The Science of Sound and Music

Lesson 5 (50 minutes)

How does the frequency of a signal relate to the pitch of sound produced?

Investigative Phenomenon: The frequencies humans can hear is different based on their age.

Big Science Ideas

- The higher the frequency of a signal, the faster a speaker moves, and a higher pitch sound is produced.
- Higher frequency signals require more energy to produce than lower frequencies.
- Hearing ranges vary based on age or type of organism.

FOR STUDENTS

Lesson Question: How does the frequency of a signal relate to the pitch of sound produced?

Success Criteria:

❑ I can explain how changing the frequency of a signal changes the movement of a speaker and the pitch we hear.

Lesson 5 - Teacher Slides

Lesson 5 - Student Scaffold

Lesson 5- Exit Ticket

Spanish Translated Materials

Lección 5- Dispositivas para los maestros

Lección 5- Documento para estudiantes

Lección 5- Boleto de Salida

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Sequence of student experiences			
Timeframe		**Student groupings**	**Materials**
Launch	10 minutes	Whole Class • Anchor Chart	• Chart paper/Smartboard/Whiteboard for teacher • Computer or Chromebook (1 per student) • Signal Generator • Student Science Notebooks
Explore	30 minutes	Whole Class • Vocabulary Student Partner Teams • Driver Navigator • A/B Partners	
Share	10 minutes	Individual • Exit Ticket	

***Building toward* these standards….**	
This lessons builds towards the following Performance Expectation: 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 and Engineering Practice(s)	• Constructing Explanations and Designing Solutions
Crosscutting Concept(s)	• Patterns • Cause and Effect
Disciplinary Core Idea(s)	MS-PS4-3: Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.

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Lesson 5

See the language scaffolds at the end of the lesson for more information.

Launch: 10 minutes

This lesson begins with setting the purpose and giving context to the lesson. Students are asked to think about the connection between the age of a person and their ability to hear, "Who has better hearing: a teacher or a student?" Students should have time to write down their own ideas in their science notebooks and then are encouraged to contribute to a whole group discussion. Facilitate a whole-class discussion: Prompt students to share their thoughts and justifications, setting the stage for the lesson's exploration of hearing and frequency. Record students' thoughts and curiosities on an Anchor Chart, their ideas will continue to develop throughout the lesson/unit.

Explore: 30 minutes

The next portion of the lesson involves the Signal Generator. Students will interact with the app as they think about ways to test hearing using it. Previewing the Science Explained slide (slide 5) would be a good idea as it will further explain the hearing test context.

First, review a few of the basic functions of the Signal Generator so students are all on the same page (slides 8-10). Students will also need to grasp the connection between amplitude and volume (slide 11). Students are first asked to navigate to the web app, but will wait for instruction before exploring.

Focused Explore: Next, students will explore the app with their partners using the driver/navigator strategy (see slide 13). Students are asked to explore what happens to the signal, speaker membrane, and sound when they move their cursor up within the Signal Generator. Discuss the questions on slide 14 with the class and consider charting student ideas here as well.

Next, students will learn more about frequency and how it is defined (slides 16-19). Utilize the visuals provided (slides 20-23) to facilitate discussions and comparisons of different frequencies and speaker movements. Talk routines are provided on the slides to encourage students to have a robust conversation with their partner. After that, reintroduce the hand modeling activity to help students visualize speaker membrane vibrations. Have students move their hands to simulate high and low pitch sounds, highlighting the difference in energy required. This will lead to the introduction of pure and complex tones. This is an opportunity to expose students to this idea, but they will do more exploring of this concept in later lessons.

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Return to Initial Lesson Question: Students will then return to the idea of how we test hearing and compare what they thought before and what they may know now. They will make the connection between hearing abilities and frequency/amplitude. Facilitate a whole-class discussion to determine a method to test hearable frequencies. Record the range of hearing of your students and the methods used to test hearing on an Anchor Chart (slide 31). Expand the initial wondering by asking "What frequencies can humans hear? How would you test this?" Have students discuss with a partner.

Lastly, students will compare the frequencies in which other species hear and will compare that to human hearing ranges using the provided charts (34-35). Explore the example of rat vocalizations in the video provided on slide 36, highlighting the high-frequency sounds humans cannot hear. Ask students to answer the questions on the slide as pairs.

- What frequencies do rats emit when tickled?
- Why can't humans hear them?

Share: 10 minutes

In the last portion of the lesson, revisit the lesson question and the success criteria. Students reflect on the "cause, mechanism, and effect" in relation to the phenomenon to help students connect the increase in pitch tothe increase in frequency (slide 39). Emphasize that there are no wrong answers as students continue to build their understanding over time (potential student responses on slide 40). Have students complete an exit ticket to assess their understanding.

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Language Supports and Scaffolds	
Vocabulary	As some students naturally use these words during exploration or view them in a video, add them to a co-created anchor chart that is accessible over the unit: **frequency, pitch,** **Do not pre-teach these words, as exploration & experience lead to context which helps the vocabulary 'stick' because the word now has meaning.** Words that could be pre-taught or reviewed and might be needed for lesson clarity: **electronic, amplitude, vibration**
Science Language Routines	**Driver/Navigator (and A/B partners)** While not explicitly a language practice routine, this partnership follows those principles as it is designed for equity of participation by giving clear roles and expectations to each partner. Students explore the web application using this partnership routine.