Achieve

NGSS Sample Bundles

Volume A:

K-5

NEXT GENERATION SCIENCE STANDARDS

For States, By States

Example Bundles Guide

The Next Generation Science Standards (NGSS) identify what students should know and be able to do in science in order to be ready for college and careers. Because the NGSS are academic standards, they do not describe curriculum or the lessons and activities in which students engage during a course or year of instruction. Curriculum designed for the NGSS, including lesson plans, activities, scope and sequence documents, and assessments, is needed for classroom instruction.

The NGSS PEs are not intended to be taught or assessed one-at-a-time, or in isolation. Therefore, one helpful approach to beginning the translation of the NGSS into curriculum and instruction is to "bundle" standards together, arranging them in groups for instruction. Bundles of standards can be helpful to show connections between ideas, facilitate phenomenon-driven instruction, and promote efficient use of instructional time. They can form end goals for instruction at a similar scale to that of traditional curricular units. Several bundles can be assembled such that they coherently address all of the standards found within a grade level of instruction; when this process is done strategically, the bundles can form the outline of an entire course.

This Example Bundles Guide explains, in detail, considerations related to bundling. The Guide accompanies a set of concrete examples within each grade level K–12 of what it can look like when several related standards are bundled together. They are by no means the only way that standards could be bundled together, but they are designed to be illustrative of the process of bundling and the types of thinking necessary in building bundles that capitalize on the connections between standards. Curriculum developers can use these example bundles in thinking about how they will create and arrange bundles in a way that coherently builds student proficiency in all three dimensions of the standards.

This Guide is intended to enable a user to read and navigate the Example Bundles documents. Another focus is to explain how to use the principle of "bundling." These two ideas overlap a great deal. Users that are working to gain a deep understanding of bundling should review these documents following this sequence: First, ensure you are very familiar with the NGSS and the National Research Council's (NRC) *Framework for K–12 Science Education*, on which the NGSS were based. Then, read through this Guide and at least one Example Bundle course (a model for one instructional year) for an introduction to bundling.

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Key Definitions of This Guide

A number of terms have a technical significance in this Guide that goes beyond their typical use in the education community. Please review this section before moving on to other parts of the Guide.

Bundle - A bundle is a group of performance expectations that have been brought together to organize instruction. A bundle in this document is intended to match the scale of the instructional "unit," as it is commonly thought of in many education settings. Additionally, within the Example Bundles, a bundle document identifies an underlying rationale and assumptions about the relationships between the performance expectations that have been grouped together.

Bundling - The iterative process of developing a bundle of performance expectations for purposes of both instruction and assessment.

CCC - Crosscutting Concept. There are seven crosscutting concepts in the NGSS, described in the *Framework for K-12 Science Education*. The progression for each crosscutting concept across the grade bands is outlined in NGSS Appendix G, with the associated elements identified in the foundation box of each performance expectation.

Course - A course is a group of bundles that collectively address all of the performance expectations in a grade level.

Course set - A course set is a set of courses that collectively address all of the performance expectations in the middle school (6–8) or high school (9–12) grade bands.

DCI - Disciplinary Core Idea. The DCIs are defined by the *Framework for K-12 Science Education*, outlined in NGSS Appendix E, with the associated elements identified in the foundation box of each performance expectation.

ED - Engineering Design. This is the title of one of the Engineering, Technology, and Applications of Science Disciplinary Core Ideas from the *Framework for K-12 Science Education*.

ETS - Engineering, Technology, and Applications of Science. This is one of the four content categories of the Disciplinary Core Ideas in the NRC Framework and the NGSS.

Grade band - In the NRC *Framework* and the NGSS, a grade band is a set of grades for elementary grades (K–2 and 3–5), middle school (6–8) or high school (9–12). The middle and high school grade bands do not indicate a sequence within the band, but they do organize all of the performance expectations that should be addressed for that band. In the elementary grades, however, the NGSS describes which performance expectations are at each grade level.

NGSS Element - An NGSS element is a grade band-specific part of a Disciplinary Core Idea, Crosscutting Concept, or Science and Engineering Practices[1]. NGSS elements are often formatted with bullets and are identified by the title of a DCI, SEP, CCC, in the foundation box of a performance expectation.

NOS - Nature of Science Statement. There are eight categories of understandings about the nature of science that are outlined in NGSS Appendix H, and identified in the foundation boxes of select performance expectations. Four of the eight categories are integrated within Science and Engineering Practices and four are associated within Crosscutting Concepts.

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[1] Anyone unfamiliar with the components of the NGSS is encouraged to review "How to Read the Standards" resources and videos on www.nextgenscience.org, and to become deeply familiar with the NGSS and the NRC Framework before using the Example Bundle documents.

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NRC *Framework* - *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (NRC, 2012)

PE - Performance Expectations. These are the form in which the NGSS is written – as student performance expectations.

Phenomenon - Something observable that happens in the real world, whether natural or man-made. Student inquiry about phenomena—together with student-driven designing of solutions to problems—should drive instruction.

SEP - Science and Engineering Practice. There are eight practices, described by the *Framework for K-12 Science Education*. The progression for each SEP across the grade bands is outlined in NGSS Appendix F, with the associated elements identified in the foundation box of each performance expectation.

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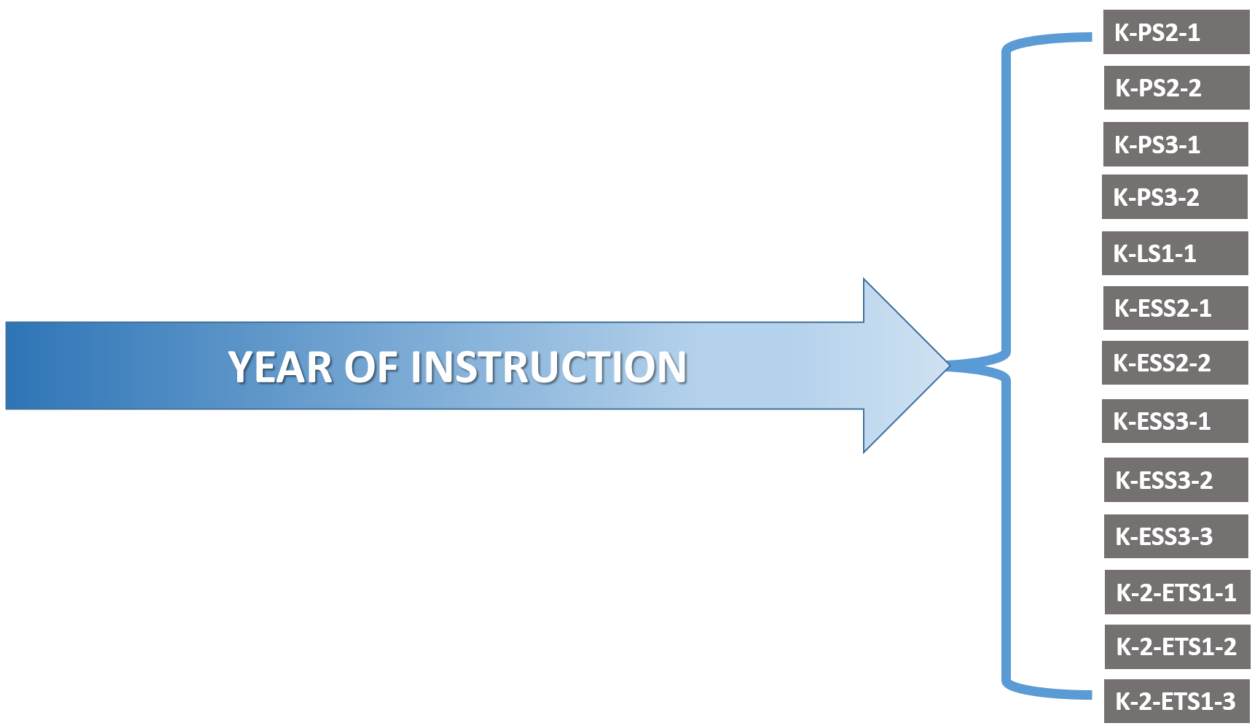
Why is Bundling Important?

The Need

As states, districts, and educators implement the Next Generation Science Standards (NGSS), a critical step in their effort is translating the grade level (or grade band) endpoint standards into units of instruction that build all three dimensions of the NGSS over the course of a year or over multiple years. In the NGSS, the standards are often called performance expectations (PEs), and instruction can be organized in many different ways throughout a year to help prepare students to meet or exceed these expectations *by the end of the year*. Figures 1, 2, and 3 below represent what this could mean for the Kindergarten PEs of the NGSS.

Figure 1: *The NGSS Kindergarten PEs are all written as expectations of what students should be ready to perform* by the end *of their Kindergarten experience.*



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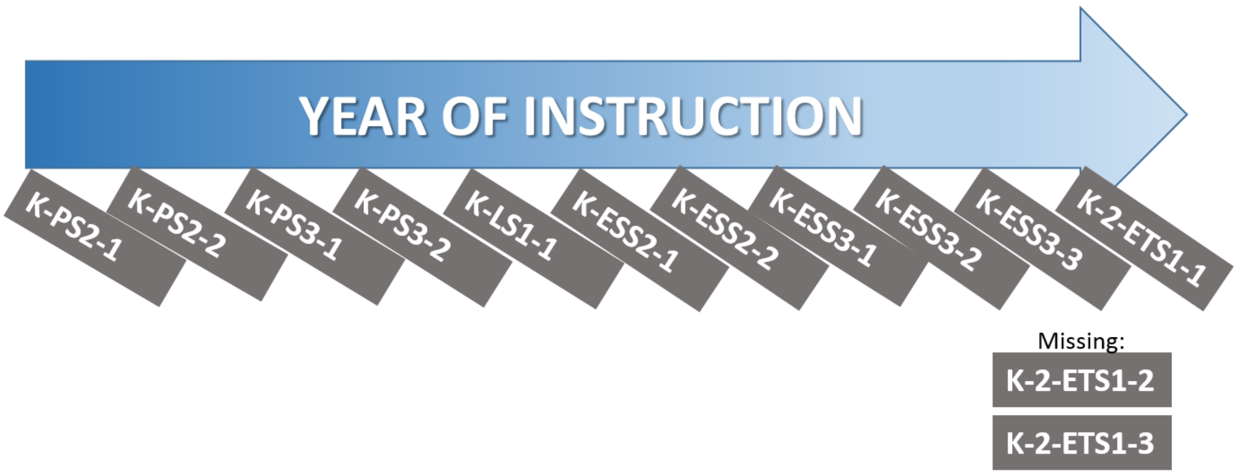
The year or years of instruction leading to PEs is typically organized into units and lessons. One way to begin to organize instruction might be to target the PEs individually, sequencing them one at a time. However, this approach often leads to instruction taught without a cohesive storyline, and leads teachers and students to rush through content and entirely miss instruction on PEs sequenced toward the end of the year.

Figure 2: *What a Kindergarten lesson sequence might look like if instruction is organized for one PE at a time.*



The NGSS PEs are not intended to be taught or assessed one-at-a-time, or in isolation. Therefore, bundling PEs can be a useful step in organizing instruction. Curriculum developers can group PEs together in manageable arrangements to help students and teachers look for the connections between ideas that naturally exist in the sciences. Instruction that builds toward a bundle of related PEs simultaneously will also help students develop a more complete explanation of phenomena. Once these arrangements—or bundles—are developed, they may be used as the unit endpoints from which to design instruction and classroom assessment[2].

[2] Classroom assessment involves both summative and formative assessment. However the Example Bundles provide information about the end goals of instruction as opposed to interim steps. Comments on the development of formative classroom assessment and other aspects of assessment, including the design of implementation of assessment systems, are topics that exist outside of the scope of these documents.

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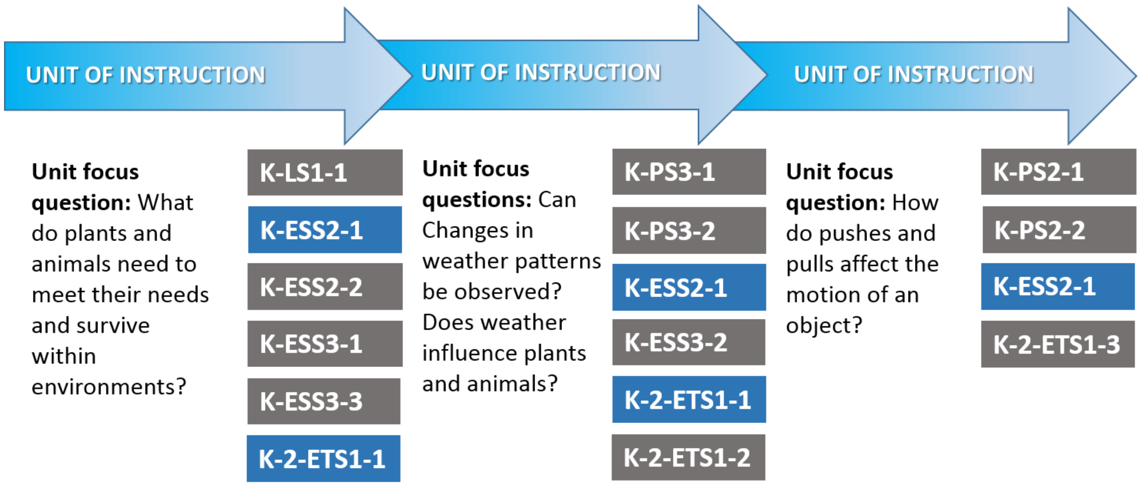
Figure 3: *What a Kindergarten unit sequence might look like with a series of PE bundles over the course of a year. PEs in blue represent PEs that are only partially met in a particular unit.*



The Example Bundles were written to demonstrate some of the many ways PEs can be grouped together to support the development of a cohesive instructional unit. Additional examples of NGSS bundles are already available in the arrangements of the NGSS; the PEs were published in two different types of arrangements: by topic and by Disciplinary Core Idea (DCI). There is no one right way to bundle PEs, so the Example Bundles are just that—examples. Curriculum developers and others designing instructional units can be creative in their approach. The inclusion of multiple instructional-year models for each grade level in K–5 and each grade band in the secondary levels emphasizes the diverse possibilities available to teachers.

The Example Bundles also do not emphasize or include all of the aspects of developing three-dimensional instruction and curriculum. After standards are bundled, additional work must be done to develop lessons, activities, and assessments. Other resources are available that address important aspects of curriculum development and should be consulted before developing curriculum.[3]

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Who Can Use the Example Bundles?

The Example Bundles were created for curriculum designers and educators who develop curriculum, who have prior knowledge of the NGSS and the NRC *Framework*, and who are looking for a resource that will help them in the development of curricula for any grade level. A Suggestions for Use of the Example Bundles section is provided later in this Guide.

[3] See Appendix 2: Further Reading on Three-Dimensional Instruction

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Getting Around the Documents

The Example Bundles documents are organized by courses, which are groups of bundles that collectively address all of the PEs in a grade level[4]. Each Example Bundle Course contains:

1. A Course Summary – a document that introduces a user to the themes of the year-long course, and briefly describes the way those themes are derived from the arrangement of the PEs within the bundles of the course.
2. A Course Flow Chart – a visual example of how the writers connected DCIs across bundles in a course.
3. Several Bundle Documents (one for each bundle of PEs) – each document includes a narrative about the connections between bundle PEs, example phenomena for the bundle, and additional science and engineering practices (SEPs), crosscutting concepts (CCCs), and nature of science (NOS) components that can be used in instruction toward the bundle.

Course Summary

Course Summaries begin with a narrative and rationale that explains the content overview for the year, the rationale for how the PEs were bundled throughout the year, and, for middle and high school courses, the source[4] of the year end-points for middle and high school.

The second part of the Course Summary includes one column for each bundle, indicating the number of example bundles in the course, the PEs grouped within those bundles, and a rough estimate of instructional duration (in weeks) for each bundle.

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[4] In grades K–5, the NGSS were written as grade-level PEs, so the Example Bundles writers started with the PEs as the year endpoints. In grades 6–12, the NGSS were written as grade-banded PEs, so the Example Bundles writers started with various arrangements of the middle and high school PEs listed in or modified from NGSS Appendix K. For example, some of the middle school Example Bundles used the California Conceptual Progressions Course Map (page 20–21 of NGSS Appendix K) as the guide for grade level endpoints, because it was the first state-specific course map to be developed. Each Course Summary document describes the origin of its end-of-year endpoints.

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Figure 4: *A Course Summary for Kindergarten*

Kindergarten Topic Model		
Narrative and Rationale: The three bundles in this Kindergarten model are characterized by the overarching ideas that weather, sunlight, and the needs of living things affect us daily—ideas that apply to the physical, life, and Earth and space sciences, as well as engineering. Bundle 1 centers on a guiding question about pushes and pulls on objects and their effects. Bundle 2 centers on a guiding question about the needs of plants and animals for food, water, and sunlight to survive. Bundle 3 centers on a guiding question about patterns and the effects of sunlight. While this framework is arranged by topic, the study of weather occurs throughout the year, over time. In Kindergarten, students begin to build their understanding of the Crosscutting Concepts (CCCs) of patterns and the relationship between cause and effect in a logical progression over time. This model also introduces students to the Science and Engineering Practices (SEPs). It places special emphasis on planning and carrying out investigations, analyzing and interpreting data, engaging in argument from evidence, and constructing explanations and designing solutions. However, additional SEPs should be used throughout instruction. The SEPs contribute to students' understanding of both the CCCs and the Disciplinary Core Ideas (DCIs) they explore in Kindergarten. Students become familiar with SEPs over the course of the year, and the level of sophistication at which they are able to engage in the SEPs increases over time.		
Bundle 1: How do objects move and what happens when they interact? **~4 weeks**	**Bundle 2:** What is the relationship between the needs of different plants and animals and the places they live? **~18 weeks**	**Bundle 3:** What can we observe about sunlight? **~14 weeks**
K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. **K-PS2-2**. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.* **K-ESS2-1**. Use and share observations of local weather conditions to describe patterns over time. [1] **K-2-ETS1-3.** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	**K-LS1-1**. Use observations to describe patterns of what plants and animals (including humans) need to survive. **K-ESS2-1.** Use and share observations of local weather conditions to describe patterns over time. [1] **K-ESS2-2.** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. **K-ESS3-1.** Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. **K-ESS3-2.** Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to severe weather. **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.* **K-2-ETS1-1**. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.[1]	**K-PS3-1.** Make observations to determine the effect of sunlight on Earth's surface. **K-PS3-2**. Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.* **K-ESS2-1**. Use and share observations of local weather conditions to describe patterns over time. **K-2-ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

1. The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.

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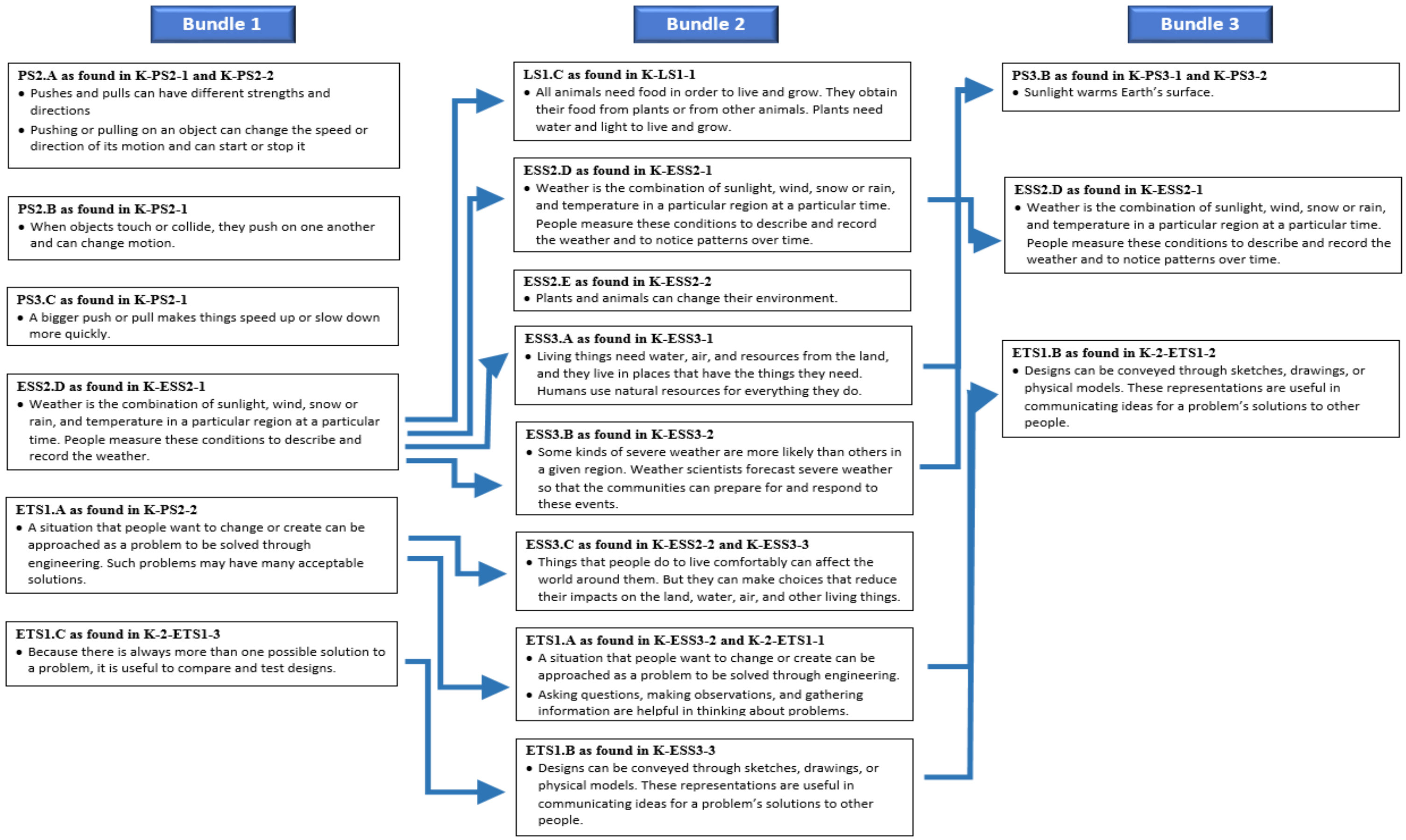
Course Flowchart

The Course Flow Chart shows the DCIs in each bundle of the course, indicates connections *between* the bundles, and provides a one-page overview of the progression of DCIs over the year. When the writers created and ordered the bundles throughout each year, these conceptual progressions were one of their main areas of focus. Therefore DCIs are emphasized in the flowchart because they were the dimension primarily used for the bundling and ordering process. However, SEPs and CCCs are also essential learning goals and components of instruction throughout the year, and are discussed in each bundle document. The DCI connections shown via the arrows in the flowchart are also not exhaustive; many more connections could be made. The arrows show opportunities for conceptual flow—not a sequence of instruction.

Figure 5: *An example of a Course Flowchart for Kindergarten*



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Bundle Document

To demonstrate the rationale behind each PE bundle, each individual bundle document identifies some of the DCI-level connections within the bundle. Also, the Example Bundles make suggestions for using SEPs, CCCs, and NOS elements during instruction. These inclusions show how multiple SEPs and CCCs can be interwoven with DCIs while building students' understandings toward the PEs.

Each Example Bundle Document contains the following components[5]:

Summary - A narrative describing the connections between the DCIs, SEPs, and CCCs in the bundle.

Performance Expectation Chart - A list of each PE in the bundle.

Phenomena – Example engaging phenomena that could be used in instruction.

Additional Practices Building to the PEs – Suggestions for additional SEPs that could be used in instruction toward the bundle PEs. .

Additional Crosscutting Concepts Building to the PEs – Suggestion for additional CCCs that could be used in instruction toward the bundle PEs.

Additional Connections to Nature of Science (NOS) – Suggestion for additional NOS elements that could be used in instruction toward the bundle PEs.

Evidence Statements - Evidence Statements support summative assessment of a given PE or part of a PE, but can be used to inform instruction and formative assessment.

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[5] A full explanation of the styles used in the Example Bundle Documents may found in Appendix 1: Example Bundle Styles and Explanations

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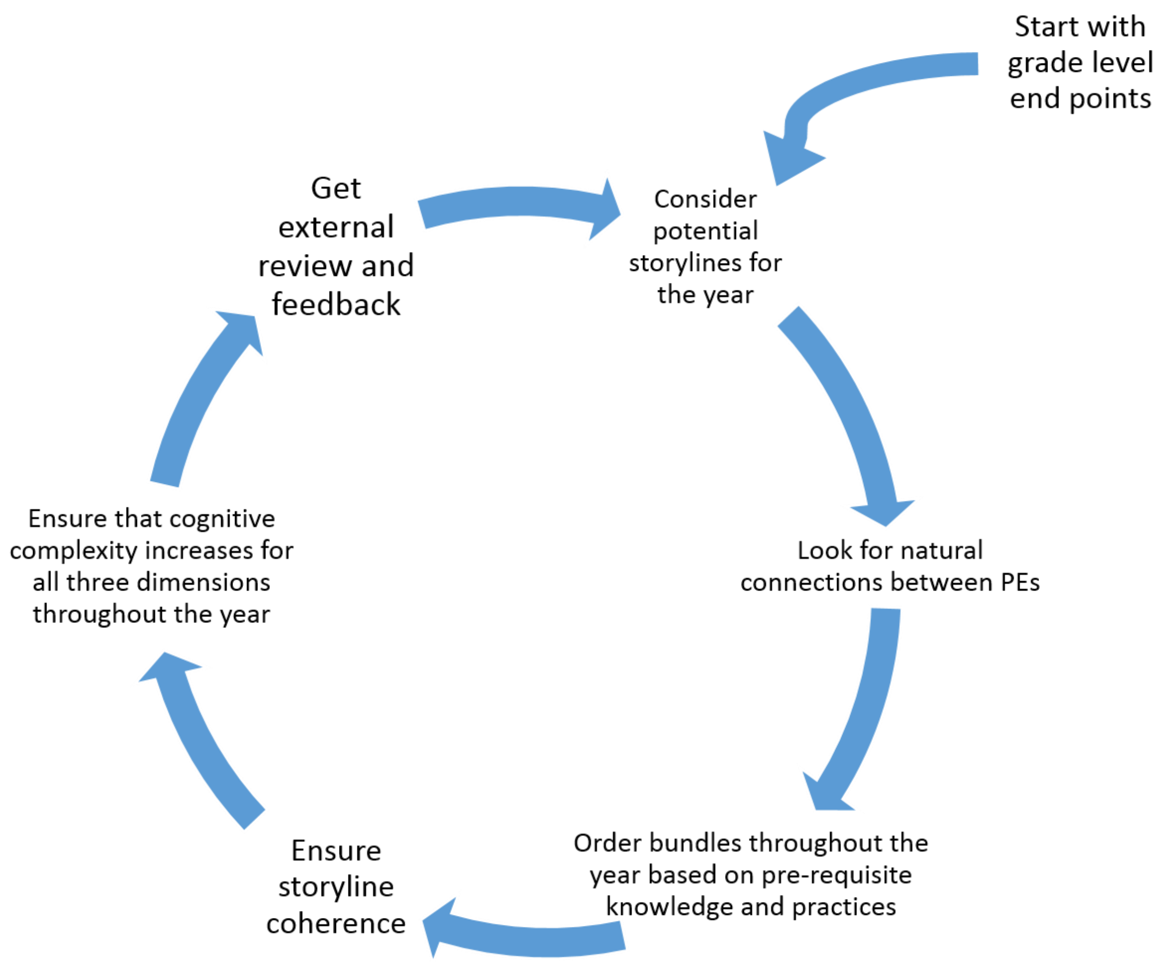
Creating Bundles, Courses, and Course Sets

The Iterative Process of Creating the Example Bundles

In a process facilitated by Achieve, the Example Bundles were developed by teams of experts, including many of the NGSS writers and other educators and scientists[6], to demonstrate the design principles curriculum developers need to understand. For this reason, the idea of presenting multiple examples of course models and bundles was made a key feature of the Example Bundles from the outset.

Figure 6: *A summary of the iterative Example Bundles development process*



As described in the figure above, the Example Bundles were developed in an iterative process, where the writers began by looking at all the PEs in a grade level[4] and considering potential storylines that could help students build toward proficiency on those PEs by the end of the year. They then considered any natural connections between concepts of the different PEs in order to create potential bundles. The Evidence Statements for each PE were often used to help find natural connections between different

[6] A full list of the Example Bundle writers who contributed to this project may be found in the Acknowledgements section.

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PEs. For example, Figure 7 on the next page shows some possible connections between MS-LS1-7 and MS-PS1-5.

Figure 7: *The evidence statements for MS-LS1-7 and MS-PS1-5 are highlighted in purple to show potential connections.*

Evidence Statements for **MS-LS1-7**:

Observable features of the student performance by the end of the course:			
1	Components of the model		
	a	To make sense of a phenomenon, students develop a model in which they identify the relevant components for describing how food molecules are rearranged as matter moves through an organism, including:	
		i.	Molecules of food, which are complex carbon-containing molecules.
		ii.	Oxygen.
		iii.	Energy that is released or absorbed during chemical reactions between food and oxygen.
		iv.	New types of molecules produced through chemical reactions involving food.
2	Relationships		
	a	In the model, students identify and describe the relationships between components, including:	
		i.	During cellular respiration, molecules of food undergo chemical reactions with oxygen, releasing stored energy.
		ii.	The atoms in food are rearranged through chemical reactions to form new molecules.
3	Connections		
	a	Students use the model to describe:	
		i.	The number of each type of atom being the same before and after chemical reactions, indicating that the matter ingested as food is conserved as it moves through an organism to support growth.
		ii.	That all matter (atoms) used by the organism for growth comes from the products of the chemical reactions involving the matter taken in by the organism.
		iii.	Food molecules taken in by the organism are broken down and can then be rearranged to become the molecules that comprise the organism (e.g., the proteins and other molecules in a hamburger can be broken down and used to make a variety of tissues in humans).
		iv.	As food molecules are rearranged, energy is released and can be used to support other processes within the organism.

Evidence Statements for **MS-PS1-5**:

Observable features of the student performance by the end of the course:			
1	Components of the model		
	a	To make sense of a given phenomenon, students develop a model in which they identify the relevant components for a given chemical reaction, including:	
		i.	The types and number of molecules that make up the reactants.
		ii.	The types and number of molecules that make up the products.
2	Relationships		
	a	In the model, students describe relationships between the components, including:	
		i.	Each molecule in each of the reactants is made up of the same type(s) and number of atoms.
		ii.	When a chemical reaction occurs, the atoms that make up the molecules of reactants rearrange and form new molecules (i.e., products).
		iii.	The number and types of atoms that make up the products are equal to the number and types of atoms that make up the reactants.
		iv.	Each type of atom has a specific mass, which is the same for all atoms of that type.
3	Connections		
	a	Students use the model to describe that the atoms that make up the reactants rearrange and come together in different arrangements to form the products of a reaction.	
	b	Students use the model to provide a causal account that mass is conserved during chemical reactions because the number and types of atoms that are in the reactants equal the number and types of atoms that are in the products, and all atoms of the same type have the same mass regardless of the molecule in which they are found.	

Because they were developing multiple models, the writers considered different approaches[7] to connecting PEs, including looking at CCC themes and answering a driving question. Overall, the writers discovered that *bundles that were based on helping students make sense of a particular phenomenon worked the best in the models,* and this is an approach they would recommend for future bundles.

The writers then developed a sequence for the bundles within the instructional year by taking into account prerequisite concepts, storyline coherence, and cognitive complexity of each of the three dimensions. They focused on avoiding the "black box"—when students are asked to memorize content during one instructional unit but only begin to understand it in a later instructional unit. The writers then sought external feedback for the bundles and prototype courses in relation to the shifts of the NGSS and the vision of the NRC *Framework*. After revising the bundles in response to the feedback, the bundles were again externally reviewed and that feedback was incorporated. As schools and districts develop their own bundles, courses, and course sets, a similar iterative process should be employed.

[7] The approach taken to bundle PEs in a specific course model is described in the course summary and is used in the name of the course model (e.g., Kindergarten Thematic Model).

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Creating Your Own Bundles

There are many important considerations for anyone working to create NGSS bundles, courses, and course sets. The assumptions and rationale that guide the formation of a bundle require careful consideration of the needs and characteristics of students in the classroom. The same reflective and collaborative thought process is required for organizing instruction and designing curriculum at every scale, from bundles, to courses, to course sets. Once curriculum developers have created bundles, they can begin to design lesson plans that collectively build toward the bundle—i.e., the instructional unit goals.

The following section outlines some questions to consider when you begin developing your own bundles. These considerations may be encountered in a variety of ways, and at different times in the development process, so they are identified without a specific sequence.

Considerations for Creating Your Own Bundles:

Scale

What is the scale of the curriculum that is being developed—is it a lesson, unit, year, or set of courses across multiple years? Is an individual bundle being created? Are a set of bundles being designed or redesigned to fit within other established curriculum?

Coherence

How are the SEPs, CCCs, and DCIs developed across each grade level and grade band? What do possible storylines suggest about the ways the PEs might be bundled and about the way bundles should be sequenced?

Phenomena

What phenomena might drive engaging lines of inquiry for the students served by this instruction? Will instruction focus on helping students explain a single phenomenon, or will different parts of instruction need to address different phenomena?

Connections

In what ways can CCCs and DCIs be used to explicitly make connections across bundles and between scientific disciplines? Are there other relevant connections between concepts? What about interdisciplinary connections to mathematics or English/language arts (ELA)? At what point in the school year will students be learning the associated mathematics and ELA concepts?

Implementation

What resources are available to support instruction? In what stage is the school or district in its transition to full NGSS implementation? Are the students ready for these DCIs, CCCs, and SEPs?

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Suggestions for Use of the Example Bundles

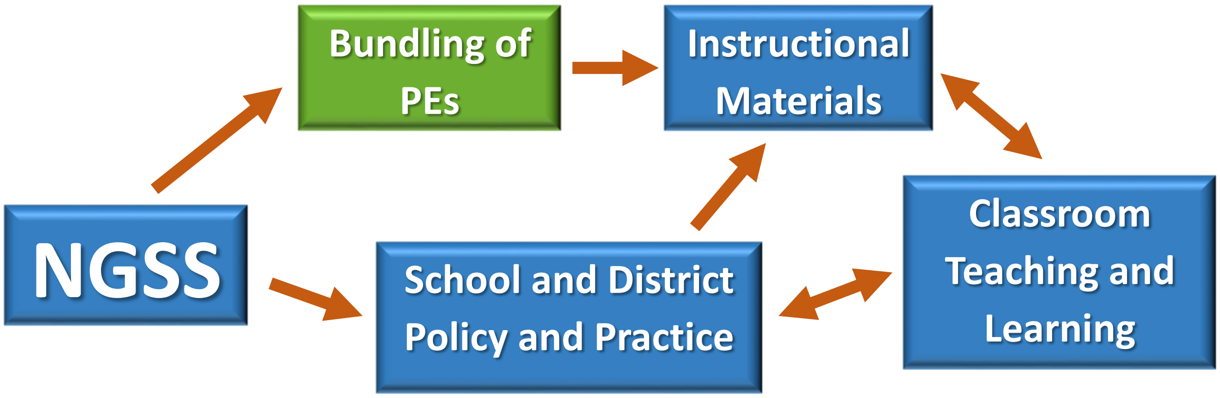

Figure 8: *Bundling is shown as an intermediary step in the instructional materials development process between the NGSS and the use of aligned instructional materials during instruction. Classroom teachers and school and district administrations are also shown as having large influences on the instructional materials that are used. This diagram does not show all the components and relationships in an education system.*

Teachers and School-based Curriculum Developers

Since teachers are ultimately responsible for the instruction in their classrooms, sometimes they are the developers of school- or classroom-based curriculum and instructional materials, or are engaged in the selection of pre-made materials that can serve the needs of their classrooms. In either case, school-based curriculum developers can use the Example Bundles and descriptions of the bundling process as examples of how other teachers have thought about bundling PEs, as a tool for reflecting on their own instructional units, and as a source of ideas for the things to consider when beginning the process of curriculum development. By engaging with the Example Bundles, teachers will also be better prepared to evaluate instructional materials.

School and District Leaders

Bundling is a first step in translating the vision of the NGSS into curriculum and then into instruction. To support the development of NGSS-aligned curriculum, school and district leaders need to be aware of the implications of the NGSS and the process of bundling, even if they are not directly involved in the development process. Though not always directly engaged in curriculum development, school and district leaders enable the development work through their common understanding of the complexity of and time required for the process. District curriculum coordinators and others involved in district curriculum development can use the Example Bundles and descriptions of the bundling process as inspiration for developing their own bundles. Administrators can also use the Example Bundles in other ways, such as for helping teachers better understand the NGSS, or as a tool to help jump start school or district professional learning communities.

Publishers and Commercial Instructional Material Developers

Since the release of the NGSS in 2013, high-quality instructional materials designed for the NGSS have been a critical need in the science education community. Choosing from commercial products is one

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way that schools fill this need. The Example Bundles may hold much of the same value for publishers that they offer to schools and districts by presenting examples of ways to organize the NGSS. Additionally, by illustrating some of the early steps related to developing NGSS-designed curriculum, the Example Bundles can provide publishers with a common language to use with educators.

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Acknowledgements: Example Bundle Authors and Contributors

In a process coordinated by Achieve, the following scientists and education professionals worked together to develop the Example Bundles. The titles below indicate their positions at the time of development.

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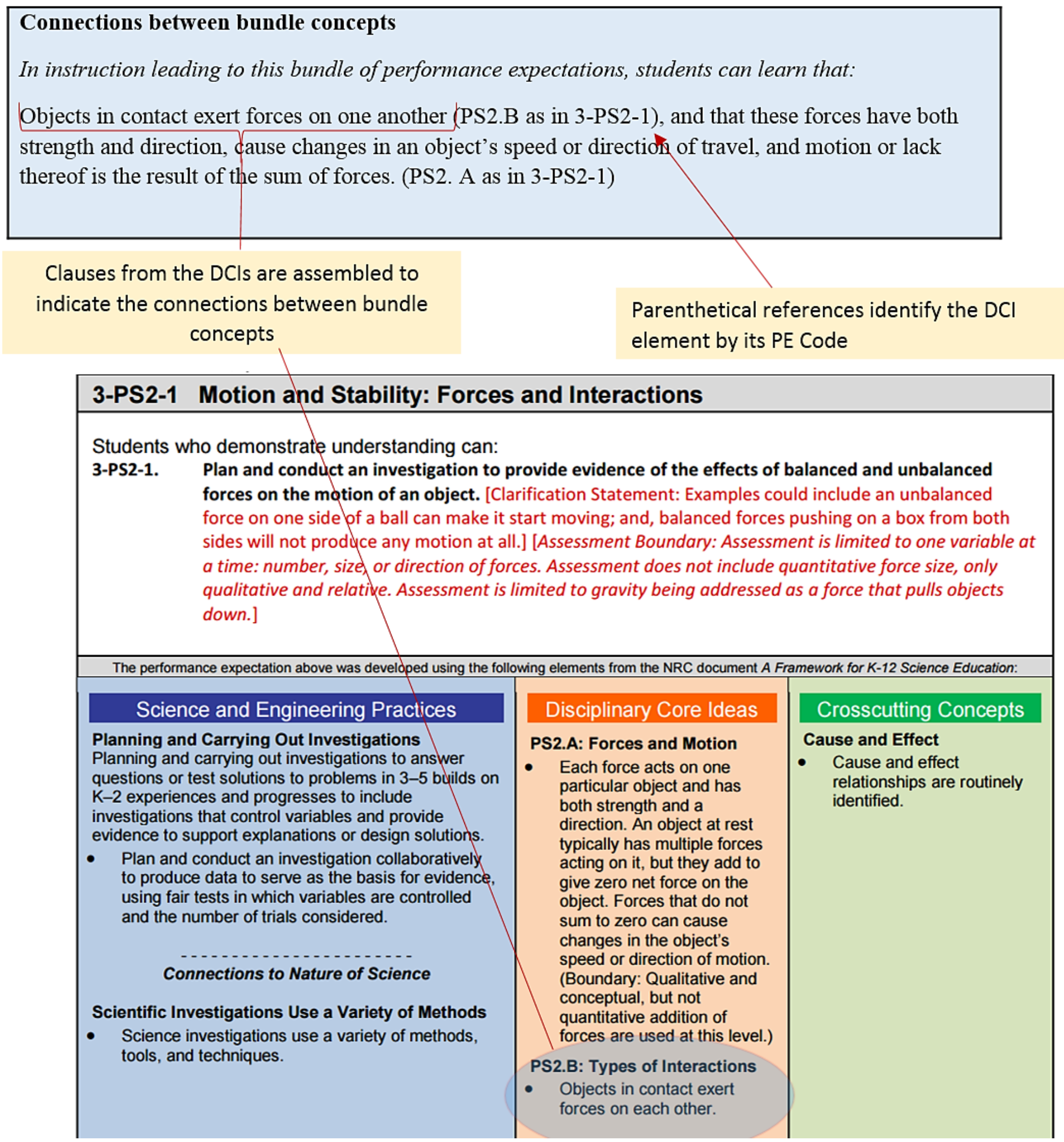
Appendix 1: Example Bundle Styles and Explanations

A Note about the Style of the Example Bundle Document

Fidelity to the language of the NGSS is a driving design principle of the Example Bundles. Wherever possible, direct quotes of NGSS language, such as clauses of the PEs or DCI, CCC, and SEP elements are used in identifying connections between the PEs. This language is identified with specific type styles, such as italics when using SEP language in the additional SEPs section, and with parenthetical references that identify the relevant PE code. Non-NGSS or paraphrased language is used as sparingly as possible; only where absolutely necessary to demonstrate connections between PEs or to offer suggestions for instruction.

Figure 9: *An excerpt from a 3rd grade bundle is shown along with its source material in 3-PS2-1.*



Connections between bundle concepts

In instruction leading to this bundle of performance expectations, students can learn that:

Objects in contact exert forces on one another (PS2.B as in 3-PS2-1), and that these forces have both strength and direction, cause changes in an object's speed or direction of travel, and motion or lack thereof is the result of the sum of forces. (PS2. A as in 3-PS2-1)

Clauses from the DCIs are assembled to indicate the connections between bundle concepts

Parenthetical references identify the DCI element by its PE Code

3-PS2-1 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [*Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.*]

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	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. - ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** • Science investigations use a variety of methods, tools, and techniques.	**PS2.A: Forces and Motion** • Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) **PS2.B: Types of Interactions** • Objects in contact exert forces on each other.	**Cause and Effect** • Cause and effect relationships are routinely identified.

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Bundle Summary

Figure 10: *An image from the Bundle Summary of a Kindergarten bundle document*

Bundle 1 Question: This bundles is assembled to address the questions of "How do objects move and what happens when they interact?"

Summary
The bundle organizes performance expectations around the topic of *pushes and pulls.* Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but recognize that instruction is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs
Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it (PS2.A as in K-PS2-1 and K-PS2-2). This concept of motion connects to the idea that a bigger push or pull makes things speed up or slow down more quickly (PS3.C as in K-PS2-1).

The concept of pushing or pulling on an object (PS2.A as in K-PS2-1 and K-PS2-2) also connects to the idea that when objects touch, or collide, they push on one another and can change motion. (PS2.B as in K-PS2-1)

The idea that a bigger push or pull makes things speed up or slow down more quickly (PS3.C as in K-PS2-1) connects to the concept that pushes and pulls can have different strengths and directions (PS2.A as in K-PS2-1 and K-PS2-2).

The concept that people measure weather conditions to describe and record the weather and to notice patterns over time (ESS2.D as in K-ESS2-1) connects to the idea that it is useful to compare and test designs (ETS1.C as in K-2-ETS1-3) through data analysis.

The ideas that a situation that people want to change or create can be approached as a problem to be solved through engineering (ETS1.A as in K-PS2-2) and that, because there is always more than one possible solution to a problem, it is useful to compare and test designs (ETS1.C as in K-2-ETS1-3) could connect to multiple physical science concepts in this bundle. For example, these concepts could connect to the idea that when objects touch or collide, they push on one another and can change motion (PS2.B as in K-PS2-1) through a task in which students are challenged to work in groups to change the direction or speed of a ball with another object and then test and compare each group's solution. Alternatively, these engineering concepts could connect to the idea that a bigger push or pull makes things speed up or slow down more quickly (PS3.C as in K-PS2-1) through a different task in which students are asked to pull or push an object in a certain amount of time and then challenged to do it faster. Students could then compare their solutions and reflect on how their pull or push needed to change in order to move the object faster.

Bundle Science and Engineering Practices
Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of planning and carrying out investigations (K-PS2-1); and analyzing and interpreting data (K-PS2-2, K-ESS2-1, and K-2-ETS1-3). Many other practice elements can be used in instruction.

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Engineering, Technology, and Applications of Science (ETS) DCIs Paired with Science DCIs

The integration of engineering design with science is a goal of the NGSS. When an Engineering, Technology, and Applications of Science (ETS) DCI is part of an example bundle, it is paired with some of the science concepts of the bundle. For example:

> *"...the concept that tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved (ETS1.B as in 3-5-ETS1-3) could connect to several concepts such as objects in contact exert forces on one another (PS2.B as in 3-PS2-1), or the idea that forces from electric and magnetic forces (PS2.B as in 3-PS2-3 and 3-PS2-4) come from objects. These connections could be made through an engineering design task such as designing a mechanical or a magnetic door latch to prevent a door from swinging open. Alternatively, students could be challenged with a different design task involving tests (ETS1.B as in 3-5-ETS1-3) that use patterns in motion to predict future motion (PS2.A as in 3-PS2-2) such as creating and testing a set of ramps designed to stop toy car rolling down a slope, modeling the challenges faced by vehicles whose brakes have failed as they descended a steep grade."*

Additionally, several examples are provided to indicate what the ETS DCI might look like during instruction.

Bundle Science and Engineering Practices and Bundle Crosscutting Concepts

To emphasize that the SEP and CCC elements of the bundle PEs are part of instruction, the summary section concludes with a listing of their titles and accompanying PE codes. Note that these are the student goals for *the end of instruction*—these are NOT the only SEPs and CCCs that could or should be used *during* instruction. An educator should not be limited by the SEP and CCC elements listed here, but rather should incorporate other SEP and CCC elements throughout instruction to ensure that all instruction is three-dimensional.

Bundle Performance Expectation Chart

The PE chart for a given bundle of PEs identifies the PE code, PE text, Assessment Boundary, and Clarification Statement associated with a given PE.

Figure 11: *A Performance Expectation chart from a Kindergarten Example Bundle*

Performance Expectations	K-PS2-1 **Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [*Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.*]** K-PS2-2 **Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.* [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [*Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.*]** K-ESS2-1 **Use and share observations of local weather conditions to describe patterns over time. [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary:***

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	***Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]** K-2-ETS1-3 **Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

Example phenomena

The example phenomena shown in this section are sample engaging phenomena that could be used in instruction, whether as an anchor for a unit or a driver for a lesson. Lines of student inquiry about these phenomena could drive instruction toward the bundle of PEs. However, these are not the only phenomena that could be used.

Figure 12: *An Example Phenomena chart from a Kindergarten Example Bundle*

Example Phenomena	A swing moves as it is pushed. A box pushed across a floor moves quickly with a strong push and slows down as when the pushing becomes weaker.

Additional Science and Engineering Practices Building to the PEs

This section demonstrates how additional SEPs—other than those already included in the bundle PEs—can support instruction. These additional SEPs are only examples and are not intended to be summatively assessed.

Figure 13: *An excerpt from the chart of Additional Practices Building to the PEs from a Kindergarten Example Bundle*

Additional Practices Building to the PEs	**Asking questions and defining problems** ● Ask and/or identify questions that can be answered by an investigation. Students could *identify questions about* **pushing or pulling on an object** *[to]* **change the speed or direction of its motion and can start or stop it** *that can be answered by an investigation.* K-PS2-1 and K-PS2-2

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In this section, an SEP element is included from each of the eight SEP categories. Below the SEP element, a statement is included that shows a possible connection between the element and a DCI from one of the bundle PEs. The statement uses italics to identify SEP language and bold italics to identify DCI language. Additional phrases, included to increase the readability of the resulting statement, but not found in either the original DCI or SEP language, are set off with brackets, [].[8]

Additional Crosscutting Concepts Building to the PEs

Additional CCCs—other than those already included in the bundle PEs—are offered to help demonstrate the large number of options available to teachers to help students identify connections between ideas and engage in sense-making. These additional CCCs are only examples and are not intended to be summatively assessed.

Figure 14: *An excerpt from the chart of Additional Crosscutting Concepts Building to the PEs*

Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Students could *observe patterns* ***of motion*** *and use these patterns as evidence* ***[of how] pushing or pulling on an object can change the speed or direction of its motion and can start or stop it***. K-PS2-1 and K-PS2-2

In this section, a CCC element is included for at least three of the seven CCCs. Below the CCC element, a statement shows a possible connection between the element and a DCI from one of the bundle PEs. The statement uses italics to identify CCC language and bold italics to identify DCI language. Plain text is used to show the suggested student action. Additional phrases, included to increase the readability of the resulting statement, but not found in either the original DCI or CCC language, are set off with brackets, [].[9]

[8] As stated in the NGSS Appendix F, "[I]t is too much to expect each performance to reflect all components of a given practice. The most appropriate aspect of the practice is identified for each performance expectation (in the NGSS foundation boxes for each PE)." (NGSS Appendices p. 50) Therefore, there are slight wording differences between some SEP elements in Appendix F of the NGSS and the appearance of those same elements when placed in context with PEs in the foundation boxes.

[9] As stated in the NGSS Appendix G, "Most performance expectations reflect only some aspects of a crosscutting concept. These aspects are indicated in the right-hand foundation box in each standard. All aspects of each core idea considered by the writing team can be found in the matrix [at the end of Appendix G]." (NGSS Appendices p. 80) Therefore, there are slight differences between some CCC elements in Appendix G of the NGSS and the appearance of those same elements when placed in context with PEs in the displays of the standards.

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Additional Connections to Nature of Science

Additional NOS connections—other than those that may already be present in the bundle PEs—are offered to help demonstrate the large number of options available to teachers. These additional NOS connections are examples only and are not intended to be summatively assessed.

Figure 15: *An excerpt from the chart of Additional Connections to Nature of Science*

Additional Connections to Nature of Science	**Scientific investigations use a variety of materials** ● Scientific investigations begin with a question. Students could *begin a scientific investigation with a question* ***[about how] pushing or pulling on an object can change the speed or direction of its motion and can start or stop it*** and then reflect on the fact that their *investigation began with a question.* K-PS2-1 and K-PS2-2.

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Below the NOS connection is a statement that shows a possible connection between the NOS idea, and a DCI and SEP from the bundle PEs. The statement uses italics to identify NOS language and bold italics to identify DCI language. Plain text shows the suggested student action. The PE code associated with the DCI is included to provide easier identification of the DCI within NGSS documents. Additional phrases, included to increase the readability of the resulting statement, but not found in either the original bundle PE, DCI, CCC, or suggested NOS language, are set off with brackets, [].

Evidence Statements

Evidence statements shown in the bundles always describe summative assessment of a given PE or part of a PE. *PEs may be broken up across several bundles* or even between courses in middle and high school, with instruction focusing on different components of a PE in different bundles. In such cases, different observable components of the evidence statements are highlighted in each bundle. Across the scope of the grade level or grade band of PEs, all of the observable components are addressed.

Figure 16: *The Evidence Statement for HS-PS2-4. The black text show the goals for one bundle and the grayed-out sections are goals for a later bundle (in this case, in the following year of instruction).*

Observable features of the student performance by the end of the course:		
1	Representation	
	a	Students clearly define the system of the interacting objects that is mathematically represented.
	b	Using the given mathematical representations, students identify and describe* the gravitational attraction between two objects as the product of their masses divided by the separation distance squared $\left(F_g = -G\frac{m_1 m_2}{d^2}\right)$, where a negative force is understood to be attractive.
	c	Using the given mathematical representations, students identify and describe* the electrostatic force between two objects as the product of their individual charges divided by the separation distance squared $\left(F_e = k\frac{q_1 q_2}{d^2}\right)$, where a negative force is understood to be attractive.
2	Mathematical modeling	
	a	Students correctly use the given mathematical formulas to predict the gravitational force between objects or predict the electrostatic force between charged objects.
3	Analysis	
	a	Based on the given mathematical models, students describe* that the ratio between gravitational and electric forces between objects with a given charge and mass is a pattern that is independent of distance.
	b	Students describe* that the mathematical representation of the gravitational field $\left(F_g = -G\frac{m_1 m_2}{d^2}\right)$ only predicts an attractive force because mass is always positive.
	c	Students describe* that the mathematical representation of the electric field $\left(F_e = k\frac{q_1 q_2}{d^2}\right)$ predicts both attraction and repulsion because electric charge can be either positive or negative.
	d	Students use the given formulas for the forces as evidence to describe* that the change in the energy of objects interacting through electric or gravitational forces depends on the distance between the objects.

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Appendix 2: Further Reading on Three-Dimensional Instruction

Bundling standards is only one part of the work needed to develop three-dimensional curriculum, lesson plans, and instructional strategies. For further reading on these topics, the resources listed below might be helpful. Many states also develop their own guidance about these issues.

Research and Visioning Documents

- A *Framework* for K-12 Science Education: www.nap.edu/catalog/13165/a-framework-for-k-12-science-education-practices-crosscutting-concepts
- Next Generation Science Standards: www.nextgenscience.org
- Taking Science To School: http://www.nap.edu/catalog/11625/taking-science-to-school-learning-and-teaching-science-in-grades. Includes much of the research underlying the NRC Framework and the NGSS, as well as descriptions of students' commonly held ideas.
- Ready, Set, SCIENCE: http://www.nap.edu/catalog/11882/ready-set-science-putting-research-to-work-in-k-8. The practitioners guide to Taking Science To School

Sources of a Wide-Range of Implementation Support and Resources

- Guide to Implementing the NGSS: http://www.nap.edu/catalog/18802/guide-to-implementing-the-next-generation-science-standards. A document from the National Research Council
- NGSS website resource library: http://nextgenscience.org/resource-library
- NGSS@NSTA website: ngss.nsta.org
- STEM Teaching Tools: http://stemteachingtools.org/

Unpacking the NGSS

- NGSS Evidence Statements: http://nextgenscience.org/evidence-statements

Resources for Equitable Instructional Strategies

- NGSS Appendix D and its accompanying case studies: http://nextgenscience.org/appendix-d-case-studies
- NGSS for All Students: www.nsta.org/store/product_detail.aspx?id=10.2505/9781938946295. Case studies of research- and standards-based classroom strategies for engaging diverse student groups.

Criteria for NGSS-aligned Instructional Materials

- EQuIP Rubric: www.nextgenscience.org/equip. Provides criteria for measuring quality and NGSS-design of lessons and units
- PEEC tool: www.nextgenscience.org/peec. NGSS Publishers Criteria, providing criteria for measuring NGSS design of year-long or multi-year instructional materials

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Resources for Developing Instructional Materials Designed for the NGSS

- www.nextgenstorylines.org
- Paper on Designing Coherent Storylines Aligned with NGSS for the K–12 Classroom: hwww.academia.edu/6884962/Designing_Coherent_Storylines_Aligned_with_NGSS_for_the_K-12_Classroom
- Paper on Planning Instruction to Meet the Intent of the Next Generation Science Standards: http://link.springer.com/article/10.1007/s10972-014-9383-2

Information about Middle and High School Course Models

- NGSS Appendix K: http://nextgenscience.org/sites/default/files/Appendix K_Revised 8.30.13.pdf

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1st Grade - Thematic Model - Bundle 1
Seeing Objects

This is the first bundle of the 1st Grade Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 1 Question: This bundle is assembled to address the question of "Can patterns of the sun, moon, and stars be used to make predictions of future observations?"

Summary

The bundle organizes performance expectations around the theme of *seeing objects*. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 seasonal patterns of sunrise and sunset can be observed, described, and predicted (ESS1.B as in 1-ESS1-2) connects to the concept that the patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted (ESS1.A as in 1-ESS1-1). These ideas also connect to the concept that objects can be seen if light is available to illuminate them or if they give off their own light (PS4.B as in 1-PS4-2).

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of planning and carrying out investigations (1-ESS1-2), analyzing and interpreting data (1-ESS1-1), and constructing explanations and designing solutions (1-PS4-2). 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 (1-ESS1-1 and 1-ESS1-2) and Cause and Effect (1-PS4-2). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations 1-ESS1-2 is partially assessable	1-PS4-2 **Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.** **[Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]** 1-ESS1-1 **Use observations of the sun, moon, and stars to describe patterns that can be predicted.** **[Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.] [*Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.*]** 1-ESS1-2 **Make observations at different times of year to relate the amount of daylight to the time of year.** **[Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [*Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*]**

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Example Phenomena	We cannot see anything in a completely darkened space. The sun moves in a particular direction during the day.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Ask and/or identify questions that can be answered by an investigation. Students could *identify questions* [related to] ***seasonal patterns of sunrise and sunset*** *that can be answered by an investigation*. 1-ESS1-2 **Developing and Using Models** • Compare models to identify common features and differences. Students could *compare models* [(e.g., pictures, diagrams, or storyboards of the sky during day and night) of the sky at different times] *to identify common features and differences* [of the different models]. 1-ESS1-1 **Planning and Carrying Out Investigations** • Make predictions based on prior experiences Students could *make predictions* [of the] ***patterns of the motion of the sun, moon, and stars in the sky*** *based on prior experiences*. 1-ESS1-1 **Analyzing and Interpreting Data** • Record information (observations, thoughts, and ideas). Students could *record information* [about what] ***objects can be seen*** [without a separate light available] ***to illuminate them***. 1-PS4-2 **Using Mathematical and Computational Thinking** • Decide when to use qualitative versus quantitative data. Students could *decide when to use qualitative or quantitative data* [when recording observations about the] ***patterns of the motion of the sun, moon, and stars in the sky***. 1-ESS1-2 **Constructing Explanations and Designing Solutions** • Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. Students could *use materials to design and build a device that solves a problem* [related to the fact that] ***objects can*** [only] ***be seen if light is available to illuminate them or if they give off their own light***. 1-PS4-2 **Engaging in Argument From Evidence** • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. Students could *listen actively to arguments* [about why] ***objects can be seen if light is available to illuminate them or if they give off their own light*** *to retell the main points of the argument*. 1-PS4-2

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Additional Practices Building to the PEs (Continued)	**Obtaining, Evaluating, and Communicating Information** • Communicate information with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas and/or practices. Students could *communicate information with others* [about their observations and predictions of] ***patterns of the motion of the sun, moon, and stars in the sky*** *in written forms that provide detail about scientific ideas and practices*. 1-ESS1-1
Additional Crosscutting Concepts Building to the PEs	**Patterns** • Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Students could describe *patterns observed* [related to the] *phenomenon* [that] ***objects can be seen if light is available to illuminate them or if they give off their own light*** [and] *use* [those patterns] *as evidence* [in explanations]. 1-PS4-2 **Scale, proportion, and quantity** • Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower). Students could *compare and describe events* [such as] ***seasonal patterns of sunrise and sunset*** [using] *relative scales (e.g., more and less)*. 1-ESS1-2 **Stability and Change** • Some things stay the same while other things change. Students could describe how *some things stay the same*—***the sun, moon, and stars*** [appear] ***in the sky*** [each calendar day]—*while other things change*—***the sun, moon, and stars*** [cannot be seen all day due to their] ***patterns of motion***. 1-ESS1-1
Additional Connections to Nature of Science	**Scientific Investigations Use a Variety of Methods** • Scientists use different ways to study the world. Students could describe [how they] *use different ways to study* ***patterns of the motion of the sun, moon, and stars in the sky*** [and] *how scientists* [also] *use different ways to study the world*. 1-ESS1-1 **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Many events are repeated. Students could describe that *many events*, [including those related to] ***the motion of the sun, moon, and stars in the sky***, *are repeated*. 1-ESS1-1

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1st Grade - Thematic Model - Bundle 2
Sound and Light

This is the second bundle of the 1st Grade Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 2 Question: This bundle is assembled to address the question "how can light or sound be used to send messages over a distance?"

Summary

The bundle organizes performance expectations around helping students understand the interaction of light with various materials, and how to apply ideas about light and sound to solve problems. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but recognize that instruction is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

Since people use sound and light to communicate information, the idea that people use a variety of devices to communicate (send and receive information) over long distances (PS4.C as in 1-PS4-4) can connect to concepts about both sound—sound can make matter vibrate, and vibrating matter can make sound. (PS4.A as in 1-PS4-1) —and light, as some materials allow light to pass through them, others allow only some light through, and others block all the light (PS4.B as in 1-PS4-3). Concepts about light can also connect to the idea that seasonal patterns of sunrise and sunset can be observed, described, and predicted (ESS1.B as in 1-ESS1-2).

The engineering design idea that before beginning to design a solution, it is important to clearly understand the problem (ETS1.A as in K-2-ETS1-1), could be applied to several concepts such as people use a variety of devices to communicate (send and receive information) over long distances (PS4.C as in 1-PS4-4). These could connect through an engineering design task, such as one in which students could work to clearly understand a problem related to communicating over long distances before beginning to design a solution. For example, students can identify who has a need to communicate over a distance and why, they can determine the distance at which that their audience needs to communicate as well as the medium (e.g., sound, light). Alternately, students could learn more about a problem related to mirrors redirecting light beam (PS4.B as in 1-PS4-3) before beginning to design a solution.

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 (K-2-ETS1-1), planning and carrying out investigations (1-PS4-1, 1-PS4-3, and 1-ESS1-2), and constructing explanations and designing solutions (1-PS4-4). 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 concepts of Patterns (1-ESS1-2) and Cause and Effect (1-PS4-1 and 1-PS4-3). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations 1-ESS1-2 and K-2-ETS1-1 are partially assessable	1-PS4-1 **Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.** **[Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]** 1-PS4-3 **Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.** **[Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [*Assessment Boundary: Assessment does not include the speed of light.*]** 1-PS4-4 **Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*** **[Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [*Assessment Boundary: Assessment does not include technological details for how communication devices work.*]** 1-ESS1-2 **Make observations at different times of year to relate the amount of daylight to the time of year.** **[Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [*Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*]** K-2-ETS1-1 **Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
Example Phenomena	Lighthouses are often found on rocky shores. I can't hear someone talk when they are at the other end of the school.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask and/or identify questions that can be answered by an investigation. Students could *ask and identify questions* [about which] ***materials allow light to pass through them,*** [which materials] ***allow only some light through and*** [which materials] ***block all the light*** *that can be answered by an investigation.* 1-PS4-3 **Developing and Using Models** ● Develop and/or use a model to represent patterns in the natural world. Students could *develop and/or use a model to represent* [their] ***observations, descriptions, and predictions*** [of] ***seasonal patterns of sunrise and sunset*** *in the natural world*. 1-ESS1-2 **Planning and Carrying Out Investigations** ● Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. Students could *make observations or measurements of a tool or solution* [intended to allow] ***people to communicate (send and receive information) over long distances*** *to determine if it meets* [the] *goal.* 1-PS4-4

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Additional Practices Building to the PEs (Continued)	**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 could *use firsthand observations to describe relationships* [between] ***sound and vibrating matter***. 1-PS4-1 **Using Mathematical and Computational Thinking** ● Use quantitative data to compare two alternative solutions to a problem. Students could *use quantitative data to compare two alternative solutions to a problem* [related to] ***people using a variety of devices to communicate (send and receive information) over long distances***. 1-PS4-4 **Constructing Explanations and Designing Solutions** ● Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. Students could *make observations (firsthand or from media) to construct an evidence-based account* [that] ***sound can make matter vibrate, and vibrating matter can make sound***. 1-PS4-1 **Engaging in Argument from Evidence** ● Distinguish between explanations that account for all gathered evidence and those that do not. Students could *distinguish between explanations that account for all gathered evidence and those that do not* [about observations that] ***some materials allow light to pass through, others allow only some light through, and others block all the light***. 1-PS4-3 **Obtaining, Evaluating, and Communicating Information** ● Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, numbers that provide detail about scientific ideas, practices, and/or design ideas. Students could *communicate information with others* [orally, providing] *detail about scientific ideas* [related to] ***seasonal patterns of sunrise and sunset*** [and the idea they] ***can be observed, described, and predicted***. 1-ESS1-2
Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Students could describe how *patterns in the natural and human designed world*—[for example, patterns related to which types of] ***materials allow light to pass through them,*** [which types] ***allow only some light through, and*** [which types] ***block all the light***— *can be observed, used to describe phenomena, and used as evidence.* 1-PS4-3 **Systems and System Models** ● Objects and organisms can be described in terms of their parts. Students could explain that *objects can be described in terms of their parts* [through the example of] ***devices*** [that] ***people use to communicate (send and receive information) over long distances***. 1-PS4-4

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Additional Crosscutting Concepts Building to the PEs (Continued)	**Structure and Function** ● The shape and stability of structures of natural and designed objects are related to their function(s). Students could identify examples of ***vibrating matter*** [that] ***makes sound*** [in which] *the shape and stability of structures of* [the] *objects are related to their function(s)*. 1-PS4-1
Additional Connections to Nature of Science	**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Scientists search for cause and effect relationships to explain natural events. Students could describe how *scientists search for cause and effect relationships to explain natural events* [just as they searched for a cause and effect relationship when investigating that] ***sound can make matter vibrate and vibrating matter can make sound***. 1-PS4-1 **Science Addresses Questions About the Natural and Material World** ● Scientists study the natural and material world. Students could explain that *scientists study the natural and material world* [just as they did when investigating that] ***mirrors can be used to redirect a light beam***. 1-PS4-3

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1st Grade – Thematic Model - Bundle 3
Organisms and Sunlight

This is the third bundle of the 1st Grade Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 3 Question: This bundle is assembled to address the question "how can we solve problems related to organisms and sunlight?"

Summary
The bundle organizes performance expectations around the theme of *organisms and sunlight.* Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 of seasonal patterns of sunrise and sunset (ESS1.B as in 1-ESS1-2) connects to the idea that plants have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow (LS1.A as in 1-LS1-1) through the concept of sunlight, which varies by season and is captured by plants, mostly through their leaves so that they can grow and survive.

The engineering design idea that designs can be conveyed through sketches, drawings, or physical models (ETS1.B as in K-2-ETS1-2) could be applied to multiple concepts, such as that plants have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow (LS1.A as in 1-LS1-1) or that seasonal patterns of sunrise and sunset can be observed, described, and predicted. (ESS1.B as in 1-ESS1-2). These ideas could connect through engineering tasks such as one in which students are asked to design a structure that mimics a way in which a plant part helps it grow and survive. Students could share their design ideas through sketches, drawings or physical models. Another possible task could be designing a solution to the problem that a plant gets too much sunlight in the summer and/or too little sunlight in the winter. Again, students could convey their solutions through sketches, drawings, or physical models. Additionally, these ideas could connect to the concept that because there is always more than one possible solution to a problem, it is useful to compare and test designs (ETS1.C as in K-2-ETS1-3) by having students compare—possibly using their sketches, drawings, or physical models—and test their solutions.

Bundle Science and Engineering Practices
Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (K-2-ETS1-2), planning and carrying out investigations (1-ESS1-2), analyzing and interpreting data (K-2-ETS1-3), and constructing explanations and designing solutions (1-LS1-1). 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 (1-ESS1-2) and Structure and Function (1-LS1-1 and K-2-ETS1-2). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations 1-ESS1-2, K-2-ETS1-2, and K-2-ETS1-3 are partially assessable	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 intruders by mimicking eyes and ears.]** 1-ESS1-2 **Make observations at different times of year to relate the amount of daylight to the time of year. [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [*Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*]** K-2-ETS1-2 **Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.** K-2-ETS1-3 **Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**
Example Phenomena	Plants sometimes grow toward a window, rather than straight up. Some people wear flippers to swim. The amount of daily sunlight changes through the year.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions based on observations to find more information about the natural and/or designed world(s). Students could *ask questions based on observations* [of] ***animals' behaviors that help them survive***. 1-LS1-1 **Developing and Using Models** ● Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). Students could *develop a model to represent relationships in the natural world* [such as the relationship between animals'] ***external parts*** [and their ability to] ***see, hear, and grasp objects*****.** 1-LS1-1 **Planning and Carrying Out Investigations** ● Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. Students could *evaluate different ways of observing* [the] ***external parts of*** [different] ***organisms*** *to determine which way can answer a question* [about how the parts] ***help them survive and grow****.* 1-LS1-1 **Analyzing and Interpreting Data** ● Use observations (firsthand or from media) to describe patterns and/or relationships in the natural world in order to answer scientific questions. Students could *use firsthand observations to describe* ***and predict seasonal patterns of sunrise and sunset*** *in order to answer scientific questions*. 1-ESS1-2

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Additional Practices Building to the PEs (Continued)	**Using Mathematical and Computational Thinking** ● Use counting and numbers to identify and describe patterns in the natural and designed world(s). Students could use *counting and numbers to identify and describe patterns in* ***designs conveyed through drawings and physical models***. K-2-ETS1-2 **Constructing Explanations and Designing Solutions** ● Make observations (firsthand or from media) to construct an evidence based account for natural phenomena. Students could *make observations (firsthand or from media) to construct an evidence-based account for* [how] ***different plant parts help them survive and grow***. 1-LS1-1 **Engaging in Argument From Evidence** ● Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence. Students could *make a claim about the effectiveness of an object* [designed to mimic a] ***way animals use their body parts to move from place to place.*** 1-LS1-1 **Obtaining, Evaluating, and Communicating Information** ● Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world. Students could *read grade-appropriate texts to obtain scientific information and determine patterns* [about] ***animals' body parts that capture information***. 1-LS1-1
Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** ● Events have causes that generate observable patterns. Students could describe that *events have causes that generate observable patterns,* [such as] ***animal behaviors*** [in] ***response to inputs***. 1-LS1-1 **Stability and Change** ● Some things stay the same while other things change. Students could identify *some things* [that] *stay the same* [and] *other things* [that] *change,* [such as] ***seasonal*** [changes] ***of sunrise and sunset***. 1-ESS1-2 **Systems and System Models** ● Systems in the natural and designed world have parts that work together. Students could describe ***plants*** [as an example of a] *system in the natural world* [that has] ***parts (roots, stems, leaves, flowers, fruits)*** *that work together* [to] ***help them survive and grow***. 1-LS1-1
Additional Connections to Nature of Science	**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Scientists use drawings, sketches, and models as a way to communicate ideas. Students could describe how they *used drawings, sketches, and models as a way to communicate ideas* [about] ***different plant parts (roots, stems, leaves, flowers, fruits) that help*** [the plants] ***survive and grow,*** *just as scientists use drawings, sketches, and models as a way to communicate ideas***.** 1-LS1-1

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Additional Connections to Nature of Science (Continued) .	**Scientific Knowledge is Based on Empirical Evidence** ● Scientists look for patterns and order when making observations about the world. Students could describe how *scientists look for patterns and order when making observations about the world* [just as they did when they] ***observed, described, and predicted seasonal patterns of sunrise and sunset***. 1-ESS1-2

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1st Grade - Thematic Model - Bundle 4
Patterns in the Natural World

This is the fourth bundle of the 1st 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 do patterns related to sunlight throughout the year as well as to relationships between parents and offspring?"

Summary

The bundle organizes performance expectations around the theme of *patterns in the natural world*, building student understanding of the traits of parents and their offspring and behaviors of parents and offspring, while concluding the study of light with seasonal change throughout the year. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 adult plants and animals can have young, and that parents and the offspring themselves can sometimes engage in behaviors that help the offspring to survive (LS1.B as in 1-LS1-2) connects to the idea that young animals are very much, but not exactly like, their parents (LS3.A as in 1-LS3-1). There are observable patterns of these relationships between parents and their offspring.

Through the concept of patterns, these ideas about the patterns of relationships between parents and offspring can connect to the idea that seasonal patterns of sunrise and sunset can be observed, described, and predicted (ESS1.B as in 1-ESS1-2).

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of planning and carrying out investigations (1-ESS1-2), constructing explanations and designing solutions (1-LS3-1), and obtaining, evaluating, and communicating information (1-LS1-2). 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 concept of Patterns (1-LS1-2, 1-LS3-1 and 1-ESS1-2). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations	1-LS1-2 **Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.** **[Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]** 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.*]** 1-ESS1-2 **Make observations at different times of year to relate the amount of daylight to the time of year.** **[Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [*Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*]**
Example Phenomena	Puppies look similar to their mother. When babies cry, their parents usually feed them.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions based on observations to find more information about the natural world. Students could *ask questions to find more information based on observations* [of] ***behaviors parents and offspring engage in that help the offspring survive***. 1-LS1-2 **Developing and Using Models** ● Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). Students could *develop a model to represent the relationships* [between] ***behaviors parents and offspring engage in*** [and] ***offspring survival***. 1-LS1-2 **Planning and Carrying Out Investigations** ● Make observations (firsthand or from media) to collect data that can be used to make comparisons. Students could *make observations to collect data that can be used to make comparisons* [between] ***individuals of the same kind of plant*** [to see how similar or varied they are]**.** 1-LS3-1 **Analyzing and Interpreting Data** ● Use and share pictures, drawings, and/or writings of observations. Students could *use pictures* ***of young animals and their parents*** [to help them support the idea that] ***young animals are very much, but not exactly like, their parents***. 1-LS3-1 **Using Mathematical and Computational Thinking** ● Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs. Students could *describe, measure, and/or compare quantitative attributes of* ***seasonal patterns of sunrise and sunset*** *and display the data using simple graphs.* 1-ESS1-2

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	Constructing Explanations and Designing Solutions ● Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. Students could *make observations (firsthand or from media) to construct an evidence-based account for* ***parents engaging in*** [certain] ***behaviors,*** [such as feeding their offspring]**.** 1-LS1-2 **Engaging in Argument From Evidence** ● Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. Students could *listen actively to arguments* [related to] ***seasonal patterns of sunrise and sunset*** *to indicate agreement or disagreement based on evidence, or to retell the main points of the argument*. 1-ESS1-2 **Obtaining, Evaluating, and Communicating Information** ● Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. Students could *describe how specific images support* [the] *scientific idea* [that] ***plants are very much, but not exactly, like their parents***. 1-LS3-1
Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** ● Events have causes that generate observable patterns. Students could describe *that events have causes that generate observable patterns* [using the] ***behaviors parents and offspring engage in that help the offspring to survive*** [as an example]. 1-LS1-2 **Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; faster and slower). Students could use *relative scales to compare and describe* [how] ***individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways***. 1-LS3-1 **Stability and Change** ● Things may change slowly or rapidly. Students could describe that *things may change slowly*, **[**such as the change in] ***sunrise and sunset*** [over the course of the year] *or rapidly*, [such as the daily change in the sun's position between] ***sunrise and sunset***. 1-ESS1-2
Additional Connections to Nature of Science	**Scientific Investigations Use a Variety of Methods** ● Science investigations begin with a question Students could describe that *science investigations begin with a question*, [just as their investigations about] ***seasonal patterns of sunrise and sunset*** *began with a question* [they were curious about]. 1-ESS1-2 **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Scientists search for cause and effect relationships to explain natural events. Students could describe that *scientists search for cause and effect relationships to explain natural events* [such as the relationship between parental] ***behavior*** [and] ***offspring survival***. 1-LS1-2

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1st Grade Thematic Model

Narrative and Rationale: This first grade model is tied together with a thread relating to light, which can be connected through the four bundles. The first bundle focuses on seeing objects, and includes the foundational and challenging idea that light is necessary for us to see. The need for light is true whether viewing objects on Earth or in the sky. Bundle 2 extends the study of light to include its interaction with various materials, and applies ideas about light and sound to solve a problem. Bundle 3 is tied to organisms and sunlight, as part of a study of the structure and function of the external parts of plants and animals. In bundle 4, while students study plants and animals with a focus on the traits of parents and their offspring and behaviors of parents and offspring, the study of light is brought back in by looking back over student observations of the amount of daylight over the past year.

Each bundle in this course also has a focus CCC, building on student understanding of the CCCs that are introduced the previous year, in Kindergarten. Bundles 1 and 4 focus on Patterns, Bundle 2 focuses on Cause and Effect, and Bundle 3 focuses on Structure and Function. Note that the practices and crosscutting concepts described are intended as end-of-instructional unit expectations and not curricular designations – additional practices and crosscutting concepts should be used throughout instruction in each bundle.

Bundle 1: Can patterns of the sun, moon, and stars be used to make predictions of future observations? **~4 Weeks**	**Bundle 2:** How can light or sound be used to send messages over a distance? **~8 Weeks**	**Bundle 3:** How can we solve problems related to organisms and sunlight? **~10 Weeks**	**Bundle 4:** How do patterns relate to sunlight throughout the year as well as to relationships between parents and offspring? **~12 Weeks**
1-PS4-2. Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated. **1-ESS1-1.** Use observations of the sun, moon, and stars to describe patterns that can be predicted. **1-ESS1-2.** Make observations at different times of year to relate the amount of daylight to the time of year.[1]	**1-PS4-1.** Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. **1-PS4-3.** Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light. **1-PS4-4.** Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.* **1-ESS1-2.** Make observations at different times of year to relate the amount of daylight to the time of year.[1]	**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.* **1-ESS1-2.** Make observations at different times of year to relate the amount of daylight to the time of year.[1] **K-2-ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.[1]	**1-LS1-2.** Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. **1-LS3-1.** Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. **1-ESS1-2.** Make observations at different times of year to relate the amount of daylight to the time of year

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	K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.[1]	**K-2-ETS1-3.** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.[1]	

1. The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.

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1st Grade Thematic Model Flowchart

Bundle 1

PS4.B as found in 1-PS4-2
- Objects can be seen if light is available to illuminate them or if they give off their own light.

ESS1.A as found in 1-ESS1-1
- Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.

ESS1.B as found in 1-ESS1-2
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

Bundle 2

PS4.A as found in 1-PS4-1
- Sound can make matter vibrate, and vibrating matter can make sound.

PS4.B as found in 1-PS4-3
- Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.)

PS4.C as found in 1-PS4-4
- People also use a variety of devices to communicate (send and receive information) over long distances.

ESS1.B as found in 1-ESS1-2
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

ETS1.A as found in K-2-ETS1-1
- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Before beginning to design a solution, it is important to clearly understand the problem.

Bundle 3

LS1.A as found in 1-LS1-1
- 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 (roots, stems, leaves, flowers, fruits) that help them survive and grow.

LS1.D as found in 1-LS1-1
- Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.

ESS1.B as found in 1-ESS1-2
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

ETS1.B as found in K-2-ETS1-2
- 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.

ETS1.C as found in K-2-ETS1-3
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

Bundle 4

LS1.B as found in 1-LS1-2
- Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive.

LS3.A as found in 1-LS3-1
- Young animals are very much, but not exactly like, their parents. Plants also are very much, but not exactly, like their parents.

LS3.B as found in 1-LS3-1
- Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.

ESS1.B as found in 1-ESS1-2
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

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2nd Grade – Thematic Model – Bundle 1
Matter

This is the first bundle of the 2nd Grade Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 1 Question: This bundle is assembled to address the questions "How do we design better products?"

Summary

The bundle organizes performance expectations with a focus on engineering design and the study of matter. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

The idea that matter can be described and classified by its observable properties (PS1.A as in 2-PS1-1) connects to the idea that different properties of matter are suited to different purposes (PS1.A as in 2-PS1-2 and 2-PS1-3).

The engineering design idea that a situation that people want to change or create can be approached as a problem to be solved through engineering (ETS1.A as in K-2-ETS1-1) could connect to multiple science concepts such as that different properties are suited to different purposes (PS1.A as in 2-PS1-2 and 2-PS1-3) and that matter can be described and classified by its observable properties (PS1.A as in 2-PS1-1). The first connection could be made by challenging students to define a problem caused by using an unsuitable material. The second connection could be made by having students first identify a situation related to the properties of materials that people want to change, and then write about how they would approach that situation as a problem that can be solved through engineering.

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 (K-2-ETS1-1); planning and carrying out investigations (2-PS1-1); analyzing and interpreting data (2-PS1-2); and constructing explanations and designing solutions (2-PS1-3). 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 (2-PS1-1); Cause and Effect (2-PS1-2); and Energy and Matter (2-PS1-3). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations	**2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.** [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.] **2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*** [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [*Assessment Boundary: Assessment of quantitative measurements is limited to length.*] **2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.** [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]

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Performance Expectations (Continued)	**K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool**
Example Phenomena	A platform made of crayons glued together supports more weight at room temperature than it does outside on a hot summer day. Cotton fabric is not used to make drinking cups.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask and/or identify questions that can be answered by an investigation. Students *could identify questions that can be answered by an investigation* [about whether] ***different kinds of matter can be either solid or liquid, depending on temperature***. 2-PS1-1 **Developing and Using Models** ● Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). Students could develop a model to represent patterns [between] ***properties of different*** [materials and their] ***purposes***. 2-PS1-1 **Planning and Carrying Out Investigations** ● Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. Students could *make observations and measurements* [to] ***classify matter by its observable properties*** 2-PS1-1 **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 could *use firsthand observations to describe the pattern* [that] ***a great variety of objects can be built from a small set of pieces***. 2-PS1-3 **Using Mathematical and Computational Thinking** ● Decide when to use qualitative vs. quantitative data. Students could *decide when to use qualitative vs. quantitative data* [when] ***describing and classifying matter by its observable properties***. 2-PS1-1 **Constructing Explanations and Designing Solutions** ● Generate and/or compare multiple solutions to a problem. Students could *compare multiple solutions to a problem* [caused by the fact that] ***matter can be either solid or liquid, depending on temperature***. 2-PS1-1 **Engaging in Argument from Evidence** ● Construct an argument with evidence to support a claim. Students could *construct an argument with evidence to support a claim* [about] ***temperature and different kinds of matter that can be either solid or liquid***. 2-PS1-1

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Additional Practices Building to the PEs (Continued)	**Obtaining, Evaluating, and Communicating Information** ● Describe how specific images (e.g. a diagram showing how a machine works) support a scientific or engineering idea. Students could *describe how a diagram showing how* [to build different things from a set of building blocks] *supports* [the idea that] ***a great variety of objects can be built up from a small set of pieces***. 2-PS1-3
Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Students could *observe patterns* [and] *use* [the patterns] *as evidence to describe* [that] ***different properties are suited to different purposes***. 2-PS1-3 **Cause and Effect** ● Simple tests can be designed to gather evidence to support or refute student ideas about causes. Students can *design simple tests to gather evidence to* [try to] *refute* [their own] *ideas about* [what] *causes* ***different kinds of matter*** [to] ***be either solid or liquid***. 2-PS1-1 **Systems and System Models** ● Objects and organisms can be described in terms of their parts. Students could use a model to describe that [different] ***objects can be built from a small set of pieces***, [and those] *objects can be described in terms of their parts*. 2-PS1-3
Additional Connections to Nature of Science	**Scientific Investigations Use a Variety of Methods** ● Scientific investigations begin with a question. Students could describe why they *began* [their] *investigation* [of whether] ***different kinds of matter can be either solid or liquid*** *with a question*. 2-PS1-1 **Science Addresses Questions About the Natural and Material World** ● Scientists study the natural and material world. Students could describe how they, like *scientists, studied the natural and material world* [when they investigated that] ***different properties are suited to different purposes***. 2-PS1-3

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2nd Grade – Thematic Model – Bundle 2
Habitats

This is the second bundle of the 2nd Grade Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 2 Question: This bundle is assembled to address the question "What kinds of solutions can help plants meet their needs?"

Summary
The bundle organizes performance expectations with a focus on engineering design and the study of habitats as a system. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs
The concept that plants depend on animals for pollination or to move their seeds around (LS2.A as in 2-LS2-2) connects to the concept that plants depend on water and light to grow (LS2.A as in 2-LS2-1) as both ideas are about plant needs. This relationship between organisms and water can also connect to the concept that there are many different kinds of living things in any area, and they exist in different places on land and in water (LS4.D as in 2-LS4-1).

Through the topic of water, these concepts connect to the idea that water exists as solid ice and in liquid form (ESS2.C as in 2-ESS2-3), and that heating or cooling a substance (such as water) may cause changes that can be observed (PS1.B as in 2-PS1-4).

The engineering design idea that designs can be conveyed through sketches, drawings, or physical models (ETS1.B as in K-2-ETS1-2 and 2-LS2-2) can be connected to multiple science concepts, such as that plants depend on animals for pollination or to move their seeds around (LS2.A as in 2-LS2-2) and there are many different kinds of living things in any area, and they exist in different places on land and in water (LS4.D as in 2-LS4-1). The first connection could be made through challenging students to design and then sketch a way to increase pollination of flowers after a decrease in the bee population. The second connection could be made by having students design two different plant habitats that each meets the needs of the many different kinds of plants that will be in each habitat. In either case, student sketches should be detailed enough to communicate their design fully.

Bundle Science and Engineering Practices
Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (2-LS2-2 and K-2-ETS1-2); planning and carrying out investigations (2-LS2-1 and 2-LS4-1); engaging in argument from evidence (2-PS1-4); and obtaining, evaluating, and communicating information (2-ESS2-3). 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 (2-ESS2-3); Cause and Effect (2-PS1-4 and 2-LS2-1); and Structure and Function (2-LS2-2 and K-2-ETS1-2). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations	2-PS1-4. **Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.** **[Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]**

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Performance Expectations (Continued)	2-LS2-1. **Plan and conduct an investigation to determine if plants need sunlight and water to grow. [Assessment Boundary: Assessment is limited to testing one variable at a time.]** 2-LS2-2. **Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*** 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.]** 2-ESS2-3. **Obtain information to identify where water is found on Earth and that it can be a solid or liquid.** K-2-ETS1-2. **Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
Example Phenomena	Plants need liquid water in order to survive; they cannot live with only solid water (ice). Different plants can live in very different places (e.g., a cactus that lives in the desert, a cattail that lives in a pond).
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions based on observations to find more information about the natural and/or designed world(s). Students could *ask questions* [to determine which] ***changes caused by heating or cooling a substance are reversible***. 2-PS4-1 **Developing and Using Models** ● Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). Students could *develop a model to represent relationships* [between] ***different places*** [and the] ***kinds of living things in*** [that] ***area***. 2-LS4-1 **Planning and Carrying Out Investigations** ● Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. Students could *make observations of different pictures to make comparisons* [between] ***water found in different areas*** [and whether that water] ***exists as solid ice or in liquid form***. 2-ESS2-3 **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 could *use observations to describe patterns and relationships* [between] ***plants*** [and] ***water*** *in order to solve problems*. 2-LS2-1 **Using Mathematical and Computational Thinking** ● Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs. Students could *measure and compare* [the temperature at which] ***heating or cooling a substance causes changes***, *and display the data using simple graphs*. 2-PS1-4

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Additional Practices Building to the PEs (Continued)	**Constructing Explanations and Designing Solutions** ● Use information from observations (firsthand or from the media) to construct an evidence-based account of natural phenomena. Students could *use information from firsthand observations to construct an evidence-based account* [that] ***heating or cooling a substance may cause changes that can be observed*** [and] ***these changes are sometimes reversible***. 2-PS1-4 **Engaging in Argument from Evidence** ● Identify arguments that are supported by evidence. Students can *identify arguments that are supported by evidence* [for the claim that] ***there are many different kinds of living things in any area***. 2-LS4-1 **Obtaining, evaluating, and communicating information** ● Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. Students could *describe how specific images support the idea* [that] ***plants depend on water and light to grow.*** 2-LS2-1
Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns in the natural and designed world(s) can be observed, used to describe phenomena, and used as evidence. Students could *use patterns of* ***changes caused by heating or cooling a substance*** *to describe phenomena*. 2-PS1-4 **Systems and System Models** ● Systems in the natural and designed world have parts that work together. Students could describe that ***plants depending on animals for pollination*** [is a] *system in the natural world* [that] *has parts that work together*. 2-LS2-2 **Stability and Change** ● Some things stay the same while other things change. Students could develop a model to describe that *some* ***water found in ponds*** *stays in* ***liquid form*** *while other* ***water changes*** [into] ***solid ice***. 2-PS1-4 and 2-ESS2-3
Additional Connections to Nature of Science	**Science is a Way of Knowing** ● Scientific knowledge helps us know about the world. Students could describe how their *scientific knowledge* [about] ***different kinds of living things*** [that] ***exist in different places on land and in water*** helps [them] know about the world. 2-LS4-1 **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Scientists search for cause and effect relationships to explain natural events. Students could construct an argument with evidence to support the claim that they, like *scientists, searched for cause and effect relationships* [*between*] ***plants*** [and] ***water and light***. 2-LS2-1

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2nd Grade – Thematic Model – Bundle 3
Changes to the Land

This is the third bundle of the 2nd Grade Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 3 Question: This bundle is assembled to address the questions "How do we prevent wind or water from changing the land?"

Summary
The bundle organizes performance expectations with a focus on engineering design and the study of changes to the land. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs
The idea that maps show where things are located and the shapes and kinds of land and water in any area (ESS2.B as in 2-ESS2-2) can connect to the idea that wind and water can change the shape of the land (ESS2.A as in 2-ESS2-1). The idea that the shape of the land can change connects to the concept that some events happen very quickly and others occur very slowly, over a time period much longer than one can observe (ESS1.C as in 2-ESS1-1).

The engineering design idea that because there is always more than one possible solution to a problem, it is useful to compare and test designs (ETS1.C as in K-2-ETS1-3) can connect to multiple science ideas, such as that wind and water can change the shape of the land (ESS2.A as in 2-ESS2-1) and that some events happen very quickly; others occur very slowly, over a time period much longer than one can observe (ESS1.C as in 2-ESS1-1). The first connection could be made by having students compare a variety of designs that are intended to prevent wind erosion of soil. The second connection could be made by having students compare designs intended to prevent danger from a rock slide.

Bundle Science and Engineering Practices
Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (2-ESS2-2); analyzing and interpreting data (K-2-ETS1-3); and constructing explanations and designing solutions (2-ESS1-1 and 2-ESS2-1). 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 (2-ESS2-2) and Stability and Change (2-ESS1-1 and 2-ESS2-1). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations	2-ESS1-1. **Use information from several sources to provide evidence that Earth events can occur quickly or slowly.** **[Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.] [*Assessment Boundary: Assessment does not include quantitative measurements of timescales.*]** 2-ESS2-1. **Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*** **[Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]**

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Performance Expectations (Continued)	2-ESS2-2. **Develop a model to represent the shapes and kinds of land and bodies of water in an area.** **[*Assessment Boundary: Assessment does not include quantitative scaling in models.*]** K-2-ETS1-3. **Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**
Example Phenomena	Canyons often have rivers at the bottom. Different oceans have different shapes on the map.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions based on observations to find more information about the natural and/or designed world(s). Students could *ask questions based on observations* [of] ***events*** [that] ***happen very quickly*** [and] ***others*** [that] ***occur very slowly*** *to find more information about the natural world*. 2-ESS1-1 **Developing and Using Models** ● Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller) and/or patterns in the natural and designed world(s). Students could *develop or use a model to represent relative scales* [of] ***land and water in*** [an] ***area*** [according to a] ***map***. 2-ESS2-2 **Planning and Carrying Out Investigations** ● Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question Students could *plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence* [about the effect of] ***wind*** [on] ***the shape of the land***. 2-ESS2-1 **Analyzing and Interpreting Data** ● Use and share pictures, drawings, and/or writings of observations. Students could *share* their *writings of observations* [of] ***the shapes and kinds of land in an area***. 2-ESS2-2 **Using Mathematical and Computational Thinking** ● Decide when to use qualitative vs. quantitative data. Students could *decide when to use qualitative vs. quantitative data* [when] ***representing the shapes and kinds of water in an area***. 2-ESS2-2 **Constructing Explanations and Designing Solutions** ● Generate and/or compare multiple solutions to a problem. Students could *compare multiple solutions* (such as bridges) *to a problem* [caused by] ***the shapes and kinds of water in an area***. 2-ESS2-2

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Additional Practices Building to the PEs (Continued)	**Engaging in Argument from Evidence** ● Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence. Students could *make a claim, supported by relevant evidence, about the effectiveness of a solution* [designed to prevent] ***water*** [from] ***changing the shape of the land***. 2-ESS2-1 **Obtaining, Evaluating, and Communicating Information** ● Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. Students could *obtain information using various texts, text features, and other media that will be useful in answering a scientific question* [about ways that] ***wind can change the shape of the land***. 2-ESS2-1
Additional Crosscutting Concepts Building to the PEs	**Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower). Students could describe how *relative scales allow* [different] ***time periods*** [such as the time over which] ***some*** [Earth] ***events happen,*** *to be compared and described*. 2-ESS1-1 **Systems and System Models** ● Objects and organisms can be described in terms of their parts. Students could communicate about how ***maps show where things are located*** and *can be described in terms of their parts*. 2-ESS2-2 **Energy and Matter** ● Objects may break into smaller pieces, be put together into larger pieces, or change shapes. Students could describe how ***the land*** *may break into smaller pieces or change shapes* [as a result of] ***wind and water***. 2-ESS2-1
Additional Connections to Nature of Science	**Science is a Way of Knowing** ● Scientific knowledge informs us about the world. Students could describe how *scientific knowledge* [about how] ***some events occur very slowly, over a period of time much longer than one can observe*** *informs* [them] *about the world*. 2-ESS1-1 **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Scientists use drawings, sketches, and models as a way to communicate ideas. Students could describe how they, like *scientists, use drawings, sketches, and models as a way to communicate ideas* [such as that] ***wind and water can change the shape of the land***. 2-ESS2-1

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2nd Grade Thematic Model

Narrative and Rationale: The three bundles in this Grade 2 model are characterized by the overarching theme that a "variety of objects, organisms, and systems are made up of parts"—an idea that applies to the physical, life, and Earth and space sciences, as well as engineering. Each of the three bundles also uses an engineering-related question to drive instruction.

The grade 2 Disciplinary Core Ideas (DCIs) in physical science focus on different kinds of matter and their observable properties and that some changes caused by heating and cooling can be reversed and some cannot. In Earth and space sciences, the DCI emphases are on wind and water, their roles in shaping the Earth's surface, and how humans can limit their effects. Students also learn that some events on Earth occur very quickly, while others can occur very slowly. In the life sciences, the grade 2 DCIs emphasize the needs of plants, how they depend on animals for seed dispersal and pollination, and the diversity of life found in different habitats.

Note that the practices and crosscutting concepts included in each bundle are intended as end-of-instructional unit expectations and not curricular designations. Additional practices and crosscutting concepts should be used throughout instruction in each bundle.

Bundle 1: How do we design better products? *~ 9 weeks*	**Bundle 2:** What kinds of solutions can help plants meet their needs? *~ 12 weeks*	**Bundle 3:** How do we prevent wind or water from changing the land? *~ 9 weeks*
2-PS1-1. Plan and conduct an investigation to describe and classify different kind s of materials by their observable properties. **2-PS1-2.** Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. **2-PS1-3.** Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. **K-2-ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	**2-PS1-4.** Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. **2-LS2-1.** Plan and conduct an investigation to determine if plants need sunlight and water to grow. **2-LS2-2.** Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants. **2-LS4-1.** Make observations of plants and animals to compare the diversity of life in different habitats. **2-ESS2-3.** Obtain information to identify where water is found on Earth and that it can be solid or liquid. **K-2-ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	**2-ESS1-1.** Use information from several sources to provide evidence that Earth events can occur quickly or slowly. **2-ESS2-1.** Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. **2-ESS2-2.** Develop a model to represent the shapes and kinds of land and bodies of water in an area. **K-2-ETS1-3.** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

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2nd Grade Thematic Model Course Flowchart

Bundle 1

PS1.A as found in 2-PS1-1
- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.

PS1.A as found in 2-PS1-2 and 2-PS1-3
- Different properties are suited to different purposes.

PS1.A as found in 2-PS1-3
- A great variety of objects can be built up from a small set of pieces.

ETS1.A as found in K–2-ETS1-1
- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Before beginning to design a solution, it is important to clearly understand the problem.

Bundle 2

PS1.B as found in 2-PS1-4
- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.

LS2.A as found in 2-LS2-1
- Plants depend on water and light to grow.

LS2.A as found in 2-LS2-2
- Plants depend on animals for pollination or to move their seeds around.

LS4.D as found in 2-LS4-1
- There are many different kinds of living things in any area, and they exist in different places on land and in water.

ESS2.C as found in 2-ESS2-3
- Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.

ETS1.B as found in 2-LS2-2 and K-2-ETS1-2
- 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.

Bundle 3

ESS1.C as found in 2-ESS1-1
- Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.

ESS2.A as found in 2-ESS2-1
- Wind and water can change the shape of the land.

ESS2.B as found in 2-ESS2-2
- Maps show where things are located. One can map the shapes and kinds of land and water in any area.

ETS1.C as found in 2-ESS2-1 and K-2-ETS1-3
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

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3rd Grade – Thematic Model – Bundle 1
Movement and Interaction of Objects

This is the first 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 1 Question: This bundle is assembled to address the question "how do objects affect the motion of other objects?"

Summary

The bundle organizes performance expectations with a focus on helping students understand the cause and affect relationships between objects when they interact and move. 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

Although objects in contact exert forces on each other (PS2.B as in 3-PS2-1), electric and magnetic forces between a pair of objects do not require that the objects be in contact (PS2.B as in 3-PS2-3 and 3-PS2-4). An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion (PS2.A as in 3-PS2-1). The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it (PS2.A as in 3-PS2-2).

The idea of determining patterns and using them to make predictions connects to the idea that scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next (ESS2.D as in 3-ESS2-1).

The engineering design idea that different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints (ETS1.C as in 3-5-ETS1-3) could connect to multiple science concepts such as that forces that do not sum to zero can cause changes in the object's speed or direction of motion (PS2.A as in 3-PS2-1) and that the size of the forces between two magnets depends on the properties of the magnets, their distance apart, and on their orientation relative to each other (PS2.B as in 3-PS2-3). The first connection could be made by challenging students to determine whether balanced or unbalanced forces will best solve the problem of changing the speed or direction of motion. The second connection could be made by supporting students to design a way to move something using magnets. In either case, criteria and constraints should be determined by the class before beginning to design a solution and students' solutions can be tested to determine which best solves the problem, given the criteria and constraints.

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-PS2-3 and 3-PS2-4), planning and carrying out investigations (3-PS2-1, 3-PS2-2, and 3-5-ETS1-3), and analyzing and interpreting data (3-ESS2-1). 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-PS2-2 and 3-ESS2-1) and Cause and Effect (3-PS2-1 and 3-PS2-3). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations 3-ESS2-1 and 3-5-ETS1-3 are partially assessable.	3-PS2-1. **Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.** [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [*Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.*] 3-PS2-2. **Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [*Assessment Boundary: Assessment does not include technical terms such as period and frequency.*] 3-PS2-3. **Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.** [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] *[Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.]* 3-PS2-4. **Define a simple design problem that can be solved by applying scientific ideas about magnets.*** [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.] 3-ESS2-1. **Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [*Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.*] 3-5-ETS1-3. **Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**
Example Phenomena	If two students push on opposite sides of a chair, the chair doesn't move. Larger magnets can pick up larger objects than can small magnets.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. Students could *ask questions* [about] ***the patterns of an object's motion*** *that can be investigated, and predict reasonable outcomes*. 3-PS2-2 **Developing and Using Models** ● Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. Students could *collaboratively develop a model* [of] ***forces causing changes in an object's speed or direction of motion*** *based on evidence that shows the relationships among variables for frequent and regular occurring events*. 3-PS2-1

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Additional Practices Building to the PEs (Continued)	**Planning and Carrying Out Investigations** ● Make predictions about what would happen if a variable changes. Students could make predictions about what would happen [to] ***the sizes of the forces between two magnets*** *if* ***their orientation relative to each other*** *changes*. 3-PS2-3 and 3-PS2-4 **Analyzing and Interpreting Data** ● Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. Students could ***observe and measure an object's motion in various situations***, *represent* [the] *data in tables and/or various graphical displays to reveal patterns*, [and use any] ***regular patterns*** [to] ***predict future motion***. 3-PS2-2 **Using Mathematical and Computational Thinking** ● Organize simple data sets that suggest relationships. Students can *organize simple data sets* [to reveal] ***patterns of the weather across different times and areas***. 3-ESS2-1 **Constructing Explanations and Designing Solutions** ● Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). Students could *construct an explanation of observed relationships* [between] ***the sizes of the forces*** [between two objects and] ***their distances apart***. 3-PS2-3 and 3-PS2-4 **Engaging in Argument from Evidence** ● 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. Students could *make a claim about the merit of a solution* [that uses the idea that] ***objects in contact exert forces on each other***. 3-PS2-1 **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 *communicate technical information* [about how] ***scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next***. 3-ESS2-1
Additional Crosscutting Concepts Building to the PEs	**Systems and System Models** ● A system can be described in terms of its components and their interactions. Students could describe how ***objects in contact exerting forces on each other*** [are] *components* [of] *a system.* 3-PS2-1

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Additional Crosscutting Concepts Building to the PEs (Continued)	**Scale, Proportion, and Quantity** ● Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. Students could ***measure the patterns of an object's motion in various situations***, [and describe how] *using standard units* [helps with communication of the patterns]. 3-PS2-2 **Stability and Change** ● Change is measured in terms of differences over time and may occur at different rates. Students can use ***patterns of the weather across different times and areas*** [to describe] *that change is measured in terms of differences over time and may occur at different rates*. 3-ESS2-1
Additional Connections to Nature of Science	**Scientific Knowledge is Based on Empirical Evidence** ● Scientists use tools and technologies to make accurate measurements and observations. Students could describe how *scientists use tools and technologies to make accurate measurements and observations*, [including of] ***patterns of the weather across different times and areas***. 3-ESS2-1 **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Science assumes consistent patterns in natural systems. Students could describe that we can ***predict future motion from past motion when that past motion exhibits a regular pattern*** *because science assumes consistent patterns in natural systems*. 3-PS2-2

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3rd Grade – Thematic Model – Bundle 2
Similarities and Differences in Organisms

This is the second 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 2 Questions: This bundle is assembled to address the question "what causes the differences between organisms?"

Summary

The bundle organizes performance expectations with a focus on helping students build an understanding of how organisms are similar and different, and about the life cycles of 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 reproduction is essential to the continued existence of every kind of organism (LS1.B as in 3-LS1-1) through the concept of survival of organisms.

Reproduction also connects to the concept of inheritance and that many characteristics of organisms are inherited from their parents (LS3.A as in 3-LS3-1). Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment (LS3.A as in 3-LS3-2).

All the previous concepts also connect to each other through the concept of patterns: patterns in fossils, patterns of reproduction across organisms, and patterns of characteristics of organisms, both inherited and from interactions with the environment. Exploring these applications of patterns can also connect to the idea that scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next (ESS2.D as in 3-ESS2-1).

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (3-LS1-1), analyzing and interpreting data (3-LS3-1, 3-LS4-1, and 3-ESS2-1), and constructing explanations and designing solutions (3-LS3-2). 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-LS1-1, 3-LS3-1, and 3-ESS2-1), Cause and Effect (3-LS3-2), and Scale, proportion, and quantity (3-LS4-1). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations 3-LS4-1 and 3-ESS2-1 are partially assessable.	3-LS1-1. **Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.** [Clarification Statement: Changes organisms go through during their life form a pattern.] *[Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.]* 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-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.] 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-ESS2-1. **Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [*Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.*]
Example Phenomena	Some trees grow at an angle on windy plains. Seedlings from the same parent plant all look slightly different.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Identify scientific (testable) and non-scientific (non-testable) questions. Students could ask questions about the ***effect*** [of] ***the environment*** [on an individuals'] ***traits,*** [and then] *identify* [which are] *scientific (testable) and non-scientific (non-testable) questions*. 3-LS3-2 **Developing and Using Models** ● Develop and/or use models to describe and/or predict phenomena. Students could *use a model to describe* [that] ***different organisms vary in how they look and function***. 3-LS3-1 **Planning and Carrying Out Investigations** ● Make predictions about what would happen if a variable changes. Students could *make predictions about what would happen* [to] ***characteristics*** [of an individual] *if* [the] ***individuals' interactions with the environment*** *changes*. 3-LS3-2

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Additional Practices Building to the PEs (Continued)	**Analyzing and Interpreting Data** ● Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. Students could *compare and contrast data* [on the] ***life cycles*** [of different] ***plants and animals*** *collected by different groups in order to discuss similarities and differences in their findings*. 3-LS1-1 **Using Mathematical and Computational Thinking** ● Organize simple data sets to reveal patterns that suggest relationships. Students could *organize simple data sets* [from] ***fossils*** [(e.g., type, size, and distributions of fossil organisms) to] ***provide evidence about the types of organisms that lived long ago*** [and] *to reveal patterns*. 3-LS4-1 **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] ***different organisms vary in how they look and function because they have different inherited information***. 3-LS3-1 **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 model* [of] ***life cycles*** [of] ***plants and animals*** *by citing relevant evidence and posing specific questions*. 3-LS1-1 **Obtaining, Evaluating, and Communicating Information** ● Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. Students could *combine information in written text* [regarding how] **some kinds of plants and animals that once lived on Earth are no longer found anywhere** *with* [information] *contained in corresponding tables, diagrams, and/or charts to support an argument*. 3-LS4-1
Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns can be used as evidence to support an explanation. Students could describe how *patterns* [across] ***individuals' characteristics*** *can be used as evidence to support an explanation* [that] ***characteristics*** [can] ***result from individuals' interactions with the environment***. 3-LS3-2 **Cause and Effect** ● Cause and effect relationships are routinely identified, tested, and used to explain change. Students could describe why they *identified the cause and effect relationship* [between the variation] ***in how different organisms look and function*** [and their] ***different inherited information***. 3-LS3-1

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Additional Crosscutting Concepts Building to the PEs (Continued)	**Scale, Proportion, and Quantity** ● Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. Students could construct an argument about why *standard units* [are useful in describing] ***characteristics of organisms*** [such as height and weight]. 3-LS3-1 and 3-LS3-2
Additional Connections to Nature of Science	**Scientific Investigations Use a Variety of Methods** ● Science investigations use a variety of methods, tools, and techniques. Students could identify that a *science investigation* [about the] ***patterns of the weather across different areas*** [may] *use* [different] *methods, tools, and techniques than a* [different type of investigation]. 3-ESS2-1 **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Science assumes consistent patterns in natural systems. Students could construct an explanation that that we can ***make predictions about what kind of weather might happen next*** *because science assumes consistent patterns in natural systems*. 3-ESS2-1

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3rd Grade – Thematic Model – Bundle 3
Survival of Organisms

This is the third 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 3 Question: This bundle is assembled to address the question "what affects organisms' survival?"
Summary The bundle organizes performance with a focus on helping students build understanding of the various factors that affect the survival of organisms and groups of 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 being part of a group helps animals obtain food, defend themselves, and cope with changes (LS2.D as in 3-LS2-1) connects to the idea that for any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all (LS4.C as in 3-LS4-3) in that both ideas are about the survival of kinds of organisms. These ideas can also connect to survival of individuals within a group and that sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing (LS4.B as in 3-LS4-2). In order to identify the differences in characteristics between individuals that may provide an advantage, it is helpful to look at the patterns of variation of a given characteristic among individuals in a species (e.g., longer or shorter thorns on individual plants, dark or light coloration of animals). And through the concept of patterns, this bundle also gives an opportunity to continue the study of the idea that scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next (ESS2.D as in 3-ESS2-1). **Bundle Science and Engineering Practices** Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of analyzing and interpreting data (3-ESS2-1), constructing explanations and designing solutions (3-LS4-2), and engaging in argument from evidence (3-LS2-1 and3-LS4-3). 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-ESS2-1) and Cause and Effect (3-LS2-1, 3-LS4-2, and 3-LS4-3). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*

Performance Expectations	3-LS2-1. **Construct an argument that some animals form groups that help members survive.** 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.]

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Performance Expectations (Continued)	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.] 3-ESS2-1. **Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [*Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.*]
Example Phenomena	Most people don't like to live completely on their own. Deer with larger antlers usually have more children.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Use prior knowledge to describe problems that can be solved. Students could use prior knowledge [about] ***patterns of the weather across different times and areas*** to describe problems that can be solved. 3-ESS2-1 **Developing and Using Models** ● Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. Students could *develop a model using an example to describe* [that in a] ***particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all***. 3-LS4-3 **Planning and Carrying Out Investigations** ● Evaluate appropriate methods and/or tools for collecting data. Students could *evaluate appropriate methods for collecting data* [on how well] ***some kinds of organisms survive in a particular environment***. 3-LS4-3 **Analyzing and Interpreting Data** ● Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. Students could *analyze and interpret data using logical reasoning to make sense* [of] ***the differences in characteristics between individuals of the same species***. 3-LS4-2 **Using Mathematical 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 could *describe, estimate, and graph quantities to address scientific questions* [about the] ***dramatic variation in group sizes***. 3-LS2-1 **Constructing Explanations and Designing Solutions** ● Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard). Students could *construct an explanation of observed relationships* [between] ***patterns of the weather*** [and] ***different times and areas***. 3-ESS2-1

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Additional Practices Building to the PEs (Continued)	**Engaging in Argument from Evidence** ● Construct and/or support an argument with evidence, data, and/or a model. Students could *construct and support an argument with evidence* [that] ***the differences in characteristics between individuals of the same species sometimes provide advantages in surviving, finding mates, and reproducing***. 3-LS4-2 **Obtaining, Evaluating, and Communicating Information** ● Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. Students could *combine information from books and/or other reliable media to explain* [why animals often live in] ***groups.*** 3-LS2-1
Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns can be used as evidence to support an explanation. Students could use *patterns* [of] ***the differences in characteristics between individuals of the same species*** *as evidence to support an explanation* ***that the different characteristics may provide advantages in surviving, finding mates, and reproducing***. 3-LS4-2 **Scale, Proportion, and Quantity** ● Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. Students could describe why it is important to *use standard units to measure and* [compare] *physical quantities* [of] ***characteristics*** [of] ***individuals*** [when identifying] ***differences in characteristics between individuals of the same species***. 3-LS4-2 **Systems and system models** ● A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. Students could describe a ***group of animals*** [that work together to] ***obtain food, defend themselves, and cope with changes*** [as a] *system* [composed] *of related parts that make up a whole and can carry out functions its individual parts cannot*. 3-LS2-1
Additional Connections to Nature of Science	**Scientific Knowledge is Based on Empirical Evidence** ● Science findings are based on recognizing patterns. Students can describe how *science findings*—[such as that] ***differences in characteristics between individuals of the same species*** [can] ***provide advantages in surviving, finding mates, and reproducing***—*are based on recognizing patterns*. 3-LS4-2 **Science is a Way of Knowing** ● Science is a way of knowing that is used by many people. Students could construct an argument that *science is a way of knowing that is used by many people* [using as evidence the example of identifying] ***patterns of the weather across different times and areas so that predictions*** [can be made] ***about what kind of weather might happen next***. 3-ESS2-1

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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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3rd Grade Thematic Model

Narrative and Rationale: The thematic model in Grade 3 is divided into four bundles that build on one another and increase in intellectual demand both in terms of content and the science and engineering practices. While other crosscutting concepts are included at this grade level, the crosscutting concepts of cause and effect is a theme that carries throughout the year.

The grade 3 disciplinary core ideas in physical science focus on forces and explanations for types of interactions involving motion, electricity, and magnetism. Core ideas in life science include life cycles of organisms, fossils as evidence of major changes over time in the environment, and traits influenced by inheritance and the environment. These ideas contribute to building the understanding that variations in traits among individuals of the same species can provide advantages in survival and reproduction. The core ideas in Earth and space science emphasize weather patterns, climates, and the connection between the two.

Note that the practices and crosscutting concepts included in each bundle are intended as end-of-instructional unit expectations and not curricular designations. Additional practices and crosscutting concepts should be used throughout instruction in each bundle.

Bundle 1: How do objects affect the motion of other objects? **~9 Weeks**	**Bundle 2:** What causes the differences between organisms? **~9 Weeks**	**Bundle 3:** What affects organisms' survival? **~9 Weeks**	**Bundle 4:** How does the climate affect organisms? **~9 Weeks**
3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. **3-PS2-2**. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. **3-PS2-3**. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. **3-PS2-4**. Define a simple design problem that can be solved by applying scientific ideas about magnets.* **3-ESS2-1**. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.[1]	**3-LS1-1.** Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death. **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. **3-LS3-2.** Use evidence to support the explanation that traits can be influenced by the environment. **3-LS4-1.** Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.[1] **3-ESS2-1.** Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.[1]	**3-LS2-1.** Construct an argument that some animals form groups that help members survive. **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. **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. **3-ESS2-1.** Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.	**3-LS4-1.** Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. **3-LS4-4.** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.* **3-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.* **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

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3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. [1]			problem based on how well each is likely to meet the criteria and constraints of the problem. [1]

1. The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.

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3rd Grade Thematic Model Flowchart

Bundle 1

PS2.A as found in 3-PS2-1
- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion.

to ESS3.B in Bundle 4

PS2.A as found in 3-PS2-2
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

PS2.B as found in 3-PS2-1
- Objects in contact exert forces on each other.

PS2.B as found in 3-PS2-3 and 3-PS2-4
- Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

ESS2.D as found in 3-ESS2-1
- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.

ETS1.B as found in 3-5-ETS1-3
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.

ETS1.C as found in 3-5-ETS1-3
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Bundle 2

LS1.B as found in 3-LS1-1
- Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.

LS3.A as found in 3-LS3-1
- Many characteristics of organisms are inherited from their parents.

LS3.A as found in 3-LS3-2
- Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.

LS3.B as found in 3-LS3-1
- Different organisms vary in how they look and function because they have different inherited information.

LS3.B as found in 3-LS3-2
- The environment also affects the traits that an organism develops.

LS4.A as found in 3-LS4-1
- Some kinds of plants and animals that once lived on Earth are no longer found anywhere.
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.

ESS2.D as found in 3-ESS2-1
- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.

Bundle 3

LS2.D as found in 3-LS2-1
- 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

LS4.B as found in 3-LS4-2
- Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.

LS4.C as found in 3-LS4-3
- For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

ESS2.D as found in 3-ESS2-1
- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.

Bundle 4

LS2.C as found in 3-LS4-4
- 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.

LS4.A as found in 3-LS4-1
- Some kinds of plants and animals that once lived on Earth are no longer found anywhere.
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.

LS4.D as found in 3-LS4-4
- Populations live in a variety of habitats, and change in those habitats affects the organisms living there.

ESS2.D as found in 3-ESS2-2
- Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.

ESS3.B as found in 3-ESS3-1
- A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts.

ETS1.A as found in 3-5-ETS1-1
- 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.

ETS1.B as found in 3-5-ETS1-2
- 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.

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4th Grade - Thematic Model - Bundle 1
Energy, Motion, and Weathering

This is the first bundle of the 4th Grade Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 1 Question: This bundle is assembled to address the question "what evidence of patterns and systems do we see in motion, weathering, fossils, and rock formation?"

Summary

The bundle organizes performance expectations with a focus on helping students build understanding of systems and energy related to motion, weathering, fossils, and rock formation. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 concept that living things affect the physical characteristics of their regions (ESS2.E as in 4-ESS2-1) connects to the idea that water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around (ESS2.A as in 4-ESS2-1). These processes cause changes in Earth's features, connecting to the idea that local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes (ESS1.C as in 4-ESS1-1). This concept also connects to the idea that when objects collide, energy can be transferred from one object to another, thereby changing their motion (PS3.B as in 4-PS3-3). This idea also connects to the concepts that the faster a given object is moving, the more energy it possesses (PS3.A as in 4-PS3-1), that energy can be moved from place to place by moving objects or through sound, light, or electric currents (PS3.A as in 4-PS3-3), and that when objects collide, the contact forces transfer energy so as to change the objects' motions (PS3.C as in 4-PS3-3).

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) could be applied to multiple science concepts such as that water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around (ESS2.A as in 4-ESS2-1), and that when objects collide, energy can be transferred from one object to another, thereby changing their motion (PS3.A as in 4-PS3-3). These connections could be made through engineering design tasks, such as by having students design a solution to reduce effects of weathering or erosion by water, ice, wind, or living organisms, and by having students attempt to reduce or increase the amount of energy transferred from one object to another in a collision. In either case, students should learn about the importance of researching the given problem before beginning to design a solution.

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 (4-PS3-3), planning and carrying out investigations (4-ESS2-1), and constructing explanations and designing solutions (4-PS3-1, 4-ESS1-1, and 3-5-ETS1-2). 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 (4-ESS1-1), Cause and Effect (4-ESS2-1), and Energy and Matter (4-PS3-1 and 4-PS3-3). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations 4-ESS2-1 and 3-5-ETS1-2 are partially assessable.	4-PS3-1 **Use evidence to construct an explanation relating the speed of an object to the energy of that object.** [*Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.*] 4-PS3-3 **Ask questions and predict outcomes about the changes in energy that occur when objects collide.** [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*] 4-ESS1-1 **Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.** [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [*Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.*] 4-ESS2-1 **Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [*Assessment Boundary: Assessment is limited to a single form of weathering or erosion.*] 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	A tennis ball that hits the wall will make a louder sound when it is thrown faster. Hills without vegetation tend to have deep cuts, or gullies, in the soil, whereas hills with vegetation have fewer gullies.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. Students could *ask questions* [about how] ***living organisms break rocks, soils, and sediments into smaller particles and move them around*** *that can be investigated, and predict reasonable outcomes based on patterns such as cause and effect relationships.* 4-ESS2-1 **Developing and Using Models** • Identify limitations of models. Students could *identify limitations of models* [that describe that] ***when objects collide, some energy is typically also transferred to the surrounding air***. 4-PS3-3 **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 or test a design solution. Students could *make observations and measurements to serve as the basis for evidence for an explanation* [that] ***the faster a given object is moving, the more energy it possesses***. 4-PS3-1

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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 that indicate relationships. Students could *represent data in various graphical displays to reveal patterns that indicate relationships* [between] ***the location of certain fossil types*** [and] ***the order in which rock layers were formed***. 4-ESS1-1 **Using Mathematical 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 could *measure and graph quantities, such as time, to address engineering problems* [related to the idea that] ***the faster a given object is moving, the more energy it possesses***. 4-PS3-1 **Constructing Explanations and Designing Solutions** • Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). Students could *construct an explanation of observed* [cause and effect] *relationships* [between] ***living things*** [and] ***the physical characteristics of their regions,*** [such as the relationship between vegetation and erosion]. 4-ESS2-1 **Engaging in Argument from Evidence** • Construct and/or support an argument with evidence, data, and/or a model. Students could *construct and/or support an argument with evidence* [that**]** ***local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes***. 4-ESS1-1 **Obtaining, Evaluating, and Communicating Information** • Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. Students could *read and comprehend grade-appropriate complex texts and/or other reliable media to obtain scientific ideas* [about] ***energy moving from place to place by moving objects or through sound, light, or electric currents*** *and to describe* [how these ideas are] *supported by evidence.* 4-PS3-3
Additional Crosscutting Concepts Building to the PEs	**Patterns** • Patterns of change can be used to make predictions. Students could use the *pattern of change* [between] ***the energy*** [of a] ***moving object*** [and] ***the*** [speed the] ***object is moving*** *to make predictions*. 4-PS3-1 **Scale, Proportion, and Quantity** • Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods. Students could identify *observable phenomena* [such as the results of] ***water, ice, wind, living organisms, and gravity breaking rocks, soils, and sediments into smaller particles and moving them around*** [that] *exist from the very small to the immensely large or from very short to very long time periods*. 4-ESS2-1

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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 use examples of ***the presence and location of certain fossil types*** [that] ***indicate the order in which rock layers were formed*** [and] ***patterns of rock formations due to earth forces*** [to provide evidence] *that change is measured in terms of differences over time and may occur at different rates.* 4-ESS2-1
Additional Connections to Nature of Science	**Science Investigations Use a Variety of Methods** • Science methods are determined by questions. Students could describe how the *science methods* [they used to investigate that] ***energy can be moved from place to place by moving objects or through sound, light, or electric currents*** [were] *determined by* [their] *questions*. 4-PS3-3 **Scientific Knowledge is Based on Empirical Evidence** • Science findings are based on recognizing patterns. Students could use [patterns of] ***living things affecting the physical characteristics of their regions*** [to describe that] *science findings are based on recognizing patterns*. 4-ESS2-1

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4th Grade – Thematic Model - Bundle 2
Transfer of Energy and Information

This is the second bundle of the 4th Grade Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the [Course Flowchart](#).

Bundle 2 Question: This bundle is assembled to address the question "what evidence of patterns and systems do we see in organism structure and how those structures function in information transfer?"

Summary

The bundle organizes performance expectations with a focus on helping students build understanding of systems related to the transfer of energy and information. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 an object can be seen when light reflected from its surface enters the eyes (PS4.B as in 4-PS4-2) connects to the idea that different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain (LS1.D as in 4-LS1-2). Processing information also connects to the idea that information can be transferred: digitized information can be transmitted over long distances without significant degradation (PS4.C as in 4-PS4-3). The idea that light can be seen and processed connects to the concepts that light transfers energy from place to place, and that energy is present whenever there are moving objects, sound, light, or heat (PS3.A and PS3.B as in 4-PS3-2).

The engineering design idea that, at whatever stage of the design process, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs (ETS1.B as in 3-5-ETS1-2) could be applied to multiple science ideas, such as that energy can be moved from place to place by moving objects or through sound, light, or electric currents (PS3.A as in 4-PS3-2) and that different sense receptors are specialized for particular kinds of information (LS1.D as in 4-LS1-2). Connections could be made through engineering design tasks, such as by having students design a solution to a problem through the use of energy transfer, and by having students design a solution to a problem by mimicking the function of a sense receptor. In both cases, students should learn the importance of communicating about and collaborating on their design ideas throughout the process, as shared ideas can lead to improved designs.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of planning and carrying out investigations (4-PS3-2), developing and using models (4-PS4-2 and 4-LS1-2), constructing explanations and designing solutions (4-PS4-3 and 3-5-ETS1-2), and engaging in argument from evidence (4-LS1-1). 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 (4-PS4-3), Cause and Effect (4-PS4-2), Systems and System Models (4-LS1-1 and 4-LS1-2), and Energy and Matter (4-PS3-2). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations	4-PS3-2 **Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.** [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*] 4-PS4-2 **Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.** [*Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.*] 4-PS4-3 **Generate and compare multiple solutions that use patterns to transfer informatio**n. [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.] 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, colored 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.*] 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	We can talk on the phone to someone across the country. A flower has brightly colored petals.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Identify scientific (testable) and non-scientific (non-testable) questions. Students could [brainstorm questions about why] ***an object can be seen*** *and* [then] *identify* [which questions are] *scientific (testable) and* [which are] *non-scientific (non-testable) questions*. 4-LS1-1 **Developing and Using Models** • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. Students could *develop a model using an analogy to describe* [that] ***high-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa***. 4-PS4-3 **Planning and Carrying Out Investigations** • Evaluate appropriate methods and/or tools for collecting data. Students could *evaluate appropriate methods and/or tools for collecting data* [on] ***plants' and animals' internal and external structures*** [and the] ***various functions*** [they] ***serve in growth, survival, behavior, and reproduction.*** 4-LS1-1 **Analyzing and Interpreting Data** • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. Students could *analyze and interpret data, using logical reasoning, to make sense of a phenomenon* [related to the idea that] ***energy moves from place to place by moving objects or through electric currents***. 4-PS3-2

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Additional Practices Building to the PEs (Continued)	**Using Mathematical and Computational Thinking** • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. Students could *decide if qualitative or quantitative data are best to determine whether a proposed object* [that is intended to mimic certain] ***external structures of plants*** *meets criteria for success*. 4-LS1-1 **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] ***light transfers energy from place to place***. 4-PS3-2 **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 model* [that describes that] ***an object can be seen when light reflected from its surface enters the eyes*** *by citing relevant evidence and posing specific questions*. 4-PS4-2 **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 *communicate scientific information through various forms of media* [about] ***different sense receptors*** [that] ***are specialized for particular kinds of information***. 4-LS1-2
Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change. Students could describe examples of *cause and effect relationships*—[like the relationship between] ***animals' perceptions and their actions***—[that are] *are routinely identified, tested, and used to explain change*. 4-LS1-2 **Systems and Systems Models** • A system can be described in terms of its components and their interactions. Students could describe the ***light reflected from*** [the] ***surface*** [of] ***an object that enters the eyes*** [as] *a system* [and] *describe the components interactions* [within that system]. 4-PS4-2 **Stability and Change** • Change is measured in terms of differences over time and may occur at different rates. Students could describe how *change is measured in terms of differences over time and may occur at different rates*, [using the collision of objects, which] ***transfer energy from one object to another thereby changing their motion***, as an example. 4-PS3-2

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Additional Connections to Nature of Science	**Science Is a Way of Knowing** • Science is a way of knowing that is used by many people. Students could describe that *science is a way of knowing* [by describing how they used science to know that] ***an object can be seen when light reflected from its surface enters the eyes***. 4-PS4-2 **Influence of Science, Engineering, and Technology on Society and the Natural World** • Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. Students could describe how engineers improve existing technologies or develop new ones [that can] ***transmit digitized information over long distances without significant degradation [and that] can receive and decode information—convert it from digitized form to voice—and vice versa*** to increase their benefits, to decrease known risks, and to meet societal demands. 4-PS4-3

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4th Grade - Thematic Model - Bundle 3
Waves and Earth Features

This is the third bundle of the 4th Grade Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 3 Question: This bundle is assembled to address the question "what evidence of patterns and systems do we see in erosion, waves, and Earth features?"

Summary
The bundle organizes performance expectations with a focus on helping students build understanding of waves, Earth features, and energy transfer. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 when waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach (PS4.A as in 4-PS4-1) could connect to the idea that a variety of hazards result from natural processes such as tsunamis, earthquakes, volcanic eruptions (ESS3.B as in 4-ESS3-2).

Both of these concepts can be connected to the idea that water—as well as ice, wind, living organisms, and gravity—breaks rocks, soils, and sediments into smaller particles and moves them around (ESS2.A as in 4-ESS2-1). This idea also connects to the concepts that energy is present whenever there are moving objects (PS3.B as in 4-PS3-3), and that living things affect the physical characteristics of their regions (ESS2.E as in 4-ESS2-1). This last idea connects to the concept that the energy and fuels that humans use are derived from natural sources and their use affects the environment in multiple ways (ESS3.A as in 4-ESS3-1).

The idea that most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans (ESS2.B as in 4-ESS2-2) also connects to the idea that a variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts (ESS3.B as in 4-ESS3-2).

Bundle Science and Engineering Practices
Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (4-PS4-1), planning and carrying out investigations (4-ESS2-1), analyzing and interpreting data (4-ESS2-2), constructing explanations and designing solutions (4-PS3-4 and 4-ESS3-2), and obtaining, evaluating, and communicating information (4-ESS3-1). 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 (4-PS4-1 and 4-ESS2-2), Cause and Effect (4-ESS2-1, 4-ESS3-1, and 4-ESS3-2), and Energy and Matter (4-PS3-4). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations	4-PS3-4 **Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*** [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [*Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.*] 4-PS4-1 **Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [*Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.*] 4-ESS2-1 **Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [*Assessment Boundary: Assessment is limited to a single form of weathering or erosion.*] 4-ESS2-2 **Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.] 4-ESS3-1 **Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.] 4-ESS3-2 **Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [*Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.*]
Example Phenomena	Some parts of the country get a lot of earthquakes and other parts never have earthquakes. Wind turbines can generate electricity.
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 that can be solved through the development of a system* [that] ***transfers energy from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light***. 4-PS3-4 **Developing and Using Models** • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. Students could *collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regularly occurring events,* [such as the relationship between] ***locations*** [and] ***mountain ranges***. 4-ESS2-2

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Additional Practices Building to the PEs (Continued)	
Additional Practices Building to the PEs (Continued)	**Planning and Carrying Out Investigations** • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success. Students could *test two different models of the same proposed process* [intended to] ***reduce the impact of a hazard resulting from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions)*** *to determine which* [model] *better meets criteria for success*. 4-ESS3-2 **Analyzing and Interpreting Data** • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. Students could *represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships*, [such as the relationship between] ***rainfall*** [and the movement of] ***soils***. 4-ESS2-1 **Using Mathematical 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 could *describe, measure, and graph quantities such as area, volume, weight, and time to address scientific questions* [related to] ***water and gravity breaking rocks, soils, and sediments into smaller particles and moving them around***. 4-ESS2-1 **Constructing Explanations and Designing Solutions** • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation. Students could *use evidence (e.g., measurements, observations, patterns) to support an explanation* [that] ***when waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach***. 4-PS4-1 **Engaging in Argument from Evidence** • 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. Students could *make a claim about the merit of a solution* [that] ***"produces energy"*** [or] ***converts stored energy into a desired form for practical use*** *by citing relevant evidence about how it meets the criteria and constraints of the problem*. 4-PS3-4 **Obtaining, Evaluating and Communicating Information** • Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. Students could *combine information* [about] ***the locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes*** *in written text with that contained in corresponding tables, diagrams, and/or charts to support scientific arguments*. 4-ESS2-2

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Additional Crosscutting Concepts Building to the PEs	**Patterns** • Patterns of change can be used to make predictions. Students could describe that ***humans cannot eliminate the hazards [that] result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions) but can take steps to reduce their impacts,*** [including by using] *patterns of change to make predictions* [about the timing and location of hazards]. 4-ESS3-2 **Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change. Students could *identify cause and effect relationships* [such as the relationship between] ***disturbing the surface*** [of] ***water*** [and production of] ***waves***; students could *use* [these relationships] *to explain change*. 4-PS4-1 **Energy and Matter** • Energy can be transferred in various ways and between objects. Students could describe how *energy can be transferred in various ways and between objects* [using the example of] ***water, ice, wind, living organisms, and gravity breaking rocks, soils, and sediments into smaller particles and moving them around***. 4-ESS2-1
Additional Connections to Nature of Science	**Science Investigations Use a Variety of Methods** • Science methods are determined by questions. Students could describe how the *science methods* [they used to investigate] ***water, ice, wind, living organisms, and gravity breaking rocks, soils, and sediments into smaller particles and moving them around*** [were] *determined by* [their] *questions*. 4-ESS2-1 **Science Addresses Questions about the Natural and Material World** • Science findings are limited to what can be answered with empirical evidence. Students could describe how *science [questions and investigations about]* ***energy and fuels that humans use*** *are limited to what can be answered with empirical evidence*. 4-ESS3-1

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4th Grade Thematic Model		
Narrative and Rationale: The three bundles in this Grade 4 model are characterized by the overarching theme that students can find evidence of patterns and systems throughout the natural and designed world. Each bundle also relates to energy transfer, as students begin to learn about the concept of energy in colliding objects and the role of energy in a large system early in the year, and then apply that knowledge to information transfer and to different Earth systems later in the year. Cognitive demand increases as the year progresses, with the expectations that students will become more adept at using the science and engineering practices and the crosscutting concepts. The instruction begins with concrete, familiar experiences and moves to more abstract learning. Note that the practices and crosscutting concepts described are intended as end-of-instructional unit expectations and not curricular designations – additional practices and crosscutting concepts should be used throughout instruction in each bundle.		
Bundle 1: What evidence of patterns and systems do we see in motion, weathering, fossils, and rock formation? **~12 weeks**	**Bundle 2:** What evidence of patterns and systems do we see in organism structure and how those structures function in information transfer? **~12 weeks**	**Bundle 3:** What evidence of patterns and systems do we see in erosion, waves, and Earth features? **~12 weeks**
4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object. **4-PS3-3.** Ask questions and predict outcomes about the changes in energy that occur when objects collide. **4-ESS1-1.** Identify evidence from patterns in rock formations and fossils in rock layers for changes in a landscape over time to support an explanation for changes in a landscape over time. **4-ESS2-1.** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.[1] **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.[1]	**4-PS3-2.** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. **4-PS4-2.** Develop a model to describe that light reflecting from objects and entering the eye. **4-PS4-3.** Generate and compare multiple solutions that use patterns to transfer information.* **4-LS1-1.** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. **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. **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.	**4-PS3-4.** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.* **4-PS4-1.** Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. **4-ESS2-1.** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. **4 ESS2-2.** Analyze and interpret data from maps to describe patterns of Earth's features. **4-ESS3-1.** Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. **4-ESS3-2.** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*

1. The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.

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4th Grade Thematic Model Course Flowchart

Bundle 1

PS3.A as found in 4-PS3-1
- The faster a given object is moving, the more energy it possesses.

PS3.A as found in 4-PS3-3
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.

PS3.B as found in 4-PS3-3
- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.

PS3.C as found in 4-PS3-3
- When objects collide, the contact forces transfer energy so as to change the objects' motions.

To ESS2.B and ESS3.B in Bundle 3

ESS1.C as found in 4-ESS1-1
- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.

To ESS2.B and ESS3.A in Bundle 3

ESS2.A as found in 4-ESS2-1
- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.

ESS2.E as found in 4-ESS2-1
- Living things affect the physical characteristics of their regions.

ETS1.B as found in 3-5-ETS1-2
- 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.

Bundle 2

PS3.A as found in 4-PS3-2
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.

PS3.B as found in 4-PS3-2
- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
- Light also transfers energy from place to place.
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.

PS4.B as found in 4-PS4-2
- An object can be seen when light reflected from its surface enters the eyes.

PS4.C as found in 4-PS4-3
- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.

LS1.A as found in 4-LS1-1
- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

LS1.D as found in 4-LS1-2
- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.

ETS1.B as found in 3-5-ETS1-2
- 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.

ETS1.C as found in 4-PS4-3
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Bundle 3

PS3.B as found in 4-PS3-4
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.

PS3.D as found in 4-PS3-4
- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use.

PS4.A as found in 4-PS4-1
- Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).

ESS2.A as found in 4-ESS2-1
- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.

ESS2.E as found in 4-ESS2-1
- Living things affect the physical characteristics of their regions.

ESS2.B as found in 4-ESS2-2
- The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.

ESS3.A as found in 4-ESS3-1
- Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.

ESS3.B as found in 4-ESS3-2
- A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts.

ETS1.A as found in 4-PS3-4
- 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.

ETS1.B as found in 4-ESS3-2
- Testing a solution involves investigating how well it performs under a range of likely conditions.

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5th Grade - Thematic Model - Bundle 1
Scale, Proportion, and Quantity

This is the first bundle of the Fifth Grade Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the *Course Flowchart*.

Bundle 1 Question: This bundle is assembled to address the question "How big is the sun, and what is it made of?"

Summary

The bundle organizes performance expectations with a focus on helping students build an understanding of the crosscutting concept of scale, proportion, and quantity along with related disciplinary concepts. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

The disciplinary core ideas in this bundle are linked through the concept of scale, proportion, and quantity. The ideas that: 1) measurements of a variety of properties can be used to identify materials (PS1.A as in 5-PS1-3), 2) the amount (weight) of matter is conserved when it changes form (PS1.A as in 5-PS1-2), and 3) the patterns caused by orbits of Earth around the sun and of the moon around Earth and the rotation of Earth about an axis such as the daily changes in the length and direction of shadows (ESS1.B as in 5-ESS1-2) connect through the idea that physical quantities can be measured and described. These ideas also connect to the concept that when two or more different substances are mixed, a new substance with different properties may be formed (PS1.B as in 5-PS1-4) as new substances could be identified by measuring different properties.

And the concepts that matter of any type can be subdivided into particles that are too small to see (PS1.A as in 5-PS1-1) and that the sun is a star that appears larger and brighter than other stars because it is closer (ESS1.A as in 5-ESS1-1) connect to each other and the rest of the bundle through the concept of scale.

The engineering design idea that different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints (ETS1.C as in 3-5-ETS1-3) could connect to multiple science concepts, such as that when two or more different substances are mixed, a new substance with different properties may be formed (PS1.B as in 5-PS1-4), and that the sun is a star that appears larger and brighter than other stars because it is closer (ESS1.A as in 5-ESS1-1). The first connection could be made through a challenge in which students test multiple different substances to find one with particular properties. The second could be made by having students test how well design solutions work for communicating how close an object is, using apparent size and scale.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (5-PS1-1); planning and carrying out investigations (5-PS1-3, 5-PS1-4, and 3-5-ETS1-3); using mathematics and computational thinking (5-PS1-2); analyzing and interpreting data (5-ESS1-2); and engaging in argument from evidence (5-ESS1-1). 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 (5-ESS1-2); Cause and Effect (5-PS1-4); and Scale, Proportion, and Quantity (5-PS1-1, 5-PS1-2, 5-PS1-3, and 5-ESS1-1). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations 5-PS1-1 and 5-ESS1-2 are partially assessable	5-PS1-1. **Develop a model to describe that matter is made of particles too small to be seen.** [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [*Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.*] 5-PS1-2. **Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.** [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.] [*Assessment Boundary: Assessment does not include distinguishing mass and weight.*] 5-PS1-3. **Make observations and measurements to identify materials based on their properties.** [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [*Assessment Boundary: Assessment does not include density or distinguishing mass and weight.*] 5-PS1-4. **Conduct an investigation to determine whether the mixing of two or more substances results in new substances.** 5-ESS1-1. **Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.** [*Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).*] 5-ESS1-2. **Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [*Assessment Boundary: Assessment does not include causes of seasons.*] 3-5-ETS1-3. **Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**
Example Phenomena	Two objects of the same size appear to be different sizes when they are different distances from the viewer. Wind can move leaves.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. Students could *ask questions* [about what happens] ***when two or more different substances are mixed*** *and predict reasonable outcomes based on cause and effect relationships.* 5-PS1-4 **Developing and Using Models** • Develop and/or use models to describe and/or predict phenomena. Students could *use models to describe* [that] ***the amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish***. 5-PS1-2 **Planning and Carrying Out Investigations** • Evaluate appropriate methods and/or tools for collecting data. Students could *evaluate appropriate methods and tools for collecting data* [on the] ***different positions of the sun, moon, and stars at different times of the day, month, and year***. 5-ESS1-2

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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 that indicate relationships. Students could *represent* ***measurements of a variety of properties*** [that] ***can be used to identify materials*** *in tables and various graphical displays to reveal patterns*. 5-PS1-3 **Mathematical and Computational Thinking** • Organize simple data sets to reveal patterns that suggest relationships. Students could *organize simple data sets* [of the] ***brightness of stars*** [and] ***their distance from Earth*** *to reveal patterns that suggest relationships*, [including that] ***the sun is a star that appears larger and brighter than other stars because it is closer***. 5-ESS1-1 **Constructing Explanations and Designing Solutions** • Use evidence (e.g., measurements, patterns) to construct or support an explanation or design a solution to a problem. Students could *use evidence to support an explanation* [that] ***when two or more different substances are mixed, a new substance with different properties may be formed***. 5-PS1-4 **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 model* [that describes that] ***matter of any type can be subdivided into particles that are too small to see*** *by citing relevant evidence and posing specific questions*. 5-PS1-1 **Obtaining, Evaluating, and Communicating Information** • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts. Students could *communicate scientific information* [about] ***stars*** [and] ***their distance from Earth*** *orally and in written formats* [to describe that] ***the sun is a star that appears larger and brighter than other stars because it is closer***. 5-ESS1-1
Additional Crosscutting Concepts Building to the PEs	**Patterns** • Patterns of change can be used to make predictions Students could identify *patterns* [when] ***matter changes form*** *to predict* [that] ***the weight of the substances*** [will] ***not change***. 5-PS1-2 **Energy and Matter** • Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. Students could describe that *matter flows and cycles can be tracked in terms of the weight of the substances* ***when two or more different substances are mixed*** [and] ***a new substance with different properties may be formed***. 5-PS1-4

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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 investigate what happens ***when two or more different substances are mixed*** [to describe that] *change is measured in terms of differences over time and may occur at different rates*. 5-PS1-4
Additional Connections to Nature of Science	**Science Knowledge Is Based on Empirical Evidence** • Science uses tools and technologies to make accurate measurements and observations. Students could describe how they used *tools and technologies to make accurate measurements and observations* ***of a variety of properties*** [that] ***can be used to identify materials***. 5-PS1-3 **Science Is a Human Endeavor** • Science affects everyday life. Students could describe how *everyday life is affected* [by the knowledge that] ***when two or more different substances are mixed, a new substance with different properties may be formed***. 5-PS1-4

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5th Grade - Thematic Model - Bundle 2
Flow and Cycles of Matter and Energy

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

Bundle 2 Questions: This bundle is assembled to address the questions "How do animals have energy to move around?"

Summary

The bundle organizes performance expectations with a focus on helping students understand flow and cycles of matter and energy, especially in the context of ecosystems. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

The concept that matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die (LS2.B as in 5-LS2-1) connects to the idea that matter of any type can be subdivided into particles that are too small to see (PS1.A as in 5-PS1-1), because matter is subdivided into particles as it flows between organisms and the air and soil. The idea about matter flows also connects to the ideas that plants acquire their material for growth chiefly from air and water (LS1.C as in 5-LS1-1) and that food provides animals with the materials they need for body repair and growth (LS1.C in 5-PS3-1).

Just as matter flows, energy can flow as well. As such, the idea that matter can flow connects to the concept that the energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (PS3.D as in 5-PS3-1).

The concept that matter flows between organisms and the air and soil also indicates interdependence between organisms and their environment. Such interdependence connects to the idea that human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space (ESS3.C as in 5-ESS3-1).

The ideas that cycles of day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year (ESS1.B as in 5-ESS1-2) can connect to the idea that matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die (LS2.B as in 5-LS2-1), but is also included in this bundle to allow students time to collect data on patterns of the sun, moon, and stars throughout the year.

The engineering design concept that solutions to a problem are limited by available materials and resources, or constraints (ETS1.A as in 3-5-ETS1-1) could connect to multiple science concepts, such as that human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space (ESS3.C as in 5-ESS3-1) and that 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 (LS2.A as in 5-LS2-1). The first connection could be made by having students solve a problem – with limited, given resources – related to an effect that humans have on the land. The second could be made through having students create a plan to improve the health of a given ecosystem within given constraints.

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); developing and using models (5-PS1-1, 5-PS3-1, and 5-LS2-1); analyzing and interpreting data (5-ESS1-2); engaging in argument from evidence (5-LS1-1); and obtaining, evaluating, and communicating Information (5-ESS3-1). Many other practice elements can be used in instruction.

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Bundle Crosscutting Concepts Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the crosscutting concepts of Patterns (5-ESS1-2); Scale, Proportion, and Quantity (5-PS1-1); Systems and System Models (5-LS2-1 and 5-ESS3-1); and Energy and Matter (5-PS3-1 and 5-LS1-1). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*	
Performance Expectations 5-PS1-1 and 5-ESS1-2 are partially assessable	5-PS1-1. **Develop a model to describe that matter is made of particles too small to be seen.** [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [*Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.*] 5-PS3-1. **Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.** [Clarification Statement: Examples of models could include diagrams, and flow charts.] 5-LS1-1. **Support an argument that plants get the materials they need for growth chiefly from air and water.** [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.] 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.] 5-ESS1-2. **Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [*Assessment Boundary: Assessment does not include causes of seasons.*] 5-ESS3-1. **Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.** 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.**
Example Phenomena	Spiders can regrow legs. Human hair can be analyzed to determine how much of an individuals' diet is corn.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. Students could *ask questions that can be investigated* [about where] ***plants acquire their material for growth***. 5-LS1-1 **Developing and Using Models** • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. Students could *collaboratively revise a model based on evidence* [to] *show the relationship* [between] ***plant growth and air***. 5-LS1-1

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Additional Practices Building to the PEs (Continued)	**Planning and Carrying Out Investigations** • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. Students could *plan and conduct an investigation collaboratively – using fair tests in which variables are controlled and the number of trials considered – to produce data to serve as the basis for evidence* [that] ***plants acquire their material for growth chiefly from air and water***. 5-LS1-1 **Analyzing and Interpreting Data** • Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. Students could *represent data in various graphical displays to reveal patterns that indicate relationships* [between] ***human activities in everyday life*** [and] ***the land, vegetation, streams, ocean, and air***. 5-ESS3-1 **Using Mathematical and Computational Thinking** • Organize simple data sets to reveal patterns that suggest relationships. Students could *organize simple data sets to reveal patterns* [in the] ***daily changes in the length and direction of shadows***. 5-ESS1-2 **Constructing Explanations and Designing Solutions** • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. Students could *use evidence to construct an explanation* [that] ***matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists***. 5-PS1-1 **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 receive critiques from peers about a proposed explanation* [that] ***energy released*** [from] ***food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water)***. 5-PS3-1 **Obtaining, Evaluating and Communicating Information** • Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. Students could *read and comprehend grade appropriate complex texts* [about the idea that] ***food provides animals with the materials they need for body repair*** *to summarize and describe how* [this concept is] *supported by evidence.* 5-PS3-1

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Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change. Students could *identify* [the] *cause and effect relationships* [between] ***human activities in industry and*** [effects on] **the air** *and use* [the relationships] *to explain change*. 5-ESS3-1 **Scale, Proportion, and Quantity** • Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods. Students could describe that *observable phenomena exist from the very small*, ***such as fungi and bacteria breaking down dead organisms*** *to the immensely large*, [such as entire] ***environments***. 5-LS2-1 **Energy and Matter** • Matter is made of particles. Students could describe that *matter is made of particles* [in the context that] ***matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die***. 5-LS2-1
Additional Connections to Nature of Science	**Scientific Investigations Use a Variety of Methods** • Science investigations use a variety of methods, tools, and techniques. Students could describe [several different] *methods, tools, and techniques* [they could use to investigate that] ***plants acquire their material for growth chiefly from air and water***. 5-LS1-1 **Scientific Knowledge is Open to Revision in Light of New Evidence** • Science explanations can change based on new evidence. Students could construct explanations of where ***plants acquire their material for growth*** [before and after an investigation and then use this experience as evidence to describe that] *science explanations can change based on new evidence*. 5-LS1-1

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5th Grade – Thematic Model - Bundle 3
Stability and Change in Earth's Systems

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

Bundle 3 Question: This bundle is assembled to address the question "Has the desert always been dry?"

Summary

The bundle organizes performance expectations with a focus on helping students build understanding of how Earth systems change or stay the same over time. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

The idea that matter of any type can be subdivided into particles that are too small to see (PS1.A as in 5-PS1-1) can connect to the concept that Earth's major systems interact in multiple ways to affect Earth's surface materials and processes (ESS2.A as in 5-ESS2-1) since matter sometimes moves through the systems as particles that are too small to see. Earth's major systems also connect to the concept that nearly all of Earth's available water is in the ocean, and most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere (ESS2.C as in 5-ESS2-2) as this concept is about the hydrosphere.

The Earth's major systems are affected by gravity as the gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center (PS2.B as in 5-PS2-1). The concept of gravitational force can also connect to the concept that the Earth orbits around the sun and the moon around Earth (ESS1.B as in 5-ESS1-2).

The engineering design concept that communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs (ETS1.B as in 3-5-ETS1-2) could connect to multiple science concepts, such as that the ocean supports a variety of ecosystems and organisms (ESS2.A as in 5-ESS2-1) and that nearly all of Earth's available water is in the ocean, and most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere (ESS2.C as in 5-ESS2-2). The first connection could be made by having students share ideas about designs regarding threatened ecosystems or organisms that are supported by the ocean. The second could be made by having students independently obtain information about processes to obtain drinkable water, and then share their findings with others to propose improved designs. In either case, students should have an opportunity to communicate with their peers throughout the design process and reflect on how sharing ideas affected their designs.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (5-PS1-1 and 5-ESS2-1); analyzing and interpreting data (5-ESS1-2); using mathematical and computational thinking (5-ESS2-2); constructing explanations and designing solutions (3-5-ETS1-2); engaging in argument from evidence (5-PS2-1); and obtaining, evaluating, and communicating Information (5-ESS3-1). 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 (5-ESS1-2); Cause and Effect (5-PS2-1); Scale, Proportion, and Quantity (5-PS1-1 and 5-ESS2-2); and Systems and System Models (5-ESS2-1). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations 5-PS1-1 and 5-ESS2-1 are partially assessable	5-PS1-1. **Develop a model to describe that matter is made of particles too small to be seen.** [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [*Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.*] 5-PS2-1. **Support an argument that the gravitational force exerted by Earth on objects is directed down.** [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [*Assessment Boundary: Assessment does not include mathematical representation of gravitational force.*] 5-ESS1-2. **Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [*Assessment Boundary: Assessment does not include causes of seasons.*] 5-ESS2-1. **Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.** [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [*Assessment Boundary: Assessment is limited to the interactions of two systems at a time.*] 5-ESS2-2. **Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** [*Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.*] 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	The Amazon rainforest receives a lot of rain. There are usually clouds around a mountaintop.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Identify scientific (testable) and non-scientific (non-testable) questions. Students could *identify scientific (testable) and non-scientific (non-testable) questions* [about] ***interactions*** [between] ***Earth's major systems – the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans)***. 5-ESS2-1 **Developing and Using Models** ● Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. Students could *develop a diagram to convey a proposed process* [for creating] ***fresh water***. 5-ESS2-2 **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 or test a design solution. Students could *make observations to serve as the basis for evidence for an explanation* [that] ***the gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center***. 5-PS2-1

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Additional Practices Building to the PEs (Continued)	**Analyzing and Interpreting Data** ● Analyze and interpret data to make sense of phenomena using logical reasoning, mathematics, and/or computation. Students could *analyze and interpret data to make sense of* [the distribution and accessibility of water on Earth, i.e., that] ***nearly all of Earth's available water is in the ocean***. 5-ESS2-2 **Using Mathematical and Computational Thinking** ● Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. Students could *decide if qualitative or quantitative data are best* [for] **detecting the existence of matter** [when] **matter is subdivided into particles that are too small to see**. 5-PS1-1 **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] ***any type of matter can be subdivided into particles that are too small to see***. 5-PS1-1 **Engaging in Argument from Evidence** ● Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. Students could *distinguish among facts, reasoned judgment, and speculation in an explanation* [related to] ***Earth's major systems interacting in multiple ways to affect Earth's surface materials***. 5-ESS2-1 **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 *communicate* [that] ***the gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center,*** [using] *written formats as well as tables, diagrams, and charts*. 5-PS2-1
Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** ● Cause and effect relationships are routinely identified, tested, and used to explain change. Students could *identify cause and effect relationships* [between] ***Earth's major systems*** [and] ***Earth's surface materials and processes*** *and use* [the relationships] *to explain change*. 5-ESS2-1 **Systems and System Models** ● A system can be described in terms of its components and their interactions. Students could describe ***the gravitational force of Earth acting on an object*** *as a system,* [and identify] *its components and their interactions*. 5-PS2-1

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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 that *change is measured in terms of differences over time and may occur at different rates*, [using examples from the interactions of] ***Earth's major systems,*** [such as] ***winds and clouds in the atmosphere interacting with the landforms to determine patterns of weather***. 5-ESS2-1
Additional Connections to Nature of Science	**Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Basic laws of nature are the same everywhere in the universe. Students could describe whether the *basic laws of nature* – [such as] **the gravitational force** – *are the same everywhere in the universe*. 5-PS2-1 **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Science explanations describe the mechanisms for natural events. Students could describe how *science explanations describe the mechanisms for natural events*, [such as] ***winds and clouds in the atmosphere interacting with the landforms to determine patterns of weather***. 5-ESS2-1

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5th Grade Thematic Model

Narrative and Rationale: The three bundles in this Grade 5 model are organized by a central focus on crosscutting concepts. Bundle 1 offers students multiple opportunities to engage in meaningful learning about scale, proportion, and quantity. Matter particles are really small and space is vast. Objects look different at different scales. Data collection for 5-ESS1-2 begins in Bundle 1 and continues through bundles 2 and 3 in order for students to have enough data to observe the patterns needed to serve as evidence to support the idea that the Earth orbits around its axis and revolves around the sun. In Bundle 2, the PEs are tied together by the crosscutting concept of energy and matter flows. Bundle 3 centers on the idea of stability and change in Earth's larger systems. The physical sciences DCIs in this last bundle help to explain the mechanisms of Earth systems.

Note that the practices and crosscutting concepts described are intended as end-of-instructional unit expectations and not curricular designations. Additional practices and crosscutting concepts should be used throughout instruction in each bundle.

Bundle 1: How big is the sun, and what is it made of? **~12 weeks**	**Bundle 2:** How do animals have energy to move around? **~12 weeks**	**Bundle 3:** Has the desert always been dry? **~12 weeks**
5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen. **5-PS1-2.** Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. **5-PS1-3.** Make observations and measurements to identify materials based on their properties. **5-PS1-4**. Conduct an investigation to determine whether the mixing of two or more substances results in new substances. **5-ESS1-1.** Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth. **5-ESS1-2.** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. **3-5-ETS1-3.** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	**5-PS1-1.** Develop a model to describe that matter is made of particles too small to be seen. **5-PS3-1.** Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. **5-LS1-1.** Support an argument that plants get the materials they need for growth chiefly from air and water. **5-LS2-1.** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. **5-ESS1-2.** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. **5-ESS3-1.** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. **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.	**5-PS1-1.** Develop a model to describe that matter is made of particles too small to be seen. **5-PS2-1.** Support an argument that the gravitational force exerted by Earth on objects is directed down. **5-ESS1-2.** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. **5-ESS2-1.** Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. **5-ESS2-2.** Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. **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.

1. The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.

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5th Grade Thematic Model Course Flowchart

Bundle 1

PS1.A as found in 5-PS1-1
- Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.

PS1.A as found in 5-PS1-2
- The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.

PS1.A as found in 5-PS1-3
- Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)

PS1.B as found in 5-PS1-4
- When two or more different substances are mixed, a new substance with different properties may be formed.

PS1.B as found in 5-PS1-2
- No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)

ESS1.A as found in 5-ESS1-1
- The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.

ESS1.B as found in 5-ESS1-2
- The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.

ETS1.B as found in 3-5-ETS1-3
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.

ETS1.C as found in 3-5-ETS1-3
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Bundle 2

PS1.A as found in 5-PS1-1
- Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.

PS3.D as found in 5-PS3-1
- The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water).

LS1.C as found in 5-PS3-1
- Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion.

LS1.C as found in 5-LS1-1
- Plants acquire their material for growth chiefly from air and water.

LS2.A as found in 5-LS2-1
- 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 plants 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.

LS2.B as found in 5-LS2-1
- 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.

ESS1.B as found in 5-ESS1-2
- The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.

ESS3.C as found in 5-ESS3-1
- 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.

Bundle 3

PS1.A as found in 5-PS1-1
- Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.

PS2.B as found in 5-PS2-1
- The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.

ESS1.B as found in 5-ESS1-2
- The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.

ESS2.A as found in 5-ESS2-1
- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.

ESS2.C as found in 5-ESS2-2
- Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.

ETS1.B as found in 3-5-ETS1-2
- 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.

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ETS1.A as found in 3-5-ETS1-1

- 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.

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Kindergarten - Thematic Model - Bundle 1
Needs of Plants and Animals

This is the first bundle of the Kindergarten Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 1 Question: This bundle is assembled to address the question of "What is the relationship between the needs of different plants and animals and the places they live?"

Summary

The bundle organizes performance expectations around *the relationship between the needs of different plants and animals and the places they live*. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 concept that all animals need food and plants need water and light (LS1.C as in K-LS1-1) connects to the idea that living things need water, air, and resources from the land, and they live in places that have the things they need (ESS3.A as in K-ESS3-1). These ideas also connect to the concept that plants and animals (including humans) can change the environment to meet their needs (K-ESS2-2). The concept that humans use natural resources for everything they do (ESS3.A as in K-ESS3-1) connects to the idea that the things 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. (ESS3.C as in K-ESS2-2 and K-ESS3-3)

Weather—which is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time (ESS2.D as in K-ESS2-1)—connects to the idea that all living things need water (ESS3.A as in K-ESS3-1) and plants also need light (LS1.C as in K-LS1-1). The idea of the needs of living things also connects to weather through making observation to notice and describe patterns as: observations can be used to describe the patterns of what plants and animals need (K-LS1-1) and observations and measurements of weather conditions can be used to describe and record the weather and to notice patterns over time (ESS2.D as in K-ESS2-1).

The idea that a situation that people want to change or create can be approached as a problem to be solved through engineering (ETS1.A, K-2-ETS1-1) could connect to several concepts such as plants need water and light to live and grow (LS1.C as in K-LS1-1), humans use natural resources for everything they do (ESS3.A as in K-ESS3-1), or that people can make choices that reduce their impacts on the land, water, air, and other living things (ESS3.C as in K-ESS3-3). These connections could be made through tasks such as designing a solution to the problem of plants in a garden not getting enough water or sunlight or identifying ways to reduce their class' impact on the local water system. Alternatively, students could be challenged with a different design task involving creating products out of natural resources that are abundant in their area. In both tasks, students need an opportunity to reflect on the situation to be changed and that it can be approached as a problem to be solved through engineering.

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 (K-2-ETS1-1); using models (K-ESS3-1); analyzing and interpreting data (K-LS1-1 and K-ESS2-1); constructing an argument to support a claim (K-ESS2-2); and communicating information (K-ESS3-3). Many other practice elements can be used in instruction.

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Bundle Crosscutting Concepts Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the crosscutting concepts of Cause and Effect (K-ESS3-3); and Patterns (K-LS1-1 and K-ESS2-1); Systems and System Models (K-ESS2-2 and K-ESS3-1). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*	
Performance Expectations K-ESS2-1 and K-2-ETS1-1 are partially assessable	K-LS1-1 **Use observations to describe patterns of what plants and animals (including humans) need to survive.** **[Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]** K-ESS2-2 **Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.** **[Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.]** K-ESS3-1 **Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.** **[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.]** 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.]** K-ESS2-1 **Use and share observations of local weather conditions to describe patterns over time.** **[Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]** K-2-ETS1-1 **Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
Example Phenomena	Plant roots break the ground. Plants look different with or without sufficient water. The places where different plants and animals live have particular water features, soil, weather, etc. in the area.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions based on observations to find more information about the natural and/or designed world. Students could *ask questions based on observations to find more information about* ***what plants need to survive.*** K-LS1-1, K-ESS2-2, K-ESS3-3 and K-ESS2-1

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Additional Practices Building to the PEs (Continued)	**Developing and Using Models** ● Develop and/or use a model to represent amounts, relationships, relative scales (faster/slower), and/or patterns in the natural and designed world(s). Students could *develop or use models to represent the relationship* ***between the needs of different plants and animals (including humans) and the places they live*** *or to represent patterns* ***[of] local weather over time.*** K-ESS3-1 and K-ESS2-1 **Planning and Carrying Out Investigations** ● With guidance, plan and conduct an investigation in collaboration with peers. *With guidance and in collaboration with peers*, students could *plan and conduct an investigation* ***[of ways] to reduce the impact of humans on land, water, air, and/or other living things in the local environment.*** K-ESS3-3 **Analyzing and Interpreting Data** ● Record information (observations, thoughts, and ideas). Students could *record information [about]* ***what plants and animals need to survive; about the impacts humans have on the land, water, air, and/or living things in the local environment; about local weather patterns over time; and about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.*** K-LS1-1, K-ESS3-3, K-ESS2-1 and K-2-ETS1-1 **Using Mathematical and Computational Thinking** ● Use counting and numbers to identify and describe patterns in the natural and designed world(s). Students could *use counting and use numbers to describe patterns* ***[of] local weather over time***. K-ESS2-1 **Constructing Explanations and Designing Solutions** ● Use tools and/or materials to design and/or build a device that solves a specific problem. Students could *use tools and/or materials to design and/or build a device that solves a specific problem related to* ***reducing impacts on the land, water, air, and other living things.*** (ESS3.C as in K-ESS3-3) **Engaging in Argument from Evidence** ● Identify arguments that can be supported by evidence. Students could *identify arguments* ***of what plants and animals need to survive, how plants and animals can change the environment to meet their needs, and about the impacts humans have on the land, water, air, and/or living things in the local environment*** *that can be supported by evidence*. K-LS1-1, K-ESS2-2 and K-ESS3-3 **Obtaining, Evaluating, and Communicating Information** ● Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas. Students could *communicate information with others in written forms using models that provide detail about scientific ideas of* ***the relationships between the needs of different plants and animals and the places they live.*** K-ESS3-1

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Suggested Crosscutting Concepts Building to the PEs	**Cause and Effect** ● Events have causes that generate observable patterns. Students could describe that events – ***[like animals] obtaining food from plants or from other animals*** – have causes – ***[that they] need food in order to live and grow*** – that generate observable patterns. K-LS1-1 ● Simple tests can be designed to gather evidence to support or refute student ideas about causes. Students could describe how designing a simple test about **how plants and animals (including humans) can change the environment to meet their needs** could allow them *to gather evidence to support or refute ideas about causes*. K-ESS2-2 **Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower). Students could describe how *relative scales allow them to compare and describe* ***their observations of local weather conditions and to notice patterns over time.*** K-ESS2-1 **Stability and Change** ● Things may change slowly or rapidly. Students could describe that *things like* ***local weather conditions*** *may change slowly or rapidly*. K-ESS2-1
Additional Connections to Nature of Science	**Scientific Knowledge Is Based on Empirical Evidence** ● Scientists look for patterns and order when making observations about the world Students can explain how *scientists make observations [about]* ***animals [obtaining] their food from plants or from other animals [to]*** *look for patterns*. K-LS1-1 **Science is a Way of Knowing** ● Science knowledge helps us know about the world. Students can describe how the science knowledge they are learning such as the **patterns of what plants and animals (including humans) need to survive** helps them know about the world. K-LS1-1 and K-ESS2-1

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Kindergarten Thematic Model-Bundle 2
Local Weather

This is the second bundle of the Kindergarten Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the [Course Flowchart]

Bundle 2 Question: This bundle is assembled to address the question of "What can we observe about weather over the course of the year?"

Summary

The bundle organizes performance expectations around *observations of weather patterns over the course of the year*. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but recognize that instruction is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

Sunlight warms Earth's surface. (PS3.B as in K-PS3-1 and K-PS3-2). This concept of sunlight warming Earth's surface connects to the idea that weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time (ESS2.D as in K-ESS2-1).

The concepts of weather and patterns of weather (ESS2.D as in K-ESS2-1) connect to the idea that some kinds of severe weather are more likely than others in a given region. (ESS3.B as in K-ESS3-2).

The concept that asking questions, making observations, and gathering information are helpful in thinking about problems (ETS1.A as in K-ESS3-2 and K-2-ETS1-1) could connect to multiple concepts such as sunlight warms Earth's surface (PS3.B as in K-PS3-1 and K-PS3-2) as well as that weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time (ESS2.D as in K-ESS2-1) and some kinds of severe weather are more likely than others in a given region (ESS3.B as in K-ESS3-2). These connections could be made by having students engage in the process of asking questions, making observations, and gathering information about sunlight's effect on Earth's surface in order to define a problem and then reflecting on this process. Alternatively, students can ask questions, make observations, and gather information to think about problems caused by both typical local weather and severe local weather.

And the concept that designs can be conveyed through sketches, drawings, or physical models (ETS1.B as in K-2-ETS1-2) could connect to multiple concepts such as sunlight warms Earth's surface (PS3.B as in K-PS3-1 and K-PS3-2) and that weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time (ESS2.D as in K-ESS2-1). These connections could be made through a task in which students must use a representation to convey their design of a structure that will provide a cool place for the students of their school to use when they are outside on a warm day. Students could also engage in a task in which they need to convey the design of an object that would protect them from any negative effects of wind and then reflect on the usefulness of conveying their ideas through representations.

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 (K-ESS3-2 and K-2-ETS1-1); developing models (K-2-ETS1-2); planning and carrying out investigations (K-PS3-1); analyzing and interpreting data (K-ESS2-1); designing solutions (K-PS3-2); and obtaining information (K-ESS3-2). Many other practice elements can be used in instruction.

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Bundle Crosscutting Concepts Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the crosscutting concepts of Patterns (K-ESS2-1); Cause and Effect (K-PS3-1, K-PS3-2, and K-ESS3-2); and Structure and Function (K-2-ETS1-2). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*	
Performance Expectations K-2-ETS1-1 is partially assessable	K-PS3-1. **Make observations to determine the effect of sunlight on Earth's surface.** **[Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.] [*Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.*]** K-PS3-2. **Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.*** **[Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]** K-ESS2-1. **Use and share observations of local weather conditions to describe patterns over time.** **[Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]** K-ESS3-2. **Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*** **[Clarification Statement: Emphasis is on local forms of severe weather.]** K-2-ETS1-1. **Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.** K-2-ETS1-2. **Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
Example Phenomena	The temperature changes throughout a day and across days, weeks, months and the year. Sometimes people know ahead of time that a storm is coming.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask and/or identify questions that can be answered by an investigation. Students could *ask questions* [about] ***the effect of sunlight on Earth's surface*** *that can be answered by an investigation*. K-PS3-2 **Developing and Using Models** ● Compare models to identify common features and differences. Students could *compare models* [of] ***structures that reduce the effect of sunlight heating the Earth's surfaces*** *to identify the common features and differences*. K-PS3-2

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Additional Practices Building to the PEs (Continued)	**Planning and Carrying out Investigations** ● Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. Students could *evaluate different ways of observing and/or measuring the phenomena* ***that sunlight warms Earth's surface and [that] structures*** [can] ***reduce the warming effects of sunlight on Earth's surface*** *to determine which way can answer a question*. K-PS3-1 and K-PS3-2 **Analyzing and Interpreting Data** ● Use and share pictures, drawings, and/or writings of observations. Students could *use and share pictures, drawings and/or writings of observations* [of] ***local weather including severe weather.*** K-ESS2-1 and K-ESS3-2 **Using Mathematical and Computational Thinking** ● Use counting and numbers to identify and describe patterns in the natural and designed world(s). Students could *use counting and use numbers to identify and describe patterns* [of] ***local weather over time***. K-ESS2-1 **Constructing Explanations and Designing Solutions** ● Generate and/or compare multiple solutions to a problem. Students can *generate and compare multiple solutions to* ***a given problem to illustrate how the shape of the object helps it function as needed*** **to solve the problem**. K-2-ETS1-2 **Engaging in Argument from Evidence** ● Distinguish between opinions and evidence in one's own explanations. Students could *distinguish between opinions and evidence in [their] explanations* [of the] ***effect of sunlight on Earth's surface,*** [how] ***structures [can] reduce the warming effect of sunlight on Earth's surface, and local weather patterns over time***. K-PS3-1, K-PS3-2, and K-ESS2-1 **Obtaining, Evaluating, and Communicating Information** ● Obtain information using various texts, text features (e.g. headings, table of contents, glossaries, electronic menus, icons) and other media that will be useful in answering a scientific question and/or supporting a scientific claim. Students could *obtain information using various texts, text features, and other media that will be useful in answering scientific questions* [about] ***the effect of sunlight on Earth's surface,*** [how] ***structures*** [can] ***reduce the warming effect of sunlight on Earth's surface, and local weather patterns over time***. K-PS3-1, K-PS3-2, and K-ESS2-1

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Suggested Crosscutting Concepts Leading to PE	**Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower). Students could describe how *relative scales allow them to compare and describe* ***their observations of local weather conditions and to notice patterns over time.*** K-ESS2-1 **Structure and Function** ● The shape and stability of structures of natural and designed objects are related to their function(s). Students could describe how *the shape* [of] ***a structure [designed to] reduce the warming effect of sunlight on Earth's surface*** [is] *related to its function.* K-PS3-2 **Stability and Change** ● Things may change slowly or rapidly. Students could describe that *things like* ***local weather conditions, including severe weather,*** *may change slowly or rapidly.* K-ESS2-1 and K-ESS3-2
Connections to Nature of Science	**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Scientists use drawings, sketches, and models as a way to communicate ideas. Students could describe why *scientists* [might] *use drawings, sketches, and models as a way to communicate ideas* [just] *like they, as students* ***[can] develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem*** *and use drawings, sketches, and models to communicate their ideas* ***[about] the effect of sunlight on Earth's surface, their design for a structure to reduce the warming effect of sunlight on Earth's surface, and local weather patterns.*** K-2-ETS1-2, K-PS3-1, K-PS3-2, and K-ESS2-1 **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Many events are repeated. Students could describe and reflect on the idea *that many events [such as]* ***sunny, cloudy, rainy, and warm days*** *are repeated.* K-ESS2-1

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Kindergarten Thematic Model - Bundle 3
Pushes and Pulls

This is the third bundle of the Kindergarten Thematic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 3 Question: This bundle is assembled to address the question of "How do pushes and pulls affect the motion of an object?"

Summary

The bundle organizes performance expectations around the theme of *how pushes and pulls affect the motion of an object*. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but recognize that instruction is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it (PS2.A as in K-PS2-1 and K-PS2-2). This concept of motion connects to the idea that a bigger push or pull makes things speed up or slow down more quickly (PS3.C as in K-PS2-1).

The concept of pushing or pulling on an object (PS2.A as in K-PS2-1 and K-PS2-2) also connects to the idea that, when objects touch or collide, they push on one another and can change motion. (PS2.B as in K-PS2-1)

The idea that a bigger push or pull makes things speed up or slow down more quickly (PS3.C as in K-PS2-1) connects to the concept that pushes and pulls can have different strengths and directions (PS2.A as in K-PS2-1 and K-PS2-2).

The concept that people measure weather conditions to describe and record the weather and to notice patterns over time (ESS2.D as in K-ESS2-1) connects to the idea that it is useful to compare and test designs (ETS1.C as in K-2-ETS1-3) through data analysis.

The ideas that a situation that people want to change or create can be approached as a problem to be solved through engineering (ETS1.A as in K-PS2-2) and that, because there is always more than one possible solution to a problem, it is useful to compare and test designs (ETS1.C as in K-2-ETS1-3) could connect to multiple physical science concepts in this bundle. For example, these concepts could connect to the idea that when objects touch or collide, they push on one another and can change motion (PS2.B as in K-PS2-1) through a task in which students are challenged to work in groups to change the direction or speed of a ball with another object and then test and compare each group's solution. Alternatively, these engineering concepts could connect to the idea that a bigger push or pull makes things speed up or slow down more quickly (PS3.C as in K-PS2-1) through a different task in which students are asked to pull or push an object in a certain amount of time and then challenged to do it faster. Students could then compare their solutions and reflect on how their pull or push needed to change in order to move the object faster.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of planning and carrying out investigations (K-PS2-1); and analyzing and interpreting data (K-PS2-2, K-ESS2-1, and K-2-ETS1-3). Many other practice elements can be used in instruction.

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Bundle Crosscutting Concepts Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the crosscutting concepts of Patterns (K-ESS2-1) and Cause and Effect (K-PS2-1 and K-PS2-2). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*	
Performance Expectations K-2-ETS1-1 and K-2-ETS1-3 are partially assessable	K-PS2-1. **Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.** **[Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [*Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.*]** K-PS2-2. **Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*** **[Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [*Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.*]** K-ESS2-1. **Use and share observations of local weather conditions to describe patterns over time.** **[Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]** K-2-ETS1-3. **Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**
Example Phenomena	Two balls of the same size collide and change direction. A cart pulled across a floor moves quicker with a strong pull than with a weak pull.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions based on observations to find more information about the natural and/or designed world. Students could *ask questions based on observations to find more information about* ***the effects of different strengths or different directions of pushes and pulls on the motion of an object.*** K-PS2-1 and K-PS2-2 **Developing and Using Models** ● Develop and/or use a model to represent amounts, relationships, relative scales (faster/slower), and/or patterns in the natural and designed world(s). Students could *develop or use models to represent relationships and relative scales (e.g, faster and slower)* [of the] ***change [in] direction of an object***. K-PS2-2

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Additional Practices Building to the PEs (Continued)	**Planning and Carrying Out Investigations** ● Make predictions based on prior experiences. Students could *make predictions* [about] ***patterns of local weather over time*** *based on prior experiences*. K-ESS2-1 **Analyzing and Interpreting Data** ● Use and share pictures, drawings, and/or writings of observations. Students could *use and share pictures, drawing, and/or writings of* [their] *observations* [of how] ***pushes and pulls can have different strengths and directions***. K-PS2-1 and K-PS2-2 **Using Mathematical and Computational Thinking** ● Decide when to use qualitative vs. quantitative data. Students could decide when to use qualitative vs. quantitative data ***to compare and test designs***. K-2-ETS1-3 ● Use counting and numbers to identify and describe patterns in the natural and designed world(s). Students could *use counting and numbers to identify and describe* ***patterns of local weather over time.*** K-ESS2-1 **Constructing Explanations and Designing Solutions** ● Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. Students could *make observations (firsthand or from media) to construct an evidence-based account for* [how] **pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.** K-PS2-1 and K-PS2-2 Students could *make observations to construct an evidence-based account for* ***patterns of local weather over time*** K-ESS2-1 **Engaging in Argument from Evidence** ● Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or retell the main points of the argument. Students could *listen actively to arguments* [about how] **pulling on an object can change the direction of its motion** to *indicate agreement of disagreement based on evidence or retell the main points of the argument.* K-PS2-1 and K-PS2-2 **Obtaining, Evaluating, and Communicating Information** ● Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. Students could *describe how specific images (e.g., a diagram weather) support* [the] *scientific idea* [that] ***people measure weather conditions to describe and record the weather and to notice patterns over time.*** K-ESS2-1

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Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Students could *observe patterns* ***of motion*** *and use these patterns as evidence* ***of the effects of different strengths or different directions of pushes and pulls on the motion of an object***. K-PS2-1 **Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower). Students could use *relative scales (faster and slower, higher and lower, longer and shorter) to compare and describe* ***the effects of different strengths or different directions of pushes and pulls on the motion of an object*****.** K-PS2-1 **Structure and Function** ● The shape and stability of structures of natural and designed objects are related to their function(s). Students could reflect on how *the shape and stability of structures of objects are related to* ***the effects pushes and pulls of different strengths or different directions [have] on the motion of*** [the] ***object***. K-PS2-1
Additional Connections to Nature of Science	**Scientific Investigations Use a Variety of Methods** ● Scientific investigations begin with a question. Students could *begin a scientific investigation with a question* [about how] ***pushing or pulling on an object can change the speed or direction of its motion and can start or stop it*** and then reflect on the fact that their investigation began with a question**.** K-PS2-1 and K-PS2-2 **Science is a Way of Knowing** ● Scientific knowledge informs us about the world. Students could describe how *scientific knowledge* [about how] ***pushing or pulling on an object can change the speed or direction of its motion and can start or stop it*** *informs us about the world*. K-PS2-1 and K-PS2-2

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Kindergarten Thematic Model

Narrative and Rationale: The three bundles in this Kindergarten model were built to focus on the observation of patterns in the natural and designed world(s), an idea that applies to the physical, life, and earth and space sciences, as well as engineering.

Bundle 1 centers on a guiding question about the needs of plants and animals for food, water, and sunlight to survive. Bundle 2 centers on guiding questions about patterns in weather data. Bundle 3 centers on a guiding question about pushes and pulls on an object and their effects. Weather-related phenomena are also used as a way to connect bundles, allowing students to develop a deep understanding of the CCCs and DCIs that are introduced in Kindergarten.

Kindergarten students begin their understanding of the Crosscutting Concepts (CCCs) of patterns and the relationships between cause and effect in a logical progression over time. This model also introduces students to the Science and Engineering Practices (SEPs). It places special emphasis on asking questions, using observations and models, analyzing data, and carrying out investigations. However, additional SEPs should be used throughout instruction. The SEPs contribute to students' understanding of the CCCs and DCIs they explore in Kindergarten. Students become familiar with SEPs over the course of the year, and the level of sophistication at which they are able to engage in the SEPs increases over time.

Bundle 1: What do plants and animals need to meet their needs and survive within environments? **~14 weeks**	**Bundle 2:** Can changes in weather patterns be observed over the course of the year? Can weather influence the ability of plants and animals to meet their needs in their environment? **~18 weeks**	**Bundle 3:** How do pushes and pulls affect the motion of an object? **~4 weeks**
K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive. **K-ESS2-1.** Use and share observations of local weather conditions to describe patterns over time.[1] **K-ESS2-2.** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. **K-ESS3-1.** Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. **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.* **K-2-ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.[1]	**K-PS3-1**. Make observations to determine the effect of sunlight on Earth's surface. **K-PS3-2.** Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.* **K-ESS2-1.** Use and share observations of local weather conditions to describe patterns over time. **K-ESS3-2.** Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.* **K-2-ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. [1] **K-2-ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	**K-PS2-1.** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. **K-PS2-2.** Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.* **K-ESS2-1.** Use and share observations of local weather conditions to describe patterns over time. **K-2-ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.[1] **K-2-ETS1-3.** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.[1]

1. The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.

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Kindergarten Thematic Model Course Flowchart

Bundle 1

LS1.C as found in K-LS1-1
- All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.

ESS2.D as found in K-ESS2-1
- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather.

ESS2.E as found in K-ESS2-2
- Plants and animals can change their environment.

ESS3.A as found in K-ESS3-1
- 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.

ESS3.C as found in K-ESS2-2 and K-ESS3-3
- 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.

ETS1.A as found in K-2-ETS1-1
- A situation that people want to change or create can be approached as a problem to be solved through engineering.

ETS1.B as found in K-ESS3-3
- 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.

Bundle 2

PS3.B as found in K-PS3-1 and K-PS3-2
- Sunlight warms Earth's surface.

ESS2.D as found in K-ESS2-1
- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.

ESS3.B as found in K-ESS3-2
- Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events.

ETS1.A as found in K-ESS3-2 and K-2-ETS1-1
- Asking questions, making observations, and gathering information are helpful in thinking about problems.

ETS1.B as found in K-2-ETS1-2
- 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.

Bundle 3

PS2.A as found in K-PS2-1 and K-PS2-2
- Pushes and pulls can have different strengths and directions
- Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it

PS2.B as found in K-PS2-1
- When objects touch or collide, they push on one another and can change motion.

PS3.C as found in K-PS2-1
- A bigger push or pull makes things speed up or slow down more quickly.

ESS2.D as found in K-ESS2-1
- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.

ETS1.A as found in K-PS2-2
- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.

ETS1.C as found in K-2-ETS1-3
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

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1st Grade Topic Model

Narrative and Rationale: The three bundles in this 1st grade model are characterized by the study of patterns of light, sound, and organism structure. Bundle 1 centers on the theme of seeing objects, with a study of both light and solar patterns, and students could begin year-long observations of seasonal changes. Bundle 2 builds on the ideas about light and introduces a study of sound and communication. Bundle 3 introduces basic concepts of heredity, structure, and function relationships in organisms. Throughout the year, students have opportunities to build and apply their science knowledge through engineering practices and DCIs. In addition, the crosscutting concepts of patterns and structure and function can be a focus of instruction throughout the year.

Note that the practices and crosscutting concepts described are intended as end-of-instructional unit expectations and not curricular designations—additional practices and crosscutting concepts should be used throughout instruction in each bundle.

Bundle 1: Light and Solar Patterns **~8 Weeks**	**Bundle 2:** Light, Sound, Space and Communication **~12 Weeks**	**Bundle 3:** Structures and Behaviors in Organisms **~12 Weeks**
1-PS4-2. Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.[1] **1-PS4-3.** Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light. **1-ESS1-2.** Make observations at different times of year to relate the amount of daylight to the time of year.[1]	**1-PS4-1.** Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. **1-PS4-2.** Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated. **1-PS4-4.** Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.* **1-ESS1-1.** Use observations of the sun, moon, and stars to describe patterns that can be predicted. **1-ESS1-2.** Make observations at different times of year to relate the amount of daylight to the time of year.[1] **K-2-ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.[1] **K-2-ETS1-3.** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.[1]	**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.* **1-LS1-2.** Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. **1-LS3-1.** Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. **1-ESS1-2.** Make observations at different times of year to relate the amount of daylight to the time of year.[1] **K-2-ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

1. The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.

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1st Grade Topics Model Course Flowchart

Bundle 1

PS4.B as found in 1-PS4-2
- Objects can be seen if light is available to illuminate them or if they give off their own light.

PS4.B as found in 1-PS4-3
- Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.)

ESS1.B as found in 1-ESS1-2
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

Bundle 2

PS4.A as found in 1-PS4-1
- Sound can make matter vibrate, and vibrating matter can make sound.

PS4.B as found in 1-PS4-2
- Objects can be seen if light is available to illuminate them or if they give off their own light.

PS4.C as found in 1-PS4-4
- People also use a variety of devices to communicate (send and receive information) over long distances.

ESS1.A as found in 1-ESS1-1
- Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.

ESS1.B as found in 1-ESS1-2
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

ETS1.A as found in K-2-ETS1-1
- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Before beginning to design a solution, it is important to clearly understand the problem.

ETS1.C as found in K-2-ETS1-3
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

Bundle 3

LS1.A as found in 1-LS1-1
- 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 (roots, stems, leaves, flowers, fruits) that help them survive and grow.

LS1.B as found in 1-LS1-2
- Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive.

LS1.D as found in 1-LS1-1
- Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.

LS3.A as found in 1-LS3-1
- Young animals are very much, but not exactly like, their parents. Plants also are very much, but not exactly, like their parents.

LS3.B as found in 1-LS3-1
- Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.

ESS1.B as found in 1-ESS1-2
- Seasonal patterns of sunrise and sunset can be observed, described, and predicted.

ETS1.B as found in K-2-ETS1-2
- 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.

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1st Grade - Topic Model - Bundle 1
Light and Solar Patterns

This is the first bundle of the 1st Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the [Course Flowchart](#)

Bundle 1 Question: This bundle is assembled to address the question "why are we able to see objects?"

Summary

The bundle organizes performance expectations around the theme of *seeing objects*. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 concept that seasonal patterns of sunrise and sunset can be observed, described, and predicted (ESS1.B as in 1-ESS1-2) connects to the idea that objects can be seen if they give off their own light or if there is light to illuminate them (PS4.B as in 1-PS4-2). This idea in turn connects to the idea that some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach (PS4.B as in 1-PS4-3).

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of planning and carrying out investigations (1-ESS1-2 and 1-PS4-3) and constructing explanations and designing solutions (1-PS4-2). 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 (1-ESS1-2) and Cause and Effect (1-PS4-2 and 1-PS4-3). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations 1-PS4-2 and 1-ESS1-2 are partially assessable	1-PS4-2 **Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated. [Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]** 1-PS4-3 **Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light. [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [*Assessment Boundary: Assessment does not include the speed of light.*]** 1-ESS1-2 **Make observations at different times of year to relate the amount of daylight to the time of year. [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [*Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*].**
Example Phenomena	We can see more during the daytime than at night. I can make shadow puppets.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Ask and/or identify questions that can be answered by an investigation. Students could *identify questions* [related to whether] ***objects need light to illuminate them*** [in order to] ***be seen*** *that can be answered by an investigation*. 1-PS4-2

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Additional Practices Building to the PEs (Continued)	**Developing and Using Models** • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). Students could *develop a model to represent* [the] *relationship* [between] **materials** [and whether they] **allow light to pass through them**. 1-PS4-3 **Planning and Carrying Out Investigations** • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. Students could *plan an investigation collaboratively to produce data to answer a question* [about whether] ***objects can be seen if light is*** [not] ***available to illuminate them***. 1-PS4-2 **Analyzing and Interpreting Data** • Record information (observations, thoughts, and ideas). Student could *record information* [to identify] ***seasonal patterns of sunrise and sunset***. 1-ESS1-2 **Using Mathematical and Computational Thinking** • Use counting and numbers to identify and describe patterns in the natural and designed world(s). Students could use *counting and numbers to describe* ***seasonal patterns of sunrise and sunset*** *in the natural world*. 1-ESS1-2 **Constructing Explanations and Designing Solutions** • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. Students could *make observations (firsthand or from media) to construct an evidence-based account for* [why] ***some materials allow light to pass through them***. 1-PS4-3 **Engaging in Argument from Evidence** • Make a claim about the effectiveness of an object, tool, or solutions that is supported by relevant evidence. Students could *make a claim about the effectiveness of objects, tool, or solutions* [intended to] ***allow light to pass through them*** *that is supported by relevant evidence*. 1-PS4-3 **Obtaining, Evaluating, and Communicating Information** • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, numbers that provide detail about scientific ideas, practices, and/or design ideas. Students could *communicate information with others in oral forms using numbers that provide detail about scientific ideas* [related to] ***seasonal patterns of sunrise and sunset***. 1-ESS1-2
Additional Crosscutting Concepts Building to the PEs	**Patterns** • Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Students could describe that *patterns in the world* – [for example, patterns related to which types of] ***materials allow light to pass through them,*** [which] ***allow only some light through and*** [which] ***block all the light*** – *can be observed, used to describe phenomena, and used as evidence.*1-PS4-3

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Additional Crosscutting Concepts Building to the PEs (Continued)	**Scale, Proportion, and Quantity** • Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower). Students could describe how using *relative scales (e.g., more and less) allowed* [them] *to compare events* [such as] ***materials*** [and whether they] ***allow light to pass through them***. 1-PS4-3 **Stability and Change** • Some things stay the same while other things change. Students could identify *some things stay the same* [and] *other things* [that] *change* [such as] ***seasonal*** [changes] ***of sunrise and sunset***. 1-ESS1-2
Additional Connections to Nature of Science	**Scientific Investigations Use a Variety of Methods** • Scientists use different ways to study the world. Students could describe how they *used different ways to study* [that] ***objects can be seen if light is available to illuminate them or if they give off their own light*** [just as] *scientists use different ways to study the world.* 1-PS4-2 **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Many events are repeated. Students could describe that *many events*, [including those related to] ***seasonal patterns of sunrise and sunset***, *are repeated.* 1-ESS1-2

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1st Grade - Topic Model - Bundle 2
Observing Objects with Sight and Hearing

This is the second bundle of the 1st Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the [Course Flowchart]

Bundle 2 Question: This bundle is assembled to address the question "why can we see objects and hear sounds?"

Summary

The bundle organizes performance expectations with a focus on the theme of *observing objects with sight and hearing.* Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 seasonal patterns of sunrise and sunset can be observed, described, and predicted (ESS1.B as in 1-ESS1-2) connects to the concept that the patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted (ESS1.A as in 1-ESS1-1). These ideas also connect to the concept that objects can be seen if light is available to illuminate them or if they give off their own light (1-PS4-2).

The concept of how objects can be seen can also connect to the idea that people also use a variety of devices to communicate (send and receive information) over long distances (PS4.C as in 1-PS4-4). Ideas about communication devices also connect to the concept that sound can make matter vibrate, and vibrating matter can make sound (PS4.A as in 1-PS4-1).

The engineering design idea that a situation that people want to change or create can be approached as a problem to be solved through engineering (ETS1.A as in K-2-ETS1-1) could be applied to different science concepts, such as to the concept that sound can make matter vibrate, and vibrating matter can make sound (PS4.A as in 1-PS4-1), and to the concept that people also use a variety of devices to communicate (send and receive information) over long distances (PS4.C as in 1-PS4-4). Connections can be made through engineering tasks such as a task in which students identify devices they, or their families, may use that have been created to solve the problem of communicating over long distances, through a task in which students are challenged to create an instrument that uses vibrations to make sound, or through a task in which students try to make something move with vibrations created by sound. Additionally, students could connect these science concepts to the idea that, because there is always more than one possible solution to a problem, it is useful to compare and test designs (ETS1.C as in K-2-ETS1-3). For example, students could test the instruments they created or they can compare different devices for how well the device allows people to communicate over long distances.

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 (K-2-ETS1-1), planning and carrying out investigations (1-PS4-1 and 1-ESS1-2), analyzing and interpreting data (1-ESS1-1), and constructing explanations and designing solutions (1-PS4-2 and 1-PS4-4). 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 (1-ESS1-1 and 1-ESS1-2) and Cause and Effect (1-PS4-1 and 1-PS4-2). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations 1-ESS1-2, K-2-ETS1-1, and K-2-ETS1-3 are partially assessable.	1-PS4-1 **Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.** **[Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]** 1-PS4-2 **Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated.** **[Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]** 1-PS4-4 **Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*** **[Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [*Assessment Boundary: Assessment does not include technological details for how communication devices work.*]** 1-ESS1-1 **Use observations of the sun, moon, and stars to describe patterns that can be predicted.** **[Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.] [*Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.*]** 1-ESS1-2 **Make observations at different times of year to relate the amount of daylight to the time of year.** **[Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [*Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*]** K-2-ETS1-1 **Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.** K-2-ETS1-3 **Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**
Example Phenomena	A speaker vibrates when it plays music. I can't see stars during the daytime.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Define a simple problem that can be solved through the development of a new or improved object or tool. Students could *define a simple problem* [related to] ***people communicating (sending and receiving information) over long distances*** *that can be solved through the development of a new object*. 1-PS4-4 **Developing and Using Models** ● Develop and/or use a model to represent patterns in the natural world. Students could *develop a model to represent* ***patterns of the motion of the sun, moon, and stars in the sky*.** 1-ESS1-1 **Planning and Carrying Out Investigations** ● Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. Students could evaluate different ways of observing [the] phenomenon [that] ***objects can be seen if light is available to illuminate them or if they give off their own light*** to determine which way can best answer a question. 1-PS4-2

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Additional Practices Building to the PEs (Continued)	**Analyzing and Interpreting Data** ● Record information (observations, thoughts, and ideas). Students could *record information* [from their] *observations* [that] ***sound can make matter vibrate, and vibrating matter can make sound***. 1-PS4-1 **Using Mathematical and Computational Thinking** ● Use quantitative data to compare two alternative solutions to a problem. Students could *use quantitative data to compare two alternative solutions to a problem* [related to] ***sound making matter vibrate***. 1-PS4-1 **Constructing Explanations and Designing Solutions** ● Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. Students could *make firsthand observations to construct an evidence-based account* [that] ***devices*** [can help] ***people communicate over long distances***. 1-PS4-4 **Engaging in Argument from Evidence** ● Distinguish between explanations that account for all gathered evidence and those that do not. Students could *distinguish between explanations* [of how] ***objects can be seen if light is available to illuminate them or if they give off their own light*** [for those] *explanations that account for all gathered evidence and those that do not*. 1-PS4-2 **Obtaining, Evaluating, and Communicating Information** ● Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas. Students could *communicate with others using drawings* [showing their] *design ideas* [related to the problem that] ***people*** [want] ***to communicate (send and receive information) over long distances***. 1-PS4-4
Additional Crosscutting Concepts Building to the PEs	**Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; faster and slower). Students could use *relative scales to compare and describe* [variations of] ***vibrating matter*** [that] ***make*** [different] ***sounds***. 1-PS4-1 **Structure and Function** ● The shape and stability of structures of natural and designed objects are related to their function(s). Students could identify examples of ***communication devices*** [in which] *the shape of structures of designed objects are related to their function(s)*. 1-PS4-4

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Additional Crosscutting Concepts Building to the PEs (Continued)	**Stability and Change** ● Some things stay the same while other things change. Students could describe how *some things stay the same*—***the sun*** [keeps producing light each day]—*while other things change*—[like flashlights that eventually burn out and stop producing] ***light***. 1-PS4-2 and 1-ESS1-1
Additional Connections to Nature of Science	**Science is a Human Endeavor** ● People have practiced science for a long time. Students could obtain information about [people in the past who studied the] ***patterns of the motion of the sun, moon, and stars in the sky*** [(e.g., Galileo) in order to describe that] *people have practiced science for a long time.* 1-ESS1-1 **Science is a Human Endeavor** ● Men and women of diverse backgrounds are scientists and engineers. Students could obtain information about the *men and women of diverse backgrounds* [who are] *scientists and engineers* [and who have studied] ***patterns of the motion of the sun, moon, and stars in the sky*** [(e.g., Sergio Fajardo-Acosta, and Neil deGrasse Tyson)]. 1-ESS1-1

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1st Grade - Topic Model - Bundle 3
Structures and Behaviors in Organisms

This is the third bundle of the 1st Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart

Bundle 3 Question: This bundle is assembled to address the question "what structures and behaviors help plants and animals survive?"

Summary

The bundle organizes performance expectations with a focus on the theme of *structures and behaviors in organisms.* Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 of seasonal patterns of sunrise and sunset (ESS1.B as in 1-ESS1-2) can be connected to the idea that plants have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow (LS1.A as in 1-LS1-1) through the concept of sunlight, which varies by season and is captured by plants, mostly through their leaves so that they can grow and survive.

The idea of organism survival also connects to the concept that, in many kinds of animals, parents and their offspring engage in behaviors that help the offspring survive (LS1.B as in 1-LS1-2). This concept connects to the idea that young animals are very much, but not exactly like, their parents (LS3.A as in 1-LS3-1).

The engineering design idea that designs can be conveyed through sketches, drawings, or physical models (ETS1.B as in K-2-ETS1-2) could be applied to multiple concepts such as that plants have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow (LS1.A as in 1-LS1-1) or that animals respond to inputs with behaviors that help them survive (LS1.D as in 1-LS1-1). Connections could be made through tasks such as one in which students are asked to design a structure that mimics a way in which a plant part helps it grow and survive. Students can share their design ideas through sketches, drawings, or physical models. Another connection could be through a task in which students design a device that has different responses for different inputs, and then students can compare their device to an animal's response to the same inputs.

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 (K-2-ETS1-1), planning and carrying out investigations (1-ESS1-2), developing and using models (K-2-ETS1-2), analyzing and interpreting data (1-ESS1-1), constructing explanations and designing solutions (1-LS1-1 and 1-LS3-1), and obtaining, evaluating, and communicating information (1-LS1-2). 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 (1-ESS1-2, 1-LS3-1, and 1-LS1-2), Structure and Function (K-2-ETS1-2 and 1-LS1-2), and Cause and Effect (1-PS4-1). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations 1-ESS1-2 is partially assessable.	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 intruders by mimicking eyes and ears.]** 1-LS1-2 **Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.** **[Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]** 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.*]** 1-ESS1-2 **Make observations at different times of year to relate the amount of daylight to the time of year.** **[Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.]** **[*Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*]** K-2-ETS1-2 **Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
Example Phenomena	Almonds have shells that have to be removed before you can eat the nut. Ducks have webbed feet but people do not.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Ask questions based on observations to find more information about the natural world. Student could *ask questions based on observations* [of how] ***different animals use their body parts in different ways to protect themselves***. 1-LS1-1 **Developing and Using Models** • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). Students could *develop a model to represent relationships in the natural world,* [such as the relationship between animals'] ***external parts*** [and their ability to] ***move from place to place***. 1-LS1-1 **Planning and Carrying Out Investigations** • Make observations (firsthand or from media) to collect data that can be used to make comparisons. Students could *make observations from media to collect data that can be used to make comparisons* [between] ***behaviors parents*** [versus] ***offspring engage in that help the offspring survive***. 1-LS1-2

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Additional Practices Building to the PEs (Continued)	**Analyzing and Interpreting Data** • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural world in order to answer scientific questions. Students could *use observations (firsthand or from media) to describe* ***seasonal patterns of sunrise and sunset*** *in order to answer scientific questions*. 1-ESS1-2 **Using Mathematical and Computational Thinking** • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs. Students could *describe, measure, and/or compare quantitative attributes of* ***young animals and their parents*** *and display the data using simple graphs* [to determine if the] ***young animals are exactly like their parents***. 1-LS3-1 **Constructing Explanations and Designing Solutions** • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. Students could *make observations (firsthand or from media) to construct an evidence-based account for* [how the] ***roots*** [of] ***plants help them survive and grow.*** 1-LS1-1 **Engaging in Argument From Evidence** • Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence. Students could *make a claim about the effectiveness of a* ***behavior*** [that] ***parents engage in*** [to help their] ***offspring survive***. 1-LS1-2 **Obtaining, Evaluating, and Communicating Information** • Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world. Students could *read grade-appropriate texts and use media to obtain scientific information* [about patterns of the structure of] ***animals' body parts that capture and convey different kinds of information***. 1-LS1-1
Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** • Simple tests can be designed to gather evidence to support or refute student ideas about causes. Students could describe *simple tests that can be designed to gather evidence to support or refute student ideas about* [how] ***different plant parts*** *cause* [plant survival]. 1-LS1-1 **Scale, Proportion, and Quantity** • Standard units are used to measure length. Students could use standard units to measure length [of plants to determine if] ***plants are exactly like their parents***. 1-LS3-1 **Systems and System Models** • Objects and organisms can be described in terms of their parts. Students could describe ***plants*** *in terms of their parts* ***(roots, stems, leaves, flowers, fruits)***. 1-LS1-1

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Additional Connections to Nature of Science	**Scientific Knowledge is Based on Empirical Evidence** • Scientists look for patterns and order when making observations about the world. Students could describe how *scientists look for patterns and order when making observations about the world* [just as the students did when they] ***observed, described, and predicted seasonal patterns of sunrise and sunset***. 1-ESS1-2 **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Scientists search for cause and effect relationships to explain natural events. Students could describe how *scientists search for cause and effect relationships to explain natural events* [just as the students did when they] *searched for cause and effect relationships [between]* ***organisms' external parts*** *[and their]* ***survival and growth***. 1-LS1-2

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2nd Grade – Topic Model – Bundle 1
Water

This is the first bundle of the 2nd Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 1 Question: This bundle is assembled to address the questions "What patterns related to water exist in the natural world?"

Summary
The bundle organizes performance expectations with a focus on helping students build understanding of patterns and the effects of water. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs
The idea that heating or cooling a substance may cause changes that can be observed (PS1.B as in 2-PS1-4) connects to the idea that different kinds of matter exist and many of them can be either solid or liquid, depending on temperature (PS1.A as in 2-PS1-1). These concepts both connect to the idea that water exists as solid ice and in liquid form (ESS2.C as in 2-ESS2-3).

Through the topic of water, these ideas also connect to the concepts that there are many different kinds of living things in any area, and they exist in different places on land and in water (LS4.D as in 2-LS4-1), and that one can map the shapes and kinds of land and water in any area (ESS2.B as in 2-ESS2-2).

The engineering design idea that asking questions, making observations, and gathering information are helpful in thinking about problems (ETS1.A as in K-2-ETS1-1) could connect to multiple science concepts, such as that different kinds of matter exist and many of them can be either solid or liquid, depending on temperature (PS1.A as in 2-PS1-1) or that there are many different kinds of living things in any area, and they exist in different places on land and in water (LS4.D as in 2-LS4-1). The first connection could be made by having students ask questions, make observations, and gather information about different kinds of matter and their states before designing a solution to a problem that involves matter. The second connection could be made when students are given a problem to solve regarding animal habitats. Before attempting to solve the problem, students will want to ask questions, make observations, and gather information about the many different kinds of living things in the given area.

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 (K-2-ETS1-1); developing and using models (2-ESS2-2); planning and carrying out investigations (2-LS4-1 and 2-PS1-1); engaging in argument from evidence (2-PS1-4); and obtaining, evaluating, and communicating information (2-ESS2-3). 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 (2-ESS2-2, 2-ESS2-3, and 2-PS1-1) and Cause and Effect (2-PS1-4). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations	2-PS1-1. **Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.** **[Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]**

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Performance Expectations (Continued) 2-PS1-4 and 2-ESS2-2 are partially assessable.	2-PS1-4. **Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.** **[Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]** 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.*]** 2-ESS2-2. **Develop a model to represent the shapes and kinds of land and bodies of water in an area.** **[*Assessment Boundary: Assessment does not include quantitative scaling in models.*]** 2-ESS2-3. **Obtain information to identify where water is found on Earth and that it can be solid or liquid.** K-2-ETS1-1. **Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
Example Phenomena	Glaciers get smaller in the summer. Many different kinds of living things can be observed in a pond.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions based on observations to find more information about the natural and/or designed world(s). Students could *ask questions based on observations* [that] ***there are many different kinds of living things in any area*** *to find more information about the natural world.* 2-LS4-1 **Developing and Using Models** ● Develop and/or use a model to represent amounts, relationships and/or patterns in the natural and designed world(s). Students could develop a model to represent relationships [between the] ***temperature*** [of] ***different types of matter and*** [whether they are] ***solid or liquid***. 2-PS1-1 **Planning and Carrying Out Investigations** ● Make predictions based on prior experiences. Students could *make predictions based on* [their] *prior experiences* [about] ***changes caused*** [by] ***heating or cooling a substance*** [and whether] ***these changes are reversible***. 2-PS1-4 **Analyzing and Interpreting Data** ● Record information (observations, thoughts, and ideas). Students could *record observations* [made when looking at] ***maps,*** [which] ***show where things are located*** [and] ***the shapes and kinds of land and water in any area***. 2-ESS2-2 **Using Mathematical and Computational Thinking** ● Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs. Students could *describe, measure, and/or compare* [the number of] ***different kinds of living things in any area*** *and display the data using simple graphs.* 2-LS4-1

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Additional Practices Building to the PEs (Continued)	**Constructing Explanations and Designing Solutions** ● Use information from observations (firsthand or from media) to construct an evidence-based account of natural phenomena. Students could *use information from observations to construct an evidence-based account* [that] ***water exists as solid ice and in liquid form***. 2-ESS2-3 **Engaging in Argument from Evidence** ● Construct an argument with evidence to support a claim. Students could *construct an argument with evidence to support a claim* [that] ***water*** [can be] ***found in the ocean, rivers, lakes, and ponds***. 2-ESS2-3 **Obtaining, Evaluating, and Communicating Information** ● Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. Students could *describe how specific images support the idea* [that] ***sometimes changes*** [caused by] ***heating or cooling a substance are reversible and sometimes they are not.*** 2-PS1-4
Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns in the natural and designed world(s) can be observed, used to describe phenomena, and used as evidence. Students could *observe* [and identify] *patterns of* ***different kinds of living things*** [that] ***exist in different places on land and in water*** [and can] *use* [the patterns] *to describe phenomena*. 2-LS4-1 **Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder). Students could describe how *relative scales allow objects* [such as the] ***location and shape of land and water*** [on a] ***map*** *to be compared and described*. 2-ESS2-2 **Stability and Change** ● Some things stay the same while other things change. Students could identify that, [after] ***heating or cooling substances***, *some things change* [back] *while other things stay the same* [(such as changes that cannot be reversed)]. 2-PS1-4
Additional Connections to Nature of Science	**Scientific Knowledge is Based on Empirical Evidence** ● Scientists look for patterns and order when making observations about the world. Students could describe how they *looked for patterns,* [just like] *scientists, when making observations about* [how] ***water exists as solid ice and in liquid form***. 2-ESS2-3 **Science is a Way of Knowing** ● Scientific knowledge informs us about the world. Students could describe how their *scientific knowledge* [about] ***different kinds of matter,*** [which] ***can be described and classified by observable properties*** *informs* [them] *about the world*. 2-PS1-1

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2nd Grade – Topic Model – Bundle 2
Changes to Land

This is the second bundle of the 2nd Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the [Course Flowchart](#).

Bundle 2 Question: This bundle is assembled to address the question of "Why does the land change over time?"	
Summary The bundle organizes performance expectations with a focus on helping students understand changes that occur on and to land. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations. **Connections between bundle DCIs** The idea that maps show where things are located and the shapes and kinds of land and water in any area (ESS2.B as in 2-ESS2-2) can connect to the idea that wind and water can change the shape of the land (ESS2.A as in 2-ESS2-1). The idea that the shape of the land can change connects to the concept that some events happen very quickly and others occur very slowly, over a time period much longer than one can observe (ESS1.C as in 2-ESS1-1). The idea that wind and water can change land can also connect to the idea that different properties are suited to different purposes (PS1.A as in 2-PS1-2 and 2-PS1-3), since water can change some parts of land that wind cannot. The idea that the land can change shape can connect to the idea that a great variety of objects can be built up from a small set of pieces (PS1.A as in 2-PS1-3), since the same pieces of dirt and sand can create different shapes of land. The engineering design idea that because there is always more than one possible solution to a problem, it is useful to compare and test designs (ETS1.C as in K-2-ETS1-3) can connect to multiple science ideas, such as that wind and water can change the shape of the land (ESS2.A as in 2-ESS2-1) and that some events happen very quickly; others occur very slowly, over a time period much longer than one can observe (ESS1.C as in 2-ESS1-1). The first connection could be made by having students compare a variety of designs that are intended to prevent a river from changing the land of the riverbank. The second connection could be made by having students compare designs intended to prevent danger from a quick event, such as a rock slide. **Bundle Science and Engineering Practices** Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (2-ESS2-2); analyzing and interpreting data (2-PS1-2 and K-2-ETS1-3); and constructing explanations and designing solutions (2-ESS1-1 and 2-ESS2-1). 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 (2-ESS2-2); Cause and Effect (2-PS1-2); and Stability and Change (2-ESS1-1 and 2-ESS2-1). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*	
Performance Expectations	2-PS1-2. **Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] *[Assessment Boundary: Assessment of quantitative measurements is limited to length.]*** 2-PS1-3. **Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]**

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Performance Expectations (Continued)	2-ESS1-1. **Use information from several sources to provide evidence that Earth events can occur quickly or slowly.** **[Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.] [*Assessment Boundary: Assessment does not include quantitative measurements of timescales.*]** 2-ESS2-1. **Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.* [Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]** 2-ESS2-2. **Develop a model to represent the shapes and kinds of land and bodies of water in an area.** **[*Assessment Boundary: Assessment does not include quantitative scaling in models.*]** K-2-ETS1-3. **Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**
Example Phenomena	A piece of plastic is good at redirecting the flow of water but a piece of paper is not. Different rivers have different shapes.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask and/or identify questions that can be answered by an investigation. Students *could identify questions that can be answered by an investigation* [about the] ***different purposes*** [for which] ***different properties are suited***. 2-PS1-2 and 2-PS1-3 **Developing and Using Models** ● Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller) and/or patterns in the natural and designed world(s). Students could *develop or use a model to represent relative scales* [of events to show that] ***some events happen very quickly and others occur very slowly, over a time period much longer than one can observe***. 2-ESS1-1 **Planning and Carrying Out Investigations** ● Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. Students could *make measurements* [of different objects that] ***can be built up from*** [the same] ***set of pieces*** *to collect data that can be used to make comparisons*. 2-PS1-3 **Analyzing and Interpreting Data** ● Use and share pictures, drawings, and/or writings of observations. Students could *use and share drawings of observations* [of the effect of] ***wind and water*** [on] ***the shape of the land***. 2-ESS2-1 **Using Mathematical and Computational Thinking** ● Decide when to use qualitative vs. quantitative data. Students could *decide* [whether] *to use qualitative vs. quantitative data* [when investigating whether] ***wind can change the shape of the land***. 2-ESS2-1

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Additional Practices Building to the PEs (Continued)	**Constructing Explanations and Designing Solutions** ● Use tools and/or materials to design and/or build a device that solves a specific problem. Students could *use materials to design and build a device that* [uses materials that are best] ***suited to*** [preventing] ***wind from changing the shape of the land.*** 2-PS1-2 and 2-ESS2-1 **Engaging in Argument from Evidence** ● Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence. Students could *make a claim that is supported by relevant evidence about the effectiveness of a* ***map*** [in showing] ***where things are located*** [and] ***the shapes and kinds of land and water in any area***. 2-ESS2-2 **Obtaining, Evaluating, and Communicating Information** ● Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. Students could *obtain information using various texts and text features that will be useful in answering a scientific question* [about] ***events*** [that] ***happen very slowly, over a time period much longer than one can observe***. 2-ESS1-1
Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** ● Simple tests can be designed to gather evidence to support or refute their own ideas about causes. Students could describe how a *simple test could be designed to gather evidence to refute their own ideas about* [how] ***water can*** *cause* ***changes*** [to] ***the shape of the land***. 2-ESS2-1 **Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; faster and slower). Students could describe how *relative scales allow objects* [such as the] ***location and shape of land and water*** [on a] ***map*** *to be compared and described*. 2-ESS2-2 **Structure and Function** ● The shape and stability of structures of natural and designed objects are related to their function(s). Students could describe how ***properties*** *and shape of structures of natural and designed objects are related to their functions* [and] ***purposes***. 2-PS1-2
Additional Connections to Nature of Science	**Scientific Investigations Use a Variety of Methods** ● Scientific investigations begin with a question. Students could describe that [their] *investigation* [of whether] ***wind and water can change the shape of the land*** *began with a question*. 2-ESS2-1 **Science is a Way of Knowing** ● Scientific knowledge informs us about the world Students could describe how their *scientific knowledge* [that] ***some*** [Earth] ***events occur very slowly*** *informs* [them] *about the world*. 2-ESS1-1

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2nd Grade – Topic Model – Bundle 3
The Needs of Plants

This is the third bundle of the 2nd Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 3 Question: This bundle is assembled to address the question "What do plants need?"

Summary

The bundle organizes performance expectations with a focus on helping students understand the needs of plants. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

The concept that plants depend on animals for pollination or to move their seeds around (LS2.A as in 2-LS2-2) connects to the concept that plants depend on water and light to grow (LS2.A as in 2-LS2-1), as both ideas are about plant needs.

The engineering design idea that designs can be conveyed through sketches, drawings, or physical models (ETS1.B as in K-2-ETS1-2 and 2-LS2-2) can be connected to multiple science concepts, such as that plants depend on animals for pollination or to move their seeds around (LS2.A as in 2-LS2-2) and that plants depend on water and light to grow (LS2.A as in 2-LS2-1). The first connection could be made through challenging students to draw a design of a way to increase the dispersal of grass seeds that move by sticking to animals' fur. And the second connection could be made by students designing and then drawing a garden or greenhouse, showing how the needs for water and light are met.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of planning and carrying out investigations (2-LS2-1) and developing and using models (2-LS2-2 and K-2-ETS1-2). 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 Cause and Effect (2-PS1-4 and 2-LS2-1) and Structure and Function (2-LS2-2 and K-2-ETS1-2). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations	2-LS2-1. **Plan and conduct an investigation to determine if plants need sunlight and water to grow.** ***[Assessment Boundary: Assessment is limited to testing one variable at a time.]*** 2-LS2-2. **Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*** K-2-ETS1-2. **Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
Example Phenomena	An indoor plant wilts when it doesn't get water. Two very different greenhouses can be built from the same basic materials.

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Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask and/or identify questions that can be answered by an investigation. Students could *ask questions that can be answered by an investigation* [about what] ***plants*** [need in order to] ***to grow, pollinate, and to move their seeds around***. 2-LS2-1 and 2-LS2-2 **Developing and Using Models** ● Compare models to identify common features and differences. Students could *compare models* [about how] ***plants depend on animals for pollination*** *to identify common features and differences* [of the models]. 2-LS2-2 **Planning and Carrying Out Investigations** ● Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. Students could *make measurements* [of different] ***plants*** [with different amounts of] ***water*** *to collect data that can be used to make comparisons*. 2-LS2-1 **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 could *use observations from* [videos] *to describe relationships* [between] ***animals*** [and] ***plant pollination*** *in order to answer scientific questions*. 2-LS2-2 **Using Mathematical and Computational Thinking** ● Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs. Students could *measure and compare* [the height] *of different* ***plants*** [that have been given different amounts of] ***light*** *and display the data using simple graphs*. 2-LS2-1 **Constructing Explanations and Designing Solutions** ● Use information from observations (firsthand or from the media) to construct an evidence-based account of natural phenomena. Students could *use information from firsthand observations to construct an evidence-based account* [that] ***plants depend on animals to move their seeds around***. 2-LS2-2 **Engaging in Argument from Evidence** ● Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence. Students can *make a claim that is supported by evidence about the effectiveness of a solution* [that will help] ***plants move their seeds around***. 2-LS2-1 and 2-LS2-2

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Additional Practices Building to the PEs (Continued)	**Obtaining, Evaluating, and Communicating Information** ● Describe how specific images (e.g. a diagram showing how a machine works) support a scientific or engineering idea. Students could *describe how a specific diagram* [showing how to mimic the function of a bee in] ***pollinating plants*** *supports the engineering idea* [that] ***drawings can be useful in communicating ideas for a problem's solution to other people***. 2-LS2-2 and K-2-ETS1-2
Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Students could *observe patterns* [and] *use the patterns as evidence to describe* [that] plants depend on water and light to grow. 2-LS2-1 **Scale, Proportion, and Quantity** ● Standard units are used to measure length. Students could describe why *standard units are used to measure length* [when investigating whether] ***plants depend on water and light to grow***. 2-LS2-1 **Systems and System Models** ● Objects and organisms can be described in terms of their parts. Students could describe ***animals*** *in terms of their parts,* [including the parts that aid] ***plants*** [with] ***pollination***. 2-LS2-2
Additional Connections to Nature of Science	**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Scientists search for cause and effect relationships to explain natural events. Students could communicate the idea that they, like *scientists, searched for cause and effect relationships to explain* [that] ***plants depend on water and light to grow***. 2-LS2-1 **Science Addresses Questions About the Natural and Material World** ● Scientists study the natural and material world. Students could describe that [studying how] ***plants depend on animals for pollination*** [is a] *study* [of] *the natural and material world*. 2-LS2-2

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2nd Grade Topic Model

Narrative and Rationale: The topic model in Grade 2 is divided into three bundles that build in complexity in terms of both disciplinary and crosscutting content, as well as the application of science and engineering practices across the year.

In Bundle 1, students can examine patterns of where water is found on the Earth in both solid and liquid forms, and patterns of where different kinds of plants and animals live on the land and in the water. In Bundle 2, students can examine how the land can change slowly or quickly by wind or water, and how different design solutions can affect these changes. In Bundle 3, students can explore the needs of plants and how animals and designed solutions can help meet plants' needs.

Note that the practices and crosscutting concepts included in each bundle are intended as end-of-instructional unit expectations and not curricular designations. Additional practices and crosscutting concepts should be used throughout instruction in each bundle.

Bundle 1: What patterns related to water exist in the natural world? **~12 weeks**	**Bundle 2:** Why does the land change over time? **~12 weeks**	**Bundle 3:** What do Plants Need? **~8 weeks**
2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. **2-PS1-4.** Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.[1] **2-LS4-1.** Make observations of plants and animals to compare the diversity of life in different habitats. **2-ESS2-2.** Develop a model to represent the shapes and kinds of land and bodies of water in an area.[1] **2-ESS2-3.** Obtain information to identify where water is found on Earth and that it can be solid or liquid. **K-2-ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	**2-PS1-2.** Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* **2-PS1-3.** Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. **2-ESS1-1.** Use information from several sources to provide evidence that Earth events can occur quickly or slowly. **2-ESS2-1.** Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.* **2-ESS2-2.** Develop a model to represent the shapes and kinds of land and bodies of water in an area. **K-2-ETS1-3.** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	**2-LS2-1.** Plan and conduct an investigation to determine if plants need sunlight and water to grow. **2-LS2-2.** Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants. **K-2-ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

1. The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.

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2nd Grade Topic Model Course Flowchart

Bundle 1

PS1.A as found in 2-PS1-1
- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.

PS1.B as found in 2-PS1-4
- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.

To LS2.A in Bundle 3

LS4.D as found in 2-LS4-1
- There are many different kinds of living things in any area, and they exist in different places on land and in water.

ESS2.B as found in 2-ESS2-2
- Maps show where things are located. One can map the shapes and kinds of land and water in any area.

ESS2.C as found in 2-ESS2-3
- Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form.

ETS1.A as found in K–2-ETS1-1
- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Before beginning to design a solution, it is important to clearly understand the problem.

Bundle 2

PS1.A as found in 2-PS1-2 and 2-PS1-3
- Different properties are suited to different purposes.

PS1.A as found in 2-PS1-3
- A great variety of objects can be built up from a small set of pieces.

ESS1.C as found in 2-ESS1-1
- Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.

ESS2.A as found in 2-ESS2-1
- Wind and water can change the shape of the land.

ESS2.B as found in 2-ESS2-2
- Maps show where things are located. One can map the shapes and kinds of land and water in any area.

ETS1.C as found in 2-ESS2-1 and K-2-ETS1-3
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

Bundle 3

LS2.A as found in 2-LS2-1
- Plants depend on water and light to grow.

LS2.A as found in 2-LS2-2
- Plants depend on animals for pollination or to move their seeds around.

ETS1.B as found in 2-LS2-2 and K-2-ETS1-2
- 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.

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3rd Grade – Topic Model – Bundle 1
Organism Traits

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

Bundle 1 Question: This bundle is assembled to address the question of "Why are organisms different from one another?"	
Summary The bundle organizes performance expectations with a focus on helping students build understanding of traits of 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 being part of a group helps animals obtain food, defend themselves, and cope with changes (LS2.D as in 3-LS2-1) connects to the idea that reproduction is essential to the continued existence of every kind of organism (LS1.B as in 3-LS1-1) through the concept of survival of organisms. Reproduction also connects to the concept of inheritance and that many characteristics of organisms are inherited from their parents (LS3.A as in 3-LS3-1). Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment (LS3.A as in 3-LS3-2). All the previous concepts also connect to each other through the concept of patterns: patterns of reproduction and life cycles across organisms, and patterns of characteristics of organisms, both inherited and from interactions with the environment. The concept of patterns also allows students to begin studying the idea that scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next (ESS2.D as in 3-ESS2-1). This idea will be further developed in subsequent bundles. **Bundle Science and Engineering Practices** Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (3-LS1-1), analyzing and interpreting data (3-LS3-1 and 3-ESS2-1), constructing explanations and designing solutions (3-LS3-2), and engaging in argument from evidence (3-LS2-1). 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-LS1-1, 3-LS3-1, and 3-ESS2-1) and Cause and Effect (3-LS2-1 and 3-LS3-2). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*	
Performance Expectations 3-LS2-1 and 3-ESS2-1 are partially assessable.	3-LS1-1. **Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death**. [Clarification Statement: Changes organisms go through during their life form a pattern.] [*Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.*] 3-LS2-1. **Construct an argument that some animals form groups that help members survive.** 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.*]

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Performance Expectations (Continued)	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.] 3-ESS2-1**. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [*Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.*]
Example Phenomena	On average, humans are taller now than they were in the past. There are "worker bees" in bee colonies.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Use prior knowledge to describe problems that can be solved. Students could use prior knowledge [about] ***patterns of the weather across different times and areas*** *to describe problems that can be solved*. 3-ESS2-1 **Developing and Using Models** ● Develop and/or use models to describe and/or predict phenomena. Students could *develop models to predict* [which] ***animals form groups***. 3-LS2-1 **Planning and Carrying Out Investigations** ● Evaluate appropriate methods and/or tools for collecting data. Students could *evaluate appropriate methods for collecting data* [on] ***patterns of the weather across different times***. 3-ESS2-1 **Analyzing and Interpreting Data** ● Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. Students could *compare and contrast data* [on] ***individuals' interactions with the environment*** *collected by different groups in order to discuss similarities and differences in their findings*. 3-LS3-2 **Using Mathematical 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 could *describe, estimate, and graph quantities to address scientific questions* [about] ***variations in group sizes***. 3-LS2-1 **Constructing Explanations and Designing Solutions** ● Construct an explanation of observed relationships Students could *construct an explanation of* [the] *observed relationships* [between] ***different inherited information*** [and] ***variations in how different organisms look and function***. 3-LS3-1

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Additional Practices Building to the PEs (Continued)	**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 and receive critiques from peers about a proposed explanation* [that] ***the environment affects the traits that an organism develops***. 3-LS3-2 **Obtaining, Evaluating, and Communicating Information** ● Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. Students could *combine information in written text* [about the] ***life cycles*** [of different] ***plants and animals*** *with that contained in corresponding tables, diagrams, and/or charts to support* [claims about the diversity of life cycles]. 3-LS1-1
Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** ● Cause and effect relationships are routinely identified, tested, and used to explain change. Students could describe why scientists *identify the cause and effect relationships* [between the variation] ***in how different organisms look and function*** [and their] ***different inherited information***. 3-LS3-1 **Systems and System Models** ● A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. Students could describe ***plants' and animals' life cycles*** *as systems of related* [stages] *that make up a whole and can carry out functions its individual* [stages] *cannot*. 3-LS1-1 **Stability and Change** ● Change is measured in terms of differences over time and may occur at different rates. Students could use ***patterns of the weather across different times and areas*** [to describe] *that change may occur at different rates*. 3-ESS2-1
Additional Connections to Nature of Science	**Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Science assumes consistent patterns in natural systems. Students could describe how we know that ***the environment affects the traits that an organism develops*** *because science assumes consistent patterns in natural systems*. 3-LS3-2 **Science is a Human Endeavor** ● Science affects everyday life. Students could describe that *science affects everyday life* [using examples of ways people apply their understanding that] ***the environment affects the traits that an organism develops***. 3-LS3-2

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3rd Grade – Topic Model – Bundle 2
Advantages in Survival

This is the second bundle of the 3rd Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the [Course Flowchart.]

Bundle 2 Question: This bundle is assembled to address the question "How does the environment affect organisms?"

Summary

The bundle organizes performance expectations with a focus on helping students build understanding of the relationships between the organism traits and survival in a habitat. 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 being part of a group helps animals obtain food, defend themselves, and cope with changes (LS2.D as in 3-LS2-1) connects to the idea that for any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all (LS4.C as in 3-LS4-3) in that both ideas are about the survival of kinds of organisms. These ideas can also connect to survival of individuals within a group and that sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing (LS4.B as in 3-LS4-2).

In order to identify the differences in characteristics between individuals that may provide an advantage, it is helpful to look at the patterns of variation of a given characteristic among individuals in a species (e.g., longer or shorter thorns on individual plants, dark or light coloration of animals). And through the concept of patterns, this bundle also gives an opportunity to continue the study of the idea that scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next (ESS2.D as in 3-ESS2-1). The idea of weather patterns can also connect to the idea that a variety of natural hazards result from natural processes (ESS3.B as in 3-ESS3-1) as some natural hazards are weather related such as hurricanes or flash flooding.

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) 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 for any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all (LS4.C as in 3-LS4-3). For example, the first connection could be made by having students research a given natural hazard before designing a solution to reduce the impact of that natural hazard. The second connection could be made by having students research the needs of a particular organism before designing an environment where that organism will survive well.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of analyzing and interpreting data (3-ESS2-1), constructing explanations and designing solutions (3-LS4-2 and 3-5-ETS1-2), and engaging in argument from evidence (3-LS2-1, 3-LS4-3, and 3-ESS3-1). 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-ESS2-1) and Cause and Effect (3-LS2-1, 3-LS4-2, 3-LS4-3, and 3-ESS3-1). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations 3-ESS2-1 is partially assessable.	3-LS2-1. **Construct an argument that some animals form groups that help members survive.** 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.] 3-ESS2-1. **Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [*Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.*] 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-ETS1-2. **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	There are many more animals living in a rainforest than in a desert. Flowers with a stronger scent attract more insects.
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 the fact that] ***some kinds of organisms cannot survive at all*** [in a] ***particular environment.*** 3-LS4-3 **Developing and Using Models** ● Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system. Students could *use a model to test interactions in and function of a designed system* [that] ***can reduce the impacts of natural hazards***. 3-ESS3-1 **Planning and Carrying Out Investigations** ● Evaluate appropriate methods and/or tools for collecting data. Students could *evaluate appropriate methods for collecting data* [on how] ***groups of animals vary dramatically in size***. 3-LS2-1 **Analyzing and Interpreting Data** ● Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. Students could *compare and contrast data collected by different groups* [about] ***the differences in characteristics between individuals of the same species*** *in order to discuss similarities and differences in their findings*. 3-LS4-2

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Additional Practices Building to the PEs (Continued)	**Using Mathematical 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 could *describe, estimate, and graph quantities to address scientific questions* [about the] ***differences in characteristics between individuals of the same species***. 3-LS4-2 **Constructing Explanations and Designing Solutions** ● Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard). Students could *construct an explanation of observed relationships* [between] ***particular environments*** [and] ***survival of organisms***. 3-LS4-3 **Engaging in Argument from Evidence** ● Construct and/or support an argument with evidence, data, and/or a model. Students could use *evidence to support an argument* [that] ***being part of a group helps animals cope with changes***. 3-LS2-1 **Obtaining, Evaluating, and Communicating Information** ● Obtain and combine information from books and other reliable media to explain phenomena or solutions to a design problem. Students could *combine information from books and other reliable media to explain* [why some animals seem to have] ***advantages in finding mates***. 3-LS4-2
Additional Crosscutting Concepts Building to the PEs	**Scale, Proportion, and Quantity** ● Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. Students could describe the importance of *using standard units to measure and* [compare] *physical quantities* [of] ***particular environments*** [in which] ***some organisms cannot survive***. 3-LS4-3 **Systems and System Models** ● A system can be described in terms of its components and their interactions. Students could describe ***animals that are part of a group*** *as components of a system*. 3-LS2-1 **Structure and Function** ● Substructures have shapes and parts that serve functions. Students could describe that ***differences in*** *substructures of* ***individuals of the same species provide advantages***. 3-LS4-2
Additional Connections to Nature of Science	**Scientific Investigations Use a Variety of Methods** ● Science investigations use a variety of methods, tools, and techniques. Students could identify that one *investigation* [to identify] ***patterns of the weather across different times and areas*** [may] *use* [different] *tools* [than a different type of investigation]. 3-ESS2-1 **Scientific Knowledge is Based on Empirical Evidence** ● Scientists use tools and technologies to make accurate measurements and observations. Students could describe that *scientists use tools and technologies to make accurate measurements and observations* [of] ***a variety of natural hazards*** [so that] ***humans can take steps to reduce their impacts***. 3-ESS3-1

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3rd Grade – Topic Model – Bundle 3
Environmental Change Over Time

This is the third bundle of the 3rd Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the *[Course Flowchart.]*

Bundle 3 Question: This bundle is assembled to address the question "how do we know the environment used to be different?"

Summary

The bundle organizes performance expectations with a focus on helping students build understanding on how the climate affects organisms over long periods of time. 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 concept 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). Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next (ESS2.D as in 3-ESS2-1).

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 scientists can make predictions about what kind of weather might happen next (ESS2.D as in 3-ESS2-1), and that populations live in a variety of habitats and changes in those habitats affect the organisms living there (LS4.D as in 3-LS4-4). The first connection could be made by having students consider the criteria for a solution to a problem caused by bad weather, and the second connection could be made by having students consider the criteria for a solution that mitigates the effect on organisms when a habitat changes.

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 and 3-ESS2-1), engaging in argument from evidence (3-LS4-4), 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 and 3-ESS2-1), 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-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-ESS2-1. **Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.** [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [*Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.*] 3-ESS2-2. **Obtain and combine information to describe climates in different regions of the world.** 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.**
Example Phenomena	There are some patterns in rocks that look like the skeletons of unfamiliar animals. Stores sell more heavy coats in the fall than they do in the spring.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions about what would happen if a variable is changed. Students could *ask questions about what would happen* [to] ***the organisms living in*** [a] ***habitat*** *if* ***the temperature of the habitat*** changes. 3-LS4-4 **Developing and Using Models** ● Identify limitations of models. Students could *identify limitations of models* ***of an area's typical weather conditions***. 3-ESS2-2 **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 or test a design solution. Students could *make observations to test a design solution* [to a problem related to a] ***change in habitats that affects the organisms living there***. 3-LS4-4 **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 data in tables or various graphical displays reveal patterns in fossil evidence about the types of organisms that lived long ago*. 3-LS4-1

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Additional Practices Building to the PEs (Continued)	**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 or graph quantities to address scientific questions* [about what happens to] ***organisms when the environment changes***. 3-LS4-4 **Constructing Explanations and Designing Solutions** ● Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. Students could *use evidence to support an explanation* ***about the types of organisms that lived long ago and also about the nature of their environments***. 3-LS4-1 **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 and receive critiques from peers about a proposed model [of] an area's typical weather conditions and the extent to which those conditions vary over years.* 3-ESS2-2 **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 *communicate scientific and/or technical information—including various forms of media as well as tables, diagrams, and charts*—[about why] ***scientists record patterns of the weather across different times and areas***. 3-ESS2-1
Additional Crosscutting Concepts Building to the PEs	**Scale, Proportion, and Quantity** ● Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. Students could describe the importance of *using standard units to measure and describe physical quantities* ***of weather*** [such as such as inches of rain and feet of snow], ***and to record patterns of the weather across different times***. 3-ESS2-1 **Systems and System Models** ● A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. Students could describe ***organisms that lived long ago and their environments*** as *a system*. 3-LS4-1 **Stability and Change** ● Some systems appear stable, but over long periods of time will eventually change. Students could describe organisms that lived long ago and their environments as a system that eventually changed over long periods of time. 3-LS4-1

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Additional Connections to Nature of Science	**Scientific Knowledge is Based on Empirical Evidence** ● Science findings are based on recognizing patterns. Students could communicate that *science findings* [about how] ***change in habitats affects organisms living there*** *are based on recognizing patterns*. 3-LS4-4 **Scientific Knowledge is Open to Revision in Light of New Evidence** ● Science explanations can change based on new evidence. Students could identify how *science explanations* ***about an area's climate*** *could change* [if] *new evidence* [were found]. 3-ESS2-2

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3rd Grade – Topic Model – Bundle 4
Forces and Interactions of Objects

This is the fourth bundle of the 3rd Grade Topic 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 "what happens when different objects interact?"	
Summary The bundle organizes performance expectations with a focus on helping students build understanding of the forces that objects exert on each other. 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** Although objects in contact exert forces on each other (PS2.B as in 3-PS2-1), electric and magnetic forces between a pair of objects do not require that the objects be in contact (PS2.B as in 3-PS2-3 and 3-PS2-4). An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion (PS2.A as in 3-PS2-1). The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it (PS2.A as in 3-PS2-2). **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-PS2-3 and 3-PS2-4) and planning and carrying out investigations (3-PS2-1 and 3-PS2-2). 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-PS2-2) and Cause and Effect (3-PS2-1 and 3-PS2-3). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*	
Performance Expectations	3-PS2-1. **Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.** [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [*Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.*] 3-PS2-2. **Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [*Assessment Boundary: Assessment does not include technical terms such as period and frequency.*]

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Performance Expectations (Continued)	3-PS2-3. **Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.** [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [*Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.*] 3-PS2-4. **Define a simple design problem that can be solved by applying scientific ideas about magnets.*** [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]
Example Phenomena	If two groups of students play tug of war, the rope might not move. If you rub a balloon on your shirt, it will then pick up paper confetti without touching the confetti.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect. Students could *ask questions that can be investigated* [about] ***changes in*** [an] ***object's speed or direction of motion***. 3-PS2-1 **Developing and Using Models** ● Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. Students could *collaboratively develop a model based on evidence that shows the relationships between* ***an object's past and future motion when the past motion exhibits a regular pattern***. 3-PS2-2 **Planning and Carrying Out Investigations** ● Make predictions about what would happen if a variable changes. Students could *make predictions about what would happen* [if] ***a force acts on an object***. 3-PS2-1 **Analyzing and Interpreting Data** ● Represent data in tables and/or various graphical displays to reveal patterns that indicate relationships. Students could *represent data in tables to reveal patterns that indicate relationships* [between] ***magnetic forces*** [and the motion of objects]. 3-PS2-3 and 3-PS2-4 **Using Mathematical and Computational Thinking** ● Organize simple data sets that suggest relationships. Students can *organize simple data sets that suggest relationships* [between] ***the force between two magnets and their distances apart***. 3-PS2-3 and 3-PS2-4 **Constructing Explanations and Designing Solutions** ● Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). Students could *construct an explanation of observed relationships* [between] ***forces on an object and a change in the object's direction of motion***. 3-PS2-1

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Additional Practices Building to the PEs (Continued)	**Engaging in Argument from Evidence** ● 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. Students could *make a claim about the merit of a solution* [that uses the idea that] ***electric forces between a pair of objects do not require that the objects be in contact*** *by citing relevant evidence about how [the solution] meets the criteria and constraints of the problem*. 3-PS2-3 and 3-PS2-4 **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 *communicate technical information—including using various forms of media*—[about] ***electric forces between a pair of objects***. 3-PS2-3
Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns can be used as evidence to support an explanation. Students could describe why *patterns* [of the effects of] ***magnetic interactions*** *can be used as evidence to support an explanation* [that] ***magnetic forces do not require that objects be in contact***. 3-PS2-3 and 3-PS2-4 **Systems and System Models** ● A system can be described in terms of its components and their interactions. Students could explain how ***objects exerting forces on each other*** [without] ***being in contact*** [with one another are] *components* [of] *a system that interact.* 3-PS2-3 and 3-PS2-4 **Stability and Change** ● Change is measured in terms of differences over time and may occur at different rates. Students could ask questions about how *change is measured* [when] ***a force acts on an object***. 3-PS2-1
Additional Connections to Nature of Science	**Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Science assumes consistent patterns in natural systems. Students could describe how we use the concept that *science assumes consistent patterns in natural systems* [to understand that] ***a force has a direction***. 3-PS2-1 **Scientific Investigations Use a Variety of Methods** ● Science investigations use a variety of methods, tools, and techniques. Students could describe that the *techniques* [they used to] *investigate* [relationships between] ***the force between magnets and their distances apart*** [may be different than the] *techniques* [they would use in another] *investigation*. 3-PS2-3 and 3-PS2-4

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3rd Grade Topic Model

Narrative and Rationale: The four bundles in this Grade 3 model all have a particular topical focus. Bundle 1 focuses on traits of organisms. Bundle 2 builds on Bundle 1 to focus on relationships between organism traits and survival in a habitat. Bundle 3 extends this study to focus on how the climate affects organisms over long periods of time. Bundle 4 shifts focus to the physical sciences, with a study of forces and motion.

Throughout the first three bundles, students have the opportunity to build understanding over time of typical weather conditions expected. Alternately, this performance expectation (3-ESS2-1) could be included solely in Bundle 3. There are also a variety of opportunities to incorporate the 3–5 engineering design performance expectations throughout the year in addition to those shown in the bundles. Although two of these performance expectations are included in this 3rd grade model, they will be fully assessable at the end of grade five.

Grade 3 places special emphasis on making sense of data, using evidence to construct arguments and explanations, developing models, and planning and conducting investigations. However, the practices and crosscutting concepts described in each bundle are intended as end-of-instructional unit expectations and not curricular designations—additional practices and crosscutting concepts should be used throughout instruction in each bundle.

Bundle 1: Why are organisms different from one another? **~9 weeks**	**Bundle 2:** How does the environment affect organisms? **~9 weeks**	**Bundle 3:** How do we know the environment used to be different? **~9 weeks**	**Bundle 4:** What happens when different objects interact? **~9 weeks**
3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death. **3-LS2-1.** Construct an argument that some animals form groups that help members survive.[1] **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. **3-LS3-2.** Use evidence to support the explanation that traits can be influenced by the environment. **3-ESS2-1.** Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.[1]	**3-LS2-1.** Construct an argument that some animals form groups that help members survive. **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. **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. **3-ESS2-1.** Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.[1] **3-ESS3-1.** Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.* **3-5 ETS1-2.** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	**3-LS4-1.** Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. **3-LS4-4.** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.* **3-ESS2-1.** Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. **3-ESS2-2.** Obtain and combine information to describe climates in different regions of the world. **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-PS2-1.** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. **3-PS2-2.** Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. **3-PS2-3.** Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. **3-PS2-4.** Define a simple design problem that can be solved by applying scientific ideas about magnets.*

1. The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.

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3rd Grade Topic Model Flowchart

Bundle 1

LS1.B as found in 3-LS1-1
- Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.

LS2.D as found in 3-LS2-1
- 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

LS3.A as found in 3-LS3-1
- Many characteristics of organisms are inherited from their parents.

LS3.A as found in 3-LS3-2
- Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.

LS3.B as found in 3-LS3-1
- Different organisms vary in how they look and function because they have different inherited information.

LS3.B as found in 3-LS3-2
- The environment also affects the traits that an organism develops.

ESS2.D as found in 3-ESS2-1
- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.

Bundle 2

LS2.D as found in 3-LS2-1
- 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

LS4.B as found in 3-LS4-2
- Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.

LS4.C as found in 3-LS4-3
- For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

ESS2.D as found in 3-ESS2-1
- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.

ESS3.B as found in 3-ESS3-1
- A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts.

to PS2.A in Bundle 4

ETS1.B as found in 3-5-ETS1-2
- 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.

Bundle 3

LS4.A as found in 3-LS4-1
- Some kinds of plants and animals that once lived on Earth are no longer found anywhere.
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.

LS2.C as found in 3-LS4-4
- 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.

LS4.D as found in 3-LS4-4
- Populations live in a variety of habitats, and change in those habitats affects the organisms living there.

ESS2.D as found in 3-ESS2-1
- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.

ESS2.D as found in 3-ESS2-2
- Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.

ETS1.A as found in 3-5-ETS1-1
- 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.

Bundle 4

PS2.A as found in 3-PS2-1
- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)

PS2.A as found in 3-PS2-2
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

PS2.B as found in 3-PS2-1
- Objects in contact exert forces on each other.

PS2.B as found in 3-PS2-3 and 3-PS2-4
- Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

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4th Grade Topical Model

Narrative and Rationale: The five bundles in this Grade 4 model all have a particular topical focus. Bundle 1 focuses on organism structure and function and information processing. In Bundle 2, the abstract concept of energy transfer is introduced alongside a focus on information transfer. Bundle 3 extends the study of energy to include cause and effect relationships between energy and collisions. In Bundle 4, students are introduced to waves and their properties. The idea that waves can cause objects to move can be used to facilitate student understanding of the scale of the rate of weathering or erosion in certain environments. Bundle 5 builds on the third grade focus on force to facilitate students' understanding of Earth systems and their processes of change. Opportunities also exist to connect back to concepts of energy transfer introduced earlier in the year.

There are a variety of opportunities to incorporate the 3–5 engineering design performance expectations throughout the year. Although these performance expectations are included in this 4th grade model, they will be fully assessable at the end of grade five. The science and engineering practices and crosscutting concepts in the fourth grade performance expectations enable students to develop a concrete understanding of phenomena associated with energy transfer. Note that the practices and crosscutting concepts described are intended as end-of-instructional unit expectations and not curricular designations—additional practices and crosscutting concepts should be used throughout instruction in each bundle.

Bundle 1: How do organisms receive and process information? **~6 weeks**	**Bundle 2:** How do we move energy and information from place to place? **~9 weeks**	**Bundle 3:** What happens when objects collide? **~6 weeks**	**Bundle 4:** What effect can water have on land? **~6 weeks**	**Bundle 5:** How can we reduce negative impacts of natural hazards and of resource use? **~9 weeks**
4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. **4-LS1-1.** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. **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. **3-5-ETS1-1.** Define a simple design problem reflecting a	**4-PS3-2.** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. **4-PS3-4.** Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.* **4-PS4-3.** Generate and compare multiple solutions that use patterns to transfer information.*	**4-PS3-1.** Use evidence to construct an explanation relating the speed of an object to the energy of that object. **4-PS3-3.** Ask questions and predict outcomes about the changes in energy that occur when objects collide. **3-5-ETS1-3.** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.*	**4-PS4-1.** Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.[1] **4-ESS1-1.** Identify evidence from patterns in rock formations and fossils in rock layers for changes in a landscape over time to support an explanation for changes in a landscape over time. **4-ESS2-1.** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. **3-5-ETS1-2.** Generate and compare multiple possible	**4-PS4-1.** Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. **4-ESS2-2.** Analyze and interpret data from maps to describe patterns of Earth's features. **4-ESS3-1.** Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. **4-ESS3-2.** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* **3-5-ETS1-2.** Generate and compare multiple possible solutions to a problem based on

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need or a want that includes specified criteria for success and constraints on materials, time, or cost.*			solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.[1]*	how well each is likely to meet the criteria and constraints of the problem.*

1. The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.

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4th Grade Topics Model Flowchart

Bundle 1

PS4.B as found in 4-PS4-2
- An object can be seen when light reflected from its surface enters the eyes.

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LS1.A as found in 4-LS1-1
- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

LS1.D as found in 4-LS1-2
- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.

ETS1.A as found in 3-5-ETS1-1
- 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.

Bundle 2

PS3.A as found in 4-PS3-2
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.

PS3.B as found in 4-PS3-2
- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
- Light also transfers energy from place to place.

PS3.B as found in 4-PS3-2 and 4-PS3-4
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.

PS3.D as found in 4-PS3-4
- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use.

PS4.C as found in 4-PS4-3
- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.

ETS1.A as found in 4-PS3-4
- 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.

ETS1.C as found in 4-PS4-3
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Bundle 3

PS3.A as found in 4-PS3-1
- The faster a given object is moving, the more energy it possesses.

PS3.A as found in 4-PS3-3
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.

PS3.B as found in 4-PS3-3
- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.

PS3.C as found in 4-PS3-3
- When objects collide, the contact forces transfer energy so as to change the objects' motion.

ETS1.B as found in 3-5-ETS1-3
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.

ETS1.C as found in 3-5-ETS1-3
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Bundle 4

PS4.A as found in 4-PS4-1
- Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).

ESS1.C as found in 4-ESS1-1
- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.

ESS2.A as found in 4-ESS2-1
- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around.

ESS2.E as found in 4-ESS2-1
- Living things affect the physical characteristics of their regions.

ETS1.B as found in 3-5-ETS1-2
- 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.

Bundle 5

PS4.A as found in 4-PS4-1
- Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (Note: This grade band endpoint was moved from K–2.)
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).

ESS2.B as found in 4-ESS2-2
- The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.

ESS3.A as found in 4-ESS3-1
- Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.

ESS3.B as found in 4-ESS3-2
- A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts.

ETS1.B as found in 4-ESS3-2
- Testing a solution involves investigating how well it performs under a range of likely conditions.

ETS1.B as found in 3-5-ETS1-2
- 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.

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4th Grade - Topical Model - Bundle 1
Structures and Functions of Organisms

This is the first bundle of the 4th Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the [Course Flowchart]

Bundle 1 Question: This bundle is assembled to address the question "how do organisms receive and process information?"

Summary
The bundle organizes performance expectations around the theme of *structures and functions of organisms*. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 an object can be seen when light reflected from its surface enters the eyes (PS4.B as in 4-PS4-2) connects to the concept that different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain (LS1.D as in 4-LS1-2). These concepts about structures and sense receptors being used to gather certain kinds of information also connects to the idea that plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (LS1.A as in 4-LS1-1)

The engineering design idea that the success of a designed solution is determined by considering the desired features of a solution (ETS1.A as in 3-5-ETS1-1) could be applied to multiple concepts, such as that plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction (LS1.A as in 4-LS1-1) and that an object can be seen when light reflected from its surface enters the eyes (PS4.B as in 4-PS4-2). Connections could be made through engineering design tasks, such as by having students design a solution to a problem by mimicking internal or external structures of plants or animals that serve various functions in growth, survival, behavior, and reproduction, or by having students solve a problem in which some barrier exists, resulting in the inability to see an object. In both cases, before students begin their designs, they should identify what the desired features of a successful solution are—in other words, they should determine the criteria for success.

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), developing and using models (4-PS4-2 and 4-LS1-2), and engaging in argument from evidence (4-LS1-1). 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 Cause and Effect (4-PS4-2) and Systems and System Models (4-LS1-1 and 4-LS1-2). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations	4-PS4-2 **Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.** [*Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.*] 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, colored 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.*] 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.***
Example Phenomena	Falcons very high up in the air can spot very small animals on the ground. Eyes are located differently in the heads of deer versus mountain lions.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Identify scientific (testable) and non-scientific (non-testable) questions. Students could [brainstorm questions about] ***internal and external structures that serve various functions in growth, survival, behavior, and reproduction*** *and* [then] *identify* [which questions are] *scientific (testable) and* [which questions are] *non-scientific (non-testable)*. 4-LS1-1 **Developing and Using Models** • Develop and/or use models to describe and/or predict phenomena. Students could *develop a model to describe a phenomenon* [related to the idea that] ***an object can be seen when light reflected from its surface enters the eyes***. 4-PS4-2 **Planning and Carrying Out Investigations** • Make predictions about what would happen if a variable changes. Students could use the idea that ***animals are able to use their perceptions and memories to guide their actions*** [to] *make predictions about what would happen*—[e.g., how an animal would act]—*if a variable changes*, [such as when what the animal perceives changes]. 4-LS1-2 **Analyzing and Interpreting Data** • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. Students could *analyze and interpret data, using logical reasoning, to make sense of a phenomenon* [related to the idea that] ***plants have external structures that serve functions in growth, survival, and reproduction***. 4-LS1-1

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Additional Practices Building to the PEs (Continued)	**Using Mathematical and Computational Thinking** • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. Students could *decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success* [in solving a problem related to an organism's ability to see]. 4-PS4-2 and 4-LS1-1 **Constructing Explanations and Designing Solutions** • Identify the evidence that supports particular points in an explanation. Students can *identify the evidence that supports particular points in an explanation* [that] ***an object can be seen when light reflected from its surface enters the eyes***. 4-PS4-2 **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 model* [that describes the] ***various functions that plants' and animals' internal and external structures have*** *by citing relevant evidence and posing specific questions*. 4-LS1-1 **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 *communicate technical information in writing* [about] ***the criteria and constraints of solutions*** [to a problem related to] ***light reflecting from objects and entering the eye***. 4-PS4-2 and 3-5-ETS1-1
Additional Crosscutting Concepts Building to the PEs	**Patterns** • Similarities and differences in patterns can be used to sort and classify natural phenomena. Students could identify *similarities and differences in patterns* [of] ***plants' and animals' internal and external structures*** [and] *use* [the patterns] *to sort and classify* [how these structures] ***serve various functions in growth, survival, behavior, and reproduction***. 4-LS1-1 **Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change. Students could describe how *cause and effect relationships*—[like the relationship between] ***light reflecting from objects and the ability for objects to be seen***—*are routinely identified, tested, and used to explain change*. 4-PS4-2 **Structure and Function** • Substructures have shapes and parts that serve functions. Students can describe the *shapes and parts* [of] ***plants' and animals' internal and external structures*** *that serve functions* ***in growth, survival, behavior, and reproduction***. 4-LS1-1

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Connections to Nature of Science	**Scientific Knowledge is Based on Empirical Evidence** • Science findings are based on recognizing patterns. Students could describe how their *science findings* [about] ***plants' and animals' internal and external structures that serve various functions in growth, survival, behavior, and reproduction*** *were based on recognizing patterns*. 4-LS1-1 **Science Is a Way of Knowing** • Science is a way of knowing that is used by many people. Students could describe that *science is a way of knowing,* [with the example of how used science to learn that] ***an object can be seen when light reflected from its surface enters the eyes***. 4-PS4-2

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4th Grade - Topical Model - Bundle 2
Energy Transfer and Information Transmission

This is the second bundle of the 4th Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart

Bundle 2 Question: This bundle is assembled to address the question "how do we move energy and information from place to place?"	
Summary The bundle organizes performance expectations around the theme of *energy transfer and information transmission.* Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 energy can be moved from place to place by moving objects or through sound, light, or electric currents (PS3.A as in 4-PS3-2) connects to the idea that electric currents can be used locally to produce motion, sound, heat, or light; the currents may have been produced to begin with by transforming the energy of motion into electrical energy (PS3.B as in 4-PS3-4). Just as energy can be transferred from place to place, digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa (PS4.C as in 4-PS4-3). **Bundle Science and Engineering Practices** Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of planning and carrying out investigations (4-PS3-2) and constructing explanations and designing solutions (4-PS3-4 and 4-PS4-3). 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 (4-PS4-3) and Energy and Matter (4-PS3-2 and 4-PS3-4). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*	
Performance Expectations	4-PS3-2 **Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.** [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*] 4-PS3-4 **Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*** [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [*Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.*] 4-PS4-3 **Generate and compare multiple solutions that use patterns to transfer information.*** [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]
Example Phenomena	A radio uses electricity to produce sound. Hand crank flashlights produce light.

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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 that can be solved through the development of a system* [that] ***transfers energy from place to place by electric currents,*** *including defining several criteria for success and constraints on materials, time, or cost*. 4-PS3-2 and 4-PS3-4 **Developing and Using Models** • Develop and/or use models to describe and/or predict phenomena. Students could *develop and/or use models to describe a phenomenon* [related to the idea that] ***energy can be moved from place to place by moving objects or through sound, light, or electric currents***. 4-PS3-2 **Planning and Carrying Out Investigations** • Make predictions about what would happen if a variable changes. Students could *make predictions about what would happen [to]* ***the energy present when objects collide***. 4-PS3-2 **Analyzing and Interpreting Data** • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. Students could *analyze and interpret data, using logical reasoning, to make sense of a phenomenon* [related to] ***energy being moved from place to place through light***. 4-PS3-2 **Using Mathematical and Computational Thinking** • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. Students could *decide if qualitative or quantitative data are best to determine whether a proposed object or tool* [that] ***transfers energy from place to place*** *meets criteria for success*. 4-PS3-2 and 4-PS3-4 **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] ***electric currents can be used to produce motion, sound, heat, or light***. 4-PS3-4 **Engaging in Argument From Evidence** • 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. Students could *make a claim about the merit of a solution to a problem* [related to the movement of] ***energy from place to place through electric currents*** *by citing relevant evidence about how it meets the criteria and constraints of the problem*. 4-PS3-2

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Additional Practices Building to the PEs (Continued)	**Obtaining, Evaluating and Communicating Information** • Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. Students could *combine information from written text with information from diagrams and charts* [about] ***high-tech devices, such as computers or cell phones,*** [that] ***can convert information from digitized form to voice and vice versa*** *to define a simple design problem*. 4-PS4-3
Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** • Cause and effect relationships are routinely identified and used to explain change. Students could describe that *cause and effect relationships*—[such as] ***when objects collide, energy can be transferred from one object to another, thereby changing their motion***—*are routinely identified and used to explain change*. 4-PS3-2 **Systems and Systems Models** • A system can be described in terms of its components and their interactions. Students could describe ***objects colliding, the energy*** [that is] ***transferred from one object to another,*** [and] ***the surrounding air*** [as] *a system*, [and could describe that system] *in terms of* [its] *components and their interactions.* 4-PS3-2 **Stability and Change** • Change is measured in terms of differences over time and may occur at different rates. Students could describe how *change is measured in terms of differences over time and may occur at different rates*, [using the] ***transformation*** [of] ***the energy of motion into electrical energy*** as an example. 4-PS3-4
Additional Connections to Nature of Science	**Science Investigations Use a Variety of Methods** • Science investigations use a variety of methods, tools, and techniques. Students could describe that science investigations *use a variety of methods, tools, and techniques*, [using as an example the variety of methods that could be used to investigate that] ***energy can be moved from place to place by moving objects or through sound, light, or electric currents***. 4-PS3-2 **Science is a Human Endeavor** • Science affects everyday life. Students could use their understanding of ***the use of devices to transmit digitized information over long distances*** [to describe that] *science affects everyday life*. 4-PS4-3

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4th Grade - Topical Model - Bundle 3
Energy and Collisions

This is the third bundle of the 4th Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart

Bundle 3 Question: This bundle is assembled to address the question "what happens when objects collide?"

Summary

The bundle organizes performance expectations around the theme of *energy and collisions.* Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 concept that the faster a given object is moving, the more energy it possesses (PS3.A as in 4-PS3-1) connects to many other ideas about energy in this bundle, including the idea that energy is present whenever there are moving objects (PS3.B as in 4-PS3-3), and that When objects collide, the contact forces transfer energy so as to change the objects' motion (PS3.C as in 4-PS3-3).

The engineering design idea that different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints (ETS1.C as in 3-5-ETS1-3) can be applied to multiple science concepts in this bundle, such as that the faster a given object is moving, the more energy it possesses (PS3.A as in 4-PS3-1) and when objects collide, energy can be transferred from one object to another, thereby changing their motion (PS3.A as in 4-PS3-3). Connections could be made through engineering design challenges, such as one in which students attempt to reduce or increase the amount of energy a moving object has, or one in which students attempt to reduce or increase the amount of energy transferred from one object to another in a collision. In either case, different student solutions could be tested to determine which best meets the criteria within the identified constraints.

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 (4-PS3-3), developing and using models (4-PS4-1), planning and carrying out investigations (3-5-ETS1-3), and constructing explanations and designing solutions (4-PS3-1). 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 (4-PS4-1) and Energy and Matter (4-PS3-1 and 4-PS3-3). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional

Performance Expectations	4-PS3-1 **Use evidence to construct an explanation relating the speed of an object to the energy of that object.** [*Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.*] 4-PS3-3 **Ask questions and predict outcomes about the changes in energy that occur when objects collide.** [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*] 3-5-ETS1-3 **Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.***

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Example Phenomena	A tennis ball that hits a wall bounces off. You hear a sound when a book is dropped.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Identify scientific (testable) and non-scientific (non-testable) questions. Students could *identify* [which] *questions* [about the speed of] ***a given object*** [are] *scientific (testable) and non-scientific (non-testable).* 4-PS3-1 **Developing and Using Models** • Develop and/or use models to describe and/or predict phenomena. Students could *use models to predict* [whether] ***objects' motions*** [will change] ***when objects collide***. 4-PS3-3 **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 or test a design solution. Students could *make observations and/or measurements to produce data to serve as the basis for evidence* [about the relationship between the speed] ***a given object is moving*** [and] ***the energy it possesses***. 4-PS3-1 **Analyzing and Interpreting Data** • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. Students could *compare and contrast data collected by different groups* [about the relationship between the speed] ***a given object is moving*** [and] ***the energy it possesses*** *in order to discuss similarities and differences in their findings*. 4-PS3-1 **Using Mathematical 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 could *measure and estimate quantities such as temperature to address engineering problems* [related to the] ***transfer of energy to the surrounding air when objects collide***. 4-PS3-3 **Constructing Explanations and Designing Solutions** • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. Students could *use evidence (e.g., measurements, observations, patterns) to support an explanation for a phenomenon* [related to the concept that] ***the faster an object is moving, the more energy it possesses***. 4-PS3-1

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Additional Practices Building to the PEs (Continued)	**Engaging in Argument from Evidence** • Construct and/or support an argument with evidence, data, and/or a model. Students could *construct an argument with evidence* [that] ***identifying failure points or difficulties through tests*** [of design solutions meant to increase the] ***energy of an object*** [through its speed] ***suggests the elements of the design that need to be improved***. 3-5-ETS1-3 **Obtaining, Evaluating and Communicating Information** • Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. Students could *read and comprehend grade-appropriate complex texts to summarize technical ideas about* [how] ***tests*** [of] ***collisions*** [between] ***objects are often designed to identify failure points or difficulties***. 4-PS3-3 and 3-5-ETS1-3
Additional Crosscutting Concepts Building to the PEs	**Patterns** • Patterns of change can be used to make predictions. Students could describe the *pattern of change* [between] ***collisions*** [between] ***objects*** [and] ***energy transfer to the surrounding air*** and use this *pattern to make predictions*. 4-PS3-1 **Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change. Students could *identify cause and effect relationships* [such as between] ***sound*** [and] ***the movement of energy from place to place;*** students could *use* [these relationships] *to explain change*. 4-PS3-3 **Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. Students could describe why *standard units are used to measure and describe physical quantities such as time* [as they investigate the relationship between the speed] ***a given object is moving, the energy it possesses***. 4-PS3-1
Additional Connections to Nature of Science	**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Science explanations describe the mechanisms for natural events. Students could *describe the mechanism*, [e.g.,] ***electric currents***, *for natural events*, [such as] ***energy moving from place to place***. 4-PS3-3 **Science is a Human Endeavor** • Most scientists and engineers work in teams. Students can describe that *most scientists and engineers work in teams,* [just as they did when investigating that] ***the faster a given object is moving, the more energy it possesses.*** 4-PS3-1

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4th Grade - Topical Model - Bundle 4
Waves and Erosion

This is the fifth bundle of the 4th Grade Topic 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 "what effect can water have on land?"
Summary The bundle organizes performance expectations around the theme of *waves and erosion.* Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 rainfall, water, ice, wind, and living organisms help to shape the land (ESS2.A as in 4-ESS2-1) connects to the idea waves, which are regular patterns of motion, can be made in water by disturbing the surface, and can cause objects to move (PS4.A as in 4-PS4-1). Another concept related to affecting the land is that living things affect the physical characteristics of their regions (ESS2.E as in 4-ESS2-1). And the relationship between living things and the land connects to the ideas that the presence and location of certain fossil types indicate the order in which rock layers were formed (ESS1.C as in 4-ESS1-1), and that rainfall affects the types of living things found in a region (ESS2.A as in 4-ESS2-1). The engineering design idea that testing a solution involves investigating how well it performs under a range of likely conditions (ETS1.B as in 3-5-ETS1-2) could be applied to multiple science concepts such as that water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around (ESS2.A as in 4-ESS2-1), and that waves can cause objects to move (PS4.A as in 4-PS4-1). Connections could be made through tasks such as by having students design a solution to reduce effects of erosion by wind, or by having students design a solution to ocean waves moving beach sand. Either kind of design should be tested within a range of likely conditions since rates of erosion can vary, as can the size of waves. **Bundle Science and Engineering Practices** Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (4-PS4-1), planning and carrying out investigations (4-ESS2-1), and constructing explanations and designing solutions (4-ESS1-1 and 3-5-ETS1-2). 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 (4-PS4-1 and 4-ESS1-1) and Cause and Effect (4-ESS2-1). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*

Performance Expectations 4-PS4-1 and 3-5-ETS1-2 are partially assessable.	4-PS4-1 **Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [*Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.*]

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Performance Expectations (Continued)	4-ESS1-1 **Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.** [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [*Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.*] 4-ESS2-1 **Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [*Assessment Boundary: Assessment is limited to a single form of weathering or erosion.*] 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	In bends in rivers, the outside of a bend has a steeper bank than the inside of a bend. Waves can be produced using a slinky.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. Students could *ask questions* [about] ***gravity breaking rocks, soils, and sediments into smaller particles and moving them around*** *that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.* 4-ESS2-1 **Developing and Using Models** • Develop and/or use models to describe and/or predict phenomena. Students could *develop a model to describe* [that] ***local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes,*** [and that] ***the presence and location of certain fossil types indicate the order in which rock layers were formed***. 4-ESS1-1 **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 or test a design solution. Students could *make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon* [related to] ***waves moving across the surface of deep water,*** [including that] ***the water goes up and down in place*** [and that] ***there is no net motion in the direction of the wave***. 4-PS4-1

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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 that indicate relationships. Students could *represent data in various graphical displays to reveal patterns that indicate relationships* [between] ***ice*** [and the] ***breaking*** [of] ***rocks, soils, and sediments into smaller particles***. 4-ESS2-1 **Using Mathematical 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 could *describe and measure quantities,* [such as length], *to address questions* [about the] ***amplitude and wavelength*** [of] ***waves***. 4-PS4-1 **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] ***waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks)***. 4-PS4-1 **Engaging in Argument from Evidence** • Construct and/or support an argument with evidence, data, and/or a model. Students could *construct an argument with evidence* [that] ***when waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave***. 4-PS4-1 **Obtaining, Evaluating and Communicating Information** • Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. Students could *combine information in written text with information in charts to support an argument* [about how] ***rainfall affects the types of living things found in a region***. 4-ESS2-1
Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** • Cause and effect relationships are routinely identified, tested, and used to explain change. Students could use *cause and effect relationships* [between] ***the presence of certain fossil types*** [and] ***the order in which rock layers were formed*** *to* [construct explanations]. 4-ESS1-1 **Scale, Proportion and Quantity** • Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods. Students could identify *observable phenomena* [related to] ***local, regional, and global patterns of rock formations*** [that occurred over] *very short* [versus] *very long time periods*. 4-ESS1-1

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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 use examples of ***local, regional, and global patterns of rock formations*** [to explain] *that change is measured in terms of differences over time and may occur at different rates.* 4-ESS1-1
Additional Connections to Nature of Science	**Science Investigations Use a Variety of Methods** • Science methods are determined by questions. Students could describe how the *science methods* [they used to investigate] ***the presence and location of certain fossils*** [were] *determined by* [their] *questions*. 4-ESS1-1 **Scientific Knowledge is Based on Empirical Evidence** • Science findings are based on recognizing patterns. Students could use *patterns* [of] ***rainfall helping to shape the land*** [to describe that] *science findings are based on recognizing patterns*. 4-ESS2-1

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4th Grade - Topical Model - Bundle 5
Reducing Impacts

This is the fifth bundle of the 4th Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the [Course Flowchart]

Bundle 5 Question: This bundle is assembled to address the question "how can we reduce negative impacts of natural hazards and of resource use?"

Summary

The bundle organizes performance expectations around the theme of *reducing impacts.* Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 when waves move across the surface of deep water, there is no net motion in the direction of the wave except when the water meets a beach (PS4.A as in 4-PS4-1) connects to the idea that a variety of hazards results from natural processes such as tsunamis, earthquakes, volcanic eruptions (ESS3.B as in 4-ESS3-2). The idea that most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans (ESS2.B as in 4-ESS2-2) also connects to the idea that humans cannot eliminate the hazards but can take steps to reduce their impacts (ESS3.B as in 4-ESS3-2).

This concept that humans can affect the natural world and can change the way it affects us could also connect to the idea that energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways (ESS3.A as in 4-ESS3-1).

The engineering design idea that communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (ETS1.B as in 3-5-ETS1-2) could be applied to multiple science concepts, such as that energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways (ESS3.A as in 4-ESS3-1) and that humans cannot eliminate the hazards from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions) but can take steps to reduce their impacts (ESS3.B as in 4-ESS3-2). Connections could be made through tasks such as identifying solutions to reduce human impacts on the environment from energy and fuel use, and identifying solutions that reduce the impacts of hazards from natural processes. For either connection, students should communicate with their peers about solutions and reflect on how such communication can lead to improved solutions.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (4-PS4-1), planning and carrying out investigations (4-ESS2-1), analyzing and interpreting data (4-ESS2-2), and constructing explanations and designing solutions (4-ESS3-2 and 3-5-ETS1-2), and obtaining, evaluating, and communicating information (4-ESS3-1). 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 (4-PS4-1 and 4-ESS2-2) and Cause and Effect (4-ESS3-1 and 4-ESS3-2). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations	4-PS4-1 **Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [*Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.*] 4-ESS2-2 **Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.] 4-ESS3-1 **Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.] 4-ESS3-2 **Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [*Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.*] 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	Hurricanes can damage houses. Oil from the ground can be used to make gasoline for cars.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. Students could *ask questions* [about] ***waves moving across the surface of deep water*** *that can be investigated and predict reasonable outcomes based on patterns* [and] *cause and effect relationships* [between the waves and the movement of water]. 4-PS4-1 **Developing and Using Models** • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. Students could *collaboratively develop a model based on evidence that shows the relationships among variables for frequent and regular occurring events* [such as the relationship between] ***use of fuels*** [and effects on] ***the environment***. 4-ESS3-1 **Planning and Carrying Out Investigations** • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success. Students could *test two different models of the same* ***tool*** [intended to] ***help locate the different land and water feature areas of Earth*** *to determine which better meets criteria for success*. 4-ESS2-2

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Additional Practices Building to the PEs (Continued)	**Analyzing and Interpreting Data** • Analyze data to refine a problem statement or the design of a proposed object, tool, or process. Students could a*nalyze data to refine the design of a proposed process* [intended to] ***reduce the impact of a hazard resulting from a natural process (e.g., earthquakes, tsunamis, volcanic eruptions)***. 4-ESS3-2 **Using Mathematical and Computational Thinking** • Organize simple data sets to reveal patterns that suggest relationships. Students could *organize simple data sets to reveal patterns that suggest relationships* [between the] ***energy that humans use*** [and the effects on] ***the environment.*** 4-ESS3-1 **Constructing Explanations and Designing Solutions** • Apply scientific ideas to solve design problems. Students could *apply scientific ideas* [about the] ***energy and fuels that humans use*** *to solve problems*. 4-ESS3-1 **Engaging in Argument from Evidence** • Construct and/or support an argument with evidence, data, and/or a model. Students could *construct an argument* [about] ***the patterns in locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes*** *with evidence*. 4-ESS2-2 **Obtaining, Evaluating and Communicating Information** • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts. Students could *communicate scientific information* [about the idea that] **waves of the same type can differ in amplitude and wavelength** *orally and/or in written formats*. 4-PS4-1
Additional Crosscutting Concepts Building to the PEs	**Patterns** • Patterns of change can be used to make predictions. Students could explain that *patterns of* ***earthquakes*** *can be used to make predictions* [about the location of future earthquakes]. 4-ESS2-2 **Systems and System Models** • A system can be described in terms of its components and their interactions. Students could explain that *a system can be described in terms of its components and their interactions* [using the example of] ***humans*** [and the] ***natural sources*** [they use for] ***energy and fuels and the*** [effect human use of energy and fuels has on] ***the environment***. 4-ESS3-1 **Energy and Matter** • Energy can be transferred in various ways and between objects. Students could describe how *energy can be transferred in various ways and between objects* [using] ***waves, which are regular patterns of motion*** [and] ***can be made in water by disturbing the surface***, [as an example]. 4-PS4-1

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Additional Connections to Nature of Science	**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Science explanations describe the mechanisms for natural events. Students could *describe the mechanisms*, [such as] ***disturbing the surface of water***, [in their] *science explanations of natural events*, [such as the creation of] ***waves***. 4-PS4-1 **Science is a Human Endeavor** • Science affects everyday life. Students could use their understanding that ***energy and fuels that humans use are derived from natural sources*** [to describe that] *science affects everyday life*. 4-ESS3-1

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5th Grade – Topic Model - Bundle 1
Physical and Chemical Changes

This is the first bundle of the Fifth Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 1 Question: This bundle is assembled to address the question "How much does air weigh?"

Summary

The bundle organizes performance expectations with a focus on helping students begin to understand the conservation of matter and its particulate nature. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

The idea that matter of any type can be subdivided into particles that are too small to see (PS1.A as in 5-PS1-1) connects to the idea that the amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish (PS1.A as in 5-PS1-2). The total weight of substances also does not change no matter what reaction or change in properties occurs (PS1.B as in 5-PS1-2).

Change in properties connects to the idea that when two or more different substances are mixed, a new substance with different properties may be formed (PS1.B as in 5-PS1-4). Measurements of a variety of properties can be used to identify materials (PS1.A as in 5-PS1-3), including the new ones that may be formed when two or more substances are mixed.

The engineering design idea that different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints (ETS1.C as in 3-5-ETS1-3) could connect to multiple science concepts, such as that when two or more different substances are mixed, a new substance with different properties may be formed (PS1.B as in 5-PS1-4), and that measurements of a variety of properties can be used to identify materials (PS1.A as in 5-PS1-3). Students can be challenged to create a new substance with particular properties (i.e., given criteria). In order to test the solution, measurements of the properties need to be taken to determine that the new substance with the desired properties has been created.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (5-PS1-1); planning and carrying out investigations (5-PS1-3, 5-PS1-4, and 3-5-ETS1-3); and using mathematics and computational thinking (5-PS1-2). 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 Cause and Effect (5-PS1-4) and Scale, Proportion, and Quantity (5-PS1-1, 5-PS1-2, and 5-PS1-3). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations	5-PS1-1. **Develop a model to describe that matter is made of particles too small to be seen.** [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [*Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.*] 5-PS1-2. **Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.** [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.] [*Assessment Boundary: Assessment does not include distinguishing mass and weight.*] 5-PS1-3. **Make observations and measurements to identify materials based on their properties.** [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [*Assessment Boundary: Assessment does not include density or distinguishing mass and weight.*] 5-PS1-4. **Conduct an investigation to determine whether the mixing of two or more substances results in new substances.** 3-5-ETS1-3. **Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**
Example Phenomena	Mixing baking soda and vinegar makes a lot of foam. You can smell food cooking from across a room.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. Students could *ask questions* [about what] ***measurements can be used to identify materials***. 5-PS1-3 **Developing and Using Models** • Develop and/or use models to describe and/or predict phenomena. Students could *use a model to predict* [whether] ***when two different substances are mixed, a new substance*** [will] ***be formed.*** 5-PS1-4 **Planning and Carrying Out Investigations** • Evaluate appropriate methods and/or tools for collecting data. Students could *evaluate appropriate methods and tools for collecting data* [on the relationship between] ***a change in properties of substances*** [and the] ***total weight of the substances***. 5-PS1-2 **Analyzing and Interpreting Data** • Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships. Students could *use graphical displays to represent data* [from] ***mixing two different substances*** *to reveal patterns in* [the resulting] ***properties*** [of the substances]. 5-PS1-4

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Additional Practices Building to the PEs (Continued)	**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 *measure* ***a variety of properties to identify materials***. 5-PS1-3 **Constructing Explanations and Designing Solutions** • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. Students could *use evidence to construct or support an explanation* [that] ***the amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish***. 5-PS1-2 **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 model* [that describes that] ***gases are made from particles that are too small to see and are moving freely around in space*** *by citing relevant evidence and posing specific questions*. 5-PS1-1 **Obtaining, Evaluating and Communicating Information** • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts. Students could *orally communicate* [the] *scientific information* [that] ***matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means***. 5-PS1-1
Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** • Events that occur together with regularity might or might not be a cause and effect relationship. Students could describe that *there might or might not be a cause and effect relationship* [between] ***matter changing form*** *and* [changing color]. 5-PS1-2 **Energy and Matter** • Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. Students could describe that *matter flows and cycles can be tracked in terms of the weight of the substances* ***when matter changes form, even when it seems to vanish***. 5-PS1-2 **Stability and Change** • Some systems appear stable, but over long periods of time will eventually change. Students could obtain information about *systems* [in which] ***air can*** [seem to only] ***affect objects*** *over long periods of time*. 5-PS1-1

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Additional Connections to Nature of Science .	**Science Knowledge Is Based on Empirical Evidence** • Science uses tools and technologies to make accurate measurements and observations. Students could describe how they used *tools and technologies to make accurate measurements and observations* [of what happens] ***when two different substances are mixed***. 5-PS1-4 **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Science explanations describe the mechanisms for natural events. Students could describe that *science explanations describe the mechanisms for natural events;* [for example,] ***the inflation and shape of a balloon*** [can be explained by the fact] ***that gases are made from matter particles that are too small to see and are moving freely around in space***. 5-PS1-1

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5th Grade – Topic Model - Bundle 2
Matter and Energy in Ecosystems

This is the second bundle of the Fifth Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 2 Question: This bundle is assembled to address the questions "What are we made out of?"

Summary

The bundle organizes performance expectations with a focus on helping students build an understanding of the flow and cycles of matter and energy. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

The idea that matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die (LS2.B as in 5-LS2-1) connects to the idea that matter of any type can be subdivided into particles that are too small to see (PS1.A as in 5-PS1-1) because matter is subdivided into particles as it flows between organisms and the air and soil. The idea that matter flows also connects to the ideas that plants acquire their material for growth chiefly from air and water (LS1.C as in 5-LS1-1) and that food provides animals with the materials they need for body repair and growth (LS1.C in 5-PS3-1).

Just as matter flows, energy can flow as well. As such, the idea that matter can flow connects to the concept that the energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (PS3.D as in 5-PS3-1).

The engineering design concept that communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs (ETS1.B as in 3-5-ETS1-2) could connect to multiple science concepts, such as that 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 (LS2.A as in 5-LS2-1) and that gases are made from matter particles that are too small to see and are moving freely around in space (PS1.A as in 5-PS1-1). The first connection could be made through having students share designs for solutions to improve the health of a given ecosystem. The second connection could be made by having students share design for a device that uses the understanding that gases are made from matter particles too small to see. In either case, students should have an opportunity to communicate with their peers throughout the design process and reflect on how sharing their ideas affected their designs.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (5-PS1-1, 5-PS3-1, and 5-LS2-1); constructing explanations and designing solutions (3-5-ETS1-2); and engaging in argument from evidence (5-LS1-1). 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 Scale, Proportion, and Quantity (5-PS1-1); Systems and System Models (5-LS2-1); and Energy and Matter (5-PS3-1 and 5-LS1-1). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

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Performance Expectations 5-PS1-1 is partially assessable	5-PS1-1. **Develop a model to describe that matter is made of particles too small to be seen.** [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [*Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.*] 5-PS3-1. **Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.** [Clarification Statement: Examples of models could include diagrams, and flow charts.] 5-LS1-1. **Support an argument that plants get the materials they need for growth chiefly from air and water.** [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.] 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.] 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	Some whales can eat more than 3,000 pounds of food per day, but humans can't eat that much. Leaves that fall from trees change form in a few weeks.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. Students could *ask questions* [and make predictions about the types of] ***environments in which organisms can survive*** *based on patterns such as cause and effect relationships.* 5-LS2-1 **Developing and Using Models** • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. Students could *collaboratively develop a model based on evidence that shows the relationships among variables for frequent and regular occurring events,* [such as] ***organisms obtaining gases, and water, from the environment***. 5-LS2-1 **Planning and Carrying Out Investigations** • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. Students *could conduct an investigation collaboratively – using fair tests in which variables are controlled and the number of trials considered – to produce data to serve as the basis for evidence* [that] ***gases are made from matter particles that are too small to see***. 5-PS1-1 **Analyzing and Interpreting Data** • Represent data in tables and/or various graphical displays to reveal patterns that indicate relationships. Students could *represent data in tables to reveal patterns that indicate relationships* [between organisms in] ***a healthy ecosystem in which multiple species of different types are each able to meet their needs***. 5-LS2-1

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Additional Practices Building to the PEs (Continued)	**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, measure, estimate, and/or graph quantities,* [such as height,] *to address scientific questions* [about where] ***plants acquire their material for growth***. 5-LS1-1 **Constructing Explanations and Designing Solutions** • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. Students could *use evidence to construct or support an explanation* [that] ***the energy released from food was once energy from the sun***. 5-PS3-1 **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 about a proposed model* [that] ***food provides animals with the materials they need for body repair and growth*** [in the form of] ***particles that are too small to see,*** *citing relevant evidence and posing specific questions*. 5-PS1-1 and 5-PS3-1 **Obtaining, Evaluating and Communicating Information** • Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. Students could *read and comprehend grade appropriate complex texts and other reliable media to describe how* [the idea that] ***plants acquire their material for growth chiefly from air and water*** *is supported by evidence*. 5-LS1-1
Additional Crosscutting Concepts Building to the PEs	**Scale, Proportion, and Quantity** • Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods. Students could describe how *observable phenomena exist from the very small* [such as] ***energy for body warmth*** [in a tiny animal] *to the immensely large* [such as] ***energy from the sun***. 5-PS3-1 **Energy and Matter** • Matter is made of particles. Students could describe that *matter is made of particles* [in the context that] ***plants acquire their material for growth chiefly from air and water***. 5-LS1-1

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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 use examples of ***newly introduced species*** [that] ***damage the balance of an ecosystem*** [to demonstrate that] *change may occur at different rates*. 5-LS2-1
Additional Connections to Nature of Science	**Scientific Investigations Use a Variety of Methods** • Science investigations use a variety of methods, tools, and techniques. Students could describe the *methods, tools, and techniques* [scientists have used to investigate that] ***the energy released from food was once energy from the sun***. 5-LS3-1 **Science is a Way of Knowing** • Science is a way of knowing that is used by many people. Students could describe how many people learn and use the information that ***a healthy ecosystem is one in which multiple species of different types are each able to meet their needs*** [to provide an example of a way that] *science is a way of knowing that is used by many people*. 5-LS2-1

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5th Grade – Topic Model - Bundle 3
Earth's Major Systems

This is the third bundle of the Fifth Grade Topic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart.

Bundle 3 Question: This bundle is assembled to address the question "Where does rain come from?"

Summary

The bundle organizes performance expectations with a focus on helping students build understanding of Earth's major systems and how they interact. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

The disciplinary core ideas in this bundle are linked through the concept of Earth's major systems. The idea that matter of any type can be subdivided into particles that are too small to see (PS1.A as in 5-PS1-1) can connect to the concept that Earth's major systems interact in multiple ways to affect Earth's surface materials and processes (ESS2.A as in 5-ESS2-1), since matter sometimes moves through the systems as particles that are too small to see.

Earth's major systems also connect to the concept that nearly all of Earth's available water is in the ocean, and most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere (ESS2.C as in 5-ESS2-2) as this concept is about the hydrosphere.

The Earth's major systems are affected by gravity as the gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center (PS2.B as in 5-PS2-1).

Finally, the idea that human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, and air also connects to our understanding of Earth's major systems.

The engineering design concept that different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success (ETS1.A as in 3-5-ETS1-1) could connect to multiple science concepts, such as that the ocean supports a variety of ecosystems and organisms (ESS2.A as in 5-ESS2-1) and that nearly all of Earth's available water is in the ocean, and most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere (ESS2.C as in 5-ESS2-2). The first connection could be made by having students propose solutions regarding threatened ecosystems that are supported by the ocean. The second connection could be made by having students design processes to locate and identify drinkable water. In either case, students should have an opportunity to compare different proposals on the basis of how well they meet given criteria.

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); developing and using models (5-PS1-1 and 5-ESS2-1); using mathematical and computational thinking (5-ESS2-2); engaging in argument from evidence (5-PS2-1); and obtaining, evaluating, and communicating information (5-ESS3-1). Many other practice elements can be used in instruction.

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Bundle Crosscutting Concepts Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the crosscutting concepts of Patterns (5-ESS1-2); Cause and Effect (5-PS2-1); Scale, Proportion, and Quantity (5-PS1-1 and 5-ESS2-2); and Systems and System Models (5-ESS2-1). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*	
Performance Expectations 5-PS1-1 is partially assessable	5-PS1-1. **Develop a model to describe that matter is made of particles too small to be seen.** [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [*Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.*] 5-PS2-1. **Support an argument that the gravitational force exerted by Earth on objects is directed down.** [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [*Assessment Boundary: Assessment does not include mathematical representation of gravitational force.*] 5-ESS2-1. **Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.** [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [*Assessment Boundary: Assessment is limited to the interactions of two systems at a time.*] 5-ESS2-2. **Describe and graph the amounts of saltwater and freshwater in various reservoirs to provide evidence about the distribution of water on Earth.** [*Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.*] 5-ESS3-1. **Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.** 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.**
Example Phenomena	One side of a mountain is often much drier than is the other side. Less smoke comes out of the back of new cars than it did from cars a long time ago.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Use prior knowledge to describe problems that can be solved. Students could *use prior knowledge* [about] ***human activities in everyday life*** [that] ***have had major effects on the land, vegetation, streams, ocean, or air*** *to describe problems that can be solved*. 5-ESS3-1 **Developing and Using Models** ● Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. Students could *develop a diagram or simple physical prototype to convey a proposed process* ***to help protect Earth's resources and environments***. 5-ESS3-1

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Additional Practices Building to the PEs (Continued)	**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 or test a design solution. Students could *make observations to serve as the basis for evidence that* ***the ocean supports a variety of ecosystems and organisms***. 5-ESS2-1 **Analyzing and Interpreting Data** ● Analyze and interpret data to make sense of phenomena using logical reasoning, mathematics, and/or computation. Students could *analyze and interpret data, using computation, to make sense of* [how] ***Earth's major systems interact to affect Earth's surface materials***. 5-ESS2-1 **Using Mathematical and Computational Thinking** ● Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. Students could *decide if qualitative or quantitative data are best to determine if a tool* [that measures] ***the gravitational force of Earth acting on an object*** [meets criteria for success]. 5-PS2-1 **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] ***the ocean influences climate***. 5-ESS2-1 **Engaging in Argument from Evidence** ● Use data to evaluate claims about cause and effect. Students could *use data to evaluate claims about cause and effect* [related to] ***human activities in everyday life and effects on vegetation***. 5-ESS3-1 **Obtaining, Evaluating and Communicating Information** ● Communicate scientific information orally, including various forms of media as well as tables, diagrams, and charts. Students could *use various forms of media to communicate* [that] ***winds and clouds in the atmosphere interact with the landforms to determine patterns of weather***. 5-ESS2-1
Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns can be used as evidence to support an explanation. Students could describe how *patterns can be used as evidence to support the explanation* [that] ***winds and clouds in the atmosphere interact with the landforms to determine patterns of weather***. 5-ESS2-1 **Cause and Effect** ● Cause and effect relationships are routinely identified, tested, and used to explain change. Students could *identify cause and effect relationships* [between] ***the gravitational force of Earth and objects near Earth's surface*** *and use* [the relationships] *to explain change*. 5-ESS2-1

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Additional Crosscutting Concepts Building to the PEs (Continued)	**Systems and System Models** ● A system can be described in terms of its components and their interactions. Students could describe ***Earth's available water*** [as a system and identify] *its components and their interactions*. 5-ESS2-1 and 5-ESS2-2
Additional Connections to Nature of Science	**Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Basic laws of nature are the same everywhere in the universe. Students could describe that the *basic laws of nature* – [such as that] ***matter of any type can be subdivided into particles that are too small to see*** – *are the same everywhere in the universe*. 5-PS1-1 **Science is a Human Endeavor** ● Science affects everyday life. Students could describe how ***the interactions of Earth's major systems*** [can] *affect everyday life*. 5-ESS2-1

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5th Grade – Topic Model - Bundle 4
Stars and the Solar System

This is the fourth bundle of the Fifth Grade Topic 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 far away are the stars?"

Summary

The bundle organizes performance expectations with a focus on helping students build understanding of the Earth's position in the solar system and universe. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, and is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

The idea that the sun is a star that appears larger and brighter than other stars because it is closer (ESS1.A as in 5-ESS1-1) connects to the idea that there are observable patterns – such as different positions of the sun at different times of the day, month, and year – caused by the orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis (ESS1.B as in 5-ESS1-2), as both address the appearance of objects in the sky based on our position relative to other objects in the solar system and universe.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of analyzing and interpreting data (5-ESS1-2) and engaging in argument from evidence (5-ESS1-1). 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 (5-ESS1-2) and Scale, Proportion, and Quantity (5-ESS1-1). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations	5-ESS1-1. **Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.** [*Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).*] 5-ESS1-2. **Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.** [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [*Assessment Boundary: Assessment does not include causes of seasons.*]
Example Phenomena	The constellation Orion appears to move across the sky throughout the night. People can tell the time from a sundial.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Identify scientific (testable) and non-scientific (non-testable) questions. Students *could identify testable and non-testable questions* [about] ***the orbits of Earth around the sun and of the moon around Earth***. 5-ESS1-2

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Additional Practices Building to the PEs (Continued)	**Developing and Using Models** ● Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. Students could *develop a model using an analogy to describe* [that] ***the sun is a star that appears larger and brighter than other stars because it is closer***. 5-ESS1-1 **Planning and Carrying Out Investigations** ● Evaluate appropriate methods and/or tools for collecting data. Students could *evaluate appropriate methods and tools for collecting data* [on the relative] ***distance of stars from Earth***. 5-ESS1-1 **Analyzing and Interpreting Data** ● Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships. Students could *represent data in various graphical displays to reveal patterns that indicate* [that] ***the sun appears larger and brighter than other stars because it is closer***. 5-ESS1-1 **Mathematical and Computational Thinking** ● Organize simple data sets to reveal patterns that suggest relationships. Students could *organize simple data sets to reveal patterns* [such as] ***daily changes in the length and direction of shadows*** *that suggest relationships* [such as between the shadows and] ***the rotation of Earth about an axis***. 5-ESS1-2 **Constructing Explanations and Designing Solutions** ● Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). Students could construct an explanation of observed relationships [between] ***different positions of the sun, moon, and stars*** [at] ***different times of the day, month, and year***. 5-ESS1-2 **Engaging in Argument from Evidence** ● Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. Students could *distinguish among facts, reasoned judgment, and speculation in an explanation* [that] ***the rotation of Earth about an axis causes the different positions of the sun*** [in the sky] ***at different times of the day***. 5-ESS1-2 **Obtaining, Evaluating, and Communicating Information** ● Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts. Students could *communicate scientific information* [about] ***the orbits of Earth around the sun and of the moon around Earth*** *using written formats*. 5-ESS1-2

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Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** ● Cause and effect relationships are routinely identified, tested, and used to explain change. Students could *identify cause and effect relationships* [between] ***the brightness and distance of stars***. 5-ESS1-1 **Systems and System Models** ● A system can be described in terms of its components and their interactions. Students could describe ***the Earth, the sun, and the orbit of the Earth around the sun*** [as] *a system* [that] *can be described in terms of its components and their interactions*. 5-ESS1-2 **Stability and Change** ● Change is measured in terms of differences over time and may occur at different rates. Students could describe that *change is measured in terms of differences over time*, [using examples of the] ***observable patterns*** [caused by] ***the orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis.*** 5-ESS1-2
Additional Connections to Nature of Science	**Science is a Way of Knowing** ● Science is a way of knowing that is used by many people. Students could describe that *science is a way of knowing that is used by many people*, [using as examples ways that people build an understanding of] ***patterns*** [caused by] ***the orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis.*** 5-ESS1-2 **Science is a Human Endeavor** ● Science affects everyday life. Students could describe how our knowledge of ***the rotation of Earth about an axis between its North and South poles*** *affects everyday life*. 5-ESS1-2

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5th Grade Topic Model

Narrative and Rationale: The four bundles in this Grade 5 model all have a particular topical focus. Bundle 1 focuses on physical and chemical changes in matter. Bundle 2 builds on Bundle 1 to focus on energy and matter flows in ecosystems. Bundle 3 extends this study to focus on larger Earth systems and how they affect one another. Bundle 4 shifts the scale to the immensely large, as students build understanding of space systems.

By building familiarity with ideas related to the conservation and particulate nature of matter early on in the year, students are prepared to put this knowledge to work in investigating various life and Earth systems in later bundles. 5-PS1-1 is included in Bundles 2 and 3 to help students make this connection.

Note that the practices and crosscutting concepts described in each bundle are intended as end-of-instructional unit expectations and not curricular designations; additional practices and crosscutting concepts should be used throughout instruction in each bundle.

Bundle 1: How much does air weigh? **~10 weeks**	**Bundle 2:** What are we made out of? **~9 weeks**	**Bundle 3:** Where does rain come from? **~10 weeks**	**Bundle 4:** How far away are the stars? **~6 weeks**
5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen. **5-PS1-2.** Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. **5-PS1-3.** Make observations and measurements to identify materials based on their properties. **5-PS1-4**. Conduct an investigation to determine whether the mixing of two or more substances results in new substances. **3-5-ETS1-3.** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	**5-PS1-1.** Develop a model to describe that matter is made of particles too small to be seen. **5-PS3-1.** Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. **5-LS1-1.** Support an argument that plants get the materials they need for growth chiefly from air and water. **5-LS2-1.** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. **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.	**5-PS1-1.** Develop a model to describe that matter is made of particles too small to be seen. **5-PS2-1.** Support an argument that the gravitational force exerted by Earth on objects is directed down. **5-ESS2-1.** Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. **5-ESS2-2.** Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. **5-ESS3-1.** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. **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.	**5-ESS1-1.** Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth. **5-ESS1-2.** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

1. The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.

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5th Grade Topic Model Flowchart

Bundle 1

PS1.A as found in 5-PS1-1
- Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.

PS1.A as found in 5-PS1-2
- The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.

PS1.A as found in 5-PS1-3
- Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)

PS1.B as found in 5-PS1-4
- When two or more different substances are mixed, a new substance with different properties may be formed.

ETS1.B as found in 3-5-ETS1-3
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.

ETS1.C as found in 3-5-ETS1-3
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Bundle 2

PS1.A as found in 5-PS1-1
- Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.

PS3.D as found in 5-PS3-1
- The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water).

LS1.C as found in 5-PS3-1
- Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion.

LS1.C as found in 5-LS1-1
- Plants acquire their material for growth chiefly from air and water.

LS2.A as found in 5-LS2-1
- 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 plants 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.

LS2.B as found in 5-LS2-1
- 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.

Bundle 3

PS1.A as found in 5-PS1-1
- Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.

PS2.B as found in 5-PS2-1
- The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.

ESS2.A as found in 5-ESS2-1
- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.

ESS2.C as found in 5-ESS2-2
- Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.

ESS3.C as found in 5-ESS3-1
- 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.

ETS1.A as found in 3-5-ETS1-1
- 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.

Bundle 4

ESS1.A as found in 5-ESS1-1
- The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.

ESS1.B as found in 5-ESS1-2
- The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.

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ETS1.B as found in 3-5-ETS1-2

- 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.

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Kindergarten Topic Model - Bundle 1
Pushes and Pulls

This is the first bundle of the Topic Model. Each bundle has connections to the other bundles in the course, as shown in the [Course Flowchart]

Bundle 1 Question: This bundle is assembled to address the questions of "How do objects move and what happens when they interact?"

Summary

The bundle organizes performance expectations around the topic of *pushes and pulls.* Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but recognize that instruction is not limited to the practices and concepts directly linked with any of the bundle performance expectations.

Connections between bundle DCIs

Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it (PS2.A as in K-PS2-1 and K-PS2-2). This concept of motion connects to the idea that a bigger push or pull makes things speed up or slow down more quickly (PS3.C as in K-PS2-1).

The concept of pushing or pulling on an object (PS2.A as in K-PS2-1 and K-PS2-2) also connects to the idea that when objects touch, or collide, they push on one another and can change motion. (PS2.B as in K-PS2-1)

The idea that a bigger push or pull makes things speed up or slow down more quickly (PS3.C as in K-PS2-1) connects to the concept that pushes and pulls can have different strengths and directions (PS2.A as in K-PS2-1 and K-PS2-2).

The concept that people measure weather conditions to describe and record the weather and to notice patterns over time (ESS2.D as in K-ESS2-1) connects to the idea that it is useful to compare and test designs (ETS1.C as in K-2-ETS1-3) through data analysis.

The ideas that a situation that people want to change or create can be approached as a problem to be solved through engineering (ETS1.A as in K-PS2-2) and that, because there is always more than one possible solution to a problem, it is useful to compare and test designs (ETS1.C as in K-2-ETS1-3) could connect to multiple physical science concepts in this bundle. For example, these concepts could connect to the idea that when objects touch or collide, they push on one another and can change motion (PS2.B as in K-PS2-1) through a task in which students are challenged to work in groups to change the direction or speed of a ball with another object and then test and compare each group's solution. Alternatively, these engineering concepts could connect to the idea that a bigger push or pull makes things speed up or slow down more quickly (PS3.C as in K-PS2-1) through a different task in which students are asked to pull or push an object in a certain amount of time and then challenged to do it faster. Students could then compare their solutions and reflect on how their pull or push needed to change in order to move the object faster.

Bundle Science and Engineering Practices

Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of planning and carrying out investigations (K-PS2-1); and analyzing and interpreting data (K-PS2-2, K-ESS2-1, and K-2-ETS1-3). 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 (K-ESS2-1) and Cause and Effect (K-PS2-1 and K-PS2-2). Many other crosscutting concepts elements can be used in instruction.

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All instruction should be three-dimensional.	
Performance Expectations K-ESS2-1 is partially assessable	K-PS2-1. **Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.** **[Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [*Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.*]** K-PS2-2. **Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*** **[Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [*Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.*]** K-ESS2-1. **Use and share observations of local weather conditions to describe patterns over time.** **[Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]** K-2-ETS1-3. **Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**
Example Phenomena	A swing moves as it is pushed. A box pushed across a floor moves quickly with a strong push and slows down as when the pushing becomes weaker.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask and/or identify questions that can be answered by an investigation. Students could *identify questions about* **pushing or pulling on an object** [to] **change the speed or direction of its motion and can start or stop it** *that can be answered by an investigation.* K-PS2-1 and K-PS2-2 **Developing and Using Models** ● Develop and/or use a model to represent amounts, relationships, relative scales (faster/slower), and/or patterns in the natural and designed world(s). Students could *develop or use models to represent relationships and relative scales (e.g., faster and slower)* [of the] ***change [in] speed of an object***. K-PS2-2 **Planning and Carrying Out Investigations** ● Make predictions based on prior experiences. Students could *make predictions* about [how] ***to change the speed or direction of an object with a push or a pull*** *based on prior experiences*. K-PS2-2

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Additional Practices Building to the PEs (Continued)	**Analyzing and Interpreting Data** ● Record information (observations, thoughts, and ideas). Students could *record observations of* [local] ***sunlight, wind, snow or rain, and temperature***. K-ESS2-1 ● Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions and solve problems Students could *use firsthand observations to describe* ***patterns*** [of local weather] ***over time*** *in order to answer scientific questions and solve problems.* K-ESS2-1 **Using Mathematical and Computational Thinking** ● Decide when to use qualitative vs. quantitative data. Students could decide when to use qualitative vs. quantitative data ***to compare and test designs***. K-2-ETS1-3 **Constructing Explanations and Designing Solutions** ● Generate and/or compare multiple solutions to a problem. Students could *generate and compare multiple solutions to a problem* [about using a] ***push or pull*** [to make] ***things speed up or slow down more quickly.*** K-PS2-1 **Engaging in Argument from Evidence** ● Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or retell the main points of the argument. Students could *listen actively to arguments* [about how] **pushing on an object can start or stop its motion** to *indicate agreement of disagreement based on evidence or retell the main points of the argument.* K-PS2-1 and K-PS2-2 **Obtaining, Evaluating, and Communicating Information** ● Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. Students could *describe how specific images (e.g., a diagram showing pushes and pulls) support [the] scientific idea* [that] ***pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.*** K-PS2-1 and K-PS2-2

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Additional Crosscutting Concepts Building to the PEs	**Patterns** ● Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. Students could *observe patterns* ***of motion*** *and use these patterns as evidence* [of how] ***pushing or pulling on an object can change the speed or direction of its motion and can start or stop it***. K-PS2-1 and K-PS2-2 **Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower). Students could use *relative scales (faster and slower, higher and lower, longer and shorter) to compare and describe* [how] ***pushing or pulling on an object can change the speed or direction of its motion and can start or stop it***. K-PS2-1 and K-PS2-2 **Stability and Change** ● Things may change slowly or rapidly. Students could reflect on how ***pushing or pulling on an object can change the speed or direction of its motion*** *slowly or rapidly*. K-PS2-1
Additional Connections to Nature of Science	**Scientific Investigations Use a Variety of Materials** ● Scientific investigations begin with a question. Students could *begin a scientific investigation with a question* [about how] ***pushing or pulling on an object can change the speed or direction of its motion and can start or stop it*** and then reflect on the fact that their *investigation began with a question*. K-PS2-1 and K-PS2-2. **Science is a Way of Knowing** ● Scientific knowledge informs us about the world. Students could describe how *scientific knowledge* [about how] ***pushing or pulling on an object can change the speed or direction of its motion and can start or stop it*** *informs us about the world*. K-PS2-1 and K-PS2-2

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Kindergarten Topic Model - Bundle 2

Living Things

This is the second bundle of the Topic Model. Each bundle has connections to the other bundles in the course, as shown in the Course Flowchart

Bundle 2 Question: This bundle is assembled to address the question of "What is the relationship between the needs of different plants and animals and the places they live?"

Summary

The bundle organizes performance expectations around *the relationship between the needs of different plants and animals and the places they live.* Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but 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 concept that all animals need food and plants need water and light (LS1.C as in K-LS1-1) connects to the idea that living things need water, air, and resources from the land, and they live in places that have the things they need (ESS3.A as in K-ESS3-1). These ideas also connect to the concept that plants and animals (including humans) can change the environment to meet their needs (K-ESS2-2). The concept that humans use natural resources for everything they do (ESS3.A as in K-ESS3-1) connects to the idea that the things 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 (ESS3.C as in K-ESS2-2 and K-ESS3-3)

Weather—which is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time (ESS2.D as in K-ESS2-1)—connects to the idea that living things need water (ESS3.A as in K-ESS3-1) and the idea that plants need light (LS1.C as in K-LS1-1). Also, the concept of the needs of living things connects to weather through making observation to notice and describe patterns as: observations can be used to describe the patterns of what plants and animals need (K-LS1-1) and observations and measurements of weather conditions can be used to describe and record the weather and to notice patterns over time (ESS2.D as in K-ESS2-1). The concepts of weather and patterns of weather (ESS2.D as in K-ESS2-1) also connect to the idea that some kinds of severe weather are more likely than others in a given region (ESS3.B as in K-ESS3-2).

The idea that a situation that people want to change or create can be approached as a problem to be solved through engineering (ETS1.A, K-2-ETS1-1) could connect to several concepts such as plants need water and light to live and grow (LS1.C as in K-LS1-1), humans use natural resources for everything they do (ESS3.A as in K-ESS3-1), or that people can make choices that reduce their impacts on the land, water, air, and other living things (ESS3.C as in K-ESS3-3). These connections could be made through tasks such as designing a solution to the problem of plants in a garden not getting enough water or sunlight or identifying ways to reduce their class' impact on the local water system. Alternatively, students could be challenged with a different design task involving creating products out of natural resources that are abundant in their area. In both tasks, students need an opportunity to reflect on the situation to be changed and that it can be approached as a problem to be solved through engineering.

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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 (K-ESS3-2 and K-2-ETS1-1); developing and using models (K-ESS3-1); analyzing and interpreting data (K-LS1-1 and K-ESS2-1); engaging in argument from evidence (K-ESS2-2); and obtaining, evaluating, and communicating Information (K-ESS3-2 and K-ESS3-3). 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 concepts of Cause and Effect (K-ESS3-2 and K-ESS3-3); and Patterns (K-LS1-1 and K-ESS2-1); Systems and System Models (K-ESS2-2 and K-ESS3-1). Many other crosscutting concepts elements can be used in instruction.

All instruction should be three-dimensional.

Performance Expectations K-ESS2-1 and K-2-ETS1-1 are partially assessable	K-LS1-1. **Use observations to describe patterns of what plants and animals (including humans) need to survive.** **[Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]** K-ESS2-2. **Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.** **[Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.]** K-ESS2-1**. Use and share observations of local weather conditions to describe patterns over time.** **[Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]** K-ESS3-1**. Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.** **[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.]** K-ESS3-2. **Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*** **[Clarification Statement: Emphasis is on local forms of severe weather.]** 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.]** K-2-ETS1-1. **Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**

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Example Phenomena	Animals dig for food and water. Beavers make dams. Forests don't have a lot of grass.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions based on observations to find more information about the natural and/or designed world. Students could *ask questions based on observations to find more information about* ***[how] plants and animals can change their environment.*** K-LS1-1, K-ESS2-2, K-ESS3-3 and K-ESS2-1 **Developing and Using Models** ● Compare models to identify common features and differences. Students could *compare models* ***[about how] living things live in places that have the things they need*** *to identify common features and differences.* K-ESS3-1 **Planning and Carrying Out Investigations** ● Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. Students could *evaluate different ways of observing* ***[local weather] conditions*** *to determine which way can answer a question*. K-ESS2-1 **Analyzing and Interpreting Data** ● Compare predictions (based on prior experiences) to what occurred (observable events). Students could *compare predictions (based on prior experiences)* ***[of local weather] conditions*** *to what occurred (observable events).* ● Use and share pictures, drawings, and/or writings of observations. Students could *use and share pictures, drawings and/or writings of observations* ***[local weather] conditions, [including] severe weather.*** K-ESS2-1 and K-ESS3-2 **Using Mathematical and Computational Thinking** ● Use counting and numbers to identify and describe patterns in the natural and designed world(s). Students could *use counting and use numbers to identify patterns* ***[of local weather] over time***. K-ESS2-1 **Constructing Explanations and Designing Solutions** ● Generate and/or compare multiple solutions to a problem. Students could *generate and/or compare multiple solutions to a problem* related to ***plants need [for] water and light to live and grow.*** K-LS1-1

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Additional Practices Building to the PEs (Continued)	**Engaging in Argument from Evidence** ● Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence. Students could *make a claim about the effectiveness of a solution* ***[intended to] reduce their impact on the land, water, air, [or] other living things*** *which is supported by relevant evidence.* K-ESS3-3 **Obtaining, Evaluating, and Communicating Information** ● Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas. Students could *communicate information with others in oral and/or written forms using models that provide detail about scientific ideas of [how]* ***living things live in places that have the things they need.*** K-ESS3-1
Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** ● Simple tests can be designed to gather evidence to support or refute student ideas about causes. Students could describe how designing a simple test about *[how]* ***plants and animals can change their environment*** could allow them *to gather evidence to support or refute ideas about causes*. K-ESS2-2 **Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower). Students could describe how *relative scales allow them to compare and describe* ***[local weather] conditions and to notice patterns over time.*** K-ESS2-1 **Stability and Change** ● Things may change slowly or rapidly. Students could describe that *things like* ***[local weather] conditions, [including] severe weather,*** *may change slowly or rapidly*. K-ESS2-1 and K-ESS3-2
Additional Connections to Nature of Science	**Scientific Knowledge Is Based on Empirical Evidence** ● Scientists look for patterns and order when making observations about the world Students can explain how *scientists make observations [about and]* ***measure [weather] conditions to describe and record the weather and to*** *look for patterns*. K-ESS2-1 **Science is a Way of Knowing** ● Science knowledge helps us know about the world. Students can describe how *the science knowledge* they are learning like *[how]* ***plants and animals can change their environment*** *helps them know about the world*. K-LS1-1, K-ESS2-2, K-ESS3-3 and K-ESS2-1

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Kindergarten Topic Model - Bundle 3
Patterns and Effects of Sunlight

This is the third bundle of the Topic Model. Each bundle has connections to the other bundles in the course, as shown in the [Course Flowchart]

Bundle 1 Question: This bundle is assembled to address the question of "What can we observe about sunlight?"
Summary The bundle organizes performance expectations around *observations of patterns and effects of sunlight*. Instruction developed from this bundle should always maintain the three-dimensional nature of the standards, but recognize that instruction is not limited to the practices and concepts directly linked with any of the bundle performance expectations. **Connections between bundle DCIs** Sunlight warms Earth's surface. (PS3.B as in K-PS3-1 and K-PS3-2). This concept of sunlight warming Earth's surface connects to the idea that weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time (ESS2.D as in K-ESS2-1). The concept that designs can be conveyed through sketches, drawings, or physical models (ETS1.B as in K-2-ETS1-2) could connect to multiple concepts such as sunlight warms Earth's surface (PS3.B as in K-PS3-1 and K-PS3-2) and weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time (ESS2.D as in K-ESS2-1). These connections could be made through a task in which students must use a representation to convey their design of a structure that will provide a cool place for the students of their school to use when they are outside on a warm day. Students could also engage in a task in which they need to convey the design of an object that would protect them from any negative effects of wind and then reflect on the usefulness of conveying their ideas through representations. **Bundle Science and Engineering Practices** Instruction leading to this bundle of PEs will help students build toward proficiency in elements of the practices of developing and using models (K-2-ETS1-2), planning and carrying out investigations (K-PS3-1), analyzing and interpreting data (K-ESS2-1), and constructing explanations and designing solutions (K-PS3-2). 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 (K-ESS2-1), Cause and Effect (K-PS3-1 and K-PS3-2), and Structure and Function (K-2-ETS1-2). Many other crosscutting concepts elements can be used in instruction. *All instruction should be three-dimensional.*

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Performance Expectations	K-PS3-1. **Make observations to determine the effect of sunlight on Earth's surface. [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.] [*Assessment Boundary: Assessment of temperature is limited to relative measures such as* *warmer/cooler.*]** K-PS3-2**. Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.* [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]** K-ESS2-1. **Use and share observations of local weather conditions to describe patterns over time. [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]** K-2-ETS1-2. **Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.***
Example Phenomena	The amount of sunlight changes throughout a day and across days, weeks, months and the year. The pavement is hotter to the touch in the sunlight than in the shade.
Additional Practices Building to the PEs	**Asking Questions and Defining Problems** ● Ask questions based on observations to find more information about the natural and/or designed world. Students could *ask questions based on observations* ***[of how] sunlight warms Earth's surface*** *to find more information about the natural world.* K-PS3-1 **Developing and Using Models** ● Distinguish between a model and the actual object, process, and/or events the model represents. Students could *distinguish between a model* ***[of a structure that reduces the effect of] sunlight warming Earth's surface*** *and the actual object.* K-PS3-2 ● Develop a simple model based on evidence to represent a proposed object or tool. Students could *develop a simple model based on evidence to represent a proposed* ***[structure that reduces the effect of] sunlight warming Earth's surface.*** K-PS3-2 **Planning and Carrying out Investigations** ● Make predictions based on prior experiences. Students could *make predictions* ***[that] sunlight warms Earth's surface*** *based on prior experiences.* K-PS3-1 and K-PS3-2 ● Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. Students could *make observations of a proposed object to determine if it meets [the] goal* ***[of reducing the effect of] sunlight warming Earth's surface.*** K-PS3-2

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Additional Practices Building to the PEs (Continued)	**Analyzing and Interpreting Data** ● Use and share pictures, drawings, and/or writings of observations. Students could *use and share pictures of observations* ***[of structures that reduces the effect of] sunlight warming Earth's surface.*** K-PS3-1 and K-PS3-2 **Using Mathematical and Computational Thinking** ● Use counting and numbers to identify and describe patterns in the natural and designed world(s). Students could *use counting and use numbers to identify and describe patterns* ***[of local weather] over time***. K-ESS2-1 **Constructing Explanations and Designing Solutions** ● Generate and/or compare multiple solutions to a problem. Students can *generate and compare multiple solutions to* ***a problem [related to local] weather or sunlight warming Earth's surface.*** K-ESS2-1, K-PS3-1, and K-PS3-2 **Engaging in Argument from Evidence** ● Analyze why some evidence is relevant to a scientific question and some is not. Students could *analyze why some evidence* ***[about local] weather*** *is relevant to a scientific question and some is not.*K-ESS2-1 ● Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence. Students could *make a claim about the effectiveness of an object* ***[intended to reduce the effect of] sunlight warming Earth's surface.*** K-PS3-2 **Obtaining, Evaluating, and Communicating Information** ● Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. Students could *describe how specific images (e.g., a diagram showing how a structure works) support a scientific or engineering idea* ***[about how] sunlight warms Earth's surface [or a structure can reduce this effect].*** K-PS3-1 and K-PS3-2 ● Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas. Students could *communicate information or design ideas* ***[about how] sunlight warms Earth's surface [or a structure can reduce this effect]*** *with others in written forms using drawings that provide detail about scientific ideas or design ideas.* K-PS3-1 and K-PS3-2

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Additional Crosscutting Concepts Building to the PEs	**Cause and Effect** ● Simple tests can be designed to gather evidence to support or refute student ideas about causes. Students could describe that they *can design a simple test* ***[about] sunlight's [role in] warming Earth's surface*** *to gather evidence to support or refute their ideas about causes.* K-PS3-1 **Scale, Proportion, and Quantity** ● Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower). Students could describe that *relative scales allow them to compare and describe* ***[the effects of] sunlight [on] Earth's surface.*** K-ESS2-1 and K-PS3-1 **Stability and Change** ● Things may change slowly or rapidly. Students could describe that *things like* ***local weather conditions*** *may change slowly or rapidly.* K-ESS2-1
Connections to Nature of Science	**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Scientists search for cause and effect relationships to explain natural events. Students could describe that *scientists search for cause and effect relationships,* ***like sunlight [causing] Earth's surface [to] warm****, to explain natural events.* K-PS3-1 **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Many events are repeated. Students could describe and reflect on the idea *that many events [such as the]* **sunlight, wind, snow or rain, and temperature in a particular region at a particular time** *repeat.* K-ESS2-1

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Kindergarten Topic Model

Narrative and Rationale: The three bundles in this Kindergarten model are characterized by the overarching ideas that weather, sunlight, and the needs of living things affect us daily—ideas that apply to the physical, life, and Earth and space sciences, as well as engineering.

Bundle 1 centers on a guiding question about pushes and pulls on objects and their effects. Bundle 2 centers on a guiding question about the needs of plants and animals for food, water, and sunlight to survive. Bundle 3 centers on a guiding question about the patterns and effects of sunlight. While this framework is arranged by topic, the study of weather occurs throughout the year, over time.

In Kindergarten students begin to build their understanding of the Crosscutting Concepts (CCCs) of patterns and the relationship between cause and effect in a logical progression over time. This model also introduces students to the Science and Engineering Practices (SEPs). It places special emphasis on planning and carrying out investigations, analyzing and interpreting data, engaging in argument from evidence, and constructing explanations and designing solutions. However, additional SEPs should be used throughout instruction. The SEPs contribute to students' understanding of both the CCCs and the Disciplinary Core Ideas (DCIs) they explore in Kindergarten. Students become familiar with SEPs over the course of the year, and the level of sophistication at which they are able to engage in the SEPs increases over time.

Bundle 1: How do objects move and what happens when they interact? **~4 weeks**	**Bundle 2:** What is the relationship between the needs of different plants and animals and the places they live? **~18 weeks**	**Bundle 3:** What can we observe about sunlight? **~14 weeks**
K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. **K-PS2-2.** Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.* **K-ESS2-1.** Use and share observations of local weather conditions to describe patterns over time.[1] **K-2-ETS1-3.** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	**K-LS1-1.** Use observations to describe patterns of what plants and animals (including humans) need to survive. **K-ESS2-1.** Use and share observations of local weather conditions to describe patterns over time.[1] **K-ESS2-2**. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. **K-ESS3-1.** Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live. **K-ESS3-2.** Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to severe weather. **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.* **K-2-ETS1-1.** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.[1]	**K-PS3-1.** Make observations to determine the effect of sunlight on Earth's surface. **K-PS3-2.** Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.* **K-ESS2-1.** Use and share observations of local weather conditions to describe patterns over time. **K-2-ETS1-2.** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

1. The bundle only includes part of this PE; the PE is not fully assessable in a unit of instruction leading to this bundle.

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Kindergarten Topic Model Course Flowchart

Bundle 1

PS2.A as found in K-PS2-1 and K-PS2-2
- Pushes and pulls can have different strengths and directions
- Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it

PS2.B as found in K-PS2-1
- When objects touch or collide, they push on one another and can change motion.

PS3.C as found in K-PS2-1
- A bigger push or pull makes things speed up or slow down more quickly.

ESS2.D as found in K-ESS2-1
- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather.

ETS1.A as found in K-PS2-2
- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.

ETS1.C as found in K-2-ETS1-3
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

Bundle 2

LS1.C as found in K-LS1-1
- All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.

ESS2.D as found in K-ESS2-1
- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.

ESS2.E as found in K-ESS2-2
- Plants and animals can change their environment.

ESS3.A as found in K-ESS3-1
- 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.

ESS3.B as found in K-ESS3-2
- Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events.

ESS3.C as found in K-ESS2-2 and K-ESS3-3
- 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.

ETS1.A as found in K-ESS3-2 and K-2-ETS1-1
- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.

ETS1.B as found in K-ESS3-3
- 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.

Bundle 3

PS3.B as found in K-PS3-1 and K-PS3-2
- Sunlight warms Earth's surface.

ESS2.D as found in K-ESS2-1
- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.

ETS1.B as found in K-2-ETS1-2
- 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.

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