

GENERATIONGENIUS Always question. Always wonder.

LESSON PLAN

DIGITAL VS. ANALOG SIGNALS GRADES 6-8

SUMMARY

Students will model signal transmission and then integrate information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

SCIENCE CORRELATION STANDARDS

MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

Science & Engineering Practices	Connections to Classroom Activity
Obtaining, Evaluating, and Communicating Information	 Students will integrate information from classroom activities and the Generation Genius video to develop evidence to support their claim.
Disciplinary Core Ideas	Connections to Classroom Activity
PS4.C: Information Technologies and Instrumentation Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	 After experiencing the phenomenon of a song played from analog and digital recordings, students will model digital and analog signal transmission, watch the Generation Genius video, and complete a t-chart to compare digital and analog signals.
Cross Cutting Concepts	Connections to Classroom Activity
Structure and Function	 Students will analyze how the structures of digital and analog signals determine their properties and relative benefits.

DURATION

90 min.



Ask students how they listen to music, and then ask them what they know about how their parents

MATERIALS

- Scissors
- Tape
- A black pen or fine-tip marker for each student
- A copy of each of the five grid aliens and five freehand aliens per table (one alien type per student).

and grandparents listened to music when they were the students' ages. Tell students that you are going to play two videos of the same song for them and that you want them to notice the similarities and differences between the videos and to think about questions they have as they watch the videos. Have students create a t-chart on paper and label one column *Notice* and the other column *Wonder*. Students should use that chart to record their observations and questions as they watch the videos. Play <u>video #1</u> (Arctic Monkeys "Do I Wanna Know" analog clip), and have students share their observations and questions with a partner. Now play <u>video #2</u> (Arctic Monkeys "Do I Wanna Know" digital clip), and again have students share their observations and questions with a partner. Now play <u>video #2</u> (Arctic Monkeys "Do I Wanna Know" digital clip), and again have students share their observations and questions with a partner. Now play <u>video #2</u> (Arctic Monkeys "Do I Wanna Know" digital clip), and again have students share their observations and questions with a partner. Have students share with the class the differences they noticed between the two videos and the questions that they have generated based on those differences. Students are likely to notice that the song sounds different in the two videos, and they are likely to wonder why. Tell students that the class is going to engage in a simulation that will help them figure out why the songs sound different in the videos.

EXPLORE

Tell students that groups of students are going to simulate two different ways of sending a message over time and distance by passing a paper from person to person and having each person recreate a drawing on the paper.

Organize students into groups of five, seated in a circle around a table. Give each student in every group a different freehand alien page. Tell the students not to show their aliens to one another. Share the following student instructions:

- 1. Cut the paper along the dotted line, and tape the two halves end to end so the alien is at the far left of the strip.
- 2. In the grid immediately to the right of your alien, use a pen or marker to redraw the alien image to the best of your ability. You are not allowed to erase or correct your drawing. You will be given 2 minutes to complete your drawing.
- 3. After 2 minutes, fold the original alien image behind the paper so that only your new drawing can be seen.
- 4. Pass the paper to your left. Each pass represents the message traveling over time and distance. When a new alien is passed to you, do not look at the part folded under.
- 5. In the grid immediately to the right of the redrawn alien, use a pen or marker to redraw the alien image you can see to the best of your ability. Do not erase or correct your drawing. You will be given 2 minutes to complete your drawing. Fold the alien image you copied behind the paper so that only your new drawing can be seen.
- 6. Repeat steps 4 and 5 until the alien you originally drew returns to you.

Have students unfold their drawings and observe the progression from the initial image to the last drawing and share their observations with a partner.

Give each student the grid-style version of the same alien they started with in the first round, and have them repeat the simulation. Have students observe the progression from the initial image to the last drawing and share their observations with a partner.

Now, have students compare the drawings from the two rounds of the simulation and discuss their observations. Use the

following questions to guide the discussion:

- Which round resulted in a more accurate final drawing? Support your choice with evidence from the activity.
- Which round represented how the song was played in <u>video #1</u>? Support your choice with evidence from the activity.
- Which round represented how the song was played in <u>video #2</u>? Support your choice with evidence from the activity.

Students are likely to connect the clarity of the song in video #2 to the clarity of the images in the grid-style drawings. This simulation activity and the t-chart comparison below are adapted from the <u>Binary, Pixels, and Data, Oh My!</u> <u>Studying How Computers Store Information</u> lesson by Science Friday.

EXPLAIN

WATCH THE GENERATION GENIUS DIGITAL VS. ANALOG SIGNALS VIDEO AS A GROUP

Tell students you will now watch the Generation Genius video to learn more about how signals can be transmitted and stored. Use the Before Discussion and After Discussion questions to activate prior knowledge and assess students' comprehension of the video.

End of Day 1

Tell students they will be using what they have learned to compare analog and digital signals. Have students create a t-chart and label one column *Analog* and the other *Digital*. Share the following statements and the images with students. Have students record the statements on their t-chart as they read through them. Alternatively, you can conduct the t-chart comparison as a card sort.

- Signals are composed of infinite possible values.
- Signals are composed of only two possible values: 0 or 1.
- Sound signal leaps from one value to another.
- Sound signals vary smoothly in volume and pitch.
- Waves are smooth and continuous.
- Waves have a step-like appearance.
- Noise and distortion can be corrected easily.
- Signals are susceptible to "noise" and distortion.
- Music played from a record player
- Music played from a smartphone
- Full or "warm" sound quality
- Shallow or "cold" sound quality
- Can be used to store and transmit large amounts of information (data)
- Has a limited capacity to store and transmit information (data)
- Represented by the freehand alien drawings
- Represented by the grid alien drawings
- Examples: Photocopier, Landline Telephone, Cassette Tape
- Examples: Smartphone, Video Game Consoles, Computers

Wave Images for T-Chart

Below their t-chart, have students write a paragraph to explain why the song in the phenomenon videos sounded different when it was played on the different devices.

Have students respond to the following writing prompt.

The Generation Genius video pointed out that GPS satellites communicate with digital signals because they are more reliable than analog signals. Construct an argument to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. Use evidence from the simulation activity, the Generation Genius video, and your Analog vs. Digital t-chart to support your argument.



There are multiple ways to assess your students' understanding of this topic. The exit ticket is an opportunity for students to use the science ideas they built in the lesson in a new context. Alternatively, you can use the Kahoot! quiz (which provides downloadable scores at the end of the game) and/or the paper quiz. All these resources are located right below the video in the assessment section.

EXTENSION

Have students research binary code and determine the code for a short message they would like to send to a friend. You can also extend student learning by having them research and construct an argument about which type of signal would be best in the following scenarios.

- Recording a highly detailed song of an endangered bird
- · Sending a short message during a natural disaster
- Telling your friend why you didn't go to his birthday party
- Reproducing the experience of attending a live concert
- Storing home movies for future viewing
- Capturing fine paintings to be studied by art historians

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