses and strengths of the information they are using. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments. **2.2.B. Heredity and evolution** – Learners have a basic understanding of the importance of genetic heritage. **2.2.C. Systems and connections** – Learners understand major kinds of interactions among organisms or populations of organisms.
MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect reliable information about the environment or environmental topics using a variety of methods and sources. **1.E. Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **2.2 The Living Environment**

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	2.2.A. Organisms, populations, and communities – Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments. **2.2B. Heredity and evolution** – Learners have a basic understanding of the importance of genetic heritage. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times. **2.4.D. Technology** – Learners understand the human ability to shape and control the environment as a function of the capacities for creating knowledge and developing new technologies.
MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	**1 Questioning, Analysis and Interpretation Skills** **1F. Working with models and simulations** – Learners understand many of the uses and limitations of models. **2.2 The Living Environment** **2.2.B. Heredity and evolution** – Learners have a basic understanding of the importance of genetic heritage.
MS-ESS1 Earth's Place in the Universe	
MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations** – Learners understand many of the uses and limitations of models. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.
MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.	
MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.	
MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners are able to judge the weaknesses and strengths of the information they are using. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their

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history.	observations and findings into coherent explanations. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.
MS-ESS2 Earth's Systems	
MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations** – Learners understand many of the uses and limitations of models. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns. **2.1.B Changes in matter** – Learners understand the properties of the substances that make up objects or materials found in the environment. **2.1.C Energy** – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.
MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners are able to judge the weaknesses and strengths of the information they are using. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.
MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners are able to judge the weaknesses and strengths of the information they are using. **1.E. Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **2.1 The Earth as a Physical System**

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	2.1.A. Processes that shape the Earth – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.
MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.	**1 Questioning, Analysis and Interpretation Skills** **1F. Working with models and simulations** – Learners understand many of the uses and limitations of models. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns. **2.1.B Changes in matter** – Learners understand the properties of the substances that make up objects or materials found in the environment. **2.1.C Energy** – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.
MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect reliable information about the environment or environmental topics using a variety of methods and sources. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.
MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations** – Learners understand many of the uses and limitations of models. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.
MS-ESS3 Earth and Human Activity	
MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability –** Learners are able to judge the weaknesses and strengths of the information they are using. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations.

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processes.	**2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns. **2.4. Environment and Society** **2.4.C. Resources** – Learners understand that uneven distribution of resources influences their use and perceived value.
MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability –** Learners are able to judge the weaknesses and strengths of the information they are using. **1.E. Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns. **2.4. Environment and Society** **2.4.B. Places –** Learners begin to explore the meaning of places both close to home and around the world. **2.4.D. Technology** – Learners understand the human ability to shape and control the environment as a function of the capacities for creating knowledge and developing new technologies.
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	**1 Questioning, Analysis and Interpretation Skills** **1.A. Questioning** – Learners are able to develop, focus, and explain questions that help them learn about the environment and do environmental investigations. **1.B. Designing investigations** – Learners are able to design environmental investigations to answer particular questions – often their own questions. **1.C. Collecting information** – Learners are able to locate and collect reliable information about the environment or environmental topics using a variety of methods and sources. **1.D. Evaluating accuracy and reliability –** Learners are able to judge the weaknesses and strengths of the information they are using. **1.E. Organizing information** – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their

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	observations and findings into coherent explanations. **3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and develop action strategies for addressing particular issues. **2.4. Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times. **2.4.D. Technology** – Learners understand the human ability to shape and control the environment as a function of the capacities for creating knowledge and developing new technologies.
MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners are able to judge the weaknesses and strengths of the information they are using. **1.G. Drawing conclusions and developing explanations** – Learners are able to synthesize their observations and findings into coherent explanations. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments. **2.2.C. Systems and connections** – Learners understand major kinds of interactions among organisms or populations of organisms. **2.3 Humans and Their Societies** **2.3.D. Global connections** – Learners become familiar with ways in which the world's environmental, social, economic, cultural, and political systems are linked. **2.4. Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times. **2.4.C. Resources** – Learners understand that uneven distribution of resources influences their use and perceived value. **2.4.E. Environmental issues** – Learners are familiar with a range of environmental issues at scales that range from local to national to global. They understand that people in other places around the world

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	experience environmental issues similar to the ones they are concerned about locally.
MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	**1 Questioning, Analysis and Interpretation Skills** **1.A. Questioning** – Learners are able to develop, focus, and explain questions that help them learn about the environment and do environmental investigations. **3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.A. Identifying and investigating issues** – Learners are able to use primary and secondary sources of information, and apply growing research and analytical skills, to investigate environmental issues, beginning in their own community. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns. **2.4. Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times. **2.4.C. Resources** – Learners understand that uneven distribution of resources influences their use and perceived value. **2.4.E. Environmental issues** – Learners are familiar with a range of environmental issues at scales that range from local to national to global. They understand that people in other places around the world experience environmental issues similar to the ones they are concerned about locally.

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HS-PS1 Matter and Its Interactions	
HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	
HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.1 The Earth as a Physical System** **2.1.B. Changes in matter** – Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena.
HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.	
HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data. **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. **1.E. Organizing information** – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses.

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	2.1 The Earth as a Physical System **2.1.B. Changes in matter** – Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena. **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.	**2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	**2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
HS-PS2 Motion and Stability: Forces and Interactions	
HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.	
HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.	
HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic	

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object during a collision.	
HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.	
HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.	**1 Questioning, Analysis and Interpretation Skills** **1.A. Questioning** – Learners are able to develop, modify, clarify, and explain questions that guide environmental investigations of various types. They understand factors that influence the questions they pose. **1.B. Designing investigations** – Learners know how to design investigations to answer particular questions about the environment. They are able to develop approaches for investigating unfamiliar types of problems and phenomena. **1.C. Collecting information** – Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data. **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. **1.E. Organizing information** – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.	
HS-PS3 Energy	
HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena.

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flows in and out of the system are known.	**2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.A. Identifying and investigating issues** – Learners apply their research and analytical skills to investigate environmental issues ranging from local issues to those that are regional or global in scope. **3.1.B. Sorting out the consequences of issues** – Learners are able to evaluate the consequences of specific environmental changes, conditions, and issues for human and ecological systems. **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and propose action strategies that are likely to be effective in particular situations and for particular purposes. **3.1.D. Working with flexibility, creativity, and openness** – While environmental issues and investigations can bring to the surface deeply held views, learners are able to engage each other in peer review conducted in the spirit of open inquiry. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).	**1 Questioning, Analysis and Interpretation Skills** **1.A. Questioning** – Learners are able to develop, modify, clarify, and explain questions that guide environmental investigations of various types. They understand factors that influence the questions they pose. **1.B. Designing investigations** – Learners know how to design investigations to answer particular questions about the environment. They are able to develop approaches for investigating unfamiliar types of problems and phenomena. **1.C. Collecting information** – Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect

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	information, including computer programs that access, gather, store, and display data. **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. **1.E. Organizing information** – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
HS-PS4 Waves and Their Applications in Technologies for Information Transfer	
HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	
HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information.	
HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.	
HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate

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different frequencies of electromagnetic radiation have when absorbed by matter.	completeness and reliability in a variety of information sources. **2.1 The Earth as a Physical System** **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.
HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.	
HS-LS1 From Molecules to Organisms: Structures and Processes	
HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.	
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.	
HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	
HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	
HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.2 The Living Environment** **2.2.D. Flow of matter and energy** – Learners are able to account for environmental characteristics based

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	on their knowledge of how matter and energy interact in living systems.
HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.	
HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.2 The Living Environment** **2.2.D. Flow of matter and energy** – Learners are able to account for environmental characteristics based on their knowledge of how matter and energy interact in living systems.
HS-LS2 Ecosystems: Interactions, Energy, and Dynamics	
HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic population dynamics and the importance of diversity in living systems. **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems.
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.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic population dynamics and the importance of diversity in living systems. **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems.

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HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.2 The Living Environment** **2.2.D. Flow of matter and** energy – Learners are able to account for environmental characteristics based on their knowledge of how matter and energy interact in living systems.
HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.2 The Living Environment** **2.2.D. Flow of matter and** energy – Learners are able to account for environmental characteristics based on their knowledge of how matter and energy interact in living systems.
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.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.2 The Living Environment** **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems. **2.2.D. Flow of matter and** energy – Learners are able to account for environmental characteristics based on their knowledge of how matter and energy interact in living systems.
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.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.2 The Living Environment** **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems.
HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.A. Identifying and investigating issues** – Learners apply their research and analytical skills to

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activities on the environment and biodiversity.	investigate environmental issues ranging from local issues to those that are regional or global in scope. **3.1.B. Sorting out the consequences of issues** – Learners are able to evaluate the consequences of specific environmental changes, conditions, and issues for human and ecological systems. **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and propose action strategies that are likely to be effective in particular situations and for particular purposes. **3.1.D. Working with flexibility, creativity, and openness** – While environmental issues and investigations can bring to the surface deeply held views, learners are able to engage each other in peer review conducted in the spirit of open inquiry. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic population dynamics and the importance of diversity in living systems. **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems. **2.3 Humans and Their Societies** **2.3.D. Global connections** – Learners are able to analyze global, social, cultural, political, economic, and environmental linkages. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs. **2.4.C. Resources** – Learners understand that the importance and use of resources change over time and vary under different economic and technological systems.
HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic population dynamics and the importance of diversity in living systems.

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HS-LS3 Heredity: Inheritance and Variation of Traits	
HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	**1 Questioning, Analysis and Interpretation Skills** **1.A. Questioning** – Learners are able to develop, modify, clarify, and explain questions that guide environmental investigations of various types. They understand factors that influence the questions they pose. **2.2 The Living Environment** **2.2B. Heredity and evolution** – Learners understand the basic ideas and genetic mechanisms behind biological evolution.
HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.2 The Living Environment** **2.2B. Heredity and evolution** – Learners understand the basic ideas and genetic mechanisms behind biological evolution.
HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	**1 Questioning, Analysis and Interpretation Skills** **1.E. Organizing information** – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes. **2.2 The Living Environment** **2.2B. Heredity and evolution** – Learners understand the basic ideas and genetic mechanisms behind biological evolution.
HS-LS4 Biological Evolution: Unity and Diversity	
HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	**1 Questioning, Analysis and Interpretation Skills** **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.2 The Living Environment** **2.2B. Heredity and evolution** – Learners understand the basic ideas and genetic mechanisms behind biological evolution.

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HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data. **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. **1.E. Organizing information** – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.2 The Living Environment** **2.2B. Heredity and evolution** – Learners understand the basic ideas and genetic mechanisms behind biological evolution.
HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.	**1 Questioning, Analysis and Interpretation Skills** **1.E. Organizing information** – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes. **2.2 The Living Environment** **2.2B. Heredity and evolution** – Learners understand the basic ideas and genetic mechanisms behind biological evolution.
HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data. **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. **1.E. Organizing information** – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic population dynamics and the importance of diversity in living systems.

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	2.2B. Heredity and evolution – Learners understand the basic ideas and genetic mechanisms behind biological evolution.
HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result 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.	**1 Questioning, Analysis and Interpretation Skills** **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic population dynamics and the importance of diversity in living systems. **2.2B. Heredity and evolution** – Learners understand the basic ideas and genetic mechanisms behind biological evolution.
HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic population dynamics and the importance of diversity in living systems. **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs.
HS-ESS1 Earth's Place in the Universe	
HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.	

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HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.	
HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.	
HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.	
HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.	
HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.	
HS-ESS2 Earth's Systems	
HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth.
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.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data. **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources.

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NGSS – Performance Expectations	**NAAEE: Guidelines for Learning Grades 9-12**
	1.E. Organizing information – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth. **2.2 The Living Environment** **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems.
HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth.
HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth. **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them. **2.2 The Living Environment** **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems.

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NGSS – Performance Expectations	**NAAEE: Guidelines for Learning Grades 9-12**
	2.2.D. Flow of matter and energy – Learners are able to account for environmental characteristics based on their knowledge of how matter and energy interact in living systems.
HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	**1 Questioning, Analysis and Interpretation Skills** **1.A. Questioning** – Learners are able to develop, modify, clarify, and explain questions that guide environmental investigations of various types. They understand factors that influence the questions they pose. **1.B. Designing investigations** – Learners know how to design investigations to answer particular questions about the environment. They are able to develop approaches for investigating unfamiliar types of problems and phenomena. **1.C. Collecting information** – Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data. **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. **1.E. Organizing information** – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth.
HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth. **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them. **2.2 The Living Environment**

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	2.2.C. Systems and connections – Learners understand the living environment to be comprised of interrelated, dynamic systems. **2.2.D. Flow of matter and** energy – Learners are able to account for environmental characteristics based on their knowledge of how matter and energy interact in living systems.
HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data. **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. **1.E. Organizing information** – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth. **2.2 The Living Environment** **2.2.B. Heredity and evolution** – Learners understand the basic ideas and genetic mechanisms behind biological evolution. **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems. **2.2.D. Flow of matter and** energy – Learners are able to account for environmental characteristics based on their knowledge of how matter and energy interact in living systems.
HS-ESS3 Earth and Human Activity	
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.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data. **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate

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NGSS – Performance Expectations	**NAAEE: Guidelines for Learning Grades 9-12**
	completeness and reliability in a variety of information sources. **1.E. Organizing information** – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs. **2.4.B. Paces** – Learners understand "place" as humans endowing a particular part of the Earth with meaning through their interactions with the environment. **2.4.C. Resources** – Learners understand that the importance and use of resources change over time and vary under different economic and technological systems.
HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and propose action strategies that are likely to be effective in particular situations and for particular purposes. **3.1.D. Working with flexibility, creativity, and openness** – While environmental issues and investigations can bring to the surface deeply held views, learners are able to engage each other in peer review conducted in the spirit of open inquiry. **2.3 Humans and Their Societies** **2.3.C. Political and economic systems** – Learners understand how different political and economic systems account for, manage, and affect natural resources and environmental quality. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs.

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NGSS – Performance Expectations	**NAAEE: Guidelines for Learning Grades 9-12**
	2.4.C. Resources – Learners understand that the importance and use of resources change over time and vary under different economic and technological systems. **2.4.D. Technology** – Learners are able to examine the social and environmental impacts of various technologies and technological systems.
HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.2 The Living Environment** **2.2.A. Organisms, populations, and communities** – Learners understand basic population dynamics and the importance of diversity in living systems. **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems. **2.3 Humans and Their Societies** **2.3.D. Global connections** – Learners are able to analyze global, social, cultural, political, economic, and environmental linkages. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs. **2.4.C. Resources** – Learners understand that the importance and use of resources change over time and vary under different economic and technological systems.
HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.	**3.1 Skills for Analyzing and Investigating Environmental Issues** **3.1.C. Identifying and evaluating alternative solutions and courses of action** – Learners are able to identify and propose action strategies that are likely to be effective in particular situations and for particular purposes. **3.1.D. Working with flexibility, creativity, and openness** – While environmental issues and investigations can bring to the surface deeply held views, learners are able to engage each other in peer review conducted in the spirit of open inquiry. **2.2 The Living Environment** **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems.

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NGSS – Performance Expectations	**NAAEE: Guidelines for Learning Grades 9-12**
	2.4 Environment and Society **2.4.A. Human/environment interactions** – Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs. **2.4.D. Technology** – Learners are able to examine the social and environmental impacts of various technologies and technological 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.	**1 Questioning, Analysis and Interpretation Skills** **1.C. Collecting information** – Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data. **1.D. Evaluating accuracy and reliability** – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources. **1.E. Organizing information** – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes. **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **1.G. Drawing conclusions and developing explanations** – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth. **2.1.C. Energy** – Learners apply their knowledge of energy and matter to understand phenomena in the world around them. **2.2 The Living Environment** **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs.

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NGSS – Performance Expectations	**NAAEE: Guidelines for Learning Grades 9-12**
HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.	**1 Questioning, Analysis and Interpretation Skills** **1.F. Working with models and simulations –** Learners are able to create, use, and evaluate models to understand environmental phenomena. **2.1 The Earth as a Physical System** **2.1.A. Processes that shape the Earth** – Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth. **2.2 The Living Environment** **2.2.C. Systems and connections** – Learners understand the living environment to be comprised of interrelated, dynamic systems. **2.4 Environment and Society** **2.4.A. Human/environment interactions** – Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs.

PART 6

Linking NAAEE *Excellence in Environmental Education: Guidelines for Learning (K-12)* and NGSS

In the following set of matrices the environmental literacy framework, described in NAAEE's *Guidelines for Learning (K-12),* form the anchors with linkages made to applicable NGSS performance expectations. For a more detailed description of the specific NGSS performance expectations shown here, please consult the matrices displayed in Part 5.

KINDERGARTEN – SECOND GRADE

EE Learner Guidelines	Kindergarten	First Grade	Second Grade
Strand 1: Questioning, Analysis & Interpretation Skills			
1. A. Questioning – Learners are able to develop questions that help them learn about the environment and do simple investigations.	**K-ESS3-2., K-2-ETS1-1.**	**K-2-ETS1-1.**	**K-2-ETS1-1.**
1.B. Designing investigations – Learners are able to design simple investigations.	**K-PS3-2.**		**2-PS1-1** **2-LS2-1.**
1.C. Collecting information – Learners are able to locate and collect information about the environment and environmental topics.	**K-PS3-1, K-ESS2-1.** **K-2-ETS1-1.** **K-2-ETS1-3.**	**1-LS1-2, 1-LS3-1.** **1-ESS1-1., 1-ESS1-2.** **K-2-ETS1-1., K-2-ETS1-3.**	**2-ESS1-1., 2-ESS2-3.** **K-2-ETS1-1., K-2-ETS1-3.**
1.D. Evaluating accuracy and reliability – Learners understand the need to use reliable information to answer their questions. They are familiar with some basic factors to consider in judging the merits of information.			
1.E. Organizing information – Learners are about to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics.	**K-ESS2-1., K-2-ETS1-3.**	**K-2-ETS1-3.**	**2-PS1-2., K-2-ETS1-3.**
1.F. Working with models and simulations – Learners understand that relationships, patterns, and processes can be represented by models.	**K-LS1-1., K-ESS3-1.** **K-2-ETS1-2.**	**K-2-ETS1-2.**	**2-LS2-2., 2-ESS2-2.** **K-2-ETS1-2.**
1.G. Drawing conclusions and developing explanations – Learners can develop simple explanations that address their questions about the environment	**K-ESS2-2., K-ESS3-3.**		**2-PS1-4.**

EE Learner Guidelines	Kindergarten	First Grade	Second Grade
Strand 2: Knowledge of Environmental processes and systems			
2.1 The Earth as a Physical system			
2.1.A. Processes that shape the Earth – Learners are able to identify changes and differences in the physical environment.	**K-ESS2-1.**	**1-ESS1-1., 1-ESS1-2.**	**2-ESS1-1., 2-ESS2-1. 2-ESS2-2., 2-ESS2-3.**
2.1.B. Changes in matter – Learners are able to identify basic characteristics of and changes in matter.			**2-PS1-1, 2-PS1-2. 2-PS1-4.**
2.1.C. Energy – While they may have little understanding of formal concepts associated with energy, learners are familiar with the basic behavior of some different forms of energy.	**K-PS3-1., K-PS3-2.**		
2.2 The Living Environment			
2.2.A. Organisms, populations, and communities – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat.	**K-LS1-1.**	**1-LS1-1.**	**2-LS2-1., 2-LS2-1**
2.2.B. Heredity and evolution – Learners understand that plants and animals have different characteristics and that many of the characteristics are intertied.		**1-LS3-1.**	
2.2.C. Systems and connections – Learners understand basic ways in which organisms are related to their environments and other organisms.	**K-ESS2-2., K-ESS3-1.**	**1-LS1-2**	**2-LS2-2., 2-LS4-1**
2.2.D. Flow of matter and energy – Learners know that living things need some source of energy to live and grow.	**K-LS1-1.**		**2-LS2-1.**
2.3 Humans and Their Societies			
2.3.A. Individuals and groups – Learners understand that people act as individuals and as group members and that groups can influence individual actions.			
2.3.B. Culture – Learners understand that experiences and places may be interpreted differently by people with different cultural backgrounds, at different times, or with other frames of reference.			
2.3.C. Political and economic systems – Learners			

EE Learner Guidelines	Kindergarten	First Grade	Second Grade
understand that government and economic systems exist because people living together in groups need ways to do things such as provide for needs and wants, maintain order, and manage conflict.			
2.3.D. Global connections – Learners understand how people are connected at many levels – including the global level – by actions and common responsibilities that concern the environment.			
2.3.E. Change and conflict – Learners recognize that change is a normal part of individual and societal life. They understand that conflict is rooted in different points of view.			
2.4 Environment and Society			
2.4.A Human/environment interactions – Learners understand that people depend on, change, and are affected by the environment.	**K-PS3-2., K-ESS2-2. K-ESS3-1., K-ESS3-2. K-ESS3-3.**		**2-ESS2-1.**
2.4.B Places – Learners understand that places differ in their physical and human characteristics.	**K-ESS3-1.**		
2.4.C. Resources – Learners understand the basic concepts of resource and resource distribution.	**K-ESS3-3.**		
2.4.D. Technology – Learners understand that technology is an integral part of human existence and culture.			
2.4.E. Environmental issues – Learners are familiar with some local environmental issues and understand that people in other places experience environmental issues as well.	**K-ESS3-3.**		
Strand 3: Skills for Understanding and Addressing Environmental Issues			
3.1 Skills for Analyzing and Investigating Environmental Issues			
3.1.A. Identifying and investigating issues – Learners are able to identify and investigate issues in their local environment and communities.	**K-2-ETS1-1.**	**K-2-ETS1-1.**	**K-2-ETS1-1.**
3.1.B. Sorting out the consequences of issues – As learners come to understand that environmental and social phenomena are linked, they are able to explore the consequences of issues.			

EE Learner Guidelines	Kindergarten	First Grade	Second Grade
3.1.C. Identifying and evaluating alternative solutions and courses of actions – Learners understand there are many approaches to resolving issues.	**K-ESS3-3.**	**1-LS1-1.**	**2-ESS2-1.**
3.1.D Working with flexibility, creativity, and openness – Learners understand the importance of sharing ideas and hearing other points of view.			
3.2 Decision Making and Citizenship Skills			
3.2.A. Forming and evaluating personal views – Learners are able to examine and express their own views on environmental issues.			
3.2.B. Evaluating the need for citizen action – Learners are able to think critically about whether they believe action is needed in particular situations and whether they believe they should be involved.			
3.2.C. Planning and taking action – By participating in issues of their choosing mostly close to home – Learners learn the basics of individual and collective action.			
3.2.D. Evaluating the results of actions – Learners understand that civic actions have consequences.			
Strand 4: Personal and Civic Responsibility			
4.A. Understanding societal values and principles – Learners can identify fundamental principles of U.S. society and explain their importance in the context of environmental issues.			
4.B. Recognizing citizens' rights and responsibilities – Learners understand the basic rights and responsibilities of citizenship.			
4.C. Recognizing efficacy – Learners possess a realistic self-confidence in their effectiveness as citizens.			
4.D. Accepting personal responsibility – Learners understand that they have responsibility for the effects of their actions.			

THIRD – FOURTH GRADE

EE Learner Guidelines	Third Grade	Fourth Grade
Strand 1: Questioning, Analysis & Interpretation Skills		
1. A. Questioning – Learners are able to develop questions that help them learn about the environment and do simple investigations.	**3-5-ETS1-1**	**3-5-ETS1-1**
1.B. Designing investigations – Learners are able to design simple investigations.	**3-5-ETS1-1, 3-5-ETS1-3**	**3-5-ETS1-1, 3-5-ETS1-3**
1.C. Collecting information – Learners are able to locate and collect information about the environment and environmental topics.	**3-ESS2-2.**	**4-PS3-2., 4-ESS1-1., 4-ESS2-1. 4-ESS3-1.**
1.D. Evaluating accuracy and reliability – Learners understand the need to use reliable information to answer their questions. They are familiar with some basic factors to consider in judging the merits of information.	**3-5-ETS1-3**	**3-5-ETS1-3**
1.E. Organizing information – Learners are about to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics.	**3-LS3-1., 3-LS4-1. 3-ESS2-2.**	**4-ESS2-2., 4-ESS3-1.**
1.F. Working with models and simulations – Learners understand that relationships, patterns, and processes can be represented by models.	**3-LS1-1., 3-ESS2-1. 3-5-ETS1-3**	**4-LS1-2. 3-5-ETS1-3**
1.G. Drawing conclusions and developing explanations – Learners can develop simple explanations that address their questions about the environment	**3-LS2-1., 3-LS3-2. 3-LS4-2., 3-LS4-3.**	**4-LS1-1.**
Strand 2: Knowledge of Environmental processes and systems		
2.1 The Earth as a Physical system		
2.1.A. Processes that shape the Earth – Learners are able to identify changes and differences in the physical environment.	**3-ESS2-1., 3-ESS2-2**	**4-ESS1-1., 4-ESS2-1. 4-ESS2-2.**
2.1.B. Changes in matter – Learners are able to identify basic characteristics of and changes in matter.		**4-ESS1-1., 4-ESS2-1.**
2.1.C. Energy – While they may have little understanding of formal concepts associated with energy, learners are familiar with the basic behavior of some different forms of energy.		**4-PS3-2., 4-PS3-4.**
2.2 The Living Environment		
2.2.A. Organisms, populations, and communities – Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat.	**3-LS1-1., 3-LS2-1., 3-LS3-1. 3-LS4-1., 3-LS4-2., 3-LS4-3. 3-LS4-4., 3-ESS2-2.**	**4-LS1-1. 4-LS1-2.**
2.2.B. Heredity and evolution – Learners understand that plants and animals	**3-LS3-1., 3-LS3-2., 3-LS4-1, 3-**	

EE Learner Guidelines	Third Grade	Fourth Grade
have different characteristics and that many of the characteristics are intertied.	**LS4-2.** **3-LS4-3., 3-LS4-4.**	
2.2.C. Systems and connections – Learners understand basic ways in which organisms are related to their environments and other organisms.	**3-LS3-2., 3-LS4-1., 3-LS4-2., 3-LS4-3., 3-LS4-4.**	**4-LS1-2.**
2.2.D. Flow of matter and energy – Learners know that living things need some source of energy to live and grow.		
2.3 Humans and Their Societies		
2.3.A. Individuals and groups – Learners understand that people act as individuals and as group members and that groups can influence individual actions.		
2.3.B. Culture – Learners understand that experiences and places may be interpreted differently by people with different cultural backgrounds, at different times, or with other frames of reference.		
2.3.C. Political and economic systems – Learners understand that government and economic systems exist because people living together in groups need ways to do things such as provide for needs and wants, maintain order, and manage conflict.		
2.3.D. Global connections – Learners understand how people are connected at many levels – including the global level – by actions and common responsibilities that concern the environment.		
2.3.E. Change and conflict – Learners recognize that change is a normal part of individual and societal life. They understand that conflict is rooted in different points of view.		
2.4 Environment and Society		
2.4.A Human/environment interactions – Learners understand that people depend on, change, and are affected by the environment.	**3-ESS3-1.**	**4-ESS3-1., 4-ESS3-2.**
2.4.B Places – Learners understand that places differ in their physical and human characteristics.		
2.4.C. Resources – Learners understand the basic concepts of resource and resource distribution.		**4-ESS3-1., 4-ESS3-2.**
2.4.D. Technology – Learners understand that technology is an integral part of human existence and culture.	**3-ESS3-1.**	
2.4.E. Environmental issues – Learners are familiar with some local environmental issues and understand that people in other places experience		**4-ESS3-1., 4-ESS3-2.**

EE Learner Guidelines	Third Grade	Fourth Grade
environmental issues as well.		
Strand 3: Skills for Understanding and Addressing Environmental Issues		
3.1 Skills for Analyzing and Investigating Environmental Issues		
3.1.A. Identifying and investigating issues – Learners are able to identify and investigate issues in their local environment and communities.	**3-5-ETS1-1**	**3-5-ETS1-1**
3.1.B. Sorting out the consequences of issues – As learners come to understand that environmental and social phenomena are linked, they are able to explore the consequences of issues.	**3-5-ETS1-1**	**3-5-ETS1-1, 4-ESS3-1**
3.1.C. Identifying and evaluating alternative solutions and courses of actions – Learners understand there are many approaches to resolving issues.	**3-LS4-4., 3-ESS3-1. 3-5-ETS1-2**	**4-ESS3-2., 3-5-ETS1-2**
3.1.D Working with flexibility, creativity, and openness – Learners understand the importance of sharing ideas and hearing other points of view.		
3.2 Decision Making and Citizenship Skills		
3.2.A. Forming and evaluating personal views – Learners are able to examine and express their own views on environmental issues.		
3.2.B. Evaluating the need for citizen action – Learners are able to think critically about whether they believe action is needed in particular situations and whether they believe they should be involved.		
3.2.C. Planning and taking action – By participating in issues of their choosing mostly close to home – Learners learn the basics of individual and collective action.		
3.2.D. Evaluating the results of actions – Learners understand that civic actions have consequences.		
Strand 4: Personal and Civic Responsibility		
4.A. Understanding societal values and principles – Learners can identify fundamental principles of U.S. society and explain their importance in the context of environmental issues.		
4.B. Recognizing citizens' rights and responsibilities – Learners understand the basic rights and responsibilities of citizenship.		
4.C. Recognizing efficacy – Learners possess a realistic self-confidence in their effectiveness as citizens.		
4.D. Accepting personal responsibility – Learners understand that they have responsibility for the effects of their actions.		

FIFTH GRADE AND MIDDLE SCHOOL

EE Learner Guidelines	Fifth Grade	Middle School
Strand 1: Questioning, Analysis & Interpretation Skills		
1.A. Questioning – Learners are able to develop, focus, and explain questions that help them learn about the environment and do environmental investigations	**3-5-ETS1-1**	**MS-PS2-3., MS-PS3-3., MS-PS3-4. MS-LS1-6., MS-ESS3-3., MS-ESS3-5.**
1.B. Designing investigations – Learners are able to design environmental investigations to answer particular questions – often their own questions	**5-PS1-4., 3-5-ETS1-1 3-5-ETS1-3**	**MS-PS1-6., MS-PS3-3., MS-PS3-4. MS-ESS3-3.,**
1.C. Collecting information – Learners are able to locate and collect information about the environment and environmental topics.	**5-PS1-3., 5-PS1-4., 5-ESS3-1**	**MS-PS1-3., MS-PS1-6., MS-PS3-3. MS-LS4-5., MS-ESS2-5., MS-ESS3-3.**
1.D. Evaluating accuracy and reliability – Learners are able to judge the weaknesses and strengths of the information they are using	**3-5-ETS1-3**	**MS-PS1-3., MS-PS1-6., MS-PS3-3. MS-LS1-4., MS-LS1-5., MS-LS1-6. MS-LS2-4., MS-LS4-2., MS-LS4-4. MS-ESS1-4., MS-ESS2-2., MS-ESS2-3. MS-ESS3-1., MS-ESS3-2., MS-ESS3-3. MS-ESS3-4.**
1.E. Organizing information – Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation.	**5-ESS1-2**	**MS-PS1-2., MS-PS1-3., MS-PS1-6. MS-PS3-1., MS-PS3-3., MS-LS2-1. MS-LS4-1., MS-LS4-5., MS-ESS2-3. MS-ESS3-2., MS-ESS3-3.**
1.F Working with models and simulations – Learners understand many of the uses and limitations of models	**5-PS1-1. , 5-PS3-1, 5-LS2-1. 5-ESS2-1, 3-5-ETS1-3**	**MS-PS1-1., MS-PS1-4., MS-PS1-5. MS-PS3-2., MS-LS1-7., MS-LS2-3. MS-LS3-1., MS-LS3-2., MS-LS4-6. MS-ESS2-1., MS-ESS2-4., MS-ESS2-6 MS-ETS1-4.**
1.G. Drawing conclusions and developing explanations – Learners are able to synthesize their observations and findings into coherent explanations.	**5-PS2-1., 5-LS1-1**	**MS-PS1-6, MS-PS3-3., MS-PS3-5. MS-LS1-4., MS-LS1-5., MS-LS1-6. MS-LS2-1., MS-LS2-4., MS-LS2-2. MS-LS2-5., MS-LS4-1., MS-LS4-2. MS-LS4-4., MS-LS4-5., MS-ESS1-4., MS-ESS2-2., MS-ESS3-1., MS-ESS3-3., MS-ESS3-4.**

EE Learner Guidelines	Fifth Grade	Middle School
Strand 2: Knowledge of Environmental processes and systems		
2.1 The Earth as a Physical system		
2.1.A. Processes that shape the Earth – Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.	**5-ESS1-2, 5-ESS2-1., 5-ESS2-2**	**MS-ESS1-4., MS-ESS2-1., MS-ESS2-2., MS-ESS2-3., MS-ESS2-4., MS-ESS2-5., MS-ESS2-6, MS-ESS3-1., MS-ESS3-2., MS-ESS3-5. MS-ESS1-1**
2.1.B. Changes in matter – Learners understand the properties of the substances that make up objects or materials found in the environment.	**5-PS1-3., 5-PS1-4., 5-ESS2-1**	**MS-PS1-1., MS-PS1-2., MS-PS1-3. MS-PS1-5., MS-LS2-3., MS-LS2-3, MS-ESS2-1., MS-ESS2-4.**
2.1.C. Energy – Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.	**5-PS3-1**	**MS-PS1-4., MS-PS1-6., MS-PS2-3. MS-PS3-1., MS-PS3-2., MS-PS3-3. MS-PS3-4., MS-PS3-5., MS-ESS2-1. MS-ESS2-4. MS-ESS2-6**
2.2 The Living Environment		
2.2.A. Organisms, populations, and communities – Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments.		**MS-LS1-4., MS-LS1-5., MS-LS2-1. MS-LS2-2., MS-LS2-4., MS-LS2-5. MS-LS4-1., MS-LS4-2., MS-LS4-4. MS-LS4-5., MS-ESS3-4.**
2.2B. Heredity and evolution – Learners have a basic understanding of the importance of genetic heritage.		**MS-LS3-1., MS-LS3-2., MS-LS4-1., MS-LS4-2., MS-LS4-4., MS-LS4-5., MS-LS4-3, MS-LS4-6**
2.2.C. Systems and connections – Learners understand major kinds of interactions among organisms or populations or organisms.	**5-LS2-1.**	**MS-LS2-1., MS-LS2-2., MS-LS2-4. MS-LS2-5., MS-LS4-1., MS-LS4-2. MS-LS4-4., MS-ESS3-4.**
2.2.D. Flow of matter and energy – Learners understand how energy and matter flow among the abiotic and biotic components of the environment.	**5-PS3-1, 5-LS1-1, 5-LS2-1.**	**MS-LS1-6., MS-LS1-7., MS-LS2-3.**
2.3 Humans and Their Societies		
2.3.A. Individuals and groups – Learners understand that how individuals perceive the environment is influenced in part by individual traits and group membership or affiliation.	**5-ESS3-1**	
2.3.B. Culture – As they become familiar with a wider range of cultures and subcultures, learners gain an understanding of cultural perspectives on the environment and how the environment may, in turn, influence culture.		

EE Learner Guidelines	Fifth Grade	Middle School
2.3.C. Political and economic systems – Learners become more familiar with political and economic systems and how these systems take the environment into consideration.		
2.3.D. Global connections – Learners become familiar with ways in which the world's environmental, social, economic, cultural, and political systems are linked.		**MS-ESS3-4.**
2.3.E. Change and conflict – Learners understand that human social systems change over time and that conflicts sometimes arise over differing and changing viewpoints about the environment,		
2.4 Environment and Society		
2.4.A. Human/environment interactions – Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.		**MS-LS2-4., MS-LS2-5., MS-LS4-5. MS-ESS3-3., MS-ESS3-4., MS-ESS3-5.**
2.4.B. Places – Learners begin to explore the meaning of places both close to home and around the world.		**MS-ESS3-2**
2.4.C. Resources – Learners understand that uneven distribution of resources influences their use and perceived value.	**5-ESS2-2**	**MS-LS2-1., MS-ESS3-1., MS-ESS3-4 MS-ESS3-5.**
2.4.D. Technology – Learners understand the human ability to shape and control the environment as a function of the capacities for creating knowledge and developing new technologies.		**MS-LS4-5., MS-ESS3-2., MS-ESS3-3. MS-ESS3-5**
2.4.E. Environmental issues – Learners are familiar with a range of environmental issues at scales that range from local to national to global. They understand that people in other places around the world experience environmental issues similar to the ones they are concerned about locally.	**5-ESS3-1**	**MS-ESS3-4, MS-ESS3-5.**
Strand 3 Skills for Understanding and Addressing Environmental Issues		
3.1 Skills for Analyzing and Investigating Environmental Issues		
3.1A. Identifying and investigating issues – Learners are able to use primary and secondary sources of information, and apply growing research and analytical skills, to investigate environmental issues, beginning in their own community	**3-5-ETS1-1**	**MS-ESS3-5., MS-ETS1-1.**
3.1.B. Sorting out the consequences of issues – Learners are able to apply their knowledge of ecological and human processes and systems to identify the consequences of specific environmental issues	**3-5-ETS1-1**	**MS-ETS1-1. MS-ESS3-5**

EE Learner Guidelines	Fifth Grade	Middle School
3.1.C. Identifying and evaluating alternative solutions and courses of action – Learners are able to identify and develop action strategies for addressing particular issues	**3-5-ETS1-2**	**MS-PS1-6., MS-LS2-5., MS-ESS3-3. MS-ETS1-1., MS-ETS1-2., MS-ETS1-3.**
3.1.D. Working with flexibility, creativity, and openness – Learners are able to consider the assumptions and interpretations that influence the conclusions they and others draw about environmental issues.		**MS-ETS1-1., MS-ETS1-2.**
3.2 Decision Making and Citizenship Skills		
3.2.A. Forming and evaluating personal views – Learners are able to identify, justify, and clarify their views on environmental issues and alternative ways to address them.		
3.2.B. Evaluating the need for citizen action – Learners are able to evaluate whether they believe action is needed in particular situations, and decide whether they should be involved.		
3.2.C. Planning and taking action – As learners begin to see themselves as citizens taking active roles in their communities, they are able to plan for and engage in citizen action at levels appropriate to their maturity and preparation.		
3.2.D. Evaluating the results of actions – Learners are able to analyze the effects of their own actions and actions taken by other individuals and groups.		
Strand 4 Personal and Civic Responsibility		
4.A. Understanding societal values and principles – Learners understand that societal values can be both a unifying and a divisive force.		
4.B. Recognizing citizens' rights and responsibilities – Learners understand the rights and responsibilities of citizenship and their importance in promoting the resolution of environmental issues.		
4.C. Recognizing efficacy – Learners possess a realistic self-confidence in their effectiveness as citizens.		
4.D. Accepting personal responsibility – Learners understand that their actions can have broad consequences and that they are responsible for those consequences.		

HIGH SCHOOL

EE Learner Guidelines	High School
Strand 1: Questioning, Analysis & Interpretation Skills	
1.A. Questioning – Learners are able to develop, modify, clarify, and explain questions that guide environmental investigations of various types. They understand factors that influence the questions they pose.	**HS-PS2-5, HS-PS3-4., HS-LS3-1., HS-ESS2-5**
1.B. Designing investigations – Learners know how to design investigations to answer particular questions about the environment. They are able to develop approaches for investigating unfamiliar types of problems and phenomena.	**HS-PS2-5, HS-PS3-4., HS-ESS2-5**
1.C. Collecting information – Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data.	**HS-PS1-5, HS-PS2-5, HS-PS3-4., HS-LS4-2., HS-LS4-4., HS-ESS2-2., HS-ESS2-5, HS-ESS2-7., HS-ESS3-1., HS-ESS3-5.**
1.D. Evaluating accuracy and reliability – Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources.	**HS-PS1-5, HS-PS2-5, HS-PS3-4., HS-PS4-4., HS-LS2-6., HS-LS2-8., HS-LS3-2., HS-LS4-2., HS-LS4-4., HS-LS4-5., HS-ESS1-5., HS-ESS1-6., HS-ESS2-2., HS-ESS2-5, HS-ESS2-7., HS-ESS3-1., HS-ESS3-5.**
1.E. Organizing information – Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes.	**HS-PS1-5. HS-PS2-5, HS-PS3-4., HS-LS3-3, HS-LS4-2., HS-LS4-3, HS-LS4-4., HS-ESS2-2., HS-ESS2-5, HS-ESS2-7., HS-ESS3-1., HS-ESS3-5.**
1.F. Working with models and simulations – Learners are able to create, use, and evaluate models to understand environmental phenomena.	**HS-PS1-4., HS-PS1-8., HS-PS3-1, HS-PS3-2., HS-PS3-5., HS-LS1-5., HS-LS1-7, HS-LS2-1., HS-LS2-2., HS-LS2-5., HS-LS4-6., HS-ESS1-1., HS-ESS2-1, HS-ESS2-3., HS-ESS2-4., HS-ESS2-6., HS-ESS3-3., HS-ESS3-5., HS-ESS3-6**
1.G. Drawing conclusions and developing explanations – Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses.	**HS-PS1-2., HS-PS1-5, HS-PS2-5, HS-PS3-4., HS-LS2-3, HS-LS2-6., HS-LS2-8., HS-LS3-2., HS-LS4-1., HS-LS4-2., HS-LS4-4., HS-LS4-5., HS-ESS1-5., HS-ESS1-6., HS-ESS2-2., HS-ESS2-5, HS-ESS2-7., HS-ESS3-1., HS-ESS3-5**
Strand 2: Knowledge of Environmental processes and systems	
2.1 The Earth as a Physical system	
2.1.A. Processes that shape the Earth – Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth.	**HS-ESS2-1, HS-ESS2-2., HS-ESS2-3., HS-ESS2-4., HS-ESS2-5, HS-ESS2-6., HS-ESS2-7., HS-ESS3-1., HS-ESS3-5., HS-ESS3-6**

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2.1.B. Changes in matter – Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena.	**HS-PS1-2., HS-PS1-5, HS-PS1-6., HS-LS1-5., HS-LS1-6.**
2.1.C. Energy – Learners apply their knowledge of energy and matter to understand phenomena in the world around them.	**HS-PS1-4., HS-PS1-5, HS-PS1-6., HS-PS1-7, HS-PS1-8., HS-PS2-5, HS-PS3-1, HS-PS3-2., HS-PS3-3., HS-PS3-4. HS-PS3-5., HS-PS4-4., HS-ESS2-4., HS-ESS2-6., HS-ESS3-5.**
2.2 The Living Environment	
2.2.A. Organisms, populations, and communities – Learners understand basic population dynamics and the importance of diversity in living systems.	**HS-LS2-1., HS-LS2-2., HS-LS2-7., HS-LS2-8., HS-LS4-4., HS-LS4-5., HS-LS4-6., HS-ESS3-3.**
2.2.B. Heredity and evolution – Learners understand the basic ideas and genetic mechanisms behind biological evolution.	**HS-LS3-1., HS-LS3-2., HS-LS3-3., HS-LS4-1., HS-LS4-2., HS-LS4-3, HS-LS4-4., HS-LS4-5., HS-ESS2-7.**
2.2.C. Systems and connections – Learners understand the living environment to be comprised of interrelated, dynamic systems.	**HS-LS2-1., HS-LS2-2., HS-LS2-5., HS-LS2-6., HS-LS2-7., HS-LS4-6., HS-ESS2-2., HS-ESS2-4., HS-ESS2-6., HS-ESS2-7., HS-ESS3-3., HS-ESS3-4., HS-ESS3-5., HS-ESS3-6**
2.2.D. Flow of matter and energy – Learners are able to account for environmental characteristics based on their knowledge of how matter and energy interact in living systems.	**HS-LS1-5., HS-LS1-7., HS-LS2-3, HS-LS2-4., HS-LS2-5., HS-ESS2-4., HS-ESS2-6., HS-ESS2-7.**
2.3 Humans and Their Societies	
2.3.A. Individuals and groups – Learners understand the influence of individual and group actions on the environment, and how groups can work to promote and balance interests.	
2.3.B. Culture – Learners understand cultural perspectives and dynamics and apply their understanding in context.	
2.3.C. Political and economic systems – Learners understand how different political and economic systems account for, manage, and affect natural resources and environmental quality.	**HS-ESS3-2.**
2.3.D. Global connections – Learners are able to analyze global, social, cultural, political, economic, and environmental linkages.	**HS-LS2-7., HS-ESS3-3.,**
2.3. E. Chance and conflict – Learners understand the functioning of public processes for promoting and managing change and conflict, and can analyze their effects on the environment.	
2.4 Environment and Society	
2.4.A. Human/environment interactions – Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs	**HS-LS2-7., HS-LS4-6., HS-ESS3-1., HS-ESS3-2., HS-ESS3-3., HS-ESS3-4., HS-ESS3-5, HS-ESS3-6**
2.4.B. Places – Learners understand “place” as humans endowing a particular part of the Earth	**HS-ESS3-1**

EE Learner Guidelines	High School
with meaning through their interactions with that environment.	
2.4.C. Resources – Learners understand that the importance and use of resources change over time and vary under different economic and technological systems.	**HS-LS2-7., HS-ESS3-1., HS-ESS3-2., HS-ESS3-3.**
2.4.D. Technology – Learners are able to examine the social and environmental impacts of various technologies and technological systems.	**HS-ESS3-2., HS-ESS3-4.**
2.4.E. Environmental issues – Learners are familiar with a range of environmental issues at scales that range from local to national to global. They understand that these scales and issues are often linked.	
Strand 3: Skills for Understanding and Addressing Environmental Issues	
3.1 Skills for Analyzing and Investigating Environmental Issues	
3.1.A. Identifying and investigating issues – Learners apply their research and analytical skills to investigate environmental issues ranging from local issues to those that are regional or global in scope.	**HS-PS3-3., HS-LS2-7., HS-ETS1-1., HS-ETS1-2.**
3.1.B. Sorting out the consequences of issues – Learners are able to evaluate the consequences of specific environmental changes, conditions, and issues for human and ecological systems.	**HS-PS3-3., HS-LS2-7., HS-ETS1-1., HS-ETS1-2., HS-ETS1-4.**
3.1.C. Identifying and evaluating alternative solutions and courses of action – Learners are able to identify and propose action strategies that are likely to be effective in particular situations and for particular purposes.	**HS-PS3-3., HS-LS2-7., HS-ESS3-2., HS-ESS3-4., HS-ETS1-1., HS-ETS1-2., HS-ETS1-4. HS-ETS1-3**
3.1.D. Working with flexibility, creativity, and openness – While environmental issues and investigations can bring to the surface deeply held views, learners are able to engage each other in peer review conducted in the spirit of open inquiry.	**HS-PS3-3., HS-LS2-7., HS-ESS3-2., HS-ESS3-4., HS-ETS1-1., HS-ETS1-2.**
3.2 Decision Making and Citizenship Skills	
3.2.A. Forming and evaluating personal views – Learners are able to communicate, evaluate, and justify their own views on environmental issues and alternative ways to address them.	
3.2.B. Evaluating the need for citizen action – Learners are able to decide whether action is needed in particular situations and whether they should be involved.	
3.2.C. Planning and taking action – Learners know how to plan for action based on their research and analysis of an environmental issue. If appropriate, they take actions that are within the scope of their rights and consistent with their abilities and responsibilities as citizens.	
3.2.D. Evaluating the results of actions – Learners are able to evaluate the effects of their own actions and actions taken by other individuals and groups, including possible intended and unintended consequences of actions.	**HS-ETS1-3.**

EE Learner Guidelines	High School
Strand 4: Personal and Civic Responsibility	
4.A. Understanding societal values and principles – Learners know how to analyze the influence of shared and conflicting societal values.	**HS-ETS1-1.**
4.B. Recognizing citizens' rights and responsibilities – Learners understand the importance of exercising the rights and responsibilities of citizenship.	
4.C. Recognizing efficacy – Learners possess a realistic self-confidence in their effectiveness as citizens.	
4.D. Accepting personal responsibility – Learners understand that their actions can have broad consequences and accept responsibility for recognizing those effects and changing their actions when necessary.	

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