Grade 4: Bundle 4

Bundle 4

Communicating Using Wave Energy

Performance Expectations		
4-PS4-1, 4-PS4-2, 4-PS4-3, 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models **Constructing Explanations and Designing Solutions**	**PS4.A (2): Wave Properties** **PS4.A (3): Wave Properties** **PS4.B (3): Electromagnetic Radiation** **PS4.C (2): Information Technologies and Instrumentation** **ETS1.C (2): Optimizing the Design Solution**	**Patterns** **Cause and Effect**

Bundle 4: Communicating Using Wave Energy is composed of four scopes. Each of these scopes provides the students with an opportunity to build their knowledge and start forming ideas that will help them complete their mission at the end of this bundle and build toward a complete answer to their Anchoring Phenomena question. Students will begin by being introduced to their Anchoring Phenomena, which introduces them to their bundle mission of creating an emergency signaling system and showing how it interacts with the eye or ear.

The students will then move through multiple scopes in which they will learn the following concepts:

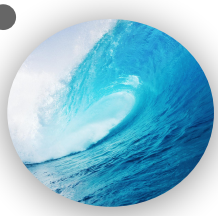
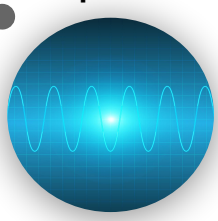
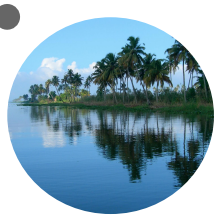
- Waves are regular patterns of motion.
- Waves differ in amplitude (height) and wavelength (distance between waves).
- We see objects because light is reflected off the objects and enters our eyes.
- Digitized information can travel over long distances by being converted from voice or text to digitized form and back to voice or text.

The students will also engage in the Science and Engineering Practices and Crosscutting Concepts listed above throughout the scopes in this bundle.

Grade 4: Bundle 4 Snapshot

Anchoring Phenomena: What system using light or sound to communicate could reach people over a distance?

Mission Goal: The students' mission is to create an emergency signaling system and show how it interacts with the eye or ear.

Scope	Investigative Phenomena	Instructional Focus	Connection to Bundle Mission
Motion of Waves 	How do waves cause objects to move?	Understand what waves do and how they move.	What forms of energy could be transferred using waves?
Wavelength and Amplitude 	How do amplitude and wavelength affect the motion of objects?	Know the differences between wavelength and amplitude.	What do you think would happen if a sound wave had a very high amplitude?
Light Reflection 	How are we able to see things?	Explain how we see objects and what the best type of surface for light to be reflected is.	How could light be used as a signal?
Information Technologies 	What kinds of communication technology are used in everyday life?	Describe how high-tech devices send information. Learn about codes and whether or not they have anything in common.	What type of code might you use to transmit information?

Bundle 4: Scope 1

Motion of Waves

Three-Dimensional Learning

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.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)	**PS4.A (2): Wave Properties** 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; it does not move in the direction of the wave except when the water meets the beach.	**Patterns** Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)

Disciplinary Core Ideas

• **PS4.A (2): Wave Properties** 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; it does not move in the direction of the wave except when the water meets the beach.	• All the elements found in the Motion of Waves scope are designed to address the subelement for PS4.A (2). • Students begin the scope by working with a metal spring to observe wave motion. • Students go on to explore how waves are created and their pattern of movement.

Science and Engineering Practices

• **Developing and Using Models** Develop a model using an analogy, example, or abstract representation to describe a scientific principle.	• In the Hook, students observe the model of a spring and answer questions about patterns they notice. • In Explore 1, students work together to create two models of waves, similar to the waves that can be observed in an ocean.

Crosscutting Concepts

• **Patterns** Similarities and differences in patterns can be used to sort and classify natural phenomena.	• In Explore 1, students will analyze their model by answering questions about the patterns they noticed in the waves they created.

The above illustrates how we integrate the three dimensions through the scope. As we know that opportunities naturally occur to model other Crosscutting Concepts and Science and Engineering Practices in many ways, we only call out the ones directly aligned by the NGSS Framework here.

Bundle 4:
Scope 1

Motion of Waves

Prior Knowledge and Progression

By the end of Grade 2, students should know that 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; it does not move in the direction of the wave—observe, for example, a bobbing cork or seabird—except when the water meets the beach. Sound can make matter vibrate, and vibrating matter can make sound.

Category	K-2	3-5	Middle School	High School
PS4.A Wave Properties	Sound can make matter vibrate, and vibrating matter can make sound.	Waves are regular patterns of motion, which can be made in water by disturbing the surface. Waves of the same type can differ in amplitude and wavelength. Waves can make objects move.	A simple wave model has a repeating pattern with a specific wavelength, frequency, and amplitude, and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena including sound and light. Waves can transmit energy.	The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. Waves can be used to transmit information and energy.

Scope Overview

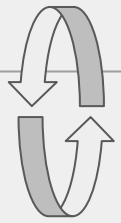
This scope begins with the introduction to the student Investigative Phenomena in the Engage section. Students will use their Graphic Organizers as their note-taking devices to record the information gained in each section as they begin to form a conceptual model of the content as they move through the scope. The teacher uses the Accessing Prior Knowledge (APK) element to help pull out students' current knowledge levels as well as any preconceptions they have before beginning the scope. In this Motion of Waves APK, students read statements about how waves affect an object and must choose and discuss the statement they agree with most. This will help uncover possible preconceptions students have before beginning the lesson. Teachers can keep any such preconceptions in mind as they move through the scope. The final element in the Engage section is the Hook. Here, students have their first experience with the content. They will build on their knowledge as they continue moving through the scope.

Students then dig deeper into the content through the Explore activity. In Explore 1, students observe how waves are created and their pattern of movement. Explore 1 includes a formative CER assessment to help the teacher gauge student understanding at that point. By the end of the Engage and Explore activities, students should be able to develop a model of waves to describe patterns in terms of amplitude and wavelength and how waves can cause objects to move.

Students will continue to refine their knowledge of the content as they move through the elements in the Explain and Elaborate sections. Teachers can use any or all of the provided elements. We know that most classrooms have limited time, so teachers should choose the Explain and Elaborate elements that best fit the needs of their students. The teacher can then formally assess the students' understanding by using any of the three summative assessments provided in the Evaluate section. If the students require additional help gaining proficiency with the content, resources can be found in the Intervention section. Students who have achieved mastery of the concept can move over to the Acceleration pieces.

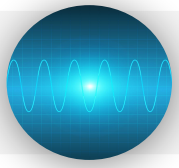
Documents are available to help the teacher assess the CCCs and SEPs taught in this scope. These are located in the Home section of each scope. Question prompts or artifacts to look for throughout the scope are provided, as well as sample answers to help the teacher plot students' understanding on the rubric. The information that is gathered on these forms can be used to track progress on the CCC and SEP Segment Inventory of Skills found in each bundle and on the CCC and SEP Yearlong Inventory of Skills document located in the Teacher Toolbox.

Scope Snapshot: Motion of Waves

Section	Element	Description
ENGAGE	Investigative Phenomena	Why isn't the ocean buoy trying to float away?
	APK	Students must choose and discuss the statement they agree with most.
	Graphic Organizer	The Graphic Organizer is a note-taking device students can use as they move through this scope.
	Hook	Students observe wave motion by working with a metal spring.
EXPLORE 	Explore 1: Activity	**Disturbing Water** Students observe how waves are created and their pattern of movement.
EXPLAIN	Picture Vocabulary	A slide presentation of important vocabulary terms along with a picture and definition as well as a vocabulary activity in which students use vocabulary words to create an illustration
	STEMscopedia	Expository text to support science content, which can be used as reference material in conjunction with Linking Literacy activities
	Linking Literacy	Strategies to help students comprehend the informational text in the STEMscopedia, including pre-, during-, and post-reading activities
	Communicate Science	A class activity in which students use different forms of communication to discuss scientific topics connected to the content of this scope
	Concept Review Game	An interactive game that can be played as a class or individually to help students review the science concepts in the module
	Content Connections Video	An inquiry video that engages students and provides meaning

ELABORATE	Math Connections	A practice that uses grade-level-appropriate math activities to address the concept
	Reading Science: Three Lexile Levels (A, B, and C)	**Making Waves** This provides additional expository text that supports real-world application of the content, including five to eight comprehension questions. Teachers can choose which level to assign each student based on students' reading Lexile levels.
	Science Today: Watch It!	**Waves** Students explore real-world connections and applications of science content through interactions with an engaging video provided by the Associated Press.
	Career Connections	**Audio Engineer** A video that introduces students to STEM careers and the 21st Century Skills needed to succeed in those fields
	Scientist Spotlight	**Jaron Lanier** – Computer Scientist
	PhET: Simulation Practice	**Wave on a String** Explore the wonderful world of waves! Observe a string vibrate in slow motion. Wiggle the end of the string and make waves, or adjust the frequency and amplitude of an oscillator.
EVALUATE	Claim-Evidence-Reasoning	Kim and Elizabeth are out on a deep-sea fishing trip. Off in the distance, they see a floating buoy. There are some large waves out there, and they wonder if the waves will make the buoy float toward their boat so they can get a better look. Write a scientific explanation describing whether the buoy will move closer to Kim and Elizabeth.
	Open-Ended Response Assessment	A short-answer and essay assessment to evaluate students' mastery of the concept
	Multiple Choice Assessment	A standards-based assessment designed to gauge students' understanding of the science concept by using their selections of the best possible answers from a list of choices
INTERVENTION	Guided Practice	Students use a rope to show the motion of waves.
	Independent Practice	A short-answer and essay assessment to evaluate students' mastery of the concept
	Concept Attainment Quiz	A standards-based assessment designed to gauge students' understanding of the science concept by using their selections of the best possible answers from a list of choices
ACCELERATION	Extensions	A set of ideas and activities that can help further elaborate on the concept
	Books on Topic	A list of trade books for the scope
	Science Art	Students write a haiku poem about waves.

Bundle 4: Scope 2



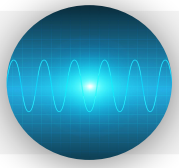
Wavelength and Amplitude

Three-Dimensional Learning

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. **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.** **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.**

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)	**PS4.A (3): Wave Properties** Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between the wave peaks).	**Patterns** Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)

Bundle 4: Scope 2



Wavelength and Amplitude

Three-Dimensional Learning

Disciplinary Core Ideas	
• **PS4.A (3): Wave Properties** Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between the wave peaks).	• All the elements found in the Wavelength and Amplitude scope are designed to address the subelement for PS4.A (2). • Students begin the scope by exploring the movement of waves, using oatmeal. • Students go on to explore the differences between wavelength and amplitude, how these characteristics affect the motion of objects, and how to construct a simple seismograph.
Science and Engineering Practices	
• **Developing and Using Models** Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)	• In the Hook, students use oatmeal as a model to explore the movement of waves. • In Explore 1, students use a model to observe amplitude and wavelength. • In Explore 2, students work collaboratively to make various wavelengths and amplitudes in water. • In Explore 3, students construct a simple seismograph.
Crosscutting Concepts	
• **Patterns** Similarities and differences in patterns can be used to sort and classify natural phenomena.	• In Explore 1, students analyze their models to answer questions about patterns they notice.

ETS (Engineering, Technology and the Application of Science)	
• 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. • 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.	• In Explore 3, students use the scientific knowledge they have gained as well as the 21st Century Skill of collaboration to design and construct a simple seismograph.

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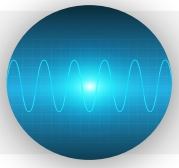
Bundle 4: Scope 2



Wavelength and Amplitude

Prior Knowledge and Progression

By the end of Grade 2, students should know that 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. It does not move in the direction of the wave, except when the water meets the beach. Observe, for example, a bobbing cork or seabird. Sound can make matter vibrate, and vibrating matter can make sound.

Category	K-2	3-5	Middle School	High School
PS4.A Wave Properties	Sound can make matter vibrate, and vibrating matter can make sound.	Waves are regular patterns of motion, which can be made in water by disturbing the surface. Waves of the same type can differ in amplitude and wavelength. Waves can make objects move.	A simple wave model has a repeating pattern with a specific wavelength, frequency, and amplitude, and mechanical waves need a medium through which they are transmitted. This model can explain many phenomena including sound and light. Waves can transmit energy.	The wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium through which it is passing. Waves can be used to transmit information and energy.

Scope Overview

This scope begins with the introduction to the student Investigative Phenomena in the Engage section. Students will use their Graphic Organizers as their note-taking devices to record the information gained in each section as they begin to form a conceptual model of the content as they move through the scope. The teacher uses the Accessing Prior Knowledge (APK) element to help pull out students' current knowledge levels as well as any preconceptions they have before beginning the scope. In this Wavelength and Amplitude APK, students decide which wave shown has the longest wavelength. This will help uncover possible preconceptions students have before beginning the lesson. Teachers can keep any such preconceptions in mind as they move through the scope. The final element in the Engage section is the Hook. Here, students have their first experience with the content. They will build on their knowledge as they continue moving through the scope.

Students then dig deeper into the content through the three Explore activities. In Explore 1, they use a model to observe amplitude and wavelength. In Explore 2, students investigate how wavelength and amplitude affect the motion of objects. In Explore 3, students follow the engineering and design process to design and construct a simple seismograph. Explore 1 includes a formative CER assessment to help the teacher gauge student understanding at that point. By the end of the Engage and Explore activities, students should be able to develop a model of waves to describe patterns in terms of amplitude and wavelength and how waves can cause objects to move.

Students will continue to refine their knowledge of the content as they move through the elements in the Explain and Elaborate sections. Teachers can use any or all of the provided elements. We know that most classrooms have limited time, so teachers should choose the Explain and Elaborate elements that best fit the needs of their students. The teacher can then formally assess the students' understanding by using any of the three summative assessments provided in the Evaluate section. If the students require additional help gaining proficiency with the content, resources can be found in the Intervention section. Students who have achieved mastery of the concept can move over to the Acceleration pieces.

Documents are available to help the teacher assess the CCCs and SEPs taught in this scope. These are located in the Home section of each scope. Question prompts or artifacts to look for throughout the scope are provided, as well as sample answers to help the teacher plot students' understanding on the rubric. The information that is gathered on these forms can be used to track progress on the CCC and SEP Segment Inventory of Skills found in each bundle and on the CCC and SEP Yearlong Inventory of Skills document located in the Teacher Toolbox.

Scope Snapshot: Wavelength and Amplitude

Section	Element	Description
ENGAGE	Investigative Phenomena	How do we know how strong an earthquake is?
	APK	Students decide which wave shown has the longest wavelength.
	Graphic Organizer	The Graphic Organizer is a note-taking device students can use as they move through this scope.
	Hook	Students explore the movement of waves, using oatmeal.
EXPLORE	Explore 1: Activity	**Wave Challenge** Students use a model to observe amplitude and wavelength.
	Explore 2: Activity	**Waves and Motion** Students investigate how wavelength and amplitude affect the motion of objects.
	Explore 3: Engineering Solution	**Waves in the Earth** Students use the scientific knowledge they have gained as well as the 21st Century Skill of collaboration to design and construct a simple seismograph.
 EXPLAIN	Picture Vocabulary	A slide presentation of important vocabulary terms along with a picture and definition, as well as a vocabulary activity in which students use vocabulary words to create an illustration
	STEMscopedia	Expository text to support science content, which can be used as reference material in conjunction with Linking Literacy activities
	Linking Literacy	Strategies to help students comprehend the informational text in the STEMscopedia, including pre-, during-, and post-reading activities
	Communicate Science	Students use different forms of communication to discuss scientific topics connected to the content of this scope.
	Concept Review Game	An interactive game that can be played as a class or individually to help students review the science concepts in the module
	Content Connections Video	An inquiry video that engages students and provides meaning

ELABORATE	Math Connections	A practice that uses grade-level-appropriate math activities to address the concept
	Reading Science: Three Lexile Levels (A, B, and C)	**Waves All Around** This provides additional expository text that supports real world application about the content, which includes five to eight comprehension questions. Teachers can choose which level to assign each student based on students' reading Lexile levels.
	Science Today: Watch It!	**Measuring Waves** Students explore real-world connections and applications of science content through interactions with an engaging video provided by the Associated Press.
	Career Connections	**Audio Engineer** A video that introduces students to STEM careers and the 21st century skills needed to succeed in those fields
	Scientist Spotlight	**Colin Turnbull** – Anthropologist
	PhET: Simulation Practice	**Wave on a String** Explore the wonderful world of waves! Observe a string vibrate in slow motion. Wiggle the end of the string and make waves, or adjust the frequency and amplitude of an oscillator.
EVALUATE	Claim-Evidence-Reasoning	Elizabeth is watching the news about an earthquake that occurred in California. Elizabeth wants to send donations to the city that most likely received the most damage. Each line on the map below shows a peak of the waves sent out by the earthquake, and the center of the circles is the epicenter. The thicker the line is, the higher the amplitude is. Using scientific reasoning, explain which of the cities on the map Elizabeth should send her donations to.
	Open-Ended Response Assessment	A short-answer and essay assessment to evaluate students' mastery of the concept
	Multiple Choice Assessment	A standards-based assessment designed to gauge students' understanding of the science concept by using their selections of the best possible answers from a list of choices
INTERVENTION	Guided Practice	Students use a metal coil to model wavelength and amplitude.
	Independent Practice	A short-answer and essay assessment to evaluate students' mastery of the concept
	Concept Attainment Quiz	A standards-based assessment designed to gauge students' understanding of the science concept by using their selections of the best possible answers from a list of choices
ACCELERATION	Extensions	A set of ideas and activities that can help further elaborate on the concept
	Books on Topic	A list of trade books for the scope
	Science Art	Students draw waves of different wavelengths and amplitudes to create patterns on lined paper.

Bundle 4: Scope 3

Light Reflection

Three-Dimensional Learning

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. **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-ETS1-3 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.**

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Develop a model to describe phenomena. (4-PS4-2)	**PS4.B (3): Electromagnetic Radiation** An object can be seen when light reflected from its surface enters the eyes.	**Cause and Effect** Cause and effect relationships are routinely identified. (4-PS4-2)

Bundle 4: Scope 3

Light Reflection

Three-Dimensional Learning

Disciplinary Core Ideas	
• **PS4.B (3): Electromagnetic Radiation** An object can be seen when light reflected from its surface enters the eyes.	• All the elements found in the Light and Reflection scope are designed to address the subelement for PS4.B (3). • Students begin the scope by observing how the addition of light in a dark room makes it easier to see writing on the board. • Students go on to explore how light travels, how light makes it easier to see objects, and how to construct a periscope.
Science and Engineering Practices	
• **Developing and Using Models** Develop a model to describe phenomena. (4-PS4-2)	• In Explore 1, students think about how objects in real life compare to the penlight-and-mirrors model they made during their investigation. • In Explore 3, students construct a periscope model.
Crosscutting Concepts	
• **Cause and Effect** Cause and effect relationships are routinely identified. (4-PS4-2)	• In the Hook, students observe how the addition of light in a dark room makes it easier to see writing on the board. • In Explore 1, students explain how mirrors affect the path of light. • In Explore 2, students observe how different amounts of light affect the ability to see an object.

ETS (Engineering, Technology and the Application of Science)	
• 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-ETS1-3 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.	• In Explore 3, students use the scientific knowledge they gained as well as the 21st Century Skill of collaboration to design and construct a model to use to see an object hidden behind a wall.

The above illustrates how we integrate the three dimensions through the scope. As we know that opportunities naturally occur to model other Crosscutting Concepts and Science and Engineering Practices in many ways, we only call out the ones directly aligned by the NGSS Framework here.

Bundle 4: Scope 3

Light Reflection

Prior Knowledge and Progression

By the end of Grade 2, students should know that objects can be seen only when light is available to illuminate them. Very hot objects give off light (e.g., a fire, the Sun). 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 (i.e., on the other side of the light source), where the light cannot reach. Mirrors and prisms 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.)

Category	K-2	3-5	Middle School	High School
PS4.B Electromagnetic Radiation	Objects can be seen only when light is available to illuminate them.	Object can be seen when light reflected from their surface enters our eyes.	The construct of a wave is used to model how light interacts with objects.	Both an electromagnetic wave model and a photon model explain features of electromagnetic radiation broadly and describe common applications of electromagnetic radiation.

Scope Overview

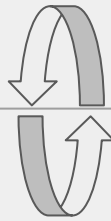
This scope begins with the introduction to the student Investigative Phenomena in the Engage section. Students will use their Graphic Organizers as their note-taking devices to record the information gained in each section as they begin to form a conceptual model of the content as they move through the scope. The teacher uses the Accessing Prior Knowledge (APK) element to help pull out students' current knowledge levels as well as any preconceptions they have before beginning the scope. In this Light and Reflection APK, students will read statements about whether or not a flashlight is needed to see an object, choose the statement they agree with most, and explain their reasoning. This will help uncover possible preconceptions students have before beginning the lesson. Teachers can keep any such preconceptions in mind as they move through the scope. The final element in the Engage section is the Hook. Here, the students have their first experience with the content. They will build on their knowledge as they continue moving through the scope.

Students then dig deeper into the content through the three Explore activities. In Explore 1, they investigate reflection and how light travels to reflect a light beam around the room as they attempt to hit a bull's-eye in the least amount of time. In Explore 2, students observe objects with and without light to determine which is easier to see. In Explore 3, students design and construct a model to use to see an object hidden behind a wall. Explores 1 and 2 include a formative CER assessment to help the teacher gauge student understanding at that point. By the end of the Engage and Explore activities, students should be able to develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

Students will continue to refine their knowledge of the content as they move through the elements in the Explain and Elaborate sections. Teachers can use any or all of the provided elements. We know that most classrooms have limited time, so teachers should choose the Explain and Elaborate elements that best fit the needs of their students. The teacher can then formally assess the students' understanding by using any of the three summative assessments provided in the Evaluate section. If the students require additional help gaining proficiency with the content, resources can be found in the Intervention section. Students who have achieved mastery of the concept can move over to the Acceleration pieces.

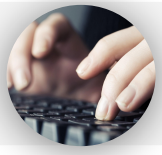
Documents are available to help the teacher assess the CCCs and SEPs taught in this scope. These are located in the Home section of each scope. Question prompts or artifacts to look for throughout the scope are provided, as well as sample answers to help the teacher plot students' understanding on the rubric. The information that is gathered on these forms can be used to track progress on the CCC and SEP Segment Inventory of Skills found in each bundle and on the CCC and SEP Yearlong Inventory of Skills document located in the Teacher Toolbox.

Scope Snapshot: Light Reflection

Section	Element	Description
ENGAGE	Investigative Phenomena	How are we able to see things?
	APK	Students choose the statement they agree with most and explain their reasoning.
	Graphic Organizer	The Graphic Organizer is a note-taking device students can use as they move through this scope.
	Hook	Students observe how the addition of light in a dark room makes it easier to see writing on the board.
EXPLORE	Explore 1: Activity	**Bull's-Eye!** Students investigate reflection and how light travels to reflect a light beam around the room as they attempt to hit a bull's-eye in the least amount of time.
	Explore 2: Activity	**Let There Be Light!** Students observe objects with and without light to determine which is easier to see.
	Explore 3: Engineering Solution	**Periscope** Students use the scientific knowledge they gained as well as the 21st Century Skill of collaboration to design and construct a model to use to see an object hidden behind a wall.
	Picture Vocabulary	A slide presentation of important vocabulary terms along with a picture and definition as well as a vocabulary activity in which students use vocabulary words to create an illustration
	STEMscopedia	Expository text to support science content, which can be used as reference material in conjunction with Linking Literacy activities
EXPLAIN	Linking Literacy	Strategies to help students comprehend the informational text in the STEMscopedia, including pre-, during-, and post-reading activities
	Communicate Science	Students use different forms of communication to discuss scientific topics connected to the content of this scope.
	Concept Review Game	An interactive game that can be played as a class or individually to help students review the science concepts in the module
	Content Connections Video	An inquiry video that engages students and provides meaning

ELABORATE	Math Connections	A practice that uses grade-level-appropriate math activities to address the concept
	Reading Science: Three Lexile Levels (A, B, and C)	**Rainbows** This provides additional expository text that supports real-world application of the content, including five to eight comprehension questions. Teachers can choose which level to assign each student based on students' reading Lexile levels.
	Science Today: Watch It!	**Lights** Students explore real-world connections and applications of science content through interactions with an engaging video provided by the Associated Press.
	Career Connections	**Eye Doctor** A video that introduces students to STEM careers and the 21st Century Skills needed to succeed in those fields
	Scientist Spotlights	**Thomas Edison** – Electrical Engineer and Inventor **C. V. Raman** – Physicist
	PhET: Simulation Practice	**Bending Light** Explore bending of light between two mediums with different indices of refraction. See how changing from air to water to glass changes the bending angle. Play with prisms of different shapes and make rainbows.
EVALUATE	Claim-Evidence-Reasoning	Jarrel and Tony were on a cave tour during their vacation. They used flashlights to look at a stream of water flowing down one of the cave walls. Jarrel moved a little closer to get a better look and tripped over a rock. He said, "Ouch! Where did that rock come from? I couldn't see it!" Use scientific reasoning to explain why Jarrel did not see the rock.
	Open-Ended Response Assessment	A short-answer and essay assessment to evaluate students' mastery of the concept
	Multiple Choice Assessment	A standards-based assessment designed to gauge students' understanding of the science concept by using their selections of the best possible answers from a list of choices
INTERVENTION	Guided Practice	Students work in pairs to determine the best position to see their partner in the mirror.
	Independent Practice	A short-answer and essay assessment to evaluate students' mastery of the concept
	Concept Attainment Quiz	A standards-based assessment designed to gauge students' understanding of the science concept by using their selections of the best possible answers from a list of choices
ACCELERATION	Extensions	A set of ideas and activities that can help further elaborate on the concept
	Books on Topic	A list of trade books for the scope
	Science Art	Students draw self-portraits of their eyes, using mirrors to see their reflections.

Bundle 4: Scope 4



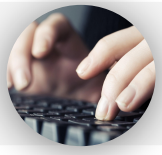
Information Technologies

Three-Dimensional Learning

Performance Expectations
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. **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.** **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.**

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)	**PS4.C (2): Information Technologies and Instrumentation** 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.C (2): Optimizing the Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (secondary to 4-PS4-3)	**Patterns** Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)

Bundle 4: Scope 4



Information Technologies

Three-Dimensional Learning

Disciplinary Core Ideas

• **PS4.C (2): Information Technologies and Instrumentation** 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.C (2): Optimizing the Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (secondary to 4-PS4-3)	• All the elements found in the Information Technologies scope are designed to address the subelements for PS4.C (2) and ETS1.C (2). • Students begin the scope by learning that information can be sent in different ways by using a code system and a drum. • Students go on to explore how codes can be used to decipher messages, how information is transferred using technology, and how to create their own code.

Science and Engineering Practices

• **Constructing Explanations and Designing Solutions** Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)	• In the Hook, students explain how drums can be used to convey messages. • In Explore 2, students explain why we use remotes for televisions. • In Explore 3, students design and create their own codes. They have the opportunity to ask and answer questions of and from their peers.

Crosscutting Concepts

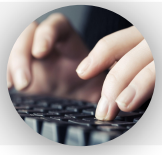
• **Patterns** Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)	• In Explore 1, students describe similarities and differences in patterns used to transfer information using codes. • In Explore 3, students explain how the various codes that were shared are used to transmit information.

ETS (Engineering, Technology and the Application of Science)

• 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. • 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.	• In Explore 3, students use the scientific knowledge they have gained as well as the 21st Century Skill of collaboration to design and create their own code.

The above illustrates how we integrate the three dimensions through the scope. As we know that opportunities naturally occur to model other Crosscutting Concepts and Science and Engineering Practices in many ways, we only call out the ones directly aligned by the NGSS Framework here.

Bundle 4: Scope 4



Information Technologies

Prior Knowledge and Progression

By the end of Grade 2, students should know that people use their senses to learn about the world around them. Their eyes detect light, their ears detect sound, and they can feel vibrations by touch. People also use a variety of devices to communicate (send and receive information) over long distances.

Category	K-2	3-5	Middle School	High School
PS4.C Information Technologies and Instrumentation	People use devices to send and receive information.	Patterns can encode, send, receive and decode information.	Waves can be used to transmit digital information. Digitized information is comprised of a pattern of 1s and 0s.	Large amounts of information can be stored and shipped around as a result of being digitized.

Scope Overview

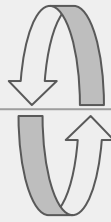
This scope begins with the introduction to the student Investigative Phenomena in the Engage section. Students will use their Graphic Organizers as their note-taking devices to record the information gained in each section as they begin to form a conceptual model of the content as they move through the scope. The teacher uses the Accessing Prior Knowledge (APK) element to help pull out students' current knowledge levels as well as any preconceptions they have before beginning the scope. In this Information Technologies APK, students read statements about how emails are sent, choose the statement they agree with most, and explain their reasoning. This will help uncover possible preconceptions students have before beginning the lesson. Teachers can keep any such preconceptions in mind as they move throughout the scope. The final element in the Engage section is the Hook. Here, the students have their first experience with the content. They will build on their knowledge as they continue moving through the scope.

Students then dig deeper into the content through the three Explore activities. In Explore 1, they use codes to decipher messages and compare the similarities and differences of those codes. In Explore 2, students explore and understand how information is transferred using various forms of technology. In Explore 3, students use the engineering design process to design and create their own code. Explore 1 includes a formative CER assessment to help the teacher gauge student understanding at that point. By the end of the Engage and Explore activities, students should be able to generate and compare multiple solutions that use patterns to transfer information.

Students will continue to refine their knowledge of the content as they move through the elements in the Explain and Elaborate sections. Teachers can use any or all of the provided elements. We know that most classrooms have limited time, so teachers should choose the Explain and Elaborate elements that best fit the needs of their students. The teacher can then formally assess the students' understanding by using any of the three summative assessments provided in the Evaluate section. If the students require additional help gaining proficiency with the content, resources can be found in the Intervention section. Students who have achieved mastery of the concept can move over to the Acceleration pieces.

Documents are available to help the teacher assess the CCCs and SEPs taught in this scope. These are located in the Home section of each scope. Question prompts or artifacts to look for throughout the scope are provided, as well as sample answers to help the teacher plot students' understanding on the rubric. The information that is gathered on these forms can be used to track progress on the CCC and SEP Segment Inventory of Skills found in each bundle and on the CCC and SEP Yearlong Inventory of Skills document located in the Teacher Toolbox.

Scope Snapshot: Information Technologies

Section	Element	Description
ENGAGE	Investigative Phenomena	What kind of communication technology would be best for a forest ranger's fire outpost?
	APK	Students choose the statement they agree with most and explain their reasoning.
	Graphic Organizer	The Graphic Organizer is a note-taking device students can use as they move through this scope.
	Hook	Students learn that information can be sent in different ways by using a code system and a drum.
EXPLORE	Explore 1: Activity	**Hidden Messages** Students use codes to decipher messages and compare the similarities and differences of those codes.
	Explore 2: Activity	**How Does It Work?** Students explore and understand how information is transferred using various forms of technology.
	Explore 3: Engineering Solution	**Secret Code** Students use the scientific knowledge they have gained as well as the 21st Century Skill of collaboration to design and create their own code.
	Picture Vocabulary	A slide presentation of important vocabulary terms along with a picture and definition, as well as a vocabulary activity in which students use vocabulary words to create an illustration
	STEMscopedia	Expository text to support science content, which can be used as reference material in conjunction with Linking Literacy activities
EXPLAIN	Linking Literacy	Strategies to help students comprehend the informational text in the STEMscopedia, including pre-, during-, and post-reading activities
	Communicate Science	Students use different forms of communication to discuss scientific topics connected to the content of this scope.
	Concept Review Game	An interactive game that can be played with a class or individually to help students review the science concepts in the module
	Content Connections Video	An inquiry video that engages students and provides meaning

ELABORATE	Math Connections	A practice that uses grade-level-appropriate math activities to address the concept
	Reading Science: Three Lexile Levels (A, B, and C)	**Technology** This provides additional expository text that supports real-world application about the content, which includes five to eight comprehension questions. Teachers can choose which level to assign each student based on students' reading Lexile levels.
	Science Today: Watch It!	**Technology** Students explore real-world connections and applications of science content through interactions with an engaging video provided by Associated Press.
	Career Connections	**Programmer** A video that introduces students to STEM careers and the 21st Century Skills needed to succeed in those fields
	Scientist Spotlight	**Lynn Conway** – Computer Scientist and Electrical Engineer
EVALUATE	Claim-Evidence-Reasoning	Fire outposts are equipped with emergency supplies, including a cell tower, flashlights, and a telegraph machine with a manual. Forest rangers working at an outpost notice flames about 100 miles east of the tower. When they try to call the ranger's station, their call won't go through due to a damaged cell tower. If they don't get word to the ranger's station soon, the town on the other side of the mountains could be destroyed, and the drive is too long to the station. The smoke in the sky is starting to get thick, and they have to think fast. Write a scientific explanation describing which type of communication device at the fire outpost is best for the scenario above.
	Open-Ended Response Assessment	A short-answer and essay assessment to evaluate students' mastery of the concept
	Multiple Choice Assessment	A standards-based assessment designed to gauge students' understanding of the science concept by using their selections of the best possible answers from a list of choices
INTERVENTION	Guided Practice	Students discuss and illustrate different technologies and patterns used to transmit information.
	Independent Practice	A short-answer and essay assessment to evaluate students' mastery of the concept
	Concept Attainment Quiz	A standards-based assessment designed to gauge students' understanding of the science concept by using their selections of the best possible answers from a list of choices
ACCELERATION	Extensions	A set of ideas and activities that can help further elaborate on the concept
	Books on Topic	A list of trade books for the scope
	Science Art	Students build maracas and use them to communicate coded messages to each other.