Scope and Sequence Models for Building Vertical Science Literacy

For use in the teaching of:

Ecosystems and Habitats, Water and Watersheds, and Atmosphere, Weather and Climate

based on the
Next Generation Science Standards (NGSS)

Prepared by
NH Education and Environment Team (NHEET)
(Updated 2017)

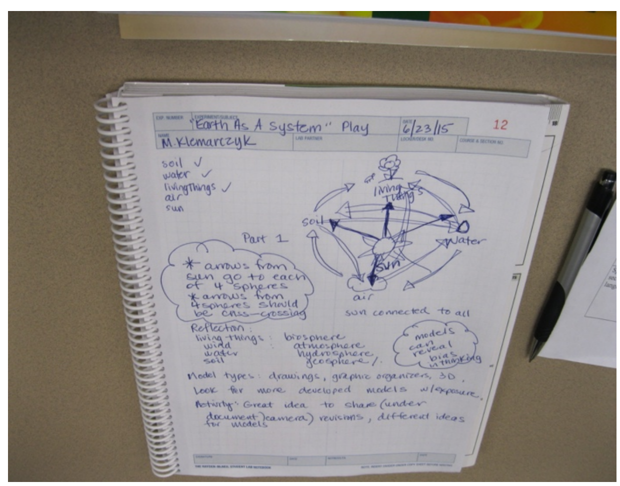
Contents

A Vision for Vertically Integrated Science Literacy

The ***Next Generation Science Standards (NGSS)***, were developed collaboratively with states and other stakeholders in science, science education, higher education, and industry. Additional review and guidance were provided by advisory committees composed of nationally-recognized leaders in science and science education as well as business and industry. As part of the NGSS development process, the standards underwent multiple reviews from many stakeholders including two public drafts, allowing all who have a stake in science education an opportunity to inform the development of the standards. This process produced a set of high quality, college- and career-ready standards that is grounded in the most current research on science and science learning. The standards were published on the NGSS website when they were completed in April 2013 (www.nextgenscience.org).

Adopting these standards at a school or district level will require looking at them through a vertical lens. The vertical integration process requires communication among teachers at all grades to ensure that the teaching of cross cutting themes spiral student learning toward greater depth and complexity. As a guide, NGSS has also developed a flow chart of how the Nature of Science expectations are different at each grade level but as you look across grade levels, you get a better picture of the spectrum of learning, and how science expectations grow and changes.

NHEET has developed scope and sequence models of how field investigations and using the environment can support NGSS implementation, its big ideas and cross cutting themes. The models use common environmental themes and selected activities from the nationally based Projects Learning Tree, WET, WILD, Aquatic WILD, and protocols and activities from the GLOBE and Elementary GLOBE programs. Additionally, process-oriented HOMES for Wildlife affords an opportunity for synthesizing prior learning through wildlife habitat schoolyard enhancement projects.



The Educational Programs

The GLOBE Program is an international K-12 science education program designed as a partnership among scientists for the implementation of data collection at schools to augment on-going research. Data is collected in a range of areas, including atmosphere, earth as a system, hydrology, land cover and soil and shared with other students and scientists worldwide. For students to post their data on the GLOBE website, teachers must be trained in the individual protocols that pertain to each type of data collected; however, teachers and students can collect data for their own use without being trained and simply follow the protocols outlined on the GLOBE website's **Teacher's Guide**. The data sets and information about GLOBE in New Hampshire can also be found at the link above.

Elementary GLOBE Elementary GLOBE is designed to introduce K-4 students to the study of Earth System Science. The complete instructional unit includes:

- Science-based storybooks designed to introduce students to key concepts in **water** **soil**, **clouds**, **seasons**, **aerosols**, and **Earth system** studies.
- Classroom learning activities complementing the science content covered in each storybook that are designed to further engage students in GLOBE's five investigation areas.

Project HOME (Homes for Wildlife in the Schoolyard), sponsored by the New Hampshire Fish and Game Department, is an award-winning, interdisciplinary, K-8 program for enhancing wildlife habitat and creating outdoor classrooms on school grounds. Students learn in the landscape of their schoolyards and take positive action for wildlife and their habitats. Project HOME emphasizes community-building and developing land stewardship. The curriculum guide, Homes for Wildlife, and a workshop for teachers, other school staff and interested community members, provide the essential information, tools and resources, including inventory and mapping techniques, fundraising, and curriculum integration, to implement a habitat enhancement project in the schoolyard.

Project Learning Tree (PLT) offers an award-winning series of activities for students in pre-kindergarten to grade twelve. The curriculum was first developed in 1973, in collaboration with hundreds of teacher and natural resource professionals. As the national environmental education program of the American Forest Foundation, it is continually updated and revised to address changes in educational theory and methods. The materials and activities address both the natural and built environment, including forests, wildlife, water, air, energy, climate change and more. New Hampshire Project Learning Tree (NHPLT) is an independent, non-profit organization that augments the national materials with state specific information for New Hampshire educators and students. More information about NHPLT can be found at *www.nhplt.org*

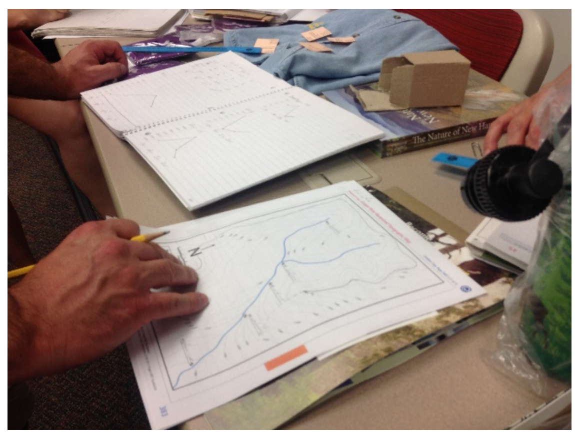
Project WET (Water Education for Teachers) is a national interdisciplinary, activity-based, K-12 environmental education program that focuses on water, including watersheds, pollution, the water cycle, groundwater and the chemical properties of water. The recently updated hands-on, interactive activities are used to supplement water-related lessons taught in the classroom or in a non-formal educational setting. First introduced in 1984, Project WET materials were developed and field-tested by hundreds of educators and resource managers working with thousands of students nationwide. The New Hampshire Department of Environmental Services, Drinking Water and Groundwater Bureau staff has been offering Project WET educator training since 1997.

Project WILD (Wildlife In Learning Design) is an international, interdisciplinary, activity-based, K-12 supplementary curriculum that focuses on wildlife. It provides strong support in the teaching of natural resource conservation and environmental education concepts, such as habitats, food webs, ecosystems, adaptations and wildlife management. Its goal is to assist students in developing the awareness and knowledge necessary to result in informed decision-making and responsible behavior as adults concerning the conservation of wildlife and the environment. First developed in 1980, Project WILD has been sponsored by the New Hampshire Fish and Game Department in the state since 1985, with additional support from the New Hampshire Wildlife Trust. More information about Project WILD in NH can be found at *www.wildlife.state.nh.us/Education/project_WILD.htm*

Aquatic WILD Water in all its forms is one of the most dramatic of today's arenas in which informed, responsible, and constructive actions are needed. Aquatic WILD uses the simple, successful format of Project WILD activities and professional training workshops but with an emphasis on aquatic wildlife and aquatic ecology. Ongoing updates to Project WILD and Aquatic WILD materials build upon developments in wildlife conservation needs as well as advances in instructional methodology in PreK through 12th grade education.

Hubbard Brook Research Foundation Hubbard Brook is not only a world-famous ecosystem study, but also a comprehensive field station and education campus that offers housing facilities, a laboratory, and conference and meeting spaces to visiting scientists, teachers, and students. The Hubbard Brook Research Foundation was founded in part to facilitate the education and outreach efforts of the Hubbard Brook Ecosystem Study participants, and has many data sets to offer teachers looking to use authentic data with students on the HBRF website.

USDA Forest Service-Conservation Education
The Forest Service's Conservation Education program helps people of all ages understand and appreciate our country's natural resources and how to conserve those resources for future generations. Through structured educational experiences and activities targeted to varying age groups and populations, conservation education enables people to realize how natural resources and ecosystems affect each other and how resources can be used wisely. Here are links to some valuable supplemental resources that this program provides free to teachers:
Natural Inquirer (scientific journal for upper elementary and middle school),
FS NatureLIVE (distance learning nature adventures for the classroom) and
Discover the Forest (information for where to visit local forests).



New Hampshire Education and Environment Team

In 2002, Projects Learning Tree, WET, WILD and HOME, the GLOBE Program and the US Department of Agriculture (USDA) Forest Service Conservation Education Program in New Hampshire created an alliance called the New Hampshire Education and Environment Team (NHEET). The projects and programs support the teaching of environmental education and encourage teachers to take their students outdoors for inquiry-based, experiential learning. The alliance was created to increase the impact and reach of each of the individual member's programs through collaboration and a pooling of resources. By working together through NHEET, higher levels of content and concept integration can be achieved, extending each of the program's missions and benefiting educators, administrators and ultimately, students statewide. Recently, NHEET has added the Hubbard Brook Research Foundation as a new partner and true model of current field science and an example of the value of long-term data. The creation of the scope and sequence models were funded by the Math and Science Partnership Program. Contact information for NHEET is in the appendix.

NHEET Models for Vertical Science Integration

Ideally, teachers at each grade level strive to increase student knowledge and their ability to integrate concepts in science, in other disciplines, and in their lives, in general. Increasing responsibilities frequently put constraints on teachers' time and limit opportunities for cooperative planning within a school or district. Too often, teachers are in the position of teaching the same topic, without knowing what has been taught before, and what will be taught after. The result is that teachers at succeeding grade levels may teach the basics of a concept, repeating what has been done in previous years. By grade twelve students may have insufficient knowledge and understanding of important topics.

The scope and sequence models are based on three universal science themes covered in most New Hampshire schools and commonly taught at several different grade levels. The common themes are:

- Ecosystems and Habitats
- Water and Watersheds
- Atmosphere, Weather and Climate

This document includes models for the *Ecosystems and Habitats* and the *Water and Watersheds* themes. The *Atmosphere, Weather, and Climate* scope and sequence will be created, and this document updated, during the summer 2017.

The scope and sequence models are examples of how vertical integration of knowledge can be achieved through grades K-12 by aligning the **Next Generation Science Standards (NGSS)** with the NHEET programs' activities. The scope and sequence models included do not represent complete curricula, but rather, provide suggested activities that help students achieve the level of content and understanding indicated in the science frameworks for the different grade spans and three common themes.

The scope and sequence models outline a way to teach what NGSS asks teachers to teach at each grade level, while also incorporating the environment in a meaningful, inquiry-based format that is aligned with the NGSS framework. Teaching using environmental themes and affording opportunities for field investigations are ways to engage students in learning how natural systems work and how they are interconnected. It helps enhance the understanding of science as an inquiry process that is used by scientists in their research. Hands-on, inquiry-based learning leads students through a process of personal discovery to understanding. They learn how to recognize and identify relationships based on evidence and see how explanations can be logically developed. The activities included in each of the NHEET programs are designed to encourage this type of learning.

Methodology

To develop the scope and sequence models, activities and/or protocols were selected from the NHEET programs that supported each of the three themes of atmosphere, weather and climate; water and watersheds; and habitats and ecosystems. Those activities were reviewed and the selection refined. They were then grouped according to their correlation with Performance Expectations by Topic of the Next Generation Science Standards (NGSS) and were broken into three grade spans: K-2, 3-5, and 6-8. From those groupings specific activities, protocols or field investigations were selected. Many of the NHEET program activities have the opportunity to create an authentic field investigation experience for students. If a particular activity identified as correlating to a Disciplinary Core Idea (DCI), would also be suited for adaption to descriptive and comparative field investigations, it was identified by a **bold, brown** text. Other activities listed should be considered as possible pre-field experience, post-field experience or cumulative experience to complete a story line for that DCI.

NHEET then came up with essential questions for each grade span, for each of the environmental themes. These questions were then broken down further into questions that are specific to exploring each of the Disciplinary Core Ideas (DCIs) at each grade level. Activities that best address each DCI were identified from each of the relevant programs.

Currently, the scope and sequence models for the *Ecosystems and Habitats* and the *Water and Watersheds* themes are complete. The *Atmosphere, Weather, and Climate* scope and sequence will be created and added to this document during the summer 2017.

The source of each activity is abbreviated and is identified as:

- Project Learning Tree (PLT)
- PLT Environmental Experience for Early Childhood (ECPLT)
- Project WILD (WILD)
- Project Aquatic WILD (Aquatic WILD)
- Growing Up Wild (GUW)
- Globe Program (GLOBE)
- Elementary Globe (Elementary GLOBE)
- Project WET (WET)
- Project HOME (HOME)
- Hubbard Brook Research Foundation (HBRF)

Finally, the vertically integrated scope and sequence models were created by combining the activities identified from each grade span for each of the themes.

Field Investigations

Field Investigations should be an integral part of any science curriculum. NHEET uses field investigations as a means of allowing students to use their learning in the classroom and apply it in the field by acting like and thinking like scientists. A great resource for learning more about field investigations is, Field Investigations: Using Outdoor Environments to Foster Student Learning of Scientific Processes.

It describes field investigations of the environment as, *"…involve the systematic collection of data for the purposes of scientific understanding. They are designed to answer an investigative question through the collection of evidence and the communication of results; they contribute to scientific knowledge by describing natural systems, noting differences in habitats, and identifying environmental trends and issues*.

This source focuses on using three types of field investigations with students; descriptive, comparative and correlative. It also suggests that descriptive investigations should be mastered before attempting comparative investigations. Also correlative investigations should not be used until students are proficient with the other two types of investigations, and should also not begin to be practiced until at least middle school. Middle School students and above are the target for correlative investigations because of the higher math and science skills that are required to properly analyze the investigation's findings.

Integrating the Scope and Sequence Models Into Your School Curriculum

A Guide for Curriculum Coordinators, Curriculum Committees, and Teachers

The scope and sequence models contained in this guide demonstrate for teachers and administrators how the ***Next Generation Science Standards (NGSS)*** can be used to create vertically aligned curricula. The models can be used to:

- Help teachers work with their colleagues to foster K-12 science literacy and coherence.
- Model how other science topic strands may be developed.
- Integrate activities from the NHEET-partner programs and the outdoors into different curriculum strands at each grade level.
- Gain support for using the ***Next Generation Science Standards***, as a developmentally appropriate guideline for choosing activities and experiences that build through the grade levels to achieve a higher level of complexity in science concepts through high school.

A New Hampshire Education and Environment Team plan to achieve full integration would ideally include:

- An initial meeting for all those in a district teaching science, where the NHEET scope and sequence models are introduced; documentation of existing science practice within their district for teaching the three themes should be readily accessible for referencing.
- Training in the NHEET programs, including activities and protocols, for groups of teachers within each grade span.
- Teachers and administrators choosing activities and protocols to be implemented at each grade level within each of the grade spans, in a way most appropriate within their school district.
- On-going NHEET support for the integration of the vertically aligned scope and sequence models.
- Additional topic strands introduced in the same manner in subsequent years.

If a plan for full integration cannot be achieved, teachers and students can benefit from a partial adoption of a scope and sequence model topic strand, involving teachers at multiple grade levels. As with the full integration plan, teachers must be trained to use all the programs, including activities and protocols. Individual teachers may also use the scope and sequence models to enhance their curricula.

Observation Skills for Science Fieldwork
Kindergarten – Grade 4 Scope and Sequence

To use the environment as a context for learning, students must first be given opportunities to learn how to be good observers of the natural world. Whether you are taking your students out into the field for the first time or the tenth time, observation is a learned skill that is best mastered with practice. By observing, discussing and recording what they see, students not only build essential science and engineering skills (as identified in the Next Generation Science Standards), but also the necessary vocabulary that is essential to further science discovery. New Hampshire Education and Environment Team programs' resources have many observation activities to support these skills. The following are a few suggestions.

Essential Question: How Can We Use Our Senses To Explore Our Schoolyard?

Kindergarten – Grade 2

The Shape of Things (PLT). Students use "sight" to find and match several familiar shapes to shapes in their environment.

Peppermint Beetle (PLT). Students use "smell" to explore the forest and animal behavior.

Sounds Around (PLT). Students identify and map "sounds" in their environment.

Get in Touch With Trees, Part A (PLT). Students use "touch and sight" to locate different objects found in a forest.

Stream Sense (WET). Students observe a stream using all of their senses.

Water Detectives (GLOBE). Students use their senses to identify mystery substances.

Color Inventory Card (HOME, Ch.1). Students match colors they see on the school site with colors in a box of crayons.

Grades 3 – 5

Peppermint Beetle, Variation (PLT). Students describe and identify different smells that are common to them.

Learning to Look, Looking to See (WILD). Students practice their observation skills, including memory, by using things found in the schoolyard environment.

Colors Inventory Card (HOME, Ch.1). Students match colors they see on the school site with colors in a box of crayons.

Get in Touch With Trees, Part B (PLT). Students use "touch" to find a mystery tree.

Graphananimal (WILD). Students look for pretend evidence of animals in the classroom before going outside to discover real signs of animals. Note: Use pictures of animal signs (ex. tracks, snake skins, scat) instead of pictures of the animals.

Life in the Fast Lane (WET). Students use a data sheet to record observations and collect data of a temporary wetland.

Rainy Day Hike (WET). Students learn about watersheds by observing and collecting data about water flowing over their school grounds.

25 Words Inventory Card (HOME, Ch. 1). Students investigate all parts of the schoolyard and come up with words to best describe different

Overview

One goal of science education is to help students understand the nature of scientific knowledge. This matrix presents eight major themes and grade level understandings about the nature of science. Four themes extend the scientific and engineering practices and four themes extend the crosscutting concepts. These eight themes are presented in the left column. The matrix describes learning outcomes for the themes at grade bands for K-2, 3-5, middle school, and high school. Appropriate learning outcomes are expressed in selected performance expectations and presented in the foundation boxes throughout the standards.

Understandings about the Nature of Science *(taken from the Next Generation Science Standards)*

Categories	K-2	3-5	Middle School	High School
Scientific Investigations Use a Variety of Methods	Science investigations begin with a question. Scientist use different ways to study the world.	Science methods are determined by questions. Science investigations use a variety of methods, tools, and techniques.	Science investigations use a variety of methods and tools to make measurements and observations. Science investigations are guided by a set of values to ensure accuracy of measurements, observations, and objectivity of findings. Science depends on evaluating proposed explanations. Scientific values function as criteria in distinguishing between science and non-science.	Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. The discourse practices of science are organized around disciplinary domains that share exemplars for making decisions regarding the values, instruments, methods, models, and evidence to adopt and use. Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge.
Scientific Knowledge is Based on Empirical Evidence	Scientists look for patterns and order when making observations about the world.	Science findings are based on recognizing patterns. Scientists use tools and technologies to make accurate measurements and observations.	Science knowledge is based upon logical and conceptual connections between evidence and explanations. Science disciplines share common rules of obtaining and evaluating empirical evidence.	Science knowledge is based on empirical evidence. Science disciplines share common rules of evidence used to evaluate explanations about natural systems. Science includes the process of coordinating patterns of evidence with current theory. Science arguments are strengthened by multiple lines of evidence supporting a single explanation.
Scientific Knowledge is Open to Revision in Light of New Evidence	Science knowledge can change when new information is found.	Science explanations can change based on new evidence.	Scientific explanations are subject to revision and improvement in light of new evidence. The certainty and durability of science findings varies. Science findings are frequently revised and/or reinterpreted based on new evidence.	Scientific explanations can be probabilistic. Most scientific knowledge is quite durable but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena	Scientists use drawings, sketches, and models as a way to communicate ideas. Scientists search for cause and effect relationships to explain natural events.	Science theories are based on a body of evidence and many tests. Science explanations describe the mechanisms for natural events.	Theories are explanations for observable phenomena. Science theories are based on a body of evidence developed over time. Laws are regularities or mathematical descriptions of natural phenomena. A hypothesis is used by scientists as an idea that may contribute important new knowledge for the evaluation of a scientific theory. The term "theory" as used in science is very different from the common use outside of science.	Theories and laws provide explanations in science, but theories do not with time become laws or facts. A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that has been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. Laws are statements or descriptions of the relationships among observable phenomena. Scientists often use hypotheses to develop and test theories and explanations.

Understandings about the Nature of Science *(taken from the Next Generation Science Standards)*

Categories	K-2	3-5	Middle School	High School
Science is a Way of Knowing	Science knowledge helps us know about the world.	Science is both a body of knowledge and processes that add new knowledge. Science is a way of knowing that is used by many people.	Science is both a body of knowledge and the processes and practices used to add to that body of knowledge. Science knowledge is cumulative and many people, from many generations and nations, have contributed to science knowledge. Science is a way of knowing used by many people, not just scientists.	Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge. Science is a unique way of knowing and there are other ways of knowing. Science distinguishes itself from other ways of knowing through use of empirical standards, logical arguments, and skeptical review. Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time.
Scientific Knowledge Assumes an Order and Consistency in Natural Systems	Science assumes natural events happen today as they happened in the past. Many events are repeated.	Science assumes consistent patterns in natural systems. Basic laws of nature are the same everywhere in the universe.	Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. Science carefully considers and evaluates anomalies in data and evidence.	Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. Science assumes the universe is a vast single system in which basic laws are consistent.
Science is a Human Endeavor	People have practiced science for a long time. Men and women of diverse backgrounds are scientists and engineers.	Men and women from all cultures and backgrounds choose careers as scientists and engineers. Most scientists and engineers work in teams. Science affects everyday life. Creativity and imagination are important to science.	Men and women from different social, cultural, and ethnic backgrounds work as scientists and engineers. Scientists and engineers rely on human qualities such as persistence, precision, reasoning, logic, imagination and creativity. Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism and openness to new ideas. Advances in technology influence the progress of science and science has influenced advances in technology.	Scientific knowledge is a result of human endeavor, imagination, and creativity. Individuals and teams from many nations and cultures have contributed to science and to advances in engineering. Scientists' backgrounds, theoretical commitments, and fields of endeavor influence the nature of their findings. Technological advances have influenced the progress of science and science has influenced advances in technology. Science and engineering are influenced by society and society is influenced by science and engineering.
Science Addresses Questions About the Natural and Material World.	Scientists study the natural and material world.	Science findings are limited to what can be answered with empirical evidence.	Scientific knowledge is constrained by human capacity, technology, and materials. Science limits its explanations to systems that lend themselves to observation and empirical evidence. Science knowledge can describe consequences of actions but is not responsible for society's decisions.	Not all questions can be answered by science. Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. Many decisions are **not** made using science alone, but rely on social and cultural contexts to resolve issues.

Ecosystems and Habitats Standards Model

We have highlighted below the Life Science DCIs from NGSS that we direct support an *Ecosystems & Habitats* theme for grades K-8. There are also physical science correlations to this theme that are not shown here (specifically PS3 and PS4).

Life Science Progression

INCREASING SOPHISTICATION OF STUDENT THINKING

	K-2	3-5	6-8	9-12
LS1.A Structure and function	All organisms have external parts that they use to perform daily functions.	Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction.	All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions.	Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.
LS1.B Growth and development of organisms	Parents and offspring often engage in behaviors that help the offspring survive.	Reproduction is essential to every kind of organism. Organisms have unique and diverse life cycles.	Animals engage in behaviors that increase the odds of reproduction. An organism's growth is affected by both genetic and environmental factors.	Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types.
LS1.C Organization for matter and energy flow in organisms	Animals obtain food they need from plants or other animals. Plants need water and light.	Food provides animals with the materials and energy they need for body repair, growth, warmth, and motion. Plants acquire material for growth chiefly from air, water, and process matter and obtain energy from sunlight, which is used to maintain conditions necessary for survival.	Plants use the energy from light to make sugars through photosynthesis. Within individual organisms, food is broken down through a series of chemical reactions that rearrange molecules and release energy.	The hydrocarbon backbones of sugars produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy.
LS1.D Information Processing	Animals sense and communicate information and respond to inputs with behaviors that help them grow and survive.	Different sense receptors are specialized for particular kinds of information; Animals use their perceptions and memories to guide their actions.	Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain; The signals are then processed in the brain, resulting in immediate behavior or memories.	N/A

	K-2	3-5	6-8	9-12
LS2.A Interdependent relationships in ecosystems	Plants depend on water and light to grow, and also depend on animals for pollination or to move their seeds around.	The food of almost any animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants, while decomposers restore some materials back to the soil.	Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving factors, any of which can limit their growth. Competitive, predatory, and mutually beneficial interactions vary across ecosystems but the patterns are shared.	Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem.
LS2.B Cycles of matter and energy transfer in ecosystems	[Content found in LS1.C and ESS3.A]	Matter cycles between the air and soil and among organisms as they live and die.	The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Food webs model how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.	Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem elements are combined in different ways and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle.
LS2.C Ecosystem dynamics, functioning, and resilience	N/A	When the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die.	Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.	If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.
LS2.D Social interactions and group behavior	N/A	Being part of a group helps animals obtain food, defend themselves, and cope with changes.	N/A	Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.

<table>
<tr><th></th><th>K-2</th><th>3-5</th><th>6-8</th><th>9-12</th></tr>
<tr><td>LS3.A
Inheritance of traits</td><td rowspan="2">Young organisms are very much, but not exactly, like their parents and also resemble other organisms of the same kind.</td><td rowspan="2">Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops.</td><td>Genes chiefly regulate a specific protein, which affect an individual's traits.</td><td>DNA carries instructions for forming species' characteristics. Each cell in an organism has the same genetic content, but genes expressed by cells can differ</td></tr>
<tr><td>LS3.B
Variation of traits</td><td>In sexual reproduction, each parent contributes half of the genes acquired by the offspring resulting in variation between parent and offspring. Genetic information can be altered because of mutations, which may result in beneficial, negative, or no change to proteins in or traits of an organism.</td><td>The variation and distribution of traits in a population depend on genetic and environmental factors. Genetic variation can result from mutations caused by environmental factors or errors in DNA replication, or from chromosomes swapping sections during meiosis.</td></tr>
<tr><td>LS4.A
Evidence of common ancestry and diversity</td><td>N/A</td><td>Some living organisms resemble organisms that once lived on Earth. Fossils provide evidence about the types of organisms and environments that existed long ago.</td><td>The fossil record documents the existence, diversity, extinction, and change of many life forms and their environments through Earth's history. The fossil record and comparisons of anatomical similarities between organisms enables the inference of lines of evolutionary descent.</td><td>The ongoing branching that produces multiple lines of descent can be inferred by comparing DNA sequences, amino acid sequences, and anatomical and embryological evidence of different organisms.</td></tr>
<tr><td>LS4.B
Natural selection</td><td>N/A</td><td>Differences in characteristics between individuals of the same species provide advantages in surviving and reproducing.</td><td>Both natural and artificial selection result from certain traits giving some individuals an advantage in surviving and reproducing, leading to predominance of certain traits in a population.</td><td>Natural selection occurs only if there is variation in the genes and traits between organisms in a population. Traits that positively affect survival can become more common in a population.</td></tr>
<tr><td>LS4.C
Adaptation</td><td>N/A</td><td>Particular organisms can only survive in particular environments.</td><td>Species can change over time in response to changes in environmental conditions through adaptation by natural selection acting over generations. Traits that support successful survival and reproduction in the new environment become more common.</td><td>Evolution results primarily from genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. Adaptation means that the distribution of traits in a population, as well as species expansion, emergence or extinction, can change when conditions change.</td></tr>
<tr><td>LS4.D
Biodiversity and humans</td><td>A range of different organisms lives in different places.</td><td>Populations of organisms live in a variety of habitats. Change in those habitats affects the organisms living there.</td><td>Changes in biodiversity can influence humans' resources and ecosystem services they rely on.</td><td>Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth.</td></tr>
</table>

Water and Watersheds Standards Flow Model

We have included below the Earth Space, Life, and Physical Science, DCIs from NGSS that we think best support a *Water & Watersheds* theme for grades K-8. The highlighted DCIs directly support this theme, and the remaining DCIs are included because they have strong correlations to this theme, therefore we did not want to leave them out.

Learning Progressions Related to Water and Watersheds from the NGSS

	K-2	3-5	6-8	9-12
ESS2.A Earth materials and systems	Wind and water change the shape of the land.	Four major Earth systems interact. Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around.	Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.	Feedback effects exist within and among Earth's systems.
ESS2.B Plate tectonics and large-scale system interactions	Maps show where things are located. One can map the shapes and kinds of land and water in any area.	Earth's physical features occur in patterns, as do earthquakes and volcanoes. Maps can be used to locate features and determine patterns in those events.	*Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history. Maps are used to display evidence of plate movement.*	*Radioactive decay within Earth's interior contributes to thermal convection in the mantle.*
ESS2.C The roles of water in Earth's surface processes	Water is found in many types of places and in different forms on Earth.	Most of Earth's water is in the ocean and much of the Earth's fresh water is in glaciers or underground.	Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features.	The planet's dynamics are greatly influenced by water's unique chemical and physical properties.
ESS3.A Natural Resources	Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.	Energy and fuels humans use are derived from natural sources and their use affects the environment. Some resources are renewable over time, others are not.	Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet	Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits

ESS3.C Human impacts on Earth systems	Things people do can affect the environment but they can make choices to reduce their impacts.	Societal activities have had major effects on the land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments.	Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.	Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies.
LS2.B Cycles of matter and energy transfer in ecosystems	[Content found in LS1.C and ESS3.A]	Matter cycles between the air and soil and among organisms as they live and die.	The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Food webs model how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.	Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem elements are combined in different ways and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle.
LS2.C Ecosystem dynamics, functioning, and resilience	N/A	When the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die.	Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.	If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem
LS4.C Adaptation	N/A	Particular organisms can only survive in particular environments. Populations of organisms live in a variety of habitats. Change in those habitats affects the organisms living there.	Species can change over time in response to changes in environmental conditions through adaptation by natural selection acting over generations. Traits that support successful survival and reproduction in the new environment become more common.	Evolution results primarily from genetic variation of individuals in a species, competition for resources, and proliferation of organisms better able to survive and reproduce. Adaptation means that the distribution of traits in a population, as well as species expansion, emergence or extinction, can change when conditions change.

LS4.D Biodiversity and humans	A range of different organisms lives in different places.	Changes in biodiversity can influence humans' resources and ecosystem services they rely on.	Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth	Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth.
PS1.A Structure of matter (includes PS1.C Nuclear processes)	Matter exists as different substances that have observable different properties. Different properties are suited to different purposes. Objects can be built up from smaller parts.	Because matter exists as particles that are too small to see, matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials.	The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter.	The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter, including chemical reactions and nuclear processes. Repeating patterns of the periodic table reflect patterns of outer electrons. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy to take the molecule apart.
PS1.B Chemical reactions	Heating and cooling substances cause changes that are sometimes reversible and sometimes not.	Chemical reactions that occur when substances are mixed can be identified by the emergence of substances with different properties; the total mass remains the same.	Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.	Chemical processes are understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved.

Atmosphere, Weather, and Climate Standards Flow Model

We have included below the Earth Space Science, DCIs from NGSS that we think best support a *Atmosphere, Weather and Climate* theme for grades K-8. The highlighted DCIs directly support this theme, and the remaining DCIs are included because they have strong correlations to this theme, therefore we did not want to leave them out.

Learning Progressions Related to Atmosphere, Weather and Climate

	K-2	3-5	6-8	9-12
ESS1.A: The Universe and Stars	Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (1-ESS1-1)	The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1)	Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1) Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2)	The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1) The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2), (HS-ESS1-3) The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2) Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2), (HS-ESS1-3)

ESS1.B Earth and the Solar System	Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1-2)	The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)	The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2), (MS-ESS1-3) This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1) The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2)	Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4) Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (secondary to HS-ESS2-4)

ESS2.A: Earth Materials and Systems	Wind and water can change the shape of the land. (2-ESS2-1)	Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1) Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)	All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1) The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2)	Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1),(HS-ESS2-2) Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3) The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4)

ESS2.C: The role of water in Earth's surface processes	Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)	Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)	Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4) The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5) Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2)	The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5)

ESS2.D Weather and Climate	Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. (K-ESS2-1)	Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3-ESS2-1) Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. (3-ESS2-2)	Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6)	Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HS-ESS3-6) The foundation for Earth’s global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy’s re-radiation into space. (HS-ESS2-2)(HS-ESS2-4) Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6),(HS-ESS2-7) Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6),(HS-ESS2-4)

ESS3.B Natural Hazards	Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. (K-ESS3-2)	A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (3-ESS3-1) (Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.)	Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)	Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)
ESS3.C: Human impacts on earth systems	Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (K-ESS3-3)	Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)	Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3) Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4)	The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3) Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

ESS3.D: Global Climate Change	none	Related back to ESS3.C	Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)	Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5) Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)

Grades K-2

Ecosystems & Habitats

Activity Correlations

Grades K, Grade 1, and Grade 2 Ecosystems and Habitats **Essential Questions:** How and where do local living things live? How is this similar and different to other living things? How do living things use their different parts to gather information in order to survive? What are the relationships between plants, between animals, and between plants and animals in a particular area?		
Students who demonstrate understanding can…	**Questions to Explore from Disciplinary Core Ideas (DCI)**	**Activity Correlations & Field Investigations**
K-LS1-1 Use observations to describe patterns of what plants and animals (including humans) need to survive.	• What do plants need to survive? • What do animals (including humans) need to survive?	What's Wild? (WILD) Beautiful Basics (WILD) Fashion a Fish (Aquatic WILD) Life Box (WET) Ants on Parade (GUW) Wiggling Worms (GUW) Aqua Charades (GUW) What's Wild? (GUW) **Wildlife is Everywhere (GUW)** **Wildlife Water Safari (GUW)** **Field Study Fun (GUW)** **Oh, Deer! (GUW)** Show Me the Energy! (GUW) **In a Grasshopper's World (GUW)** Lunch for a Bear (GUW) **Water Safari (Aquatic WILD)** **Ruby-throated Hummingbird Protocol (GLOBE)**
K-ESS2-2 Construct and argument supported by evidence for how plants and animals (including humans) can change the environment to fit their needs.	• Where do animals live and why do they live there?	**Oh, Deer! (GUW)** **Are Vacant Lots Vacant?-Variation Only (PLT)**
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.	• What is the relationship between what they need and where they live?	Everybody Needs a Home (WILD) What's That Habitat? (WILD) **Water Safari (Aquatic WILD)** **Who Lives in a Tree? (GUW)** **Oh, Deer! (GUW)** **Wildlife Water Safari (GUW)** **In a Grasshopper's World (GUW)** Wiggling Worms (GUW) The Deep Blue Sea (GUW) What's Wild? (GUW) **Adopt a Tree (EC PLT)** • **Signs of Fall (EC PLT)** • **Evergreens in Winter (EC PLT)**

		• **Bursting Buds (EC PLT)** All Year Long (Elementary GLOBE) Soil Connections (Elementary GLOBE)
K-ESS3-3 Communicate solutions that will reduce the impact of humans on land, water, air, and/or other living things in the local environment.	• How can humans show responsibility when it comes to nature?	Three Cheers for Trees (EC PLT) We All Need Trees (EC PLT) Earth Manners (PLT) Make Your Own Paper (PLT) Plant a Tree (PLT) A Forest of Many Uses-Part A (PLT) **Trees in Trouble-Part A (PLT)** Pollution Search-Part B (PLT) Less is More (GUW) Playing Lightly on the Earth (WILD) **Water Safari (Aquatic WILD)** **Site Inventory Cards (HOME)** Pass the Jug (WET) Water Audit (WET)
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.	• How do plants and animals use external structures to survive, grow and meet their needs? • What are some ways that plants and animals meet their needs so they can survive and grow?	Getting in Touch with Trees Part A (PLT) Peppermint Beetle (PLT) To Be a Tree (EC PLT) Bird Beak Buffet (GUW) Make a Coat! (WILD) Lunch for a Bear (GUW) Terrific Turkeys (GUW) **Schoolyard Safari (PLT)** Every Tree For Itself (PLT) **Trees as Habitats (EC PLT)** Habitracts (WILD)

1-LS3-1 Make observations to construct evidence-based account that young plants and animals are like, but not exactly like, their parents.	• How are parents and their children similar and different? • How do behaviors of parents and offspring help the offspring survive?	Are You Me? (Aquatic WILD) Grow as We Go (GUW)
2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.	• What do plants need to survive and what happens if one of these needs is limited?	How Plants Grow-Variation Only (PLT) **Tree Lifecycle (PLT)** **Sunlight and Shades of Green (PLT)** Every Tree For Itself (PLT) Plant a Tree (PLT) The Life Box (WET) Show Me the Energy! (GUW) Earth System in a Bottle (GLOBE)
2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants	• How do plants depend on animals to support their population growth?	**Have Seeds, Will Travel (PLT)** The Forest of S.T. Shrew (PLT) Seed Need (GUW)
2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.	• How do plants and animals meet their needs in the environment where they occur? • What kinds of living things exist together in different habitats?	Color Crazy (WILD) **Graphananimal (WILD)** Are you Me? (Aquatic WILD) Water Plant Art (Aquatic WILD) Picture This! (PLT) **Field, Forest, and Stream-Variation Only (PLT)** **The Closer You Look (PLT)** **Looking at Leaves (PLT)** Environmental Exchange Box (PLT) Habitat Pen Pals (PLT) Treemendous Science! (PLT E-Unit) • Level A Lesson #3 • Level B Lesson #1 • Level C Lesson #1, #3, #4, #5 Spider Web Wonders (GUW) The Deep Blue Sea (GUW) Wildlife is Everywhere! (GUW) **Field Study Fun (GUW)**

		Who Lives in a Tree? (GUW) **Wildlife Water Safari (GUW)** **Looking at Leaves (GUW)** **In a Grasshopper's World (GUW)** Elementary GLOBE Activities: • Mystery of the Missing Hummingbirds • Water Wonders • We All Need Soil **GLOBE Protocols:** • **Green Up** • **A Sneak Peek at Budburst** • **A First Look at Phenology**

Grades K-2

Water & Watersheds

Activity Correlations

Grades K, Grade 1 (none), and Grade 2 Water and Watersheds

Essential Questions: How does water occur and change in our environment?

Grade K: Big Ideas

- **Biogeology**
  - Plants and animals can change their environment.
- **Human Impacts and Earth Systems**
  - Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air and on other living things.
- **Natural Resources**
  - Living things need water, air and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.

Students who demonstrate understanding can…	Questions to Explore from Disciplinary Core Ideas (DCI)	Activity Correlations & **Field Investigations**
K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. This is a crossover standard…see the K-2 Ecosystems and Habitats Scope and Sequence for even more activity ideas.	• In what ways can plants and animals change their environment?	We All Need Soil (Elementary GLOBE)
K-ESS3-1. Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. This is a crossover standard…see the K-2 Ecosystems and Habitats Scope and Sequence for even more activity ideas.	• Where do animals live and why do they live there? • How do plants and animals (including humans) find their needs where they live?	Pass the Jug (WET) The Long Haul (WET) Common Water PreK-2 Option (WET) Life Box (WET) Trees as Habitats (EC PLT) **Wildlife Water Safari (GUW)** **Water Safari (Aquatic WILD)** What's Wild? (WILD) Classroom Carrying Capacity (WILD) Habitracks (WILD) What's That Habitat? (WILD) Everybody Needs a Home (WILD) **Environmental Barometer (WILD)** Make a Coat! (WILD) Animal Charades (WILD)

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<tr>
<td>K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

This is a crossover standard…see the K-2 Ecosystems and Habitats Scope and Sequence for even more activity ideas.</td>
<td>• In what ways can humans reduce their impact on land, water, air and other living things?</td>
<td>Pass the Jug (WET)
Water Audit (WET)
Common Water PreK-2 Option (WET)
Rainy Day Hike (WET)
There is No Away! (WET)
Three Cheers for Trees (EC PLT)
Pollution Search (Part B) (PLT)
Aqua Charades (GUW)
Less is More (GUW)
Water Safari (Aquatic WILD)
First Impressions (WILD)
Too Close for Comfort (WILD)
Ethi-Thinking (WILD)
Playing Lightly on the Earth (WILD)</td>
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<td>K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.</td>
<td colspan="2">Since water is an essential need of all living things, this is a crossover standard…see the K-2 Ecosystems and Habitats Scope & Sequence for activity ideas.</td>
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<tr>
<td colspan="3">Grade 2 Big Ideas:
• The Role of Water in Earth's Surface Processes
o Water is found in the ocean, rivers, lakes, and ponds.
o Water exists in solid ice and in liquid form.
• Structure and Properties of Matter
o Different kinds of matter exist and many of them can be either solid, or liquid, depending on temperature.
o Matter can be described and classified by its observable properties.
• Earth Materials and Systems
o Wind and water can change the shape of the land.
• Plate Tectonics and Large-Scale System Interactions
o Maps show where things are located. One can map the shapes and kinds of land and water in any area.
• Biodiversity and Humans
o There are many different kinds of living things in an area, and they exist in different places on land and in water.</td>
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<td>2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.</td>
<td>• How are materials similar and different from one another, and how do the properties of the materials relate to their use?
• What are the properties of water and how is it similar and different to other liquids?</td>
<td>Looking at Leaves (GUW)</td>
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<td>2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.</td>
<td>• How does land change and what are some things that cause it to change?</td>
<td>Water Safari: In Step with STEM Connection (Aquatic WILD)
Rainy Day Hike (WET)
Just Passing Through (WET)</td>
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2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.	• What are the different kinds of land and bodies of water in the area?	**Mapping Wet Places (HOME)** **Rainy Day Hike (WET)** Blue Planet (WET) Discover the Waters of Our National Parks (WET) Get the Groundwater Picture (WET) Water Audit (WET) Hydrology: Model a Catchment Basin (GLOBE) Hydrology: Water Walk (GLOBE) Measure Up (Elementary GLOBE)
2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.	• Where is water found on Earth? • Where is salt water found? • Where is freshwater found?	The Deep Blue Sea (GUW) A Drop in the Bucket (K-2 Option) (WET) Blue Planet (WET)
2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.	Since water is an essential need of all living things, this is a crossover standard…see the K-2 Ecosystems and Habitats Scope & Sequence for activity ideas.	

Grades K-2

Atmosphere, Weather, and Climate

Activity Correlations

Grades K, Grade 1, and Grade 2 Atmosphere, Weather and Climate

Essential Questions:

How does the weather in our area change from season to season?

How does weather compare from season to season?

Students who demonstrate understanding can…	Questions to Explore from Disciplinary Core Ideas (DCI)	Activity Correlations & Field Investigations
K-ESS2-1: Use observations to describe local weather and patterns over time.	• How would you describe the weather today? This week? This month? This season? • What does the weather tell us about the season that we are in? • What can colors in nature tell us about the current season and changing of seasons?	Thunderstorm (WET) House of Seasons (WET) **Color Matching Inventory Cards (HOME)** GLOBE Elementary • Discoveries at Willow Creek • The Mystery of the Missing Hummingbirds o The Colors of the Seasons • Cloud Fun • We're All Connected: Earth System Interactions • What in the World is Happening with Our Climate? o Weather Adds Up to Climate **Current Temperature Protocol (GLOBE)** **Precipitation Protocol (GLOBE)**
K-ESS3-2: Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather	• How can weather forecasting help people plan for or respond to, severe weather? • How do we know when severe weather might occur? • How can "community helpers" help us keep us safe during severe weather?	There is No Away! (WET)
K-ESS3-3: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment This is a crossover standard…see the K-2 Water and Watersheds Scope and Sequence for even more activity ideas.	• How do people affect the land, water, air, and/or other living things in the local environment in positive and negative ways?	What Powers the Move? (PLT Energy and Society) What in the World is Happening with Our Climate? (GLOBE Elementary) • Seashores on the Move • We're All Part of the Solution Playing Lightly on the Earth (WILD) Ethi-thinking (WILD) Too Close for Comfort (WILD)

1-ESS1-1: Use observations of the sun, moon, and stars to describe patterns that can be predicted.	• How would you describe the night sky? Does it always look the same? How do you know? • How would you describe the position of the sun at different times during the day? • Does the moon always look the same at night?	Aerosols (Elementary GLOBE) • Sky Observers
1-ESS1-2: Make observations at different times of year to relate the amount of daylight to the time of year	• How does the amount of sunlight change each day? Week? Month? Season?	Aerosols (Elementary GLOBE) • Up in the Air Treemendous Science! (PLT E-Unit) • Level A Lesson #3 • Level B Lesson #1, #4 • Level C Lesson #1
2-ESS2-1: Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land	Since water is an essential need of all living things and a component of weather… see the K-2 Water and Watersheds Scope & Sequence for activity ideas.	
2-ESS2-3: Obtain information to identify where water is found on Earth and that it can be solid or liquid	Since water is an essential need of all living things and a component of weather… see the K-2 Water and Watersheds Scope & Sequence for activity ideas.	

Grade K-2

Cross Cutting Concepts (CCC)

and

Science Engineering Practices (SEP)

(taken from the Next Generation Science Standards)

Cross Cutting Concepts for Grades K-2

Patterns

In grades **K-2,** children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

- Example: Use observations of the sun, moon, and stars to describe patterns that can be predicted.

Cause and Effect

In grades **K-2**, students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.

- Example: Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.

Scale, Proportion and Quantity

In grades **K-2**, students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length. (No example Performance Expectation given)

Systems and System Models

In grades **K-2**, students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.

- Example: Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.

Energy and Matter

In grades **K-2,** students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.

- Example: 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.

Structure and Function

In grades **K-2**, students observe the shape and stability of structures of natural and designed objects are related to their function(s).

- Example: Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.

Stability and Change

In grades **K-2**, students observe some things stay the same while other things change, and things may change slowly or rapidly.

- Example: Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

Science and Engineering Practices for Grades K-2

Practice: Asking Questions and Defining Problems

Asking questions and defining problems in **K–2** builds on prior experiences and progresses to simple descriptive questions that can be tested.

- Ask questions based on observations to find more information about the natural and/or designed world(s).
- Ask and/or identify questions that can be answered by an investigation.
- Define a simple problem that can be solved through the development of a new or improved object or tool.

Practice: Developing and Using Models

Modeling in **K–2** builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

- Distinguish between a model and the actual object, process, and/or events the model represents.
- Compare models to identify common features and differences.
- Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).
- Develop a simple model based on evidence to represent a proposed object or tool.

Practice: Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in **K–2** builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- With guidance, plan and conduct an investigation in collaboration with peers (for K).
- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.
- Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question.
- Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.
- Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal.
- Make predictions based on prior experiences.

Practice: Analyzing and Interpreting Data

Analyzing data in **K–2** builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Record information (observations, thoughts, and ideas).
- Use and share pictures, drawings, and/or writings of observations.
- Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
- Compare predictions (based on prior experiences) to what occurred (observable events).
- Analyze data from tests of an object or tool to determine if it works as intended.

Practice: Using Mathematics and Computational Thinking
Math and computational thinking in **K–2** builds on prior experience and progresses to recognizing that math can be used to describe the natural & designed world(s).

- Decide when to use qualitative vs. quantitative data.
- Use counting and numbers to identify and describe patterns in the natural and designed world(s).
- Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.
- Use quantitative data to compare two alternative solutions to a problem.

Practice: Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in **K–2** builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
- Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.
- Generate and/or compare multiple solutions to a problem.

Practice: Engaging in Argument from Evidence
Engaging in argument from evidence in **K–2** builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).

- Identify arguments that are supported by evidence.
- Distinguish between explanations that account for all gathered evidence and those that do not.
- Analyze why some evidence is relevant to a scientific question and some is not.
- Distinguish between opinions and evidence in one's own explanations.
- Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument.
- Construct an argument with evidence to support a claim.
- Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.

Practice: Obtaining, Evaluating and Communicating Information
Obtaining, evaluating, and communicating information in **K–2** builds on prior experiences and uses observations and texts to communicate new information.

- Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).
- Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea.
- Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim.
- Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Grades 3-5

Ecosystems & Habitats

Activity Correlations

Grades 3, Grade 4, and Grade 5 Ecosystems and Habitats **Essential Questions:** What are the relationships between plants, between animals, and between plants and animals in a particular area? How do structures support the survival, growth, behavior and reproduction of plants and animals? How does matter cycle through an ecosystem?		
Students who demonstrate understanding can…	**Questions to Explore from Disciplinary Core Ideas (DCI)**	**Activity Correlations & Field Investigations**
3-LS2-1. Construct an argument that some animals form groups that help members survive.	• What are ways that animal groups (in varying sizes) can help each other to survive?	Muskox Maneuvers (WILD) **Artic Bird Migration Monitoring Protocol (GLOBE)**
3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.	• How do scientists uncover evidence of animals and environments that once occurred on Earth? • How are living things and environments of the past similar/different to current living things and environments?	
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.	• In what ways do physical appearance and behaviors help animals to survive in a particular area? • How do organisms vary in their traits?	Color Crazy (WILD) **Who Fits Here? (WILD)** **Environmental Barometer (WILD)** **Got Water? (Aquatic WILD)** Thicket Game (WILD) Adaption Artistry (WILD) Classroom Carrying Capacity (WILD) Fashion a Fish (WILD Aquatic) Fishy Who's Who (Aquatic WILD) **Got Water? (Aquatic WILD)** Designing a Habitat? (Aquatic WILD) **Soil Stories-Part A (PLT)** Birds and Worms (PLT) Picture This! (PLT) A Home for Many (PLT E-Unit) My Water Address, Take Action! (WET)

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.	• What happens to organisms when their environment changes? • How do environmental factors determine the populations of plants and animals that survive in a particular area?	Ethi-thinking (WILD) Invaders! (WET) Invasive Species (PLT E-Unit) **Trees in Trouble (PLT)** **Site Selection Protocol (GLOBE)** **Manual Land Cover Mapping Protocol (GLOBE)** Hooks and Ladders (Aquatic WILD) Plastic Voyages (Aquatic WILD)
4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.	• How does energy allow us to see?	
4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	• How do internal and external structures function to support the survival, growth, behavior and reproduction of plants and animals?	Tree Factory (PLT) Charting Diversity (PLT) Birds and Worms (PLT) **Bursting Buds (PLT)** **Looking at Leaves (PLT)** **Sunlight and Shades of Green (PLT)** Aqua Notes (WET) Whale of a Tail (Aquatic WILD) Seeing is Believing (WILD) What Bear Goes Where? (WILD) **Grasshopper Gravity (WILD)** Surprise Terrariums (WILD) **Micro Odyssey (Aquatic WILD)** Water Wonders (Elementary GLOBE) **Ruby-throated Hummingbird Protocol (GLOBE)**
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.	• What different kinds of information can different senses provide to an animal? • How do animals respond to information from their senses? • How are senses specialized for gaining particular information for an animal?	Getting in Touch with Trees (PLT) Peppermint Beetle (PLT) **Sounds Around (PLT)** Migration Headache (Aquatic WILD) Turtle Hurdles (Aquatic WILD) Sockeye Scents (Aquatic WILD)

5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.	• Where does the energy in food come from and what is it used for?	What's for Dinner? (WILD) Lobster in Your Lunchbox (WILD) **Owl Pellets (WILD)** Pass the Plants, Please (PLT) On Track With Hydration (WET)
5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.	• How can you provide evidence to support a claim that plants need air and water for growth?	**How Plants Grow? (PLT)** **Sunlight and Shades of Green (PLT)** **Signs of Fall (PLT)** Air Plants (PLT) Power Plants (PLT E-Unit) A Beginning Look at Photosynthesis (GLOBE)
5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment	• How does matter cycle through an ecosystem?	The Forest of S.T. Shrew (PLT) **Natures Recyclers (PLT)** **Tree Lifecycle (PLT)** **Fallen Log (PLT)** Web of Life (PLT E-Unit) What Did Your Lunch Cost Wildlife? (WILD) **Owl Pellets (WILD)** **Marsh Munchers (Aquatic WILD)** Soil: the Great Decomposer (GLOBE) Earth as a System (Elementary GLOBE) Healthy Habitats (WET) Invaders! (WET)

Grades 3-5

Water & Watersheds

Activity Correlations

Grades 3, Grade 4, and Grade 5 Water and Watersheds

Essential Questions: How do properties of water affect life forms?
How does the cycling of water into and out of the Earth's atmosphere affect weather?

Grade 3 Big Ideas:

- **Ecosystem Dynamics, Functioning and Resilience**
  - When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.
- **Adaptation**
  - For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.
- **Biodiversity and Humans**
  - Populations live in a variety of habitats, and change in those habitats affects the organisms living there.

Students who demonstrate understanding can…	Questions to Explore from Disciplinary Core Ideas (DCI)	Activity Correlations & Field Investigations
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. This is a crossover standard…see the 3-5 Ecosystems and Habitats Scope and Sequence for even more activity ideas.	• In what ways do physical appearance and behaviors help animals to survive in a particular area? • How do organisms vary in their traits?	Macroinvertebrate Mayhem (WET) Ocean Habitats (WET) Fishy Who's Who: Extension #1 (Aquatic WILD) **Got Water (Aquatic WILD)** Water Plant Art (Aquatic WILD) **Marsh Munchers (Aquatic WILD)** **Blue Ribbon Niche (Aquatic WILD)** **Edge of Home (Aquatic WILD)** Turtle Hurdles (Aquatic WILD) Aquatic Roots (Aquatic WILD) Kelp Help (Aquatic WILD) Color Crazy (WILD) Classroom Carrying Capacity (WILD) **Who Fits Here? (WILD)** Thicket Game (WILD)
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. This is a crossover standard…see the 3-5 Ecosystems and Habitats Scope and Sequence for even more activity ideas.	• What happens to organisms when their environment changes? • How do environmental factors determine the populations of plants and animals that survive in a particular area? •	**Pollution Search Part A (PLT)** Invaders! (WET) Fishy Who's Who: Adapting Extension #4 (Aquatic WILD) Got Water: including Extension #1 (Aquatic WILD) Designing a Habitat (Aquatic WILD) **Blue Ribbon Niche: with Extension #2 (Aquatic WILD)** Aquatic Roots (Aquatic WILD)

<table>
<tr><td></td><td></td><td>Silt: A Dirty Word (Aquatic WILD)
Dragonfly Pond (Aquatic WILD)
Conversation Messaging (Aquatic WILD)
Environmental; Barometer (WILD)
Ethi-thinking (WILD)
Land Cover: (GLOBE)
• Site Selection
• Manual Land Mapping Cover Protocol</td></tr>
<tr><td colspan="3"><u>Grade 4 Big Ideas:</u>
• Earth Materials and Systems
o Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.
• Biogeology
o Living things affect the physical characteristics of their regions.
• Plate Tectonics and Large-Scale System Interactions
o The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns.
o Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans.
o Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.
• Natural Resources
o Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.</td></tr>
<tr><td>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.</td><td>• How can water, ice, wind and vegetation change the land?</td><td>Water Wonders, Part B (PLT)
Soil Stories (PLT)
Rainy Day Hike (WET)
Just Passing Through (WET)
Seeing Watersheds (WET)</td></tr>
<tr><td>4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth’s features.</td><td>• What patterns of Earth’s features can be determined with the use of maps?</td><td>Got Water? (Aquatic WILD)
Wetland Metaphors: with In Step with STEM #1 (Aquatic WILD)
Water We Eating?: with Evaluation #3 and Extensions #1 & #2 (Aquatic WILD)
Rainy Day Hike (WET)
Seeing Watersheds (WET)</td></tr>
<tr><td>4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.</td><td></td><td>Renewable or Not? (PLT)
Energy Detectives (PLT Energy & Society)
May the Source Be With You (PLT Energy & Society)
What Powers the Move (PLT Energy & Society)
In the Driver’s Seat (PLT Energy & Society)
Energy Challenge Game (PLT Energy & Society)
Energetic Water (WET)</td></tr>
</table>

<u>Grade 5 Big Ideas:</u>

- **The Roles of Water in Earth's Surface Processes**
  - Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.
- **Structure and Properties of Matter**
  - The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish [Similar: PS1.B Chemical Reactions--No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)]
  - Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)
- **Earth Materials and Systems**
  - Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.
- **Human Impacts on Earth Systems**
  - Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.

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.	• When matter changes, does its weight change?	What's the Solution? (WET)
5-PS1-3. Make observations and measurements to identify materials based on their properties.	• How can how a material is used, help to define its properties? • Can new substances be created by combining other substances?	**H2Olympics (WET)** Is There Water on Zork? (WET) **Earth as a System: (GLOBE)** • GC2: Components of the earth system working together • ESS: 3. Explore Relationships between Types of Data (across columns) • LC1: Connecting the parts of the study site • LC2: Representing the study site in a diagram • LC4: Diagramming the study site for others • LC5: Comparing the study site to one in another region • Green-Down Protocol • Green-Up Protocol

		• Phenological Gardens Protocol **Atmosphere: (GLOBE)** **Land, Water and Air** • Digital Multi-Day Max/Min/Current Air and Soil Temperature Protocol • Automated Soil and Air Temperature Monitoring ProtocolAWS WeatherBug Protocol • Davis Weather Station Protocol • RainWise Weather Station Protocol • WeatherHawk Weather Station Protocol • Cloud Protocols • Max/Min/Current Air Temperature Protocol • Precipitation Protocols • Relative Humidity Protocol • Surface Temperature Protocol **Land Cover: (GLOBE)** • Land Cover Sample Site Protocol • Manual Land Cover Mapping Learning Activity **Hydrology: (GLOBE)** • Dissolved Oxygen Protocol • Water Temperature Protocol • Water Transparency Protocol **Soil: (GLOBE)** • Infiltration Protocol • Soil Temperature • Soil Characterization
5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	• How does matter cycle through ecosystems?	**Water Wonders (PLT)** **Field, Forest Stream (PLT)** **The Incredible Journey (WET)** **Adventures in Density (WET)** Blue River (WET) Seeing Watersheds (WET) Make a Mural (WET) Snow and Tell (WET) Springing into Action (WET) **Rainfall and the Forest (WILD)** Earth Systems Play (Elementary GLOBE)

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.	• Where is water found on Earth? • What percent is salt water • What percent is freshwater? • What percent is usable water? • How does the amount of usable water compare to other freshwater sources?	**Water Wonders (PLT)** **Every Drop Counts (PLT)** Drop in the Bucket (WET) Blue Planet (WET) Blue River (WET) Seeing Watersheds (WET) **The Incredible Journey (WET)**
5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	• How can science concepts guide towns' land use decisions?	Sum of the Parts (WET) Common Water (WET) Drop in the Bucket (WET) Blue Planet (WET) Blue River (WET) My Water Footprint (WET) Super Bowl Surge (WET) Urban Water (WET) Virtual Water (WET) **Water Audit (WET)** Dragonfly Pond (Aquatic WILD) **Blue Ribbon Niche: with Extension #2 (Aquatic WILD)** Water Works (Aquatic WILD) Alice in Waterland (Aquatic WILD) Aquatic Roots (Aquatic WILD) What Did Your Lunch Cost Wildlife? (WILD) Here Today, Gone Tomorrow: with Extensions #1 & #2 (WILD) History of Wildlife Management (WILD) Cabin Conflict (WILD) Career Critters: with Extension #2 (WILD) **Water Wonders (PLT)** Every Drop Counts (PLT) Energy Detectives (PLT Energy & Society) May the Source Be With You (PLT Energy & Society) In the Driver's Seat (PLT Energy & Society) **Hydrology: (GLOBE)** • Model a Catchment Basin

Grades 3-5

Atmosphere, Weather and Climate Activity Correlations

Grades 3, Grade 4, and Grade 5 Atmosphere, Weather and Climate **Essential Questions:** What are the key characteristics of weather in your town? How does weather data help predict future weather related events or impacts?		
Students who demonstrate understanding can…	**Questions to Explore from Disciplinary Core Ideas (DCI)**	**Activity Correlations & Field Investigations**

3-ESS2-1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season	• How would you describe the average temperature, precipitation, and/or wind direction of a particular season?
	• Based on your weather data, what would you predict the weather to be next?
		Thunderstorm Part 1 & 2 (WET)
		Land, Water and Air
		• Cloud Protocols
		• Max/Min/Current Air Temperature Protocol
		• Precipitation Protocols
		Earth as a System
		• What Can We Learn About Our Seasons?
		GLOBE Elementary
		• The Mystery of the Missing Hummingbirds
		  o All Year Long
		• Clouds
		  o Cloudscape

3-ESS2-2: Obtain and combine information to describe climates in different regions of the world.	• How does our weather data compare with other years/seasons in our area? Other areas?	Earth Systems Poster (GLOBE) Climate Foundations (GLOBE) • From Weather to Climate – Air Temperature Data • What is your Climate Classification Earth As a System Packet (GLOBE) • Exploring Annual Changes **Who Fits Here? (WILD)**
3-ESS3-1: Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard. (also addressed in 4-ESS3-2)	• In what ways can we reduce the impacts of a weather-related hazard in our area? Other areas?	Thunderstorm Part 1 & 2 (WET)

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.	Since weather in an area effects the rate of erosion… see the 3-5 Water and Watersheds Scope & Sequence for activity ideas.	
4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. (also addressed in 3-ESS3-1)	• How do different design-solutions compare to reduce the impacts of a particular natural Earth process (earthquakes, tsunamis, volcanic eruptions)?	Storm Water (WET) Just Passing Through (WET)
5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	Since the hydrosphere is part of the Earth's system… see the 3-5 Water and Watersheds Scope & Sequence for activity ideas.	
5-ESS2-2: Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.	Since the hydrosphere is part of the Earth's system… see the 3-5 Water and Watersheds Scope & Sequence for activity ideas.	
5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment *(also related to ESS3.D: Global Climate Change)*	Since the hydrosphere is part of the Earth's system… see the 3-5 Water and Watersheds Scope & Sequence for activity ideas.	

Grade 3-5

Cross Cutting Concepts (CCC)

and

Science Engineering Practices (SEP)

(taken from the Next Generation Science Standards)

Cross Cutting Concepts for Grades 3-5

Patterns

In grades **3-5,** students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.

- Example: Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

Cause and Effect

In grades **3-5**, students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

- Example: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

Scale, Proportion and Quantity

In grades **3-5**, students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.

- Example: Support an argument that the apparent brightness of the sun and stars is due to their relative distances from Earth.

Systems and System Models

In grades **3-5**, students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.

- Example: 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.

Energy and Matter

In grades **3-5**, students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change.

- Example: Support an argument that plants get the materials they need for growth chiefly from air and water.

Structure and Function

In grades **3-5**, students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions. (No example Performance Expectation given)

Stability and Change

In grades **3-5**, students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change. (No example Performance Expectation given)

Science & Engineering Practices for Grades 3-5

Practice: Asking Questions and Defining Problems

Asking questions and defining problems in **3–5** builds on K–2 experiences and progresses to specifying qualitative relationships.

- Ask questions about what would happen if a variable is changed.
- Identify scientific (testable) and non-scientific (non-testable) questions.
- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
- Use prior knowledge to describe problems that can be solved.
- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

Practice: Developing and Using Models

Modeling in **3–5** builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Identify limitations of models.
- Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.
- Develop and/or use models to describe and/or predict phenomena.
- Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.
- Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

Practice: Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in **3–5** builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
- Evaluate appropriate methods and/or tools for collecting data.
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
- Make predictions about what would happen if a variable changes.
- Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.

Practice: Analyzing and Interpreting Data

Analyzing data in **3–5** builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.
- Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
- Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
- Analyze data to refine a problem statement or the design of a proposed object, tool, or process.
- Use data to evaluate and refine design solutions.

Practice: Using Mathematics and Computational Thinking

Mathematical and computational thinking in **3–5** builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.

- Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success.
- Organize simple data sets to reveal patterns that suggest relationships.
- Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
- Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem.

Practice: Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in **3–5** builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard).
- Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.
- Identify the evidence that supports particular points in an explanation.
- Apply scientific ideas to solve design problems.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Practice: Engaging in Argument from Evidence

Engaging in argument from evidence in **3–5** builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Compare and refine arguments based on an evaluation of the evidence presented.
- Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.
- Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions.
- Construct and/or support an argument with evidence, data, and/or a model.

- Use data to evaluate claims about cause and effect.
- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Practice: Obtaining, Evaluating and Communicating Information

Obtaining, evaluating, and communicating information in **3–5** builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.
- Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.
- Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices.
- Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.
- Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.

Middle School (6-8)
Ecosystems & Habitats
Activity Correlations

Middle School (Grade 6-8) Atmosphere, Weather, and Climate Matter and Energy in Organisms and Ecosystems & Interdependent Relationships in Ecosystems **Essential Questions:** How do nonliving elements influence living elements in an ecosystem? How does changes to physical and biological components of an ecosystem influence the growth of organisms and populations?		
Students who demonstrate understanding can…	**Questions to Explore from Disciplinary Core Ideas (DCI)**	**Activity Correlations & Field Investigations**
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.	• What role does photosynthesis play in the cycling of matter and flow of energy in an ecosystem?	GLOBE Activities: • A Sneak Preview of Budburst • A Beginning Look at Photosynthesis • Investigating Leaf Pigments • Green-Up Cards **GLOBE Protocols:** • Budburst/Green-Up • Green-Down Kelp Help (Aquatic WILD) **Adopt a Tree-Part B (PLT)**
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.	• How do organisms obtain and use matter and energy?	Hangin’ Together (WET)

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.	• How can limited resources affect organisms and populations in an ecosystem?	**Bearly Growing (WILD)** **Rainfall and the Forest (WILD)** Seed Need (WILD) I'm Thirsty (WILD) Changing the Land (WILD) **Bird Song Survey (WILD)** Healthy Habits (WET) GLOBE Activities: • Components of the Earth System Working Together • Effects of Inputs and Outputs on a Region • Global Patterns **GLOBE Protocols:** • Artic Bird Migration Monitoring • Budburst • Green-Up • Green-Down • Ruby-throated Hummingbird • Freshwater Macroinvertebrates Migration Headache (Aquatic WILD) Hooks and Ladders (Aquatic WILD) Turtle Hurdles (Aquatic WILD) **Trees in Trouble-Part B (PLT)** Hunt and Peck Migratory Birds Math and Science Lessons (HBRF) Finding Food in the Forest Migratory Birds Math and Science Lessons (HBRF) Population Ecology Module (What Limits the Reproductive Success of Migratory Birds?) (HBRF)
MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem	• How do matter and energy move through an ecosystem?	Energy Pipeline (WILD) GLOBE Activities: • Carbon Cycle Adventure Story • Carbon Travels Game • Turnover Rate & Residence Time Energy Chains (PLT Energy & Society) What Powers the Move (PLT Energy & Society)

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	• How does changes to physical and biological components of an ecosystem influence the growth of organisms and populations?	**How Many Bears Can Live in This Forest? (WILD)** Habitat Lap Sit (WILD) Hazardous Links, Possible Solutions (WILD) World Travelers (WILD) Changing the Land (WILD) Checks and Balances (WILD) GLOBE Activities: • A First Look at Phenology • A Sneak Preview of Budburst • Temperature and Precipitation as Limiting Factors in an Ecosystem **GLOBE Protocols:** • Green-Up • Green-Down • Budburst • Ruby-throated Hummingbird • Artic Bird Migration Monitoring • Phenological Gardens • Freshwater Macroinvertebrates • Land Cover Change Detection **Where Does Water Run? (Aquatic WILD)** **Where Have All the Salmon Gone? (Aquatic WILD)** Migration Headache (Aquatic WILD) Pond Succession (Aquatic WILD) Urban Waterway Checkup (Aquatic WILD) **Planet Diversity (PLT)** **Nothing Succeeds Like Succession-Part B&C (PLT)** **The Global Climate (PLT)** Bye-bye Birdie Migratory Birds Math and Science Lessons (HBRF) Finding Food in the Forest Migratory Birds Math and Science Lessons (HBRF)

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	• How do organisms interact with other organisms in the physical environment to obtain matter and energy? • How does a system of biotic and abiotic things operate to meet the needs of the organism in an ecosystem?	**Oh, Deer! (WILD)** Which Niche? (WILD) Good Buddies (WILD) Invaders! (WET) **Water Canaries (Aquatic WILD)** **Micro Odyssey (Aquatic WILD)** **Edge of Home (Aquatic WILD)** **Are Vacant Lots Vacant? (PLT)** **Field, Forest, and Stream (PLT)** Tree Cookies (PLT) Hunt and Peck Migratory Birds Math and Science Lessons (HBRF) Finding Food in the Forest Migratory Birds Math and Science Lessons (HBRF) Population Ecology Module (What Limits the Reproductive Success of Migratory Birds?) (HBRF)
MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.	• What are some scientific, economic or social considerations when maintaining biodiversity and ecosystem services?	**Eco-Enrichers (WILD)** **Ecosystem Facelift (WILD)** History of Wildlife Management (WILD) **Improving Wildlife Habitat in the Community (WILD)** Model a Catchment Basin Activity (GLOBE)Urban Waterway Checkup (Aquatic WILD) Net Gain, Net Effect (Aquatic WILD) Watered-Down History (Aquatic WILD) What's in the Water? (Aquatic WILD) Something's Fishy Here! (Aquatic WILD) Dragonfly Pond (Aquatic WILD) **Invasive Species (PLT)** Renewable or Not? (PLT) A Forest of Many Uses-Part B (PLT) Forest Consequences (PLT) **Loving it Too Much (PLT)** 400-Acre Wood (PLT) I'd Like to Visit a Place Where…-Part B&C (PLT) Forest for the Trees- +Variation (PLT) Improve Your Place (PLT)

Middle School (6-8)

Water & Watersheds
Activity Correlations

Middle School Water and Watersheds

Essential Questions: How is water quality positively or negatively affected by outside sources?
How have living organisms changed the Earth and how have Earth's changing conditions impacted living organisms?

Middle School Big Ideas:

- **The Role of Water in Earth's Surface Processes**
    - Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.
    - Global movements of water and its changes in form are propelled by sunlight and gravity.
- **Structure and Properties of Matter**
    - Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
    - In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
    - The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.
- **Earth Materials and Systems**
    - The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.
- **Human Impacts on Earth Systems**
    - Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) on living things.
- **Plate Tectonics and Large-Scale System Interactions**
    - Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.
- **Ecosystem Dynamics, Functioning, and Resilience**
    - Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.
- **Adaptation**
    - Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.
- **Biodiversity and Humans**
    - Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling.
- **Natural Resources**
    - Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.

Students who demonstrate understanding can…	Questions to Explore from Disciplinary Core Ideas (DCI)	Activity Correlations & Field Investigations
MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	• How does water influence weather, circulate in the oceans, and shape Earth's surface?	**Hydrology: (GLOBE)** • Model a Catchment Basin **Soil: (GLOBE)** • Why Do We Study Soil? • Just Passing Through: Beginning Level High Water History (WET) Just Passing Through (WET) The Carbon Cycle (PLT E-Unit)
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.	• What can we use geologic evidence and how the Earth's surface looks now to interpret how the Earth's surface once looked and how it's changed?	FLEXE - Ecology Unit Activity 2 (GLOBE)
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.	• In what ways is water cycling affected by the sun and geologic forces?	**Water Wonders (PLT)** **Incredible Journey (WET)** River Talk (WET) **Atmosphere: (GLOBE)** • Land, Water and Air • Precipitation Protocols • Relative Humidity Protocol **Watershed Dynamics: (GLOBE)** • Module I #1 Natural Water Availability **Go with the Flow** (HBRF)
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 processes.	• How has the distribution of Earth's natural resources been influenced by geologic processes?	Get the Ground Water Picture (WET) **Hydrology: (GLOBE)** Model a Catchment Basin
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	• How do human activities affect Earth systems?	My Water Footprint (WET) Common Water (WET) Color Me a Watershed (WET) **Back to the Future (WET)** Grave Mistake (WET) Drop in the Bucket (WET) Snapshot in Time (WET) **There is No Away! (WET)** **Water Audit (WET)** Humpty Dumpty (WET)

		Watch on Wetlands (PLT) **Every Drop Counts (PLT)** **Improve Your Place (PLT)** **Water Wonders (PLT)** **Every Drop Counts (PLT)** What Powers the Move? (PLT Energy & Society) In the Driver's Seat (PLT Energy & Society) Migration Headache: with Extensions #2 & #7 (Aquatic WILD) **Where Does Water Run? (Aquatic WILD)** Urban Waterway Checkup (Aquatic WILD) **Water Canaries (Aquatic WILD)** **Edge of Home: with Extension #3 (Aquatic WILD)** Net Gain, Net Effect (Aquatic WILD) What's in the Air?: with Extensions (Aquatic WILD) What's in the Water: with In Step with STEM Connections (Aquatic WILD) Water Works: with In Step with STEM Connections (Aquatic WILD) Alice in Waterland (Aquatic WILD) Fishable Waters: with Extension #2 (Aquatic WILD) Dam Design (Aquatic WILD) Conservation Messaging: with In Step with STEM #1 (Aquatic WILD) What Did Your Lunch Cost Wildlife? (WILD) Noisy Neighbors (WILD) Flip the Switch for Wildlife (WILD) Planning for People and Wildlife (WILD) Enviro-Ethics (WILD)
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.	• How can thermal energy alter states of matter?	**Atmosphere: Cloud Protocols (GLOBE)** **Adventures in Density (WET)** Molecules in Motion (WET) What's the Solution? (WET) Hangin' Together (WET)

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations This is a crossover standard…see the Middle School Ecosystems and Habitats Scope and Sequence for even more activity ideas.	• How does a system of living and non-living things operate to meet the needs of the organisms in an ecosystem? • How does changes to physical and biological components of an ecosystem influence the growth of organisms and populations?	Poison Pump (WET) Invaders! (WET) **Water Quality? Ask the Bugs! (WET)** Migration Headache (Aquatic WILD) Urban Waterway Checkup (Aquatic WILD) **Where Does Water Run? (Aquatic WILD)** **Water Canaries (Aquatic WILD)** Hooks and Ladders (Aquatic WILD) **Blue Ribbon Niche (Aquatic WILD)** Puddle Wonders (Aquatic WILD) What's in the Air? (Aquatic WILD) What's in the Water? (Aquatic WILD) Fishable Waters (Aquatic WILD) Turtle Hurdles (Aquatic WILD) **Where Have all the Salmon Gone? (Aquatic WILD)** Dam Design (Aquatic WILD) **How Many Bears Can Live in the Forest? (WILD)** **Rainfall and the Forest (WILD)** I'm Thirsty: with aquatic scenario in Extension#2 (WILD) Move Over Rover (WILD) Hazardous Links, Possible Solutions (WILD) World Travelers (WILD) Changing the Land (WILD) Checks and Balances (WILD) **Earth as a System: (GLOBE)** • P3: A First Look at Phenology • P2: A Sneak Preview of Budburst • P7: Temperature and Precipitation as Limiting Factors in Ecosystems • Green-Up • Green-Down • Budburst • Ruby-throated Hummingbird • Artic Bird Migration Monitoring • Phenological Gardens • Land Cover Change Detection **Hydrology: (GLOBE)** • Freshwater Macroinvertebrates **Land Cover: (GLOBE)** • Land Cover Change Detection Protocol

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* This is a crossover standard…see the Middle School Ecosystems and Habitats Scope and Sequence for even more activity ideas.	• What are some scientific, economic or social considerations when maintaining biodiversity and ecosystem services?	**Watch on Wetlands (PLT)** **Net Gain, Net Effect (Aquatic WILD)** Dam Design (Aquatic WILD) Facts and Falsehoods: with In Step with STEM connections (Aquatic WILD) What Did Your Lunch Cost Wildlife? (WILD) **Eco-Enrichers (WILD)** **Ecosystem Facelift (WILD)** **Improving Wildlife Habitat in the Community (WILD)** **Back to the Future (WET)** Storm Water (WET) **Hydrology: (GLOBE)** • Model a Catchment Basin
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.	• How do organisms change over time in response to changes in the environment? • How has the way animals look today, changed over time and why?	Bottleneck Genes: with Extension #2 (WILD)

Middle School (6-8)

Atmosphere, Weather, and Climate

Activity Correlations

Middle School: Atmosphere, Weather and Climate Earth's System & Weather and Climate **Essential Questions:** What factors influence the climate of an area? What is the relationship between atmosphere, weather, and climate?		
Students who demonstrate understanding can…	**Questions to Explore from Disciplinary Core Ideas (DCI)**	**Activity Correlations & Field Investigations**
MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales	This is a crossover standard…see the Middle School Water and Watersheds Scope and Sequence for activity ideas.	
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	This is a crossover standard…see the Middle School Water and Watersheds Scope and Sequence for activity ideas.	
MS-ESS2-5: Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions	• How is climate influenced by the process of the water cycle?	**Atmosphere (GLOBE)** • Observing, Describing, and Identifying Clouds • Aerosols Protocol • Automated Soil and Air Temperature Monitoring Protocol • Barometric Pressure Protocol • Cloud Protocols • Digital Multi-Day Max/Min/Current Air and Soil Temperature Protocol • Instrument Construction, Site Selection and Set-Up • Max/Min/Current Air Temperature Protocol • Precipitation Protocols • Relative Humidity Protocol • Surface Ozone Protocol • Surface Temperature Protocol • Water Vapor Protocol • AWS WeatherBug Protocol • Davis Weather Station Protocol • RainWise Weather Station Protocol

		• WeatherHawk Weather Station Protocol Rain Reasons (PLT) What is Climate? (PLT E-Unit)
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	• How do the interactions of weather and climate vary regionally and affect oceanic and atmospheric flow patterns?	**Adventures in Density (WET)** Earth as a System (GLOBE) • GC1: Your regional and global connection • S4: Modeling the Reasons for Seasonal Change • GC2: Components of the earth system working together Climate Foundations (GLOBE) • From Weather to Climate – Air Temperature Data What is Climate? (PLT E-Unit)
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	• How can understanding geological forces and historical maps help us to predict the locations and likelihood of future events?	High Water History (WET)
MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment	This is a crossover standard…see the Middle School Water and Watersheds Scope and Sequence for activity ideas.	
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	• In what ways can human consumption of food and natural resources affect Earth's systems?	Drop in the Bucket (WET) **Back to the Future (WET)** Color Me a Watershed (WET) Get the Groundwater Picture (WET) What Did Your Lunch Cost Wildlife? (WILD) Pay to Play (WILD) Let's Talk Turkey (WILD) History of Wildlife Management (WILD) No Water Off a Duck's Back (WILD) Migration Barriers (WILD) Shrinking Habitat (WILD) Flip the Switch for Wildlife (WILD) To Zone or Not to Zone (WILD) Hazardous Links, Possible Solutions (WILD) Pro and Con: Consumptive and Nonconsumptive Uses of Wildlife (WILD) Changing the Land (WILD) Planning for People and Wildlife (WILD)

MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century	• What factors have been proven to affect the rise in global temperatures over the past 100 years?	**The Global Climate (PLT)** Is it Only Natural? (PLT E-Unit) Climate Time Machine (PLT E-Unit) Are You a Bigfoot? (PLT E-Unit)

Grade 6-8

Cross Cutting Concepts (CCC)

and

Science Engineering Practices (SEP)

(taken from the Next Generation Science Standards)

Cross Cutting Concepts for Grades 6-8

Patterns

In **grades 6-8,** students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships, and use graphs and charts to identify patterns in data.

- Example: 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.

Cause and Effect

In grades **6-8**, students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

- Example: 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.

Scale, Proportion and Quantity

In grades **6-8**, students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.

- Example: Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

Systems and System Models

In grades **6-8**, students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study.

- Example: Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

Energy and Matter

In grades **6-8**, students learn matter is conserved because atoms are conserved in physical and chemical processes. They also learn within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.

- Example: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

Structure and Function

In grades **6-8**, students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

- Example: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Stability and Change

In grades **6-8**, students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales, including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time

- Example: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Science & Engineering Practices for Grades 6-8

Practice: Asking Questions and Defining Problems

Asking questions and defining problems in **6–8** builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
  - to identify and/or clarify evidence and/or the premise(s) of an argument.

- to determine relationships between independent and dependent variables and relationships in models.
    - to clarify and/or refine a model, an explanation, or an engineering problem.
    - that require sufficient and appropriate empirical evidence to answer.
    - that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
    - that challenge the premise(s) of an argument or the interpretation of a data set.
- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Practice: Developing and Using Models

Modeling in **6–8** builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Evaluate limitations of a model for a proposed object or tool.
- Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed.
- Use and/or develop a model of simple systems with uncertain and less predictable factors.
- Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.
- Develop and/or use a model to predict and/or describe phenomena.
- Develop a model to describe unobservable mechanisms.
- Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.

Practice: Planning and Carrying Out Investigations

Planning and carrying out investigations in **6-8** builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.

- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
- Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.

Evaluate the accuracy of various methods for collecting data.

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- Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
- Collect data about the performance of a proposed object, tool, process or system under a range of conditions.

Practice: Analyzing and Interpreting Data

Analyzing data in **6–8** builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
- Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.
- Distinguish between causal and correlational relationships in data.
- Analyze and interpret data to provide evidence for phenomena.
- Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible.
- Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials).
- Analyze and interpret data to determine similarities and differences in findings.
- Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.

Practice: Using Mathematics and Computational Thinking

Mathematical and computational thinking in **6–8** builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.

- Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends.
- Use mathematical representations to describe and/or support scientific conclusions and design solutions.
- Create algorithms (a series of ordered steps) to solve a problem.
- Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.
- Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design.

Practice: Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in **6–8** builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

- Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena.
- Construct an explanation using models or representations.
- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
- Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.
- Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.
- Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.
- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.
- Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing.

Practice: Engaging in Argument from Evidence

Engaging in argument from evidence in **6–8** builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

- Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts.
- Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.
- Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
- Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

Practice: Obtaining, Evaluating and Communicating Information

Obtaining, evaluating, and communicating information in **6–8** builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.

- Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).
- Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.
- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.
- Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts.
- Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.

Appendix:

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