FOURTH GRADE: ENGINEERING

Standards Bundle

Standards are listed within the bundle. Bundles are created with potential instructional use in mind, based upon the potential for related phenomena that can be used throughout a unit.

4-PS4-3 Create and compare multiple solutions that use patterns to transfer information. (SEP: 6; DCI: PS4.C, ETS1.C; CCC: Patterns) Alignment may include 3-5-ETS1-3 [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1s and 0s representing black and white to send information about a picture, and using Morse code to send text.]

Content Overview

This section provides a generic overview of the content or disciplinary core ideas as an entry point to the standards.

Throughout history, people have used many different means of communicating information. Today many different devices are used to transfer information from one person to another over long distances. Devices that use patterns to transfer information are telescopes, cell phones, and computers. Each is unique because of the information it communicates about our universe, instantly or through stored information.

Phenomena

Phenomena can be used at varying levels of instruction. One could be used to anchor an entire unit, while another might be more supplemental for anchoring just a unit. Please remember that phenomena should allow students to engage in the SEP and use the CCC/DCI to understand and explain the phenomenon.

- Coding.
- Morse code.
- Explore the US Postal Service Zip Codes.
- Computer storage of documents, forms, etc. on the hard drive.
- Firefly blinking patterns.
- Satellite images.

Storyline

This section aims to decode not only the DCI connections but also the SEP and CCC in a detailed account of how they possibly fit together in a progression for student learning, including both rationale and context for the bundle.

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.	**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. **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)	**Patterns** ● Similarities and differences in patterns can be used to sort and classify designed products.

Students develop at least two design solutions for a given problem. The design solutions should use patterns to transmit a given piece of information, for example, a picture or message. Students describe how the design solution is based on knowledge of digitized information transfer. Some examples may include information that can be converted from a sound wave into a digital signal such as patterns of 1s and 0s and vice versa, or visual or verbal messages can be encoded in patterns of flashes of light to be decoded by someone else across the room. Students should also describe how the design solution is based on ways that high-tech devices convert and transmit information. An example of this may include cell phones convert sound waves into digital signals, so they can be transmitted long distances, and then converted back into sound waves. Another example is a picture or message that can be encoded using light signals to transmit the information over a long distance.

Within the student's design solution, they should describe the accuracy of the final transmitted information and that digitized information (patterns) transfer is used. The constraints of the design solution may include the distance over which information is transmitted, safety considerations, and materials available.

Student's potential solutions compare how well each meets the criteria and constraints. Also, students can identify similarities and differences in the types of patterns used in the solutions to determine whether some ways of transmitting information are more effective than others at addressing a problem.

Formative Assessment

Formative assessment is crucial because all learners benefit from timely and focused feedback from others. It promotes self-reflection, self-explanation, and social learning. It can also make learning more relevant. Each of the questions below might be used throughout the formative assessment process. Specific prompts may focus on individual practices, core ideas, or crosscutting concepts, but, together, the components need to support inferences about students' three-dimensional science learning as described in a given bundle, standard, or lesson-level performance expectation.

SEP Constructing Explanations and Designing Solutions

- Research different codes that have been created throughout history and explain why they were needed.
- Construct an explanation as to why Code Talkers during WWII were successful.

CCC Patterns (Technology)

- Generate a code and a means to transfer this code to communicate with classmates.
- Analyze a code or coded message from a classmate and rate its accuracy.
- Why are patterns important in the sending and receiving of messages?

Performance Outcomes

These are statements of how students use knowledge and are similar to the standards in how they blend DCI, SEP, and CCC, but at a smaller grain size. These are potential outcomes for instruction as it plays out in lessons and activities in the classroom. It is important to also think of these as smaller outcomes that build toward the larger goal of mastering the standards.

- **Construct an explanation** that explains how technology was used to communicate in secret and the *effect* it may have had on historical events.
- **Design a solution** using a *pattern* to communicate with your classmates.
- **Analyze data** to explain how communication devices *transmit* data.