UNIT 4: Waves and Information

Topics at a Glance: Students will develop models to describe wave and reflection of light.

It is recommended for students to have a science journal that will allow them to display their thoughts and ideas, define vocabulary, and respond to discussion and writing prompts.
Unit Vocabulary

disturbing	amplitude	wavelength
degradation	digitized	convert
decode		

Stage 1 – Desired Results (Also see Disciplinary Core Ideas below)

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.*

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-EST-1-2: 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.

Enduring Understandings (1-3 max) Students will understand that: (connects with EQ 1)*Students who understand the concepts are able to*	**Essential Questions** **Guiding Question: *How can we use waves to gather and transmit information?*** EQ 1:*If a beach ball lands in the surf, beyond the breakers, what will happen to it?*
● 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) Students will understand that: (connects with EQ 2) *Students who understand the concepts are able to:* ● *Different solutions need to be tested in order to determine which of them best solve the problem, given the criteria and the constraints.* ● *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.* ● *Tests are often created to embed improvements to improve the design/process*	EQ 2: *Which team can design a way to use patterns to communicate with someone across the room?*

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models ● Develop a model using an analogy, example, or abstract representation to describe a s **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) ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of	**PS4.A: 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; 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*	**Patterns** ● Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena. (4-PS4-1) ● Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3) ----------

the design problem. (3-5-ETS1-2) ---------- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** ● Science findings are based on recognizing patterns. (4-PS4-1) **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. (3-5-ETS1-3)	*K–2.)* (4-PS4-1) ● Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1) **PS4.C: 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. (4-PS4-3) **ETS1.C: 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)* **ETS1.B: Developing Possible Solutions** ● Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it	***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** ● Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3) **Influence of Science, Engineering, and Technology on Society and the Natural World** ● Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

	performs under a range of likely conditions. (3-5-ETS1-2) ● 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. (3-5-ETS1-2) ● Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3) ETS1.C: 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. (3-5-ETS1-3)	

Stage 2 – Model Assessments	
Summative Performance Task(s) Sort and classify natural phenomena using similarities and differences in patterns. ● Develop a model (e.g., diagram, analogy, or physical model) of waves to describe patterns in terms of amplitude and wavelength, and that waves can cause objects to move. *Students who understand the concepts can:* ● Sort and classify designed products using similarities and differences in patterns ● Generate and compare multiple solutions that	**Formative Evidence for EQ 1:** **Guiding Question: *How can we use waves to gather and transmit information?*** EQ 1:*If a beach ball lands in the surf, beyond the breakers, what will happen to it?* ● 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.

use patterns to transfer information. Examples of solutions could include: ○ Drums sending coded information through sound waves; ○ Using a grid of ones and zeroes representing black and white to send information about a picture;	EQ 2: *Which team can design a way to use patterns to communicate with someone across the room?* ● Writing Connection: Using your knowledge of sound waves, argue the best material for sending sound through a toy telephone. Display a picture of a toy telephone. ● Unit 4 Navigating Nonfiction- Use the skills and mini-lessons taught in this unit to read informational texts presented in this Science unit.

Stage 3 – Learning Plan / Road Map (Design to make as student centered as possible)
● **Suggested Resources for Planning:** ● Mystery Science, NewsELA, Tower Garden Lessons, NJCTL.org, thewonderofscience.org, and other relevant resources.
Learning Activities: Students will develop models to describe wave and reflection of light. **Mystery Science Resources** Mystery 1: How far can a whisper travel? Standard:4-PS4-1, 4-PS4-3 Target: ● I can develop models to describe wave and reflection of light. ● Anchor Chart **NewsELA-** Cat Name Mystery 2: What would happen if you scream in outer space? Standard:4-PS4-1

Target:

- I can develop models to describe wave and reflection of light

NewsELA-

Ocean Connection

Mystery 3: Why are some sounds high and some sounds low?

Standard:4-PS4-1

Target:

- I can develop models to describe wave and reflection of light.

NewsELA-

Ocean and Humans

Additional Resources

Picture-Perfect Science Lessons: “Sounds of Science” pages 217-226

Books: The Remarkable Farkle McBride

Phenomena:

- 4-PS4-1 Amazing Slinky Tricks 4-PS4-1
- 4-PS4-3 Daniel Kish Uses Echolocation To Navigate
- 1-PS4-1, 4-PS4-1 Is there sound in space?