3rd Grade – Thematic Model – Bundle 4
Changes to Organisms' Environments

This is the fourth bundle of the 3rd Grade Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 4 Question: This bundle is assembled to address the question "how does the climate affect organisms?"

Summary
The bundle organizes performance expectations with a focus on helping students build understanding that environments change over time and that those changes can affect organisms. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and recognize that instruction is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs
The idea that some kinds of plants and animals that once lived on Earth are no longer found anywhere (LS4.A as in 3-LS4-1) connects to the idea that 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 (LS2.C as in 3-LS4-4). And environmental changes can connect to the concepts that climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years (ESS2.D as in 3-ESS2-2) and that a variety of natural hazards result from natural processes (ESS3.B as in 3-ESS3-1).

The engineering design idea that the success of a designed solution is determined by considering the desired features of a solution, or criteria (ETS1.A as in 3-5-ETS1-1) could connect to multiple science concepts such as that humans cannot eliminate natural hazards but can take steps to reduce their impacts (ESS3.B as in 3-ESS3-1) and that populations live in a variety of habitats, and change in those habitats affects the organisms living there (LS4.D as in 3-LS4-4). The first connection could be made by having students determine the criteria for reducing the impact of a natural hazard, and the second connection could be made by having students consider the criteria for mitigating the negative effects on organisms when a habitat changes. In either case, connections can also be made to the engineering design idea that research on a problem should be carried out before beginning to design a solution (ETS1.B as in 3-5-ETS1-2).

Bundle Science and Engineering Practices
Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of asking questions and defining problems (3-5-ETS1-1), analyzing and interpreting data (3-LS4-1), constructing explanations and designing solutions (3-5-ETS1-2), engaging in argument from evidence (3-LS4-4 and 3-ESS3-1), and obtaining, evaluating, and communicating information (3-ESS2-2). Many other practice elements can be used in instruction.

Bundle Crosscutting Concepts
Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the crosscutting concepts of Patterns (3-ESS2-2), Cause and Effect (3-ESS3-1), Scale, Proportion, and Quantity (3-LS4-1), and Systems and System Models (3-LS4-4). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations 3-5-ETS1-2 is partially assessable.	3-LS4-1 **Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.** [Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.] [*Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.*] 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.*] 3-ESS2-2 **Obtain and combine information to describe climates in different regions of the world.** 3-ESS3-1 **Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*** [Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lighting rods.] 3-5-ETS1-1 **Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.** 3-5-ETS1-2 **Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**
Example Phenomena	Fossils from sea creatures can be found on some hilltops. Houses in Florida often have hurricane shutters.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. Students could *define a simple design problem* [caused by] ***natural hazards*** that can be solved through the development of an object, process, or system and includes several criteria for success and constraints on materials, time, or cost. 3-ESS3-1 **Developing and Using Models** ● Use a model to test cause and effect relationships or interactions concerning the functioning of a natural system. Students could *use a model to test cause and effect relationships between* ***changes in the environment*** [and whether] ***organisms survive and reproduce, move to new locations, move into the transformed environment,*** [or] ***die***. 3-LS4-4 **Planning and Carrying Out Investigations** ● Make predictions about what would happen if a variable changes. Students could *make predictions about what would happen* [to] ***organisms*** *if a variable* [related to the] ***physical characteristics*** [of] ***the environment*** *changes.* 3-LS4-4

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Additional Practices Building to the PEs (Continued)	**Analyzing and Interpreting Data** ● Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns. Students could *represent* ***climate*** *data in various graphical displays reveal patterns*. 3-ESS2-2 **Using Mathematical and Computational Thinking** ● Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems. Students could *describe quantities to address scientific questions* [about the] ***range of an area's typical weather conditions and the extent to which those conditions vary over years***. 3-ESS2-2 **Constructing Explanations and Designing Solutions** ● Identify the evidence that supports particular points in an explanation. Students could *identify the evidence that supports particular points in an explanation* [that] ***when the environment changes in ways that affect a place's physical characteristics some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die***. 3-LS4-4 **Engaging in Argument from Evidence** ● Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. Students could respectfully provide critiques to peers about a proposed explanation ***about the types of organisms that lived long ago and also about the nature of their environments*** by citing relevant evidence and posing specific questions. 3-LS4-1 **Obtaining, Evaluating, and Communicating Information** ● Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts. Students could *orally communicate scientific and technical information* [about the] ***variety of natural hazards*** [that] ***result from natural processes*** [and the] ***steps humans can take to reduce their impacts***. 3-ESS3-1
Additional Crosscutting Concepts Building to the PEs	**Structure and Function** ● Substructures have shapes and parts that serve functions. Students can look at the *substructures* [of] ***fossils***, [including their] *shapes and parts that serve functions,* [for] ***evidence about the types of organisms that lived long ago and about the nature of their environments***. 3-LS4-1 **Systems and System Models** ● A system can be described in terms of its components and their interactions. Students could describe the ***steps humans take to reduce the impacts of a variety of natural hazards, which result from natural processes***, *as components of a system*. 3-ESS3-1

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Additional Crosscutting Concepts Building to the PEs (Continued)	**Stability and Change** ● Change is measured in terms of differences over time and may occur at different rates. Students could describe the *differences* [of an] ***environment*** *over time*—[as] *changes that may occur at different rates*. 3-LS4-4
Additional Connections to Nature of Science	**Scientific Knowledge is Open to Revision in Light of New Evidence** ● Science explanations can change based on new evidence. Students could identify [an example of] how *science explanations* ***about the types of organisms that lived long ago*** *could change* [if] *a new* ***fossil*** [were found]. 3-LS4-1 **Science is a Way of Knowing** ● Science is a way of knowing that is used by many people. Students could describe how we use *science as a way of knowing* [about the] *range of an area's typical weather conditions*. 3-ESS3-1

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3-LS4-1 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

3-LS4-1. **Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.** [Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.] [*Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data

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

- Analyze and interpret data to make sense of phenomena using logical reasoning.

Disciplinary Core Ideas

LS4.A: Evidence of Common Ancestry and Diversity

- Some kinds of plants and animals that once lived on Earth are no longer found anywhere. *(Note: moved from K-2)*
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.

Crosscutting Concepts

Scale, Proportion, and Quantity

- Observable phenomena exist from very short to very long time periods.

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Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes consistent patterns in natural systems.

Observable features of the student performance by the end of the grade:

1	Organizing data		
	a	Students use graphical displays (e.g., table, chart, graph) to organize the given data, including data about:	
		i.	Fossils of animals (e.g., information on type, size, type of land on which it was found).
		ii.	Fossils of plants (e.g., information on type, size, type of land on which it was found).
		iii.	The relative ages of fossils (e.g., from a very long time ago).
		iv.	Existence of modern counterparts to the fossilized plants and animals and information on where they currently live.
2	Identifying relationships		
	a	Students identify and describe* relationships in the data, including:	
		i.	That fossils represent plants and animals that lived long ago.
		ii.	The relationships between the fossils of organisms and the environments in which they lived (e.g., marine organisms, like fish, must have lived in water environments).
		iii.	The relationships between types of fossils (e.g., those of marine animals) and the current environments where similar organisms are found.
		iv.	That some fossils represent organisms that lived long ago and have no modern counterparts.
		v.	The relationships between fossils of organisms that lived long ago and their modern counterparts.
		vi.	The relationships between existing animals and the environments in which they currently live.
3	Interpreting data		
	a	Students describe* that:	
		i.	Fossils provide evidence of organisms that lived long ago but have become extinct (e.g., dinosaurs, mammoths, other organisms that have no clear modern counterpart).
		ii.	Features of fossils provide evidence of organisms that lived long ago and of what types of environments those organisms must have lived in (e.g., fossilized seashells indicate shelled organisms that lived in aquatic environments).

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		iii.	By comparing data about where fossils are found and what those environments are like, fossilized plants and animals can be used to provide evidence that some environments look very different now than they did a long time ago (e.g., fossilized seashells found on land that is now dry suggest that the area in which those fossils were found used to be aquatic; tropical plant fossils found in Antarctica, where tropical plants cannot live today, suggests that the area used to be tropical).

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3-LS4-4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

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.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence

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

- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Disciplinary Core Ideas

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.*(secondary)*

LS4.D: Biodiversity and Humans

- Populations live in a variety of habitats, and change in those habitats affects the organisms living there.

Crosscutting Concepts

Systems and System Models

- A system can be described in terms of its components and their interactions.

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Connections to Engineering, Technology, and Applications of Science

Interdependence of Engineering, Technology, and Science on Society and the Natural World

- Knowledge of relevant scientific concepts and research findings is important in engineering.

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students make a claim about the merit of a given solution to a problem that is caused when the environment changes, which results in changes in the types of plants and animals that live there.
2	Identifying scientific evidence	
	a	Students describe* the given evidence about how the solution meets the given criteria and constraints. This evidence includes:
		i. A system of plants, animals, and a given environment within which they live before the given environmental change occurs.
		ii. A given change in the environment.
		iii. How the change in the given environment causes a problem for the existing plants and animals living within that area.
		iv. The effect of the solution on the plants and animals within the environment.
		v. The resulting changes to plants and animals living within that changed environment, after the solution has been implemented.
3	Evaluating and critiquing evidence	
	a	Students evaluate the solution to the problem to determine the merit of the solution. Students describe* how well the proposed solution meets the given criteria and constraints to reduce the impact of the problem created by the environmental change in the system, including:
		i. How well the proposed solution meets the given criteria and constraints to reduce the impact of the problem created by the environmental change in the system, including:
		1. How the solution makes changes to one part (e.g., a feature of the environment) of the system, affecting the other parts of the system (e.g., plants and animals).
		2. How the solution affects plants and animals.

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	b	Students evaluate the evidence to determine whether it is relevant to and supports the claim.
	c	Students describe* whether the given evidence is sufficient to support the claim, and whether additional evidence is needed.

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3-ESS2-2 Earth's Systems

Students who demonstrate understanding can:

3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

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.

Disciplinary Core Ideas

ESS2.D: Weather and Climate

- Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.

Crosscutting Concepts

Patterns

- Patterns of change can be used to make predictions.

Observable features of the student performance by the end of the grade:

1	Obtaining information	
	a	Students use books and other reliable media to gather information about:
		i. Climates in different regions of the world (e.g., equatorial, polar, coastal, mid-continental).
		ii. Variations in climates within different regions of the world (e.g., variations could include an area's average temperatures and precipitation during various months over several years or an area's average rainfall and temperatures during the rainy season over several years).
2	Evaluating information	
	a	Students combine obtained information to provide evidence about the climate pattern in a region that can be used to make predictions about typical weather conditions in that region.
3	Communicating information	
	a	Students use the information they obtained and combined to describe*:
		i. Climates in different regions of the world.
		ii. Examples of how patterns in climate could be used to predict typical weather conditions.
		iii. That climate can vary over years in different regions of the world.

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3-ESS3-1 Earth and Human Activity

Students who demonstrate understanding can:

3-ESS3-1. **Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*** [Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lighting rods.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence

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

- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Disciplinary Core Ideas

ESS3.B: Natural Hazards

- A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. *(Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.)*

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change.

Connections to Engineering, Technology, and Applications of Science

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

- Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones).

Connections to Nature of Science

Science is a Human Endeavor

- Science affects everyday life.

Observable features of the student performance by the end of the grade:		
1	Supported claims	
	a	Students make a claim about the merit of a given design solution that reduces the impact of a weather-related hazard.
2	Identifying scientific evidence	
	a	Students describe* the given evidence about the design solution, including evidence about:
		i. The given weather-related hazard (e.g., heavy rain or snow, strong winds, lightning, flooding along river banks).
		ii. Problems caused by the weather related hazard (e.g., heavy rains cause flooding, lightning causes fires).
		iii. How the proposed solution addresses the problem (e.g., dams and levees are designed to control flooding, lightning rods reduce the chance of fires) [note: mechanisms are limited to simple observable relationships that rely on logical reasoning].
3	Evaluating and critiquing evidence	
	a	Students evaluate the evidence using given criteria and constraints to determine:
		i. How the proposed solution addresses the problem, including the impact of the weather-related hazard after the design solution has been implemented.
		ii. The merits of a given solution in reducing the impact of a weather-related hazard (i.e., whether the design solution meets the given criteria and constraints].
		iii. The benefits and risks a given solution poses when responding to the societal demand to reduce the impact of a hazard.

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3-5-ETS1-1 Engineering Design

Students who demonstrate understanding can:

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems

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

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.

Crosscutting Concepts

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

- People's needs and wants change over time, as do their demands for new and improved technologies.

Observable features of the student performance by the end of the grade:		
1	Identifying the problem to be solved	
	a	Students use given scientific information and information about a situation or phenomenon to define a simple design problem that includes responding to a need or want.
	b	The problem students define is one that can be solved with the development of a new or improved object, tool, process, or system.
	c	Students describe* that people's needs and wants change over time.
2	Defining the boundaries of the system	
	a	Students define the limits within which the problem will be addressed, which includes addressing something people want and need at the current time.
3	Defining the criteria and constraints	
	a	Based on the situation people want to change, students specify criteria (required features) of a successful solution.
	b	Students describe* the constraints or limitations on their design, which may include:
		i. Cost.
		ii. Materials.
		iii. Time.

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3-5-ETS1-2 Engineering Design

Students who demonstrate understanding can:

3-5-ETS1-2. **Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions

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

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.

Disciplinary Core Ideas

ETS1.B: Developing Possible Solutions

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.

Crosscutting Concepts

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

- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.

Observable features of the student performance by the end of the grade:		
1	Using scientific knowledge to generate design solutions	
	a	Students use grade-appropriate information from research about a given problem, including the causes and effects of the problem and relevant scientific information.
	b	Students generate at least two possible solutions to the problem based on scientific information and understanding of the problem.
	c	Students specify how each design solution solves the problem.
	d	Students share ideas and findings with others about design solutions to generate a variety of possible solutions.
	e	Students describe* the necessary steps for designing a solution to a problem, including conducting research and communicating with others throughout the design process to improve the design [note: emphasis is on what is necessary for designing solutions, not on a step-wise process].
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe*:
		i. The given criteria (required features) and constraints (limits) for the solutions, including increasing benefits, decreasing risks/costs, and meeting societal demands as appropriate.
		ii. How the criteria and constraints will be used to generate and test the design solutions.
3	Evaluating potential solutions	
	a	Students test each solution under a range of likely conditions and gather data to determine how well the solutions meet the criteria and constraints of the problem.
	b	Students use the collected data to compare solutions based on how well each solution meets the criteria and constraints of the problem.

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