▶ **Link to Video**

LESSON PLAN

INFORMATION TRANSFER
GRADES 3-5

SUMMARY

Students explore the science behind how devices like cellphones, tablets and computers transfer text, images and sound. Students delve into the history of information transfer by learning about Morse code as another example of using patterns to transfer messages. Students participate in hands-on experiences using both Morse code and patterns of zeros and ones to transfer information.

NEXT GENERATION SCIENCE STANDARDS CORRELATION

4-PS4-3 Generate and compare multiple solutions that use patterns to transfer information.

Science & Engineering Practices	Connections to Classroom Activity
Constructing Explanations and Designing Solutions (4-PS4-3) **Additional SEP addressed by this lesson:** **Using Mathematics and Computational Thinking**	• Explore, compare and utilize different ways that humans have used patterns to transfer information past and present. • Explain how patterns in symbols can be used to transfer information using computers.

Disciplinary Core Ideas	Connections to Classroom Activity
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	• Explore digitizing and decoding patterns of information using Morse Code (patterns of dots and dashes) and patterns of zeros and ones. • Recognize that different solutions to the problem of transferring information over long distances have been used throughout history and that our

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)

technologies have improved and allowed for more sophisticated information transfer.

Crosscutting Concepts	Connections to Classroom Activity
Patterns (4-PS4-3) **Connections to Engineering, Technology, and Applications of Science**	• Use, create, and recognize patterns of dots and dashes and numbers to transfer information. • Observe and test out devices engineered to transfer information using scientific concepts related to light, electricity, sound and vision.

DURATION

Two 45-minute classroom periods

PRE-ASSESSMENT QUESTIONS

Please see Discussion Questions located under the video. These can be discussed as a group or answered individually in student science notebooks.

ENGAGE

Ask an adult volunteer (e.g. parent, student teacher, or co-teacher) to call in to your cellphone at a prearranged time during class. Have that volunteer send a photo via text. Share the call (on speaker) and/or the photo with the class. How does the speaker's voice and/or image get to where the speaker is calling from to the phone in the classroom?

EXPLORE

Prior to the lesson prepare several scavenger hunt clues using Morse code. You can create your own clues using a

MATERIALS

Prepared Morse Code Messages

- Volunteer adult helper
- Cellphone in the classroom (teacher phone)
- Morse code key PDF
- Online Morse code generator (optional)
- Scissors
- Tape

DIY Activity
- A color copy of a photo of what you want to pixelate (works best to start with a photo with only 3 colors)
- Graph paper
- At least three different colored markers
- A pencil with a good eraser

Morse code translator or use the ones provided. Tape the images around the room with the corresponding number on the back. Groups can work together to decipher what image will be on the other side of the paper. Once groups begin to finish you can either have them go and check themselves or ask groups what they got for each number and then reveal the answer.

Clue (text)	Clue (Morse code)—Cut and give to one of the groups	Image—Cut and tape in the location given by the clue
Image 1 Giraffe.	Clue 1 --. .. .-. .- ..-. ..-. .	 By Daniel Ramirez from Honolulu, USA, CC BY 2.0
Image 2 Gorilla.	Clue 2 --. --- .-. .. .-.. .-.. .-	 By Hendrik Dacquin, CC BY 2.0
Image 3 Seahorse.	Clue 3 ... . .- .... --- .-.	 By Tony Alter from Newport News, USA CC BY 2.0
Image 4 Melon.	Clue 4 -- . .-.. --- -.	 By Steve Evans, CC BY 2.0
Image 5 Snowman.	Clue 5 ... -. --- .-- -- .- -.	 By Petritap, CC BY-SA 3.0
Image 6 Airplane	Clue 6 .- .. .-. .--. .-.. .- -. .	 By Meteb Ali, CC BY-SA 4.0
Image 7 Pizza.	Clue 7 .--. .. --.. --.. .-	 By Scott Bauer, Public domain
Image 8 Octopus.	Clue 8 --- -.-. - --- .--. ..- ...	 By Daiju Azuma, CC BY-SA 2.5

Divide the students into groups of up to four. Give each group a copy of the clues to decipher. Encourage them to each work on a code and check each other's work. *Note: Some online Morse code generators also give audio and visual options so students could hear beeps or see pulses of light and translate coded clues.*

MORSE CODE
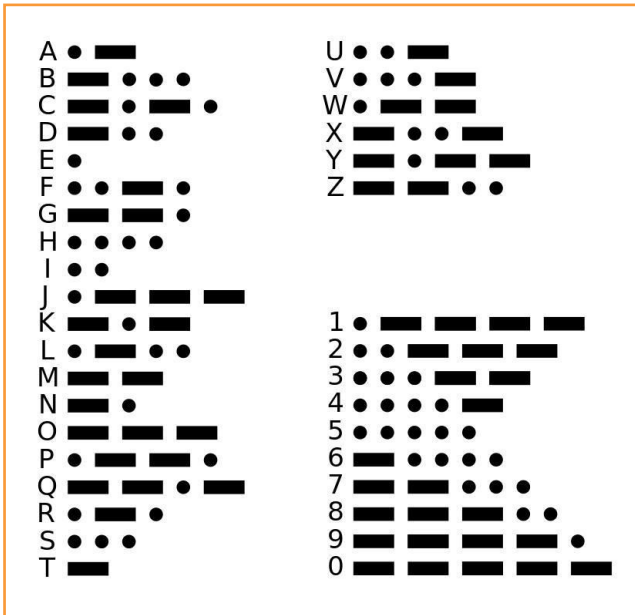
EXPLAIN

When all groups have found their image, gather the class and discuss what happened. Facilitate the discussion in the direction that patterns were used to transfer information. You may also get into a discussion about Morse code as a historical way to transfer information that has evolved over time with new technologies. Ask students whether they know how patterns are used to transfer information today. You may want to bring up what was observed during the Engage portion of the activity.

Explain that the class will now watch a video that explains historical and current methods of information transfer.

WATCH THE GENERATION GENIUS INFORMATION TRANSFER VIDEO AS A GROUP.
Then facilitate a conversation using the Discussion Questions.

ELABORATE

Students previously used Morse code to transfer information through patterns. Now they will use patterns of 0s and 1s to transfer information. Students should use the DIY Activity to create their own pixelated image just like Zoe's from the video. Then, they can take their understanding further by creating and trading patterns of 0s and 1s to decode each other's images.

Provide students with a simple gridded image to digitize, such as the example below. Instruct students to "digitize" this information in their science notebooks. That is, create a pattern of 1s and 0s that represent this text.
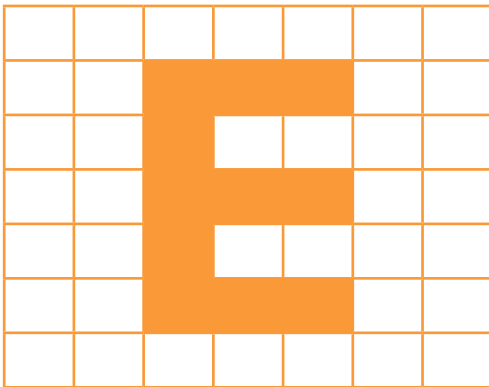
Answer:
0000000
0011100
0010000
0011100
0010000
0011100
0000000

In their individual science notebooks, ask students to explain how text, audio, and images were transferred from one cellphone to the other (phenomena from Engage portion of the lesson).