PS4: Waves and Their Application in Technology for Information Transfer
Interdisciplinary Lesson Plan

This set of lessons provides students with opportunities to investigate and observe how sound waves and light waves can be used to communicate information. Students will work with informational text to research and discuss the history of Morse Code and how <u>it was designed to solve a problem and to meet a need (engineering)</u>. Students will also apply their understanding of electrical circuits to investigate Morse Code and to identify its benefits and limitations. Finally, students will use what they have learned about Morse Code and their understanding of current technology to respond to reflection questions Morse Code and why it has been replaced with other technologies. These lessons address 4th grade Disciplinary Core Ideas within NGSS and the Common Core but can be adjusted for other grade levels, as well.

Disciplinary Core Ideas (DCI):
PS4.C Information Technologies and Instrumentation
PS3.B Conservation of Energy and Energy Transfer
Science and Engineering Practices (SEP):
Asking Questions and Defining Problems
Obtaining, Evaluating, and Communicating Information
Planning and Carrying Out Investigations
Developing and Using Models
Crosscutting Concepts:
Patterns: Similarities and differences in patterns can be used to sort, classify, and communicate.
Structure and Function: Substructures have shapes and parts that serve functions.
Systems: A system can be described in terms of its components and their interactions.
Energy and Matter: Energy can be transferred in various ways and between objects.

Common Core Standards
CCSS.ELA-LITERACY.RI.4.1
Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
CCSS.ELA-LITERACY.RI.4.3
Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
CCSS.ELA-LITERACY.RI.4.7
Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
CCSS.ELA-LITERACY.RI.4.9
Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.
CCSS.ELA-LITERACY.W.4.1
Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
CCSS.ELA-LITERACY.W.4.2
Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
CCSS.ELA-LITERACY.SL.4.1
Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly.
CCSS.ELA-LITERACY.SL.4.4
Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

Natural Phenomena: Students listen to a video/audio clip of Morse Code and try to identify patterns. *(Instructional Notes): Type in a message that you want to communicate to the students but don't let them see the message. Also note, that you can select between light, sound, or both.)*
https://morsecode.scphillips.com/translator.html

Display the following scaffolding questions on the board (small groups or individually). As students share their observations and questions, record them on chart paper and leave them displayed throughout this set of lessons.
- What observations can you make about patterns you notice?
- What questions do you have about the patterns?
- What questions do you have about Morse Code?

Instructional Plan:
- Identify the questions students have asked that they can research and investigate. (Scaffold question: What is the difference between a scientific and a non-scientific question?) See attached resource.
- Students work with a partner to research the history of Morse code. A recommended site is: https://wonderopolis.org/wonder/why-was-morse-code-invented
  They should record the historical information they gather on a graphic organizer (attached resource).
- Conduct an investigation to answer questions about how Morse Code uses sound waves to communicate. (Instructional Note: There are two ways for students to complete this investigation. I have described both options here.)
  Option 1: Students continue to work with their partner to investigate how Morse Code works on the website used in the phenomena phase of this lesson.
  https://morsecode.scphillips.com/translator.html . Be sure to have them use the Translator Tool as well as The Code Tool as they explore the site.
  Option 2: Students use wires, bulbs, buzzers, batteries, and switches to build circuits that will transmit Morse code through sound and/or light.
- Students identify the patterns between the visual representation and the audio representation to determine what each symbol in the code stands for.
  - Students then tap out the code on their desks or notebooks.
  - Scaffold Question: What do you hear when there is a dot? What do you here when there is a dash?
- Draw a model to explain how sound energy is transferred to communicate over distances. Students use their research and observations to draw a model on poster/chart paper to explain the transfer of energy from the person operating the Morse Code machine (energy of motion) to sound energy in order to communicate. Remind students to label the parts of their model and to draw arrows showing the transfer of energy. Students travel around the classroom and leave positive comments and questions about each model.
- Identify the advantages of Morse Code.
  - Why is it important to be able to communicate information near and far?
  - How were sound waves (and light waves) used to communicate in Morse Code?
  - How was information transmitted prior to the development of Morse Code? (By foot, wagon, horse, train)
- Identify limitations of Morse Code.

- o What challenges did you encounter when trying to use it?
- o Why don't we use this today?
- o What role has modern technology played in replacing it?
- After discussing the advantages and limitations of Morse Code, ask students to identify ways that they communicate information. Ask: Which method do you prefer? Why?
- Students use their observations from their investigation, information gathered during research, and their models explaining the transfer of sound energy to respond to reflection questions.
  - o How was sound energy used to communicate information in Morse Code?
  - o Why was this code so important when it was created?
  - o Identify two different methods of using sound energy to communicate information since the development of Morse Code? How did they contribute to Morse Code becoming outdated?

NOTE: The Morse Code written on the bottom of the Reflection Sheet says, "I studied Morse Code."

Materials provided by teacher:
Books about Morse Code and/or Computers
Circuit Supplies: bulbs, buzzers, switches, wires
Chart Paper and Markers

Materials included with this lesson plan:
Morse Code Translator Guide
Grapic Organizer for Research
Reflection Writing Activity

Assessment:
- Students make observations about patterns they notice when listening to and looking at Morse Code.
- Students ask appropriate questions about Morse Code and how it works.
- During research, students record key historical facts about Morse Code.
- Students identify patterns between audio and symbols.
- Students identify advantages and limitations of Morse Code and can explain possible reasons why it's no longer used.
- Students develop an accurate model that explains the transfer of sound energy in order to communicate information.
- Students explain how Morse Code works, why it was important during the historical time period it was created in, and why newer technologies may have replaced it.