ASSOCIATION of FISH & WILDLIFE AGENCIES

Project WILD

Correlations

of the

Project WILD K-12 Curriculum & Activity Guide

(4th Edition)

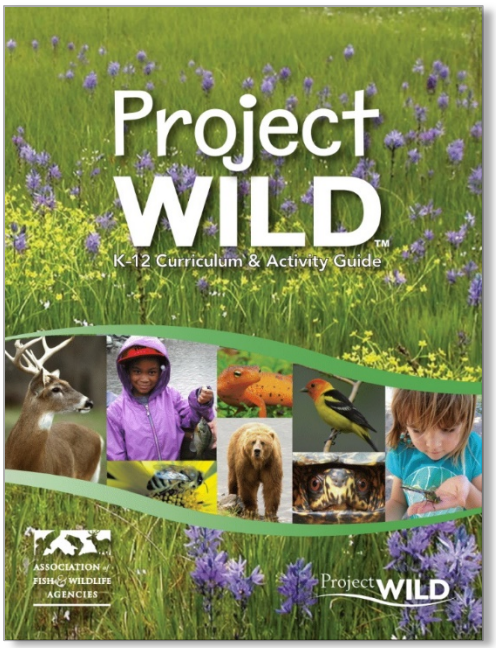
to

Next Generation Science Standards

and the

Framework for K-12 Science Education

2020



Project WILD Science Correlations

Introduction

Purpose:

The *Project WILD K-12 Curriculum & Activity Guide* (WILD) is interdisciplinary, offering activities that focus on everything from mathematics to social studies, but Project WILD is especially relevant to science, specifically the K-12 science classroom. Most states have now adopted *The Next Generation Science Standards* (NGSS) or standards based on *A Framework for K-12 Education.* The foundations for both are the three dimensions of science: Disciplinary Core Ideas, Science and Engineering Practices, and Crosscutting Concepts. Project WILD provides phenomenon-based experiences and activities that are three-dimensional, supporting the standards teachers must work to help their students achieve. Now more than ever, Project WILD can be viewed as a tool to help teachers get students outside while engaging in standards-based teaching and learning. This document was developed in 2020 as a companion for Project WILD in order to highlight the three-dimensionality and phenomenon-based aspects of the 60+ science-focused activities.

NGSS & the Framework:

The NGSS are national K–12 science content standards. They set the expectations for what students should know and be able to do at the end of instruction. The NGSS were developed by states to improve science education for all students by providing a set of research-based, up-to-date K–12 science standards. These benchmarks give local educators the flexibility to design classroom learning experiences that stimulate students' interests in science and prepare them for college, careers, and citizenship.

Learn more about how Achieve coordinated the work of twenty-six Lead State Partners and collaborated with critical partners, including the National Research Council, the National Science Teachers Association, and the American Association for the Advancement of Science, to develop the NGSS based on the NRC's K-12 Framework for Science Education.

Terms to Know

DCI: Disciplinary Core Idea | SEP: Science and Engineering Practice | CCC: Crosscutting Concept

PE: Performance Expectation

Phenomenon-Based & The Untethered Dimensions:

According to NGSS, natural phenomena are observable events that occur in the universe and that we can use our science knowledge to explain or predict. Framing the phenomenon at the crux of the activity for each correlation is a "Guiding Question." This question or phenomenon is meant to drive the instruction and allow students to use SEPs to explain or predict and CCCs to make sense of that phenomenon.

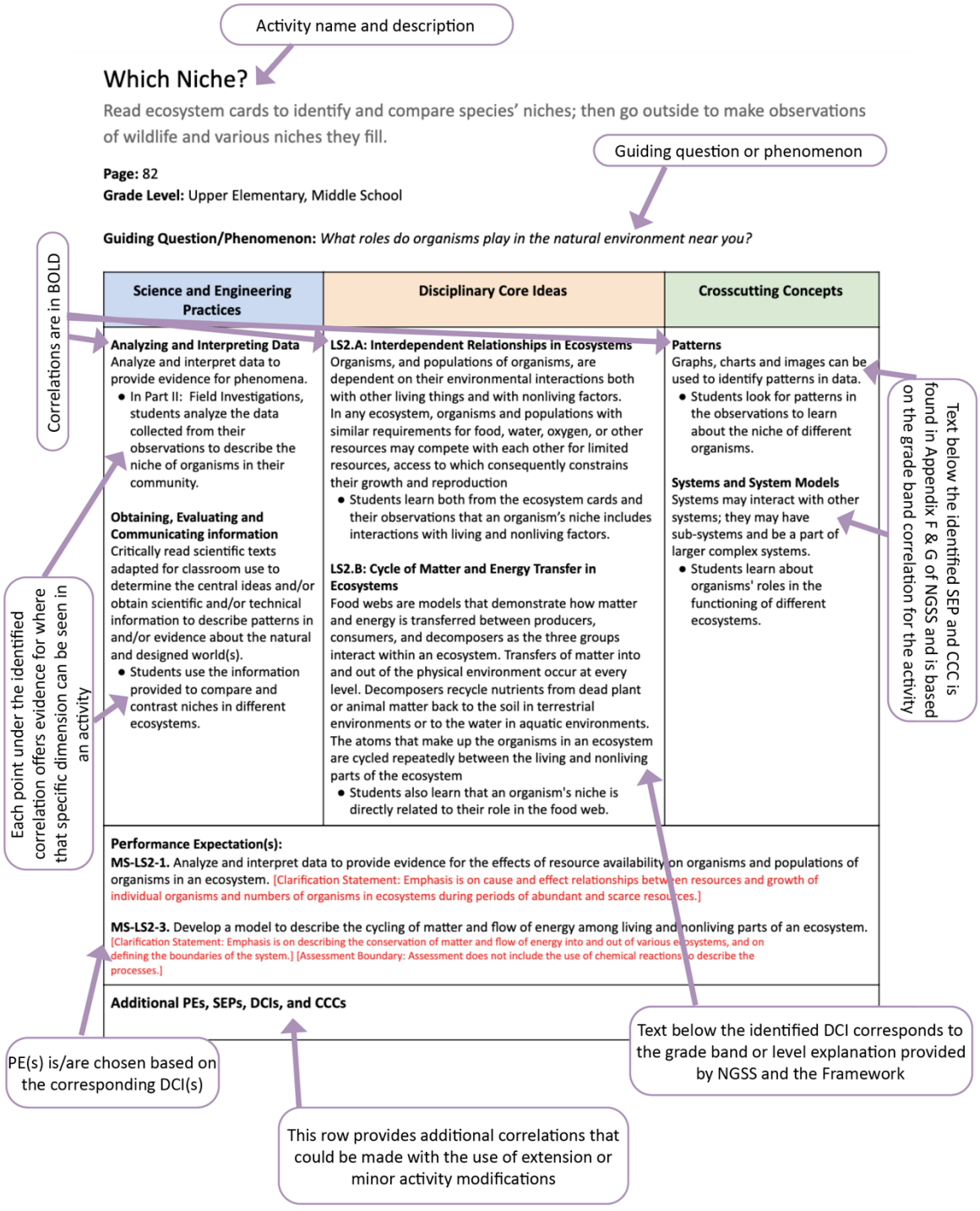
The actual "standard" in NGSS is the three-dimensional Performance Expectation (PE). The PEs are not the focus of these correlations because any single standard (or PE) cannot be effectively taught in one lesson or activity. Consequently, the approach for developing these correlations is known as "untethered," where the appropriate DCI from the Performance Expectation is used but is not necessarily the stated SEPs or CCCs. Rather, the SEPs and CCCs actually used by students in the activity are specified in the correlations.

The Correlation Document:

Each correlation document begins with basic details about the activity and a guiding question/phenomenon. The guiding question is meant to serve teachers with an idea for how the experience can be based on and driven by phenomena. Teachers are encouraged to adapt the guiding question to make it as relevant to students and their environment as possible.

The actual correlations can be found in the table on each document. The correlations are broken down by the three-dimensions and three columns: SEPs, DCIs, and CCCs. The bold words in each column signify the specific correlation(s). In most instances, there are

multiple correlations for each dimension. Each correlation has a bullet providing evidence of the specified dimension from the activity. The Performance Expectation (the actual standard) supported by the learning experience is in the row below the three columns. As stated above, however, we have used the untethered approach as recommended by Nextgenscience for connecting the SEPs and CCCs. Both the SEP and the CCC text below the bolded correlations are found in the NGSS progressions, Appendix F and Appendix G respectively. These progressions show how each SEP or CCC relates directly to an activity's specified grade band. Some activities can be easily modified to support additional correlations. Notes about these additional correlations, where applicable, have been made in the last row of the table. Below is a diagram to help with understanding each correlation page.



A Dire Diet

Search for food as different animals in a food chain to analyze possible consequences of pesticide accumulation in the environment.

Page: 361
Grade Level: Middle School

Guiding Question/Phenomenon: *How do toxic chemicals get into food chains, including the food we eat?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop a model to describe phenomena. ● Students simulate the transfer of matter, including toxic chemicals found in pesticides, throughout a food chain. **Obtaining, Evaluating, and Communicating Information** Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication. ● Students research bioaccumulation of toxic chemicals, their effects on food chains, and legislative efforts to control them.	**LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. ● Students model the transfer of toxic chemicals as consumers interact within a food chain. **LS2.C: 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. ● Students discuss the effects of bioaccumulation of toxic chemicals on populations of organisms throughout the food web.	**Energy and Matter** The transfer of energy can be tracked as energy flows through a natural system. ● Students model the transfer of matter throughout populations of consumers in a food chain. **Stability and Change** Small changes in one part of a system might cause large changes in another part. ● Students discuss how changes in the diet of 'pests' can alter the health of animals throughout the food chain.

Performance Expectation(s):

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

Additional PEs, SEPs, DCIs, and CCCs

A Home Away from Home

Design a zoo habitat that provides all the necessary elements for a polar bear to survive in Phoenix.

Page: 222
Grade Level: Middle School

Guiding Question/Phenomenon: *How could you keep a polar bear alive in your town?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ● Students plan and design a zoo enclosure for polar bears. **Developing and Using Models** Developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ● Students draw their design plans for a zoo enclosure to support the needs of a polar bear exhibit.	**ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. ● Students discuss some of the challenges in providing the right kind of habitat for raising polar bears in captivity.	**Systems and System Models** Models can be used to represent systems and their interactions ● Students design the right kind of habitat for raising polar bears in captivity.
Performance Expectation(s): **MS-LS2-5**. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.] **MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.		
Additional PEs, SEPs, DCIs, and CCCs		

A Picture is Worth a Thousand Words

Analyze pictures over time to explore how scientific knowledge and technological advancements change attitudes toward wildlife.

Page: 463
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *How have advances in scientific knowledge and technologies changed attitudes toward wildlife?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information 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. ● Students evaluate photographs and texts about historical wildlife management practices.	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. ● Students discuss how various wildlife management practices have affected the biodiversity of various North American ecosystems.	**Stability and Change** Small changes in one part of a system might cause large changes in another part. ● Students discuss how wildlife management practices for one species caused larger changes within given ecosystems.
Performance Expectation(s): **MS-LS2-5**. Evaluate competing design solutions for maintaining biodiversity and ecosystem services. [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]		
Additional PEs, SEPs, DCIs, and CCCs		

Adaptation Artistry

Design and construct your own bird and describe your creation's adaptations and habitats.

Page: 206
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *The birds resting and feeding outside the classroom window look very different from birds on the seashore, or those that live in the tropics or polar regions. Why are there so many variations in beaks, feet, legs, wings, and coloration?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop models to describe phenomena. ● Students develop a model to represent the adaptations (trait variations) of the bird they design to live in a particular habitat. **Constructing Explanations and Designing Solutions** Use evidence (e.g. observations, patterns) to support an explanation Use evidence (observations, patterns) to construct an explanation. ● Students use evidence represented by their bird's designed characteristics to explain how it could live successfully in the selected habitat the students created for it.	**LS1.A: Structure and Function** Animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. ● Students assign specialized functions to the structures they assign to their designed bird **LS3.B: Variations of Traits** 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. ● Students explain how inherited information and/or environmental factors influence how the bird looks and acts. **LS4.B: Natural Selection** Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. ● Students explain how the structures assigned to their bird gives it advantages to survive and thrive in their habitat.	**Cause and Effect** Cause and effect relationships are routinely identified. ● Students explain how inherited or environmentally influenced traits have caused their birds to be able to survive and thrive in their habitats. **Systems and System Models** A system can be described in terms of its components and their interactions. ● Students describe how each structure (subsystem) works with the other structures of the bird (system) to ensure its success in its habitat (ecosystem).

Performance Expectation(s):

3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. [Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.]

3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. [Clarification Statement: Examples of cause and effect relationships could plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]

Additional PEs, SEPs, DCIs, and CCCs
N/A

Animal Charades

Play a guessing game to depict and identify different characteristics of wild and domesticated animals.

Page: 337
Grade Level: Lower Elementary, Upper Elementary

Guiding Question/Phenomenon: *A bobcat and my pet cat are both cats, but only one of them is wild. What clues help me understand if an animal is wild, tame, domesticated or feral?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop models to describe phenomena. ● During the game of charades, students model animal characteristics and behaviors of wild or domesticated animals. **Constructing Explanations and Designing Solutions** Use evidence (e.g. observations, patterns) to support an explanation Use evidence (observations, patterns) to construct an explanation. ● After the game of charades, students clarify their definitions of wild and domesticated, tame, and feral by explaining what they have in common and what their differences are.	**LS3.B: Variations of Traits** 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. ● Students explain how inherited information and/or environmental factors influence how well an animal will survive in a wild or domestic habitat. **LS4.B Natural Selection** Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. ● Students explain how an animal, such a feral cat, can share similar characteristics with a pet cat but has learned to survive in the wild.	**Patterns** Similarities and differences in patterns can be used to sort and classify natural phenomena ● Wild and domesticated animals may have similar physical features, but their behavioral differences can be used to sort and classify them. **Cause and Effect** Cause and effect relationships are routinely identified. ● Students will explain how physical and behavioral traits have caused a wild or domesticated animal to live successfully in their given habitat.

Performance Expectation(s):

1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. [Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.] [Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.]

3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. [Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.]

3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. [Clarification Statement: Examples of cause and effect relationships could plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]

Additional PEs, SEPs, DCIs, and CCCs

Ants on a Twig

Observe ant behavior, then model ant movement and communication

Page: 105
Grade Level: Lower Elementary

Guiding Question/Phenomenon: *Have you ever watched a parade of ants marching in a line, like a game of Follow the Leader? Have you wondered where they're going, why they're going, and what they're doing?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop models to describe phenomena. Use a model to test interactions concerning the functioning of a natural system. ● Students will model how ants use their sensory structures to receive and communicate information. **Constructing Explanations and Designing Solutions** Use evidence (e.g. observations, patterns) to support an explanation Use evidence (observations, patterns) to construct an explanation. ● Students will use evidence represented by modeling of ant behavior to explain how ants obtain and communicate information.	**LS1.A: Structures and Functions** Animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. ● Students will observe the external structures of ants and model the function of ants' antennae. **LS1.D: Information Processing** Different sense receptors are specialized for particular kinds of information, which may then be processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. ● Students will observe and model how ants' perceptions and memories guide and communicate actions.	**Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. ● Students will observe and model the communication patterns of ants. **Cause and Effect** Cause and effect relationships are routinely identified. ● Students will explain how the information received by ants causes a change in the group's behavior.

Performance Expectation(s):

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. [Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting by mimicking eyes and ears.]

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]

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. [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

Additional PEs, SEPs, DCIs, and CCCs

Back from the Brink

Read about the American alligator, black-footed ferret, and gray wolf and examine issues related to the decline and recovery of threatened and endangered species.

Page: 414
Grade Level: High School

Guiding Question/Phenomenon: *What are the threatened or endangered species in your region or state? What can you do to impact their status?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating and Communicating Information Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. ● Students first obtain information about their assigned species and then communicate through an infomercial and their final recommendations.	**LS4.C: Adaptation** Changes in the physical environment, whether naturally occurring or human-induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions and the decline–and sometimes the extinction–of some species ● Students explore the population decline in different animals. The decline may be related to changes in the physical environment. **ESS3.C: Human Impacts on Earth Systems** The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources ● Participants address human impacts as they complete their issue analysis and recommendations.	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. ● Participants discover how populations have changed over time.

Performance Expectation(s):

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]

HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]

HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]

Additional PEs, SEPs, DCIs, and CCCs

This activity also correlates well with Obtaining, Evaluating and Communicating Information at the middle school level.

Bat Blitz

Simulate bats feeding on insects and perform calculations to learn about one of the roles bats play in an ecosystem.

Page: 135
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *What might happen to the health of our ecosystem if bats were removed from it?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop (and use) a model to describe phenomena ● Students model how many insects a population of bats collect and consume over time, during which there are changes in the bat population size, due to disease. **Analyzing and Interpreting Data** Analyze and interpret data to provide evidence for phenomena. ● Students analyze data collected during the simulation to determine how diseased bats affect the populations of insects in an ecosystem.	**LS2.C: 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. ● Students discuss how physical changes in bats, which decreases their population, affects the populations of other organisms in an ecosystem.	**Stability and Change** Small changes in one part of a system might cause large changes in another part. ● Students discuss how changes in the bat population cause changes in the populations of other organisms in an ecosystem.
Performance Expectation(s): **MS-LS2-4.** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]		
Additional PEs, SEPs, DCIs, and CCCs		

Bird Song Survey

Identify and inventory the local bird population.

Page: 459
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *How many different kinds of birds live in your community?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Select appropriate tools to collect, record, analyze, and evaluate data. ● Through observations, students collect data about the different kinds of birds found in their study site. **Analyzing and Interpreting Data** Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution ● Students compile the class data from their bird survey and map that information. This provides information about breeding pairs, species, and habitats of the local bird population.	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. ● By completing the bird song survey of their study site, students have gathered information about numbers and kinds of birds in that area. This can be used as a baseline to track changes in the populations after a disturbance.	**Patterns** Empirical evidence is needed to define patterns ● Students use patterns to analyze their bird survey information.

Performance Expectation(s):

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [Assessment Boundary: Assessment is limited to provided data.]

Additional PEs, SEPs, DCIs, and CCCs

This activity also correlates well with the same SEPs and CCCs at the middle grades level.

Birds of Prey

Interpret data on wildlife populations and climate to recognize the interdependence of a healthy, functioning ecosystem.

Page: 184
Grade Level: High School

Guiding Question/Phenomenon: *How do abiotic and biotic factors impact the predator and prey relationships in an ecosystem near you?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. ● Students analyze graphs to determine how the population of falcons is related to that of squirrels as well as the influence of different abiotic factors on these populations. **Using Mathematics and Computational Thinking** Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations**.** ● Students use graphical information to explain the relationship between predator-prey populations and the influence of abiotic factors on population sizes.	**LS2.A: Interdependent Relationships in Ecosystems** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. ● As students analyze graphs, they determine how predation and abiotic factors determine prey population size.	**Patterns** Empirical evidence is needed to define patterns. ● Students look for patterns in graphical data to determine the relationships between predator-prey populations as well as the influence of abiotic factors.

Performance Expectation(s):

HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent including boundaries, resources, climate and competition. Examples of mathematical comparisons could include graphs, charts, histograms, or population changes from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]

Additional PEs, SEPs, DCIs, and CCCs

This activity also correlates well with the same SEPs and CCCs at the middle grades level.

Bottleneck Genes

Using a bottle, colored beads, and environmental scenario cards, investigate how genetic diversity within a population affects a species' ability to adapt and survive.

Page: 268
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *How does genetic diversity contribute to the health of an endangered species in your area?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems. ● Students use a model of a black-footed ferret population to determine the effects of genetic diversity on their ability to survive under different environmental conditions. **Using Mathematics and Computational Thinking** Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. ● Students mathematically describe the genetic diversity of a black ferret population and use that ratio to predict the black ferret's success in various environmental scenarios.	**LS4.B: Natural Selection** The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. ● Students use a model of a black-footed ferret population to determine if the traits of that population will positively affect survival under different environmental conditions.	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. ● Students explore how genetic variability relates to stable populations in different environmental scenarios.

Performance Expectation(s):

HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. [Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] [Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.]

Additional PEs, SEPs, DCIs, and CCCs

This activity also correlates well with the same SEPs and CCCs at the middle grades level.

Busy Bees, Busy Blooms

Learn the process of pollination by acting as a bee or flower as pollen or nectar are exchanged.

Page: 111
Grade Level: Lower Elementary, Upper Elementary

Guiding Question/Phenomenon: *The bees we see in the garden sure seem busy as they fly from flower to flower, but what exactly are they doing?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop models to describe phenomena. ● During the Busy Bee game, students will model the roles of flowers and pollinators. **Constructing Explanations and Designing Solutions** Use evidence (e.g. observations, patterns) to support an explanation Use evidence (observations, patterns) to construct an explanation. ● After the game students explain how the physical structures of pollinators and flowers aid the process of pollination.	**LS1.A: Structure and Function** Animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. ● Students will observe and model how the external structures of insects, birds, and plants function to spread pollen from flower to flower. **LS2.A: Interdependent Relationships in Ecosystems** Plants depend on animals for pollination or to move their seeds around. ● Students will model the roles of flowers and pollinators.	**Structure and Function** The shape and stability of structures of natural and designed objects are related to their functions. ● Students will use the photographs to explain how the structures of pollinators and flowers serve to successfully pollinate plants. **Cause and Effect** Cause and effect relationships are routinely identified. ● Students will explain how the pollinators' search for food causes pollination to occur.

Performance Expectation(s):

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.* [Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting by mimicking eyes and ears.]

2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]

Additional PEs, SEPs, DCIs, and CCCs

The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

ETS1.B: Developing Possible Solutions Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (secondary to 2-LS2-2)

Career Critters

Examine ecological niches by matching "Critter Cards" to environmental problems in a local community and evaluating their contributions of an organism to help control the problem.

Page: 433
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *How can wildlife and plants be solutions to environmental problems, some of which we cause?*

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concepts
Developing and Using Models Use a model to describe phenomena. ● Students use the map and information cards to explore environmental problems and possible solutions. **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from reliable media to explain phenomena or solutions to a design problem. ● Students evaluate information on the Critter Cards and then match one to a selected Ecosystem Card which will solve the environmental problem.	**ESS3.C: 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. ● Students select Critter Card solutions to environmental problems, some of which were caused by human encroachment on natural areas.	**Cause and Effect** Cause and effect relationships are routinely identified. ● Students explain how natural solutions can have a positive effect on environmental problems.
Performance Expectation(s): **5-ESS3-1.** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
Additional PEs, SEPs, DCIs, and CCCs		

Carrying Capacity

Participate in a relay to see how food abundance or scarcity affects the carrying capacity of an ecosystem.

Page: 55
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *What determines how many deer or other wildlife can live in your region?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems. ● Students play a game that models how certain factors such as food determine the carrying capacity of a deer population.	**LS2.A: Interdependent Relationships in Ecosystems** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem ● Students learn about the concept carrying capacity and its relationship to food availability through a model.	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. ● Students explore how population size can change based on factors that determine carrying capacity.
Performance Expectation(s): **HS-LS2-1.** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent including boundaries, resources, climate and competition. Examples of mathematical comparisons could include graphs, charts, histograms, or population changes from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]		
Additional PEs, SEPs, DCIs, and CCCs This activity also correlates well with the same SEPs and CCCs at the middle grades level.		

Changing the Land

Interpret student-page maps and scenarios to evaluate how habitat fragmentation affects wildlife, then compare and contrast aerial photographs to consider how changes in land use affect ecosystems.

Page: 395
Grade Level: Middle School

Guiding Question/Phenomenon: *What effect has human land use had on wildlife in our area?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. Develop and use a model to describe phenomena. ● Students use a series of maps to describe and design ways humans can avoid ecosystem fragmentation and habitat loss.	**ESS3.C: 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) for different living things ● Students determine how human decisions on land use have led to ecosystem fragmentation and how we can make land-use decisions to reduce the negative impact on wildlife.	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation ● Students describe how ecosystem fragmentation has caused a loss of habitat for wildlife and how future decisions on land use can have a positive effect on wildlife populations.
Performance Expectation(s): **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]		
Additional PEs, SEPs, DCIs, and CCCs		

Checks and Balances

Acting as wildlife managers, play a card game and perform calculations to understand factors affecting a herd of animals.

Page: 448
Grade Level: Middle School

Guiding Question/Phenomenon: *What conditions impact wildlife populations? How can humans manage those conditions to maintain those populations?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop and use a model to describe phenomena. ● Students play a card game to collect data on how changes in four ecological factors can affect the size of a wildlife population over time. **Analyzing and Interpreting Data** Analyzing data in 6–8 progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings. ● Students analyze how variations in four factors can affect the size of a wildlife population over time.	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. ● Students identify at least four factors that can affect the size of a wildlife population. **ESS3.C: 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) for different living things. ● Students evaluate hypothetical wildlife management decisions that might have positive or negative effects on wildlife populations.	**Stability and Change** Small changes in one part of a system might cause large changes in another part. ● Students discuss how variations in four ecological factors can affect the size of a wildlife population over time

Performance Expectation(s):

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

Additional PEs, SEPs, DCIs, and CCCs

Color Crazy

Create representations of wild animals designed to visually blend into or stand out in their habitats, then discuss coloration as an adaptation for survival.

Page: 8
Grade Level: Lower Elementary, Upper Elementary

Guiding Question/Phenomenon: *Why do some animals blend in with their surroundings, and some are so brightly colored, they stand out easily?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop models to describe phenomena. ● Students develop a model animal to demonstrate the advantages of specialized coloration in an animal's survival **Constructing Explanations and Designing Solutions** Use evidence (e.g. observations, patterns) to support an explanation Use evidence(Observations, patterns) to construct an explanation. ● Students explain how their animal model's coloration contributes to its success in its habitat.	**LS4.B: Natural Selection** Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. ● Students' creations will show how coloration helps animal models blend in or stand out in their setting.	**Cause and Effect** Cause and effect relationships are routinely identified. ● Students explain how coloration adaptations caused their animals to be able to survive in their habitats.
Performance Expectation(s): **3-LS4-2.** Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. [Clarification Statement: Examples of cause and effect relationships could plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]		
Additional PEs, SEPs, DCIs, and CCCs		

Deer Dilemma

Consider an advocate for varying opinions on how an abundant deer population should be managed during a simulated commission meeting.

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Grade Level: High School

Guiding Question/Phenomenon: *If your community had (or actually has) a wildlife problem, who are the community officials that would be in charge of making management decisions?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. ● Participants learn how wildlife management decisions are made through the use of a role-play activity. **Obtaining, Evaluating and Communicating Information** Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. ● As participants prepare for the role play section, they are obtaining information and then communicating this information through the actual role play.	**ESS3.C Human Impacts on Earth Systems** The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. ● As participants prepare for and engage in the role play, they explore the responsible management of natural resources--in this case, the deer population.	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. ● Participants discuss different ways to manage the deer for stable population levels.

Performance Expectation(s):

HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [Assessment Boundary: Assessment is limited to provided data.]

Additional PEs, SEPs, DCIs, and CCCs

CCC--Cause and Effect: Participants could include some information about how their management idea will actually cause a change in the deer population.

Dropping in on Deer

Estimate the population density of deer in a given area by counting deer pellet groups.

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Grade Level: High School

Guiding Question/Phenomenon: *Why do wildlife specialists manage the deer population in your state? How do they collect information to do that?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Select appropriate tools to collect, record, analyze, and evaluate data. ● Students collect data about deer populations to determine population size, learn about wildlife management techniques as well as to be able to suggest potential deer management decisions. **Analyzing and Interpreting Data** Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution ● Students analyze data they collected in the field to determine the size of the deer population.	**LS2.A: Interdependent Relationships in Ecosystems** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. ● After determining the deer population for an area, students develop management suggestions based on this information.	**Patterns** Empirical evidence is needed to define patterns. ● Students look for patterns in the data they collected to answer questions related to deer populations and to suggest wildlife management decisions based on that information.
Performance Expectation(s): **HS-LS2-2.** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [Assessment Boundary: Assessment is limited to provided data.]		
Additional PEs, SEPs, DCIs, and CCCs This activity also correlates well with the same SEPs and CCCs at the middle grades level.		

Eco-Enrichers

Design and conduct an experiment to investigate soil types and organisms found in soil.

Page: 177
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *Would you classify the soil around your house or school alive or dead? Explain.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. ● After a discussion about soil and decomposers, students develop their own research question focusing on how decomposers impact soil. **Planning and Carrying Out Investigations** Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. ● Students plan a field investigation that is designed to answer their research question and then carry out that investigation. **Constructing Explanations and Designing Solutions** Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. ● Students use data from their investigation as evidence to answer their research questions.	**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. ● Students investigate the link between soil formation and decomposition.	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. ● Students explore the relationship between decomposers and soil properties. Depending on their research question, it may be cause or correlation. **Energy and Matter** Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. ● Students' investigations help them learn how matter is recycled in a soil ecosystem.

Performance Expectation(s):
HS-LS2-4. Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. [Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.] [Assessment Boundary: Assessment is limited to proportional reasoning to describe the of matter and flow of energy.]

Additional PEs, SEPs, DCIs, and CCCs
If more emphasis was focused on the process of data analysis then, Analyzing and Interpreting Data could also be incorporated at the high school level.
Analyzing and Interpreting Data
Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
- Students will have to analyze their data in some way in order to provide an answer to their research question.

Ecosystem Architects

Design an ecosystem restoration project to improve habitat and biodiversity in a fictional scenario.

Page: 260
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *How could you turn an abandoned shopping center into a sustainable, natural ecosystem?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system ● Using a case study, students develop a plan to create a sustainable ecosystem. **Constructing Explanations and Designing Solutions** Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. ● Students design a plan to replace a damaged area with a sustainable ecosystem.	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. ● Students design a solution to reverse the human impact on an area and restore the natural biodiversity.	**Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. ● Students develop a plan for a sustainable ecosystem that models energy flow and matter cycling through a natural food web.

Performance Expectation(s):
HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

Additional PEs, SEPs, DCIs, and CCCs
If students are given choices of formats to use when presenting their food web and ecosystem design then the SEP**: Obtaining, Evaluating, and Communicating Information** would be incorporated at the high school level.
Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Environmental Barometer

Plan an investigation of biotic and abiotic elements in an area to consider relationships between environmental factors and the presence or absence of wildlife.

Page: 158
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *Is our schoolyard a healthy ecosystem? How can we use wildlife to determine environmental quality?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. ● After a discussion about abiotic and biotic factors as well as a visit to the study sites, students develop research questions around the theme of wildlife and environmental quality. **Planning and Carrying Out Investigations** Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. ● Students plan and carry out a field investigation to collect data comparing the environmental quality of 2 different sites. **Analyzing and Interpreting Data** Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. ● Students organize and analyze their data to provide answers to their research question.	**LS4.D: Biodiversity and Humans** Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. ● During their investigation students explore the relationship between factors influencing wildlife diversity and environmental quality..	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. ● As students analyze their data, they look for patterns to help determine the relationship between abiotic factors and the diversity of wildlife.

Performance Expectation(s):
HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

Additional PEs, SEPs, DCIs, and CCCs
This activity also addresses the crosscutting concept of Cause and Effect at the middle school level as they are analyzing the data comparing their two study sites.

Fire Ecologies

Carry out an investigation of burned and unburned habitat areas to evaluate the positive and negative effects fire has on wildlife and habitat.

Page: 233
Grade Level: High School

Guiding Question/Phenomenon: *What are the positive and negative effects of fire in a forest or grassland ecosystem near you?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. ● After a discussion about the impact of fire on ecosystems and the fire history of their study site, students develop questions to research about the positive and negative effects of fire. **Analyzing and Interpreting Data** Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. ● Students analyze their data to answer their research questions about fire's effects on ecosystems. This data is then used to summarize the positive and negative effects of fire.	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. ● Students investigate the impact of fire on ecosystem functioning.	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. ● As students analyze their data, they look for patterns to help determine the positive and negative effects of fire on an ecosystem. **Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. ● Students' investigations help them understand the role of fire in the stability or change of specific ecosystems.
Performance Expectation(s): **HS-LS2-7.** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]		
Additional PEs, SEPs, DCIs, and CCCs This activity does address Planning and Carrying Out Investigations at the middle school level since students do conduct an investigation but don't actually plan it.		

Food Footprint

Construct a flow diagram to trace the origins of food sources, consider impacts of production, and recommend improvements.

Page: 375
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *Everybody has a favorite food. How does the production of our favorite food impact the environment?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. ● Students use a flow chart to both chart a trace food from its origin and to indicate where alternatives could be used. **Engaging in Argument from Evidence** Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence and challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining what additional information is required to resolve contradictions. ● Students present and defend their recommendation for an alternative ingredient source or method of production.	**LS2.C: Ecosystem Dynamics, Functioning and Resilience** Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. ● Students explore the impact of their food on wildlife habitat.	**Cause and Effect** Changes in systems may have various causes that may not have equal effects. ● As students trace their food from its source, they can learn about how the impact of food production causes negative effects on the environment.

Performance Expectation(s):
HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

Additional PEs, SEPs, DCIs, and CCCs
This activity as written also directly applies to the middle school DCI:
ESS3.C: 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) for different living things.
● Students trace the impact of their food on the environment and wildlife. They also propose an alternative that would provide a positive impact.

Forest in a Jar

Conduct a simple investigation using a jar, soil, water, seeds, and a plant to explain the process of ecological succession.

Page: 218
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *If our schoolyard environment suddenly changed, how might that affect the kinds and amounts of plants that grow here?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop models to describe phenomena. Use a model to test interactions concerning the functioning of a natural system. ● Students create a model ecosystem to observe succession from a wetland to a forest. **Constructing Explanations and Designing Solutions** Use evidence (e.g. observations, patterns) to support an explanation Use evidence (observations, patterns) to construct an explanation. ● Students use notes and drawing of their observations to explain the process of succession they observed in their jars.	**LS2.C: 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. ● Students observe how the aquatic plants die out and the seeds of other plants germinate and either die or thrive in the changing environment of the jar during the observation period.	**Systems and System Models** A system can be described in terms of its components and their interactions. ● Students describe the interactions of plant life and soil conditions over the observation period **Cause and Effect** Cause and effect relationships are routinely identified. ● Students will identify how the change in soil moisture affected the kinds of plants growing in the jar.

Performance Expectation(s):
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.* [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

Additional PEs, SEPs, DCIs, and CCCs

Good Buddies

Play a card game to understand symbiotic relationships.

Page: 128
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *What makes a 'good buddy' in the natural world? Do both buddies benefit from the relationship?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop models to describe phenomena. Use a model to test interactions concerning the functioning of a natural system. ● Students play a card game to identify pairs of organisms that have symbiotic relationships. **Constructing Explanations and Designing Solutions** Use evidence (e.g. observations, patterns) to support an explanation. Use evidence (Observations, patterns) to construct an explanation. ● Students use the Good Buddies Information sheet to explain the cooperative or competitive interactions in buddy pairs' relationships.	**LS2.D: Social Interaction and Group Behavior** Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size. ● Students describe the interactions of animals in symbiotic relationships.	**Systems and System Models** A system can be described in terms of its components and their interactions. ● Students describe a system in which symbiotic relationships are beneficial for the health of the system.
Performance Expectation(s): **3-LS2-1.** Construct an argument that some animals form groups that help members survive.		
Additional PEs, SEPs, DCIs, and CCCs		

Graphanimal

Tally and graph the diversity of animals on a nature walk to compare different environments.

Page: 61
Grade Level: Lower Elementary

Guiding Question/Phenomenon: *How can we compare the numbers of animals hiding around our school grounds?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Describe, measure, and/or compare quantitative attributes of different objects and display data using simple graphs. ● Students list, tally and compare the numbers of each kind of animal they find in their assigned habitats.	**LS4.D: Biodiversity and Humans** There are many different kinds of living things in any area, and they exist in different places on land and water. ● Students look for and tally different species of animals within assigned locations/habitats.	**Patterns** Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. ● Students observe patterns in the numerical relationships of animals in the various habitats they explored.
Performance Expectation(s): **2-LS4-1.** Make observations of plants and animals to compare the diversity of life in different habitats. [Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]		
Additional PEs, SEPs, DCIs, and CCCs		

HabiCache

Map evidence of wildlife and key habitat components using handheld devices with GPS to draw conclusions about the habitat needs of wildlife and humans.

Page: 123
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *How can we use technology to locate and document evidence of wildlife on our school grounds?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. ● Students design maps, including map keys and GPS coordinates so that another team can hunt for the evidence they located. **Constructing Explanations and Designing Solutions** Use evidence (e.g. observations, patterns) to support an explanation. ● Students explain how the evidence they located indicates that certain wildlife can survive well on the school's campus.	**LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. ● Students document evidence of certain wildlife that survive well on the school campus.	**Cause and Effect** Cause and effect relationships are routinely identified and used to explain change. ● Students generalize that geographic factors contribute to the habitat features that are essential to wildlife in this location.
Performance Expectation(s): **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. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]		
Additional PEs, SEPs, DCIs, and CCCs		

Habitat Circles

Physically form an interconnected circle to demonstrate the interdependence of habitat components.

Page: 78

Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *What could happen to wildlife here if we removed just one habitat component?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop models to describe phenomena. Use a model to test interactions concerning the functioning of a natural system ● Students model the suitable arrangement of habitat components for wildlife to thrive there. ● Students model what happens when one or more habitat components are removed from an area. **Constructing Explanations and Designing Solutions** Use evidence (e.g. observations, patterns) to support an explanation. ● Students explain how organisms depend on a suitable amount and arrangement of habitat components for them to survive. ● Students explain how an absence of components can affect the health of the ecosystem.	**LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. ● Students model and discuss environmental components necessary for organisms to survive well and how changes in the environment can cause a collapse in their ability to support wildlife.	**Systems and System Models** A system can be described in terms of its components and their interactions. ● Students model and discuss how each component of a habitat is needed to support organisms interacting with it and the other organisms in it. **Cause and Effect** Cause and effect relationships are routinely identified and used to explain change. ● Students model and discuss how the removal of one or more habitat components affects the health of an ecosystem.

Performance Expectation(s):

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. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

Additional PEs, SEPs, DCIs, and CCCs

Here Today, Gone Tomorrow

Identify reasons that wildlife become vulnerable to extinction, and assess the vulnerability of various species.

Page: 251
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *What are the threatened or endangered species in your region? What factors contribute to their status?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating and Communicating Information Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. ● Students use information from their observations, Threatened and Endangered Species Profile Cards and internet resources to develop a vulnerability rating guide.	**LS4.C: Adaptation** Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. ● Students explore different factors that influence the vulnerability of a species.	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. ● Students develop a vulnerability rating scale that helps to predict how species' survival will change over time.
Performance Expectation(s): **HS-LS4-5.** Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]		
Additional PEs, SEPs, DCIs, and CCCs This activity also correlates well with middle school DCI Human Impacts on Earth Systems, without any modifications. **ESS3.C: 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) for different living things		

Insect Inspection

Ask an investigative question related to insects, then collect and explore insects to find out more.

Page: 2

Grade Level: Lower Elementary

Guiding Question/Phenomenon: *How do I know if the bug I find is or is not an insect?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Use evidence (e.g. observations, patterns) to support an explanation Use evidence (observations, patterns) to construct an explanation. ● Students explain if their arthropod is or is not an insect-based on the diagram or information chart shared by the teacher. **Analyzing and Interpreting Data** Use observations (firsthand or from media) to describe patterns or relationships in the natural world in order to answer scientific questions. ● Students record, share and analyze the features of the collected arthropods to determine which are insects and which are not.	**LS1.A: Structure and Function** All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. Plants also have different parts that help them survive and grow. ● Students observe the external structures of arthropods. **LS1.A: Structure and Function** Animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. ● Students observe the external structures of arthropods.	**Patterns** Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. ● Students observe that arthropods have common features such as more than four legs and exoskeletons. They will observe that insects are arthropods, but share some specialized features.

Performance Expectation(s):

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.* [Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting by mimicking eyes and ears.]

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]

Additional PEs, SEPs, DCIs, and CCCs

Interview a Spider

Research and interview native wildlife species in a mock web talk show.

Page: 15
Grade Level: Upper Elementary

Guiding Question/Phenomenon: *If I could talk to an animal around here, to find out what makes it special, which animal would it be?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtain and combine information from reliable media to explain phenomena or solutions to a design problem. ● Students research and share information about an animal found in the local ecosystem.	**LS4.D: Biodiversity and Humans** There are many different kinds of living things in any area, and they exist in different places on land and water. ● Students research and share some of the animals that live in the local ecosystem. **LS1.A: Structure and Function** Animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. ● Students research and share how unique structures of their animals' function to enable their survival.	**Structure and Function** The shape and stability of structures of natural and designed objects are related to their function(s). ● Students research and share the unique features of an animal and describe how those features help it live successfully in its ecosystem.

Performance Expectation(s):

2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats. [Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]

Additional PEs, SEPs, DCIs, and CCCs

Keeping Cool

Use thermometers in an investigation to explore how reptiles adapt to temperature changes.

Page: 200
Grade Level: Elementary

Guiding Question/Phenomenon: *Where might we find reptiles resting throughout the day?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Use evidence (e.g. observations, patterns) to support an explanation Use evidence (observations, patterns) to construct an explanation. ● Students use their research information and study site temperature readings as evidence that reptiles change location to control their body temperatures. **Analyzing and Interpreting Data** Use observations (firsthand or from media) to describe patterns or relationships in the natural world in order to answer scientific questions. ● Students record and analyze temperatures at various study site locations to determine where reptiles might move throughout the day to maintain healthy body temperatures.	**LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. ● Based on the temperature readings they have made throughout the day, students choose appropriate places reptiles will locate to maintain healthy body temperatures. **LS1.A: Structure and Function** Animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. ● Students describe behavioral adaptations of reptiles that cause them to move locations to control their body temperatures.	**Systems and System Models** A system can be described in terms of its components and their interactions. ● Students discuss how reptiles interact within their habitat to control body temperature. **Cause and Effect** Cause and effect relationships are routinely identified and used to explain change. ● Students discuss how a change in temperature throughout the day affects the behavior of reptiles.

Performance Expectation(s):

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. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

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. [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

Additional PEs, SEPs, DCIs, and CCCs

Let's Talk Turkey

Using background information cards, construct a timeline chronicling societies' historical use of the wild turkey.

Page: 322
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *How can human decisions affect wildlife populations?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. Obtain and combine information from books and other reliable media to explain phenomena. ● Students use information cards to describe how human development affected turkey populations and about methods, laws, and management tools used to conserve turkeys in the wild.	**LS4.D: Biodiversity and Humans** Populations live in a variety of habitats, and change in those habitats affects the organisms living there. ● Students explain how human interaction affected wild turkey populations throughout historical periods.	**Cause and Effect** Cause and effect relationships are routinely identified and used to explain change. ● Students describe how human development affected turkey populations and about methods, laws, and management tools used to conserve turkeys in the wild. **Patterns** Similarities and differences in patterns can be used to sort and classify natural phenomena. ● Students establish patterns between human activity and turkey populations throughout historical periods.
Performance Expectation(s): **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.* [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]		
Additional PEs, SEPs, DCIs, and CCCs		

Lights Out!

Learn about light pollution and its impacts, and design an action plan to reduce light pollution in your community.

Page: 366
Grade Level: Upper Elementary, Middle School, High School

Guiding Question/Phenomenon: *How can light pollution from our parking lot affect the nightlife of animals in our area?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles to design an object, tool, process or system ● Students develop an action plan to decrease light pollution in their area. The plan will be based on their research on the topic and a light audit conducted at their location.	**ESS3.C: 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) for different living things. ● Students research light pollution and conduct a light audit of their location.	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. ● Students conduct research to explain the cause and effects of artificial light on wildlife in their area.
Performance Expectation(s): **MS-ESS3-3**. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]		
Additional PEs, SEPs, DCIs, and CCCs		

Limiting Factors: How Many Bears?

Simulate bears gathering habitat components to determine limiting factors for the given populations.

Page: 26

Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *What happens to a population of animals if they can't find enough food?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop models to describe phenomena. Use a model to test interactions concerning the functioning of a natural system. ● Students participate in a simulation activity to model and describe how limiting factors affect bear populations. **Analyzing and Interpreting Data** Use observations (firsthand or from media) to describe patterns or relationships in the natural world in order to answer scientific questions. ● Students record, share and analyze the resources they collected to determine limiting factors and carrying capacity of a given population.	**LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. ● Students describe how bears in an ecosystem are affected by the availability of resources.	**Systems and System Models** A system can be described in terms of its components and their interactions. ● Students will model and discuss how each component of a habitat is needed to support bear populations. **Cause and Effect** Cause and effect relationships are routinely identified and used to explain change. ● Students will model and discuss how the accessibility of one or more habitat components affects the bear population in an ecosystem.
Performance Expectation(s): **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. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]		
Additional PEs, SEPs, DCIs, and CCCs		

Map That Habitat

Create a map to identify the location of components of an animal's habitat

Page: 73

Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *What wild animals have a habitat at our study site?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop models to describe phenomena. Use a model to test interactions concerning the functioning of a natural system ● Students create a map to show the suitable arrangement of habitat components for wildlife species to thrive at the study site.	**LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. ● Students document evidence of habitat factors that help certain wildlife survive well at the study site.	**Systems and System Models** A system can be described in terms of its components and their interactions. ● Students create a model to show how habitat components are suitably arranged to support organisms interacting within it.
Performance Expectation(s): **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. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]		
Additional PEs, SEPs, DCIs, and CCCs		

Migration Barriers

Using a real-life example, make recommendations based on the consequences of developing a highway through a deer migration path.

Page: 455
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *What solutions can you propose to a wildlife migration issue?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating and Communicating Information Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). ● Students use information from the Migration Barriers Student Page and internet research to explore the issue of wildlife migration and present a proposed solution.	**ESS3.C: Human Impacts on Earth Systems** The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. ● Students explore the wildlife management issue of migration barriers.	**Patterns** Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system. ● Students use the patterns of deer behavior in response to the highway fence to research and provide a recommendation for a solution to the issue.

Performance Expectation(s):
HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]

Additional PEs, SEPs, DCIs, and CCCs
If the activity was modified so students developed their own ideas for solutions then the SEP **Constructing and Explanation and Designing a Solution** would be correlated with the experience--
Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Monarch Marathon

Students simulate the multi-generation monarch butterfly migration and experience the limiting factors affecting monarch survival.

Page: 18
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *How is the survival of monarch butterflies affected by various factors in our region?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe phenomena. ● Students participate in a simulation activity to model monarchs' migrations from Zone 1 (wintering ground) to Zone 4 (summer home). Along the way, they will find food and host sites to lay eggs. Limiting factors will be introduced during various rounds.	**LS2.A: Interdependent Relationships in Ecosystems** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. Growth of organisms and population increases are limited by access to resources. ● Students experience various limiting factors during their simulation activity and will use these experiences to understand how factors constrain population growth. **ESS3.C: 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) for different living things ● Students model how human activity, such as using pesticides or removing habitat, or reducing pesticide use and restoring habitat, can influence monarch survival during their migrations.	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems ● Students discuss how various factors during monarch migration affect population increases or decreases.

Performance Expectation(s):

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. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).

Additional PEs, SEPs, DCIs, and CCCs

Muskox Maneuvers

Simulate adaptations in predator and prey relationships in a game of “flag tag.”

Page: 209
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *How do wild animals that live in herds protect their young?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Use a model to predict and/or describe phenomena. ● Students participate in a simulation to help them understand the predator-prey relationship between muskoxen and wolves, as well as the resulting adaptations of this relationship. **Obtaining, Evaluating, and Communicating Information** 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. ● Students can research other examples of predatory and prey relationships to evaluate the strategies of the predators and prey, as well as their behavior and adaptations.	**LS2.A: Interdependent Relationships in Ecosystems** Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. ● Students discuss the animal adaptations and predator-prey relationships observed in the simulation.	**Patterns** Patterns can be used to identify cause and effect relationships. ● Students explore the patterns of protective behavior of muskoxen due to their predator-prey relationship with wolves.

Performance Expectation(s):

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
[Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

Additional PEs, SEPs, DCIs, and CCCs

My Kingdom for a Shelter

Create a model of an animal shelter

Page: 70

Grade Level: Lower Elementary, Upper Elementary, Middle School

Guiding Question/Phenomenon: *How can I create a model of an animal shelter that is similar to what the animal would do?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Use and develop models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. Use a model to represent relationships in the natural world. ● Students use found materials to create models of animals' shelters. **Obtaining, Evaluating, and Communicating Information:** Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas ● Students will observe, research, and make models of animal shelters.	**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 ● Students participate in a discussion of animals' and humans' needs, including shelter.	**Systems and System Models** Systems in the natural and designed world have parts that work together. ● Students observe, research, and discuss the parts of the ecosystem they use to create shelter.
Performance Expectation(s): **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. [Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas, and grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]		
Additional PEs, SEPs, DCIs, and CCCs		

No Water off a Duck's Back

Conduct an investigation to examine ways that oil spills can negatively affect birds.

Page: 353
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *How do oil spills affect birds?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems. ● Students measure the area covered by oil to calculate how much area could be covered by a large oil spill. **Planning and Carrying Out Investigations** Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. ● Students investigate the effect of oil on eggs and feathers to determine the possible effects on birds from an oil spill.	**ESS3.C: 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) for different living things. ● Students investigate the effect of oil on eggs and feathers to examine some of the possible impacts human pollution can have on wildlife species, humans, and the environment.	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. ● Students examine the effect of oil pollution on wildlife species, humans, and the environment.
Performance Expectation(s): **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of air, water, or land).]		
Additional PEs, SEPs, DCIs, and CCCs		

Oh Deer!

Students become deer and habitat components in a physical activity that demonstrates population fluctuations, carrying capacity, and limiting factors.

Page: 42
Grade Level: Upper Elementary, Middle School, High School

Guiding Question/Phenomenon: *What factors affect deer populations?*

Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concepts
Developing and Using Models Use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. ● Students participate in a simulation to model the fluctuation in deer population based on a variety of factors. Identify limitations of models (3-5). ● Students discuss what is realistic and unrealistic about the simulation, examining the limitations of the model. **Using Mathematics and Computational Thinking** Use mathematical and/or computational representations of phenomena to support explanations. ● Students develop graphical representations of the fluctuation in deer population based on the simulation.	**LS2.A: Interdependent Relationships in Ecosystems** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) or species in any given ecosystem. ● Students discuss carrying capacity for deer populations based on the simulation and the factors that contribute to the carrying capacity of an ecosystem.	**Patterns** Mathematical representations are needed to identify some patterns. ● Students look for patterns in the graphical representations to identify fluctuations in deer populations .
Performance Expectation(s): **HS-LS2-1.** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent including boundaries, resources, climate and competition. Examples of mathematical comparisons could include graphs, charts, histograms, or population changes from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]		
Additional PEs, SEPs, DCIs, and CCCs		

Owl Pellets

Examine owl pellets, reconstruct prey skeletons, and draw a food chain based on the contents.

Page: 146
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *What is an owl pellet and what can it tell you?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Make observations and/or measurements to produce data to serve as the basis for evidence of an explanation of a phenomenon. ● Students dissect owl pellets to collect data concerning the number and types of bones found in order to answer questions about the diet of animals eaten by the owl. **Constructing Explanations and Designing Solutions** Use evidence (measurements, observations, patterns) to construct or support an explanation. ● Students use the evidence of bones found in owl pellets to determine what sort of animals the owl consumed.	**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. ● Students dissect and explore the solid waste created by owls in the form of owl pellets to determine what owls eat and then release back into the environment. **LS2.A: Interdependent Relationships in Ecosystems** The food of almost any kind of 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. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plant parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. ● Students discuss trophic levels, identifying where each level obtains their energy, tracing the source of energy back to producers and their source of energy, the sun. ● Based on evidence from their dissection of owl pellets, students develop a food chain that includes the owls, its prey, and what the prey eats.	**Systems and System Models** A system can be described in terms of its components and their interactions ● The owl pellet provides evidence of the system in which the owl lives and how components of the system interact. **Energy and Matter** Energy can be transferred in various ways and between objects. ● Students discuss energy transfer through the idea of food chains and trophic levels based on evidence from the owl pellets.

Performance Expectation(s):

5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations]

Additional PEs, SEPs, DCIs, and CCCs

Pay to Play

Play a board game to investigate the requirements and consequences of consumptive and nonconsumptive uses of wildlife and natural resources

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Grade Level: Middle School, High School

Guiding Question/Phenomenon: How and why do humans manage wildlife?

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Use a model to predict and/or describe phenomena. ● Students participate in a game that models the cost and aspects of wildlife management for humans and their effects on wildlife. **Constructing Explanations and Designing Solutions** Construct an explanation using models or representations. ● After participating in the model and discussions, students work toward constructing an explanation for the cost of managing wildlife.	**ESS3.C 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) for different living things. 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. ● Students participate in a game representing the human impacts of wildlife management; they discuss the impacts and how consumptive and nonconsumptive-uses of wildlife have changed over a period of time.	**Cause and Effect** Cause and Effect relationships may be used to predict phenomena in natural or designed systems. ● Students examine the process and cost of wildlife management by humans and the resulting effects on wildlife.

Performance Expectation(s):

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of air, water, or land).]

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. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]

Additional PEs, SEPs, DCIs, and CCCs

Phenology at Play

Perform skits and graph data to understand effects of climate change on phenology and a migrator bird population.

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Grade Level: Middle School, High School

Guiding Question/Phenomenon: *Have you noticed changes in the natural cycles such as when flowers bloom in your community? What kind of impact could those changes have?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. ● Students analyze graphs and charts as well as create a graph to describe the effects of phenological changes. **Obtaining, Evaluating and Communicating Information** Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). ● Students obtain information from research, data charts and graphs about the impacts of phenological changes and then present that information to their peers.	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species ● Students explore phenological changes which may be due to climate change and how these changes may disrupt an ecosystem.	**Patterns** Mathematical representations are needed to identify some patterns. ● Students use graphs and charts to determine the patterns in phenophases and phenological changes. **Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. ● Students analyze graphs and charts to describe phenological changes.

Performance Expectation(s):
HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

Additional PEs, SEPs, DCIs, and CCCs
This activity also correlates well with the same SEPs and CCCs at the middle grades level.

Quick-Frozen Critters

Learn the importance of predator and prey adaptations in this version of “freeze tag”

Page: 214
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *When do animals stop and freeze?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Use models to describe and/or predict phenomena. ● Students participate in a simulation to model how prey use their senses to aid in their survival.	**LS2.A: Interdependent Relationships in Ecosystems** Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. Students discuss the animal adaptations and predator-prey relationships observed in the simulation. ● Students model the behaviors exhibited by prey to avoid their predators.	**Cause and Effect** Cause and effect relationships are routinely identified. ● Students use cause and effect to explain the sensation of predator or prey causing a behavior change in an animal.
Performance Expectation(s): **MS-LS2-2.** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]		
Additional PEs, SEPs, DCIs, and CCCs		

Raindrops and Ranges

Create digital maps to explore interrelationships among rainfall, vegetation, and wildlife species.

Page: 99
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *How can you use digital mapping to determine the relationships between temperature, rainfall, vegetation, and wildlife in your region?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. ● Students use digital mapping tools to analyze the relationships between temperature, rainfall, vegetation, and wildlife. .	**LS2.A: Interdependent Relationships in Ecosystems** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem ● Students map the relationships between the abiotic factors of rain and temperature and their influence on vegetation and wildlife.	**Patterns** Mathematical representations are needed to identify some patterns. ● Students use digital mapping to identify the patterns in the relationships between temperature, rainfall, vegetation, and wildlife.

Performance Expectation(s):
HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent including boundaries, resources, climate and competition. Examples of mathematical comparisons could include graphs, charts, histograms, or population changes from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]

Additional PEs, SEPs, DCIs, and CCCs
This activity also correlates well with the same SEPs and CCCs at the middle grades level.

Seed Need

Sort seeds based on dispersal method, and act as wildlife in a simulation to demonstrate seed dispersal.

Page: 117
Grade Level: Lower Elementary, Upper Elementary

Guiding Question/Phenomenon: *How do seeds from the plants in your schoolyard travel to other places?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop and/or use models to describe and/or predict phenomena. ● Students participate in a game that models how seeds are dispersed by different animals. **Analyzing and Interpreting Data** 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. ● Students use their observations of the seeds they collected to compare seeds from different locations and to determine how those seeds are dispersed.	**LS2.A: Interdependent Relationships in Ecosystems** Plants depend on animals for pollination or to move their seeds around. ● Students learn about all the different ways that seeds can be dispersed and then play a game focusing on how animals disperse seeds.	**Patterns** Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants. ● Students use the idea of patterns to compare and contrast seeds found in different locations as well as to determine how different animals disperse seeds. **Structure and Function** The shape and stability of structures of natural and designed objects are related to their function(s). ● Students examine the structure of the seeds they collected in order to determine how they can be dispersed.
Performance Expectation(s): **2-LS2-2.** Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants. [Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]		
Additional PEs, SEPs, DCIs, and CCCs		

Smokey Bear Said What

Create a mural to illustrate an ecosystem, before, during, and after a fire.

Page: 357
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *How can forest and grassland fires actually benefit an ecosystem?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating and Communicating Information 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).Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations. ● Students research the positive and negative benefits of fire and present those through a mural.	**LS2.C: 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. ● Students explore the impact of fire on grassland and forest ecosystems. **ESS3.C: 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) for different living things. ● Students research the impact of forest and grassland fires caused by humans.	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. ● Students research both the positive and negative effects of grassland and forest fires.

Performance Expectation(s):

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of air, water, or land).]

Additional PEs, SEPs, DCIs, and CCCs

Surprise Terrarium

Make observations of live animals to learn about camouflage and adaptations that help animals survive.

Page: 189
Grade Level: Lower Elementary

Guiding Question/Phenomenon: *How can animals hide in your schoolyard?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data 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. ● Students use their observations of animals both in a terrarium and outside to learn about camouflage.	**LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. ● Students learn that camouflage is an adaptation that helps animals to survive in a specific environment.	**Patterns** Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. ● Students use patterns seen in their observations to explain the importance of camouflage as an adaptation.
Performance Expectation(s): **3-LS4-3.** Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and cannot survive at all. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]		
Additional PEs, SEPs, DCIs, and CCCs		

Sustainability: Then, Now, Later

Explore the concept of sustainability through an active simulation, then analyze first-person narratives reflecting the lifestyles of various time periods.

Page: 491
Grade Level: Middle School

Guiding Question/Phenomenon: *What is sustainability and how do my choices affect it?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop and/or use a model to predict and/or describe phenomena. ● Students participate in a game that models the use of natural resources and the idea of sustainability. **Obtaining, Evaluating and Communicating Information** 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). ● Students read different scenarios to compare and contrast sustainability over different time factors.	**ESS3.A Natural Resources** Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, freshwater, 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 participate in a game that parallels the use of natural resources and sustainability. They discuss renewable vs. nonrenewable, develop lists of such resources they use in daily life, and how resources may be overused in a non-sustainable way. **ESS3.C: Human Impacts on Earth Systems** The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. ● Students obtain information about how the use of natural resources has changed over time and the impact of those changes on sustainability.	**Cause and Effect** Cause and effect relationships might be used to predict phenomena in natural or designed systems. ● Students discuss the use of renewable and nonrenewable resources and the effect of overuse. **Stability and Change** Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale. ● Students explore how natural resource use has changed over time and the effects of those uses on ecosystems and human systems.

Performance Expectation(s):

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. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]

Additional PEs, SEPs, DCIs, and CCCs

The Power of Planning

Create a concept map to evaluate various energy sources, then advocate for an assigned form of energy production during a simulated city council meeting.

Page: 382
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *What effect does the electricity generation at your local power plant have on the environment, wildlife, and people?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. ● Students apply scientific information about different energy sources to determine the best choice for their simulated city. **Obtaining, Evaluating and Communicating Information** Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). ● Students use information from their concept maps, the Energy Source Information Sheet and the internet to obtain and present information about different sources of energy.	**ESS3.A: Natural Resources** All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. ● Students explore the different energy sources and their risks and costs while participating in a simulated city council meeting.	**Energy and Matter** Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. ● The conservation of energy will be reinforced as students explore the risks and benefits of different energy sources.

Performance Expectation(s):
HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on benefit ratios. [Clarification Statement: Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen.]

Additional PEs, SEPs, DCIs, and CCCs
Without any modifications, this activity clearly addresses the SEP **Developing and Using Models** at the middle school level: Develop and/or use a model to predict and/or describe phenomena.

Thicket Game

Learn about the importance of adaptations in a predator and prey version of “hide and seek.”

Page: 193
Grade Level: Lower Elementary, Upper Elementary

Guiding Question/Phenomenon: *How can animals in your schoolyard hide from their predators?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop and/or use models to describe and/or predict phenomena. ● Students participate in a game that helps them learn how certain adaptations can help prey hide from their predators.	**LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. ● Students learn that adaptations that help organisms hide from their predators help them survive.	**Patterns** Patterns can be used as evidence to support an explanation. ● After several rounds of the game, the students use the patterns found in the results to explain that adaptations help organisms hide from their predators.
Performance Expectation(s): **3-LS4-3.** Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and cannot survive at all. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]		
Additional PEs, SEPs, DCIs, and CCCs		

Time Lapse

Activity description as stated in the back of the guide

Page: 239
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *How can a natural area like a field, pond, or forest in your community change over time?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop and/or use a model to predict and/or describe phenomena. ● Students' visual representation of a successional stage serves as a model to help describe that stage. **Obtaining, Evaluating and Communicating Information** 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). Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations. ● Students use the text provided to learn about succession and specific successional stages and then, create a visual presentation.	**LS2.C: 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. ● Students use models to explore how ecosystems change through time through the process of succession.	**Patterns** Patterns can be used to identify cause and effect relationships. ● Students observe the patterns of change represented in the models of successional stages. **Stability and Change** Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale. ● Students learn that succession involves both stability and change due to time and changes in environmental factors.

Performance Expectation(s):

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

Additional PEs, SEPs, DCIs, and CCCs

If the activity was modified to include abiotic factors in the visual representation along with the interactions within the successional stage, this crosscutting concept, Systems and System Models, would apply.

Systems and System Models

Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.

● Students' visual representations are a model of an ecosystem in a specific stage of succession.

Tracks!

Search for and identify wildlife tracks, then make plaster casts of tracks.

Page: 36
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *How can you use tracks to learn about the animals in your community?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop and/or use models to describe and/or predict phenomena. ● In the beginning activity, students used models or pictures of tracks to learn the basics of track identification. **Analyzing and Interpreting Data** Analyze and interpret data to provide evidence for phenomena. ● Students analyze their observations to determine what animals made the tracks.	**LS1.A: Structure and Function** Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. ● Students learn that an animal's paws or feet make different tracks based on the different structures and functions.	**Patterns** Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products. ● Students sort or classify different tracks based on patterns they observe in the beginning activity. They also use observed patterns to help identify tracks they find outside.
Performance Expectation(s): **4-LS1-1.** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]		
Additional PEs, SEPs, DCIs, and CCCs		

Trophic Transfer

Work together as an increasingly complex assembly line to model organic production and energy loss at different trophic levels in an ecosystem.

Page: 151
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *What happens to energy and matter in a food chain made up of animals in your community?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop and/or use a model to predict and/or describe phenomena. ● Students participate in a game that models energy flow in a food chain. **Analyzing and Interpreting Data** Analyze and interpret data to provide evidence for phenomena. ● Students analyze the data collected from their game to describe how energy flows through a food chain.	**LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. ● Students participate in a game to explore how energy is transferred through different trophic levels.	**Energy and Matter** The transfer of energy can be tracked as energy flows through a designed or natural system. ● As students participate in the game and analyze the data, they learn that energy can be tracked as it flows through a food chain.
Performance Expectation(s): **MS-LS2-3.** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]		
Additional PEs, SEPs, DCIs, and CCCs		

Turkey Tallies

Compute and graph turkey population data over time to distinguish between exponential and linear growth and to examine how limiting factors affect population growth.

Page: 426
Grade Level: High School

Guiding Question/Phenomenon: *How would you describe the population growth of your favorite wildlife species?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. ● Use mathematical computations and graphing to learn the difference between exponential and linear growth.	**LS2.A: Interdependent Relationships in Ecosystems** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. ● As students learn about the difference between exponential and linear population growth, they discuss carrying capacity and limiting factors.	**Stability and Change** Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. ● Students explore the rates of change in exponential vs linear population growth.

Performance Expectation(s):
HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent including boundaries, resources, climate and competition. Examples of mathematical comparisons could include graphs, charts, histograms, or population changes from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]

Additional PEs, SEPs, DCIs, and CCCs
This activity also correlates well with the same SEPs and CCCs at the middle grades level.

Urban Nature Search

Go on a scavenger hunt to observe and record different types of wildlife and habitat features in your schoolyard.

Page: 94
Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *What kind of wild organisms can you find in your community?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyze and interpret data to provide evidence for phenomena. ● Students make observations to determine what kinds of wildlife exist in their environment.	**LS2.A: Interdependent Relationships in Ecosystems** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. ● Through their observations and subsequent discussion, students learn how the kinds of organisms they find in their community are dependent on the living and nonliving factors of the environment.	**Patterns** Graphs, charts and images can be used to identify patterns in data. ● Students use patterns found in their observations to determine the types and characteristics of wildlife living in their community.

Performance Expectation(s):

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. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and numbers of organisms in ecosystems during periods of abundant and scarce resources.]

Additional PEs, SEPs, DCIs, and CCCs

If observations and discussion questions were focused more on interactions between organisms including food sources, then the activity could easily include the following DCI:

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems

Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.

These same modifications would incorporate the CCC:

Energy and Matter

Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter

Water Mileage

Perform calculations to understand how adaptations enable animals to survive in harsh environments.

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Grade Level: Middle School, High School

Guiding Question/Phenomenon: *What kind of adaptations do animals need to have in dry or hot environments?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. ● Students do a variety of calculations in order to understand the adaptations that desert bighorn sheep and gopher tortoises have developed to obtain water.	**LS4.C: Adaptation** Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. ● Students explore the adaptations of the desert bighorn sheep and the gopher tortoise.	**Scale, Proportion, and Quantity** The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. ● The concept of quantity is important to understand the adaptations of the desert bighorn sheep and gopher tortoise related to water use.

Performance Expectation(s):
HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations. [Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]

Additional PEs, SEPs, DCIs, and CCCs
Extension #2 addresses an additional HS DCI: **LS4.D: Biodiversity and Humans**.
Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.

What Bear Goes Where?

Create posters of three different bear habitats to illustrate that animals have adapted in order to live where they do.

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Grade Level: Lower Elementary, Upper Elementary

Guiding Question/Phenomenon: *Why can't any bear live anywhere? What adaptations help them live in their unique environments?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop models to describe phenomena ● Students work in teams to create a poster to show ecosystem components where each kind of bear lives.	**LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. ● Students discuss species adaptations of the polar bear, grizzly bear, and black bear. **LS3.B: Variation of Traits** 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. ● Students discuss how inherited information and environmental factors affect each bear's traits.	**Systems and System Models** A system can be described in terms of its components and their interactions. ● Students include habitat components on their posters to show what and how the bears depend on to survive.
Performance Expectation(s): **3-LS4-2**. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. [Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.] **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. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]		
Additional PEs, SEPs, DCIs, and CCCs		

What You Wear Is What They Were

Describe materials that humans have used for clothing, and consider the impact on wildlife and the environment. Construct and decorate a coat out of paper to represent different types of clothing materials used.

Page: 304
Grade Level: Lower Elementary, Upper Elementary, Middle School

Guiding Question/Phenomenon: *Have you ever thought about what your clothing is really made of?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Use a model to represent relationships in the natural world ● Students decorate paper bag 'coats' to represent the natural resources used to make clothing.	**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. ● Students identify the sources of clothing materials in terms of renewable/ nonrenewable. Older students may discuss impacts on the environment.	**Cause and Effect** Events have causes that generate observable patterns ● Students discuss the effects on plants and animals and/or other environmental impacts clothing materials have made.
Performance Expectation(s): **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.* [Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.]		
Additional PEs, SEPs, DCIs, and CCCs		

What's That, Habitat?

Sort daily items into categories of "wants" and "needs" to examine what humans and wildlife need to survive.

Page: 65
Grade Level: Lower Elementary, Upper Elementary

Guiding Question/Phenomenon: *What are our basic needs? Do we 'need' everything we 'want'?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Use a model to represent relationships in the natural world ● Students pull items from a bag and sort them into a Venn Diagram of humans' needs and wants.	**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 ● Students discuss the items in the bag as they pertain to basic human needs.	**Systems and System Models** Systems in the natural and designed world have parts that work together ● Students discuss how the proper arrangements of resources within a space are necessary for survival, and for wildlife constitutes a habitat.

Performance Expectation(s):
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. [Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas, and grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]

Additional PEs, SEPs, DCIs, and CCCs *that are easily identified and to which the activity correlates with the use of extensions or minor activity modification. For each of these additional correlations, provide a very brief text to identify the relevant extension or to describe the modification. While AFWA does not anticipate additional correlations for most activities, there may be opportunities for the contractor to easily identify and document some additional correlations.*

What's Wild?

Identify, classify, and make collages of wild versus domesticated animals.

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Grade Level: Lower Elementary, Upper Elementary

Guiding Question/Phenomenon: *What makes some animals wild and some animals tame?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop a model to represent patterns in the natural world**.** ● Students sort pictures of wild and domesticated animals and glue the pictures on poster board to make a collage. **Obtaining, Evaluating, and Communicating Information** Obtain and combine information from books and other reliable media to explain phenomena. ● Students who read "A Day in the Life" stories will identify differences in a pet dog and wild squirrel.	**LS4.D: Biodiversity and Humans** There are many different kinds of living things in any area, and they exist in different places on land and in water. ● Students discuss a diversity of wild and domesticated animals. **LS3.B: Variation of Traits** 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. ● Students discuss how the environment can determine if an animal is wild or domesticated (tame).	**Patterns** Similarities and differences in patterns can be used to sort and classify natural phenomena ● Students discuss similarities and differences in wild and domesticated animals.

Performance Expectation(s):

2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats. [Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]

3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment. [Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.]

Additional PEs, SEPs, DCIs, and CCCs

Which Niche?

Read ecosystem cards to identify and compare species' niches; then go outside to make observations of wildlife and various niches they fill.

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Grade Level: Upper Elementary, Middle School

Guiding Question/Phenomenon: *What roles do organisms play in the natural environment near you?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyze and interpret data to provide evidence for phenomena. ● In Part II: Field Investigations, students analyze the data collected from their observations to describe the niche of organisms in their community. **Obtaining, Evaluating and Communicating information** 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). ● Students use the information provided to compare and contrast niches in different ecosystems.	**LS2.A: Interdependent Relationships in Ecosystems** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction ● Students learn both from the ecosystem cards and their observations that an organism's niche includes interactions with living and nonliving factors. **LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem ● Students also learn that an organism's niche is directly related to their role in the food web.	**Patterns** Graphs, charts and images can be used to identify patterns in data. ● Students look for patterns in the observations to learn about the niche of different organisms. **Systems and System Models** Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. ● Students learn about organisms' roles in the functioning of different ecosystems.
Performance Expectation(s): **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. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and numbers of organisms in ecosystems during periods of abundant and scarce resources.] **MS-LS2-3.** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]		
Additional PEs, SEPs, DCIs, and CCCs		

Wild Words

Create your own nature journal and analyze the writings of well-known naturalists.

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Grade Level: Upper Elementary, Middle School, High School

Guiding Question/Phenomenon: *Why is it useful to record your observations of nature?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating and Communicating Information (MS) 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). ● Participants obtain information about naturalists' journal writing. They also communicate information through their own journals.	N/A	**Patterns** (3-5) Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products. ● Students use patterns to analyze naturalists' journals and when they compare those journals with their own.
Performance Expectation(s): N/A		
Additional PEs, SEPs, DCIs, and CCCs This activity also correlates well with the same SEP at the 3-5 level.		

Wildlife and the Environment: Community Survey

Design and conduct a survey to determine views community members hold on issues relating to natural resources.

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Grade Level: Middle School, High School

Guiding Question/Phenomenon: *What are the important wildlife or environmental issues in your community and how do people feel about them?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating and Communicating Information Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. ● Students use a variety of sources of information to identify and research wildlife or environmental issues in their community. **Analyzing and Interpreting Data** Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. ● Students analyze and interpret survey data to determine community attitudes and recommendations.	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. ● Students investigate their communities' attitudes and concerns about wildlife and/or other environmental issues	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. ● When students analyze their survey data, they will be using patterns to discern community attitudes and recommendations.
Performance Expectation(s): **HS-LS2-7.** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]		
Additional PEs, SEPs, DCIs, and CCCs This activity also correlates well with the same SEPs and CCCs at the middle grades level.		

World Travelers

Plan and carry out an investigation in your schoolyard to identify native and nonnative plant populations, examining the positive and negative effects of their presence.

Page: 404
Grade Level: Middle School, High School

Guiding Question/Phenomenon: *How can you determine what kinds of plants are in your schoolyard and if these plants are native species?*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. ● After discussing native and non-native plants found in the community and a trip to the study site, students develop a researchable question about the types of plants found there. **Planning and Carrying Out Investigations** Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. ● Students plan and implement a scientific investigation based on their researchable question **Analyzing and Interpreting Data** Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. ● Students organize their data and analyze it in order to answer their research question. **Constructing Explanations and Designing Solutions** Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. ● Students use their data to write a clear statement answering their research question.	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. ● Students plan and implement an investigation to learn about invasive species in their community	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. ● When students analyze their data, they will be looking for patterns to help answer their research question.
Performance Expectation(s): **HS-LS2-7.** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]		
Additional PEs, SEPs, DCIs, and CCCs This activity also correlates well with the same SEPs and CCCs at the middle grades level.		